Methodology for a New Microeconomics
The Critical Foundations

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Introduction

ON THE FOUNDATIONS OF COMPARATIVE STATICS

We have now to examine the general relations of demand and supply; especially those which are connected with that adjustment of price, by which they are maintained in ‘equilibrium’. This term is in common use and may be used for the present without special explanation. But there are many difficulties connected with it, which can only be handled gradually.

Alfred Marshall [1920/64, p. 269]

It may seem discouraging that brilliant mathematical economists are able to prove little more than they assume in this area, but there may be a methodological problem that inhibits progress. No sooner is a mathematician let loose on non-market-clearing problems than he attempts to prove the existence of a static equilibrium in which there is no incentive for an agent to change prices. Perhaps the fixation on equilibrium is a crucial handicap.


One sometimes has the impression that there are only two groups of economists: those who do not understand a difference equation; and those who understand nothing else.

Joseph Schumpeter [1954, p. 1168]

This book is a methodological examination of neoclassical economic theory. It is primarily concerned with one fundamental analytical tool of neoclassical economics – namely, the idea of an economy being in a complete state of equilibrium. There seems to be widespread agreement that what is taught in traditional textbooks about equilibrium falls far short of providing an adequate methodological foundation for its unquestioned use as a basis for explaining the behavior of individual consumers and producers. Recent efforts to repair neoclassical equilibrium models have unfortunately been directed at identifying ad
hypotheses about disequilibrium behavior. As these efforts seem to beg more questions than are answered, we will examine them to see how a more adequate foundation for complete neoclassical explanations of the behavior of autonomous individual decision-makers might be provided.

### 1. Equilibrium and Explanation

The concept of equilibrium has been central in economics for over 200 years, that is, since the time of Adam Smith. For Smith and many of his followers the concept has often been used to explain away supposed evil human tendencies such as ‘greed’ by showing that, in a state of competitive equilibrium, greed will actually lead to the good of everyone. Picture an economy in a textbook state of general competitive equilibrium. In such a state each individual is personally optimizing, given his or her respective resources, and there is no way any self-interested individual can get ahead except by being greedy. Should we think that greed is a social evil we must despair since such a greediness, constrained by the state of equilibrium, can be seen as a ‘virtue’ rather than a ‘vice’. Supposedly, any state of equilibrium exists only because, given the constraints which are actually imposed by nature and the state of technical knowledge, no possible gains not already exploited by one or more self-interested individuals exist.

In the state of general competitive equilibrium all producers must be just covering their costs, including opportunity costs; in other words, everyone’s excess profits must be zero. If excess profits were not zero there would be an incentive either for new firms to start up or for losing firms to go out of business. In a state of general equilibrium every firm is maximizing profit subject to given constraints, even though the maximum happens to be zero. Thus, to make more profits, the given constraints must be changed. One changeable constraint is the current state of technology. A new technique which will lower the average costs of producing any good can create an advantage in the market that will yield excess profits. While one might still think such profits are immoral – since the producer is able to sell at a price that is higher than that just necessary to produce the good in a state of equilibrium – it is easy to show that if there are no artificial (i.e. no non-natural) constraints on competition, then the existence of excess profits for one producer represents an incentive for others to imitate the new technology. And, so long as the incentive exists, more and more producers will imitate until any incentives (excess profits) disappear. The result is both an elimination of the ‘evil’ advantage and a general reduction of costs. The latter is a benefit to everyone. Under these circumstances – namely, the absence of restraints on competition – ‘greed’ will be seen to be a ‘virtue’ rather than a ‘vice’.

In technical economics literature everything above is taken for granted. The concept of equilibrium is usually embraced for reasons other than its role in Smith’s social philosophy of private goods and social evils. The reasons are to be found in Alfred Marshall’s self-conscious theory of ‘scientific explanation’ which today is called ‘comparative statics’. Marshall claims that ‘this is the only method by which science has ever made any great progress in dealing with complex and changeful matter, whether in the physical or moral world’ [Marshall, 1920/64, p. 315, footnote 1]. Comparative statics explains things in a very special way. In modern textbooks, we are told to distinguish between endogenous and exogenous variables. The variables that we want to explain are called endogenous variables and their explanation is always conditional, that is, endogenous variables depend on certain given called exogenous variables – usually these are such things as tastes, technology, resource availability, government regulations, etc.

As long as the exogenous variables do not change, the equilibrium values of the endogenous variables will not change. To explain the endogenous variables we show that their values can be deduced with the hypothetically known values of the exogenous variables and the help of a behavioral theory (or model) which logically connects all the variables in question. In comparative statics analysis two different sets of values for the endogenous variables, representing two different states of equilibrium, are compared. The two equilibrium states are distinguished only by the value of a single exogenous variable being different. A typical example explains how demand would change if (exogenous) tastes change in favor of one good. The argument would usually go that *ceteris paribus* the (endogenous) price of the good would increase. The term *ceteris paribus* is only shorthand for the technique of comparative statics explanation, namely that all other exogenous variables do not change while the new value of the endogenous variable (price) is being determined. What is being explained is the differences in the values of the endogenous variables (the non-givens) and thus the effect or the role of the one exogenous variable in question. In a limited sense, the differences are explained by the change in that one given variable, since within the confines of the comparison the only reason for any differences is the singular exogenous change. If this is all one wishes to explain – namely the *ceteris paribus* influence of each exogenous variable on the equilibrium values of the endogenous variables – then comparative statics is a very powerful method.

Almost all of our understanding of the economy is based on careful applications of the method of comparative statics. Even the multiplier in
macroeconomic analysis is based on this method. Critics might want to
attack directly the significance of a method of explanation that only
examines the role of one exogenous variable at a time. But to the con-
trary, the acceptability is assured by an elementary understanding of
differential calculus and the idea of a partial derivative. Generally speaking, one can look at any
point of equilibrium as being the outcome of changes in many ex-
ogenous variables such that the change in each endogenous variable (i.e.
the total differential) is the sum of the changes in all exogenous
variables, each of which is weighted by their partial derivatives. For
example, the change in one endogenous variable \( X \) can be seen to be
determined by the sum of possible changes in the exogenous variables, \( Y \)
and \( Z \), such as in

\[
dX = (\partial X/\partial Y)dY + (\partial X/\partial Z)dZ.
\]

In effect, the partial derivative is a measure of the contribution of one
unit of an exogenous variable to the total change. In comparative static
analysis either \( dY \) or \( dZ \) would be zero; and since we are only discussing
changes in the equilibrium values at least one set of values for all
endogenous and exogenous variables is known. In order to explain the
initial equilibrium values, ideally all we would need is an explanation of
the equilibrium value of each endogenous variable such as \( X \). An
explanation might be provided either by performing an integration over
the range of the values of the exogenous variables or by solving an
appropriate differential equation. With a little matrix algebra all of this
is easily extended to deal with all endogenous and exogenous variables
simultaneously in the same manner.

One well-known critic of Marshall’s method, Piero Sraffa [1926], ex-
plicitly rejected any method based on \textit{ceteris paribus} and argued for the
necessity of using general equilibrium analysis. For him general equi-
librium analysis was implied by the necessity of considering imperfect
competition. The reason was simple. Consider the usual textbook ex-
planation of a price-taking individual’s demand curve for good \( X \) subject
to two givens, the individual’s income (or budget) and the price of any
other good, say \( Y \). A change in the quantity demanded of \( X \) (along the
demand curve) is the result of the \textit{ceteris paribus} change in the price of
\( X \). Except in special cases, where the demand elasticity is unitary or the
number of demanders is infinite, the quantity demanded of the other
good, \( Y \), will also change. This means that if the original given price of
\( Y \) was an equilibrium price (as in any comparative statics analysis) then
any change in the demand for \( Y \) must cause a disequilibrium in the
market for \( Y \). Similarly, a price-taking producer considers different

levels of output to supply for a given price by comparing the different
levels of marginal cost to the price. The firm is a price taker only when
there is virtually an infinity of sellers. If the number of sellers is finite,
not only does the level of the marginal cost change with the level of
output but so does the price – just as it does in the textbook explanation
of the firm under imperfect competition. But, as Sraffa in effect argues,
a complete explanation must explain how the price varies with the level
of output and thus requires consideration of the behavior of all
participants in all markets. Thus for Sraffa, either one accepts \textit{ceteris paribus} (i.e. partial equilibrium) analysis or one’s explanation of an
individual’s behavior requires general equilibrium analysis and
imperfect competition.

2. Equilibrium Implies Disequilibrium Dynamics

Consideration of general equilibrium does not necessitate a rejection of
any use of partial derivatives. The mention of matrix algebra above
recognized that it is possible to deal with partial derivatives in a system
of simultaneous equations. While Sraffa’s critique concerns Marshall’s
use of partial derivatives, the emphasis on the necessary role of imper-
fect competition does not require the rejection of partial derivatives.
This is clearly demonstrated by Joan Robinson [1934/69] who, while
criticizing Marshall’s method in her famous book on imperfectly com-
petitive equilibria, made explicit use of partial derivatives. While the
keystone of comparative statics is the thorough use of partial derivatives,
both critics and proponents of equilibrium analysis accept the use of
partial derivatives. If the idea of a partial derivative is acceptable, there
would seem to be little to argue about here.

Many arguments have been advanced in the last twenty-five years that
seem to suggest we spend too much time analyzing equilibrium states
and that we should be worrying more about everyday disequilibrium
phenomena. Doubts about calculus or partial equilibrium analysis are
not the source of current interest in disequilibrium economics. The
current doubts about basing all economics on the concept of equilibrium
stem from the analysis of the necessary conditions for equilibrium
regardless of how the equilibrium is reached or analyzed. In some sense,
the current interest in disequilibrium economics was motivated by the
work of John Maynard Keynes [see Richardson, 1959; Clower, 1965].
Robert Clower, for example, explicitly claimed that Keynes did not
reject orthodox equilibrium theory but only argued that it could not
provide an adequate account of (short-run) disequilibrium macroeco-
nomic phenomena; the theory of market equilibrium does not allow
transactions to take place at disequilibrium prices (i.e. before reaching
equilibrium prices).

The microeconomic theorist’s concern is more fundamental and has two different sources. The first started with Kenneth Arrow [1959], who explicitly identified a possible contradiction between the assumptions used to explain the behavior of individuals in a state of equilibrium and those necessary to explain the adjustment of prices in a state of disequilibrium. As Arrow saw it, perfect competition was consistent with any state of equilibrium but a disequilibrium would require an explanation of the movement toward equilibrium based on imperfect competition. The second source of current interest in disequilibrium economics has been the related concern for the knowledge requirements of any participant in a state of equilibrium [Richardson, 1959; Barro and Grossman, 1971; Solow, 1979]. Let us consider, in turn, these two microeconomic perspectives on disequilibrium concepts.

2.1. Equilibrium vs. Imperfect Competition

The problem addressed by Arrow [1959] is fundamental even though it has not caused any major revolutions in economic methodology. To appreciate his problem consider a market of \( m \) buyers and \( n \) sellers. At any given price each participant decides either how much to buy to maximize utility or how much to sell to maximize profits. The total demand is the sum of all the \( m \) individuals’ demands and the total supply is the sum of all the \( n \) individuals’ supplies. If the given price is the equilibrium price, the total demand will just equal the total supply. In such an equilibrium state each individual need only consider the given price and his or her private circumstances (income, resources, technology, etc.). Given the equilibrium price they will all unintentionally choose quantities which are market clearing – regardless of the number of buyers and sellers. But, what happens if the market participants are not given the equilibrium price? To answer the question, consider the following table for any given price (\( P \)):

<table>
<thead>
<tr>
<th>Demand</th>
<th>Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>( d_1 )</td>
<td>( s_1 )</td>
</tr>
<tr>
<td>( d_2 )</td>
<td>( s_2 )</td>
</tr>
<tr>
<td>( d_3 )</td>
<td>( s_3 )</td>
</tr>
<tr>
<td>( \vdots )</td>
<td>( \vdots )</td>
</tr>
<tr>
<td>( d_m )</td>
<td>( s_n )</td>
</tr>
</tbody>
</table>

Totals: \( (d_1 + d_2 + \ldots + d_m) \) \( (s_1 + s_2 + \ldots + s_n) \)

If the given price (\( P \)) is not the equilibrium price, ‘total demand’ does not equal the ‘total supply’. If the demand is greater than the supply at least one of the \( m \) demanders is not able to buy the quantity which maximizes his or her utility. An excess supply means that at least one of the \( n \) suppliers cannot maximize profit. In either case, equilibrium theorists recognize that someone will have to compete by offering a different price if maximization is still the objective. The disappointed demander would have to bid the price up and the disappointed seller would have to bid the price down.

Arrow observes that our recognition that either a buyer or a seller would have to alter the ‘given price’ when it is not an equilibrium price means that we are not assuming that individuals are price-takers, as we would in the perfect competition theory of prices and quantities. What is required, Arrow said, is some form of an imperfect competition theory of price-quantity behavior. The question posed is, how do we explain the adjustment of price and the process of learning the demand or supply curve in a manner consistent with perfect competition? Later Donald Gordon and Allen Hynes [1970] argued, in effect, that such an explanation was generally impossible. Thus the question of how to provide a neoclassical disequilibrium adjustment and learning process was left in abeyance.

2.2. Equilibrium and Necessary Knowledge

Some critics of neoclassical economics have focused on the logical requirements of any state of equilibrium, rather than on what is required for a disequilibrium learning process. George Shackle [1972] and Herbert Simon [1979] have each repeatedly argued that there is a problem with any equilibrium concept which requires universal maximization. On the one hand, Shackle argues that we have no reason to think that any individuals going to the market could have acquired sufficient knowledge in advance to ensure they actually are all maximizing. On the other hand, Simon argues that even if such knowledge acquisition were logically possible, it would be too difficult or too costly. In either case the likelihood of ever being able to satisfy the knowledge requirement for equilibrium is questioned.

In a similar examination of the requirements for a state of equilibrium, G. B. Richardson [1959] identified two types of knowledge: private knowledge of one’s own circumstances such as income, tastes, technical abilities, etc., and public knowledge such as what other people will demand or supply in the market. While assuming that everyone can know with adequate certainty about his or her private circumstances might be acceptable, there is little reason to think that everyone has adequate knowledge about the public behavior of other market participants. There is more reason to think that every individual market participant
must form expectations about the public circumstances. Unless there is some way of forming these expectations ‘rationally’ – that is, in a manner consistent with maximization-type decision-making – there is no reason to expect any individual to make the optimal choice in the market and hence no reason to expect an equilibrium.

Still, if we are only interested in building models, one could simply begin with the assumption that an equilibrium exists. If one does assume that an equilibrium exists, one would be implicitly assuming that everyone has somehow acquired sufficient knowledge to be maximizing without necessarily claiming that knowledge is perfect. Today this is often handled as a question of how to deal optimally with uncertainty – that is, is there an optimal method of making decisions when one’s knowledge is uncertain? How one answers this question depends on one’s theory of knowledge or of learning. If one believes that everyone learns only by collecting more information – that is, by induction – in that more information means less uncertainty, then the question concerns the economics of information. It is a question of comparing the benefits and costs of information acquisition [e.g., Stigler, 1961]. Given that information is costly, there is claimed to be an optimum degree of uncertainty such that the benefits of less uncertainty do not exceed the extra cost of reducing uncertainty. In the economics of information, the quality of one’s knowledge or expectations is chosen ‘rationally’ when the net benefit of information collection has been maximized. Such rational expectations models simply assume that learning is inductive, and consequently that if a more perfect equilibrium were a benefit to anyone there would be an incentive for someone to collect the required additional information. In rational expectations models (given inductive learning) a real-time equilibrium does not require perfectly certain knowledge as some of the critics of such models seem to think. But more important, given inductive learning, any so-called disequilibrium can be explained away by one of two arguments. On the one hand, the charge of ‘disequilibrium’ wrongly presumes that the alternative perfect state of equilibrium is economically feasible. On the other hand, the state of disequilibrium exists only because not enough time has been allowed for the participants to acquire the necessary degree of certainty to make equilibrium decisions. If we were to deny the possibility of inductive learning, it is not clear that a state of disequilibrium can so easily be explained away.

3. The Hidden Agenda of Comparative Static Methodology

By any usual definition, the existence of an equilibrium requires that all participants be making optimal choices, so a disequilibrium implies that at least one of them is not. In order to explain (rather than explain away) a disequilibrium, what is needed is an explanation of why an individual might be in a non-optimal situation. What will be argued in Part I is that all orthodox models of non-optimal situations are strongly dependent on the conceptual possibility of an optimal situation. This dependence opens the door to the view that there is a certain unity of method concerning the explanation of disequilibria – a disequilibrium can be explained only as a distortion from some ideal optimum state. Since all orthodox theories of disequilibrium are indirectly based on optimizing models, there is a certain methodological vulnerability when the knowledge requirements for disequilibrium models are considered.

The major difficulty with any attempt to explain a disequilibrium state is determining what would be an acceptable explanation. Basing one’s explanation on the existence, in principle, of a state of equilibrium begs too many questions. Nevertheless, there are some minimum requirements which every neoclassical theorist accepts. To be acceptable to any mainstream neoclassical economist there are two important considerations which we call the ‘hidden agenda’ [Boland, 1982a]. The first is the requirement that any explanation must come to grips with the ‘problem of induction’. Either we demonstrate how individuals learn inductively, that is, acquire the necessary knowledge or expectations to make maximizing decisions or we explain how they cope with the ‘problem with induction’. As there is no inductive logic that would allow individuals to learn only from experience we must show how people make judgements from limited information. Either one solves these problems or one gives reasons why they need not be solved.

The second, and more important, requirement is that in any neoclassical explanation of the economy all phenomena can be explained on the basis that only individuals make decisions. This requirement is called ‘methodological individualism’. It is primarily a restriction on the type of exogenous variables that can be presumed in any complete model. While, by definition, every endogenous variable can be seen to be the direct or indirect consequence of individuals making choices, exogenous variables are not chosen by anyone. They are the ultimate givens of any model. While the exogenous variables influence the ultimate values of the endogenous variables, any change in an endogenous variable will not have an influence on the values of the exogenous variables. The only variables that cannot be influenced by someone’s decisions are the
naturally given variables such as the weather, the amount of resources available on Earth and any physical limitations to one’s productive skills. From the perspective of one individual there are many non-natural given variables that cannot be influenced directly by his or her choices. The existing laws or other social institutions are the most obvious. Nevertheless, laws or institutions are not natural phenomena and so they cannot be used as exogenous variables in the ultimate explanation of the individual’s behavior. If we accept the requirement of methodological individualism then any social institution or event, such as the market price or equilibrium, must ultimately be explained as the intentional or unintentional consequence of the actions of individuals and not the consequence of natural phenomena alone. One implication is that if individuals are thought to interact in any way, the complete explanation of one individual requires the simultaneous explanation of all individuals.

While almost all neoclassical theorists openly accept the requirements of methodological individualism, few seem fully aware of the complexity of the requirement. Moreover, they are unaware of the conflicts between their tools of analysis and their commitment to methodological individualism. Our main purpose in this book is to examine the many ways in which our standard model-building techniques (such as comparative statics and general equilibrium analysis) often create hidden obstacles for the fulfillment of the task of building microeconomic models that are consistent with methodological individualism. Most theorists seem to think that all that is required is an explanation sufficiently general that to be applicable to all individuals. Thus when one individual’s behavior is explained, the behavior of every individual is explained. With this in mind, it is not always clear what is meant by ‘an individual’s behavior’. As Arrow pointed out, a universal theory of the individual may only work if one is explaining the behavior of the typical individual in a state of general equilibrium. If we consider a state of disequilibrium then some individuals may have to be explained differently than others. We will argue here that what is needed is a generalized methodological individualism, one that not only requires that only individuals make decisions, but does so in a manner that allows individualistic choice behavior. And thus, if everyone is behaving in the same way we must explain why they chose to do so. Any microeconomics that needs to presume that everyone is alike in order to explain social events is not really explaining individual behavior.

We will argue here that the problem of induction is more of an explanatory obstacle than a requirement, and has unfortunately made it difficult for disequilibrium theorists to make much headway towards solving the problem posed by Arrow. There is another related difficulty that has hindered understanding of disequilibrium phenomena. This is the view that the only way to represent an individual is in terms of psychology [Scitovsky, 1976]. That is, suppose two people face the same constraints. Will they make the same decision? The usual answer would be that they would not. If we ask why the two people would differ, the answer would have to be because they are individuals. If we ask how they are different as individuals, the answer would ultimately be that they are psychologically different. For example, their tastes are given psychologically and may be different. We call this approach to individuality ‘psychologism’, and when it is combined with the requirements of methodological individualism, we call it ‘psychologistic individualism’. Typically, in economics, the more narrow requirements of the psychologistic version of methodological individualism are taken for granted. Individuals are identified with their psychologically given utility functions and are presumed to be endowed with certain learning skills which really reduce to a matter of how fast they learn inductively. Inductive learning is almost always taken to be a psychological fact of nature.

We will eventually argue that, while we accept the requirement of methodological individualism (only people make decisions – things do not make decisions), we cannot assume inductive learning or psychologism if we are going to build a complete neoclassical model of the economy. A complete model is one that not only explains the state of equilibrium but also explains why any given state of disequilibrium will either persist or be eventually transformed into an equilibrium state by the actions of autonomous individuals.

4. An Outline of the Book

Before we can come to grips with the problem of providing a uniform method of explaining equilibrium states as well as disequilibrium states, we must arrive at a clear understanding of how psychologistic individualism both constrains and motivates the neoclassical use of equilibrium models. We do this in Chapter 1. Our idea of an equilibrium is closely related to our understanding of an individual’s optimization decision process, a relationship which we examine in Chapter 2. We will see that the question posed by any relationship between a disequilibrium of an entire economy and the optimizing decisions of singular individuals involves difficulties for maintaining a methodological individualist view of the economy. Thus, in Chapter 3 we dig a little deeper to find that the fundamental concepts of differential calculus are the primary tools used to support methodological individualism. But, the use of fundamental
calculus concepts, such as the partial derivative, may actually limit us to restrict our explanations to the behavior of individuals in a state of long-run or general equilibrium. This is only made apparent when we consider, in Chapter 4, the precarious relationship between individualism and the possibility of a logically consistent disequilibrium state. If there is a problem with the use of calculus, it is still not clear whether it is an inherent problem of calculus itself or merely the result of how we use calculus in economic explanations. In Chapter 5 we dig even deeper to see how many of the difficulties with methodological individualist models of disequilibrium may be the result of problems inherent in calculus.

The basic thrust of recent examinations of models which question the adequacy of equilibrium models is that any model which uses an equilibrium state must include an analysis of the stability of the presumed equilibrium. This turns out in most cases to be a question of the dynamics of decision processes. It is not clear that the idea of an equilibrium is compatible with the dynamics of an individual’s decision-making process. So, in Chapters 6 and 7 we consider several approaches to determining what it might take to make equilibrium models capable of dealing with the dynamics of individual decision-makers. In Chapter 8, we briefly examine the usual ways of avoiding the questions posed by the consideration of the dynamics of equilibrium models.

The primary question we are addressing throughout this book concerns what it would take to provide a complete explanation of the behavior of autonomous individuals without violating the requirements of methodological individualism. In the last three chapters we consider the three obvious avenues for dealing with all the methodological problems of constructing a complete microeconomics, that is, a microeconomic theory that explains the behavior of individuals whether they be facing equilibria or disequilibria. Our primary argument throughout will be that the only way to construct such a complete microeconomics is to recognize that individuals must every day come to grips with the methodological problems of learning; at the same time it must be recognized that there is no possibility of inductive learning, and that the usual psychologism of neoclassical models is actually a denial of individualism.

Part I

The Economics of Sub-optimal Economies
To my students from Milwaukee to Vancouver who question and criticize when they cannot understand.
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secondary roads are preferred... it was some years ago that we first began to catch on these roads... these roads are truly different from the main ones. the whole pace of life and personality of the people who live along them are different. they’re not going anywhere. they’re not too busy to be courteous. the hereness and newness of things is something they know all about. it’s the others, the ones who moved to the cities years ago and their lost offspring, who have all but forgotten it. the discovery was a real find.

i’ve wondered why it took us so long to catch on. we saw it and yet we didn’t see it. or rather we were trained not to see it. conned, perhaps, into thinking that the real action was metropolitan and all this was just boring hinterland. it was a puzzling thing. the truth knocks on the door and you say, ‘go away, i’m looking for the truth’, and so it goes away. puzzling.

robert pirsig [1974, pp. 4–5]

over the last twenty-five years an ever widening gap has appeared between what we teach economics undergraduates and what we expect graduate students to understand. the gap is due entirely to our graduate theory classes since the microeconomics we teach our undergraduates has not changed significantly from what we taught in the late 1940s. today the gap between what we teach at these two levels is such that it amounts to a contradiction.

graduate microeconomic theory is considered a ‘new microeconomics’. graduate students are supposed to be concerned with the ‘disequilibrium foundations’ of equilibrium economics rather than with the static descriptions of a market where demand equals supply. the old microeconomics that we teach undergraduates is concerned with only a simple appreciation of the virtues of a world governed by a market system – that is, an appreciation that if everyone were guided by market determined prices and were satisfied by making their decisions independently, we would have an equilibrium which is the ‘best of all possible worlds’. while graduate students are supposed to understand ‘disequilibrium economics’, undergraduate students are supposed to be
satisfied with equilibrium models alone.

This gap is at best unfortunate and at worst educationally unjustifiable. If we have learned anything over the last twenty-five years it is that we have been teaching undergraduates more about a fantasy world than the world we see outside our window. Unless we know why an economy is in a state of equilibrium, we know very little. Moreover, unless we know that the world outside our window is in a state of equilibrium, there is little that can be explained. We are leaving our undergraduate students woefully unprepared to deal with the real world – despite the usual promises made to them.

Teachers of undergraduate economics almost always think it is necessary to simplify the idea of equilibrium so that students can learn the ‘important’ ideas. However, the simplification seems to ‘throw the baby out with the dirty bath water’. The simplification here is the view that a market equilibrium is just the equality between demand and supply. A more complex view recognizes that it is possible to think of an equality of demand and supply in a market where demand curves are upward sloping and supply curves are downward sloping. Everyone will immediately dismiss this observation by saying that it is only concerned with an ‘unstable equilibrium’. But anyone who has used the idea of an equilibrium in other disciplines will be puzzled by the concept of an ‘unstable equilibrium’ since it is self-contradictory. To avoid the contradiction, we must appreciate that any equilibrium-based explanation of the economy must imply a ‘stable equilibrium’. The economics we teach undergraduates fails to provide such an explanation. It is for this reason that graduate students have to worry about what is called ‘stability analysis’.

As a student, economic theory made little sense to me until I was introduced to stability analysis. And when I began teaching economic theory I found it easier to explain the reasons for our assumptions if I first explained the basis for the stability of the usual textbook market – the market with downward sloping demand curves and upward sloping supply curves. In particular, I found it much easier to explain why so much of consumer theory is concerned with showing that, even though individuals make their consumption decisions autonomously and independently, the market demand curves will always be downward sloping whenever consumers are optimizers. It is also easier to see why microeconomics must imply that supply curves are upward sloping as a consequence of the nature of the scarcity that faces profit maximizing producers. What the textbook market ensures is the possibility of truly autonomous individual decision-making. I tried to demonstrate this approach to teaching microeconomics in a textbook manuscript [Boland, 1967], but publishers, while saying that it was clearly written, never thought there was a market for it. I found this puzzling since microeconomics makes little sense without an appreciation of elementary stability analysis.

Today, I think I can understand where I went wrong. An approach to teaching microeconomics that stresses questions of stability analysis must promote a self-consciousness about explanatory methodology. What I had failed to appreciate was that most economists consider methodology to be a waste of time. In my 1982 [Boland, 1982a] book I showed why methodology is an essential part of the economics we teach. But that book does not address the more elementary problems of stability analysis that can be appreciated by undergraduate economic theory students.

In this book I offer a critical examination of the neoclassical model which typically fails to include an explicit stability analysis. I show that much of the sophisticated theoretical literature over the last thirty years can be understood as ad hoc attempts to overcome the deficiencies of models that are limited by the absence of stability analysis. At the end of this book I explain what we must do to update undergraduate theory, and above all, to develop a truly individualist version of microeconomics that is both complete and consistent with the methodological principles of all neoclassical models.

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It has long been held on philosophical grounds that product must be a homogeneous function of the first order of all the variables, and that if this is not so, it must be either because of ‘indivisibility’ or because not all [inputs] have been taken into account. With regard to the first point, it is clear that labeling the absence of homogeneity as due to indivisibility changes nothing and merely affirms by the implication that ‘indivisibility’ does exist, the absence of homogeneity.

With respect to the second point, ... [it] is a scientifically meaningless assertion that doubling all [inputs] must double product. ... [T]he statement is meaningless because it could never be refuted, in the sense that no hypothetically conceivable experiment could ever controvert the principle enunciated. This is so because if product did not double, one could always conclude that some factor was ‘scarce’.

I suggest that ... ‘inputs’ ... be confined to denote measurable quantitative economic goods or services. The production function must be associated with a particular institution (accounting, decision-making, etc.), and must be drawn up as of any unique circumstances pertaining to this unit....

So defined, the production function need not be homogeneous of the first order. If really homogeneous, marginal costs would always be constant. It is indicative of the lack of integration ... that many writers assume U-shaped [average] cost curves in the same breath with homogeneity of the production function.

Paul Samuelson [1947/65, pp. 84–5]
Although it is not obvious, the viability of a narrow psychologistic individualist view of the world depends heavily on the possibility of a linear-homogeneous production function (i.e. one which is ‘homogeneous of the first order’ or equivalently, where there are ‘constant returns to scale’). Only if all inputs to all production functions are variable is it possible to explain all endogenous variables (including inputs) as being the consequences of only naturally constrained individual optimization, subject only to the psychologically given utility functions. If any input were not variable then it would be a non-natural, non-individualist constraint on the ultimate equilibrium and thus on the equilibrium prices. As we shall see, the primary endogenous variable is the price of any good or service. What concerns us here are neoclassical models which claim that all prices are equilibrium prices.

The centerpiece of neoclassical equilibrium economics has always been the claim that the prices we see in the ‘real world’ are equilibrium prices. To understand the significance of such a claim it might be helpful to consider some alternative explanations of ‘real world’ prices. One could say that (i) prices are ‘causally determined’ by natural forces, or that (ii) prices are accidental (perhaps within certain ‘reasonable’ ranges) at least to the extent that they are never precisely determined. Both of these explanations of prices can be found in the economics literature. The former can be seen in the classical labor theory of value and the latter in more modern macroeconomic models where the everyday price is considered a stochastic variable.

Perhaps both explanations of prices are plausible and should not be dismissed without consideration. Nevertheless, both of these alternative explanations of prices would be considered undesirable from a methodological individualist perspective of neoclassical economics since we would like to explain prices as endogenous variables, that is, as consequences of individuals’ choices. Alternative (i) might easily be alleged to be a denial of ‘free will’, and alternative (ii) might be alleged to be a denial of the possibility of explaining prices [see Boland, 1970, Latsis, 1972]. Stated another way, we will usually admit, rightly or wrongly, that the price is ‘determined’ when someone puts it on the price tag, we have no reason to expect any particular price to be placed on the tag. This raises an interesting methodological question. Is there a plausible way to reconcile these two alternatives to form a more acceptable option? One approach might be to modify alternative (ii) such that we can explain the limits on the range of possible (accidental) prices. We could combine (i) and (ii) by modifying alternative (i) such that the ‘natural forces’ are the ‘causes’ of the limits on any price decision. We could modify (i) by postulating that there are many possible ‘causal determinants’ of any price – which determinants considered to be relevant for the person selecting the price may be accidental or at best arbitrary.

The acceptability of any of these approaches depends on our theory of what constitutes an explanation. The theory of explanation that most economists take for granted is the one promoted by Adam Smith. It is one that can be traced back to a common belief that the famous eighteenth-century physicist Isaac Newton was undoubtedly successful in explaining the mechanics of the Solar System. Newton’s explanation was that the Solar System is in a mechanical equilibrium, one that is completely and rationally determined. Accordingly, if we know all the facts, then given the laws of mechanics, we could determine all the particular aspects of the state of equilibrium (position, velocity, etc.) by means of ordinary rational argument. The philosophical impact of his alleged success was that it led economists to believe that all economic phenomena could be explained relative to a given state of equilibrium (a balance of forces) by explaining each variable’s role in the maintenance of the equilibrium.

The ultimate failure of Newton’s mechanics to explain all physical phenomena (including magnetic forces) was recognized late in the nineteenth century [see Einstein and Infeld, 1938/61], at about the same time that economics was just being established as a serious academic discipline. The failure of Newton’s explanatory method presented a serious dilemma for anyone attempting to explain all aspects of any state of an economy. In particular, the dilemma was, how can we both recognize the apparent failure of Newton’s method and still advocate the use of his rational method of explanation? One response to this dilemma was to attempt to rationalize the apparent failure of Newton’s mechanics – that is, attempt to derive some sort of ad hoc mechanical explanation of the failure, thereby vindicating that method of explanation. Those who felt this was still possible continued to regard all explanations to be ‘rational’ to the extent that they could be represented by a mechanical equilibrium.

Not until the early twentieth century was it recognized that there is another ‘rational’ response which would allow for an alternative to Newton’s mechanics. One version of the new alternative allows us to give explanations by accepting the concept of what might be called ‘natural probability’ in place of ‘natural causes’ or ‘forces’. In this approach, to explain some event we need only to show that the event has a ‘sufficiently high probability’ of occurring under the circumstances [cf. Boland, 1977c]. In light of this new approach, Newton’s theory could be reinterpreted to be a good approximation with a high probability of success. Clearly this is a defeatist position for those who require causal determination although it does retain an air of ‘rationality’ – a ‘sufficiently high probability’ is declared to be ‘sufficient’ reason.
In economics the probabilistic or stochastic view of rational explanation led to the development of econometrics, although the meaning of the term ‘cause’ has been restricted to how we distinguish exogenous from endogenous variables. Moreover, the probability or approximation approach to explanation still allows for a ‘win-win’ methodology. Namely, it could still be said that either Newton’s theory, or any theory, is true (because it can be rationally or inductively justified with observed facts) or its truth does not matter. If it does not matter it is because any explanation is alleged to be only a rational approximation of observed facts, or it does not matter since we can never know all the facts anyway. Clearly, another approach is still possible. We could admit that Newton’s theory or any theory can be false and then set out to correct its flaws or replace it. But for those who believe in the ‘mechanical’ method of explanation, admitting that Newton’s theory is false would be equivalent to admitting that there is no rational method which could guarantee the success of any of our theories.

For some of us, any theory can be either true or false since all theories are conjectures or guesses [Popper, 1963/65]. Whether any theory is true or false does not depend on any extant human having a reliable method to prove the theory’s truth status. Our theories may be guesses about the ‘causes’ of events or guesses about the ‘probabilities’ of events occurring, or merely guesses about the relationships between various objects in the ‘real world’. But most important, any of these guesses may be false or they may be true. Of course, this view of theories applies equally well to our theories of explanation.

1. Methodological Individualism and Equilibrium Methodology

This brief tour of the philosophical origins of the neoclassical economist’s equilibrium-based mechanical theory of explanation leads us back to the various approaches to explaining economic variables such as prices. While recognizing that any specific price marked on a price tag must be decided by people, we have no reason to expect any particular price to be placed on the tag. Despite the failure of the mechanical theory of the physical world, the concept of equilibrium has some attributes that make it even more interesting for economics where the question of ‘free will’ is a central concern. The concept of equilibrium seems to allow for any individual’s ‘free will’ at the same time as giving a rationalist explanation of the economy as a whole. However, it remains to be seen whether an equilibrium explanation of prices can be constructed such that both ‘free will’ is preserved and a mechanical determination of prices made.

Being able to juggle the apparently conflicting philosophical demands for ‘free will’ with the methodological demands of rational determination and explanation is an interesting challenge, which to a certain extent, has been accomplished within the textbook version of neoclassical economics. By carefully considering this juggling act we can understand such things as why traditional neoclassical theory separates the determination of demand from the determination of supply. Perhaps economists think that by separating demand from supply we can build in a minimum, but essential, element of ‘free will’ for autonomous decision-making. For any particular prices charged, the autonomous individual agent acts freely in deciding what, or how much, to demand or supply. Here we are viewing the separation of demand and supply as a decision made by the theorist – i.e. deliberate methodological individualism. Since this theoretical decision seems rather arbitrary, or at least overly convenient, textbooks attempt to rationalize why it is made. Much of traditional theory has been developed to justify this separation by showing that when demand and supply are separated in the ‘real world’, autonomous decision-making is preserved and the ‘real world’ will be the ‘best of all possible worlds’. Moreover, it certainly would not be the ‘best’ whenever individuals encourage collusion or are dependent on each other’s approval. As Adam Smith’s view of the world would have us believe, we should never depend on authorities such as the church or the state since the ‘best of all possible worlds’ will be achieved when everyone is independently pursuing self-interest and is not inhibited except by givens provided by Nature.

To understand clearly our modern economic concept of equilibrium let us consider it differently. Our equilibrium theory of prices says that prices are social institutions. To say this, however, brings up in a new form the dilemma concerning ‘free will’ versus explanation. There are two basic views of social institutions and they are diametrically opposed. On the one hand there is the strict methodological-individualist view which says that all institutions are merely aggregate manifestations of individual behavior and hence institutions are explained only in terms of the behavior of each and every individual [see Boland, 1979b]. For example, if prices are social institutions, then prices will be the equilibrium prices only if everyone agrees that they should not be changed. On the other hand, there is the strict holist view which says that some institutions have an existence (and hence a determination) beyond the individuals that use or help create them. For example, the real price may reflect its ‘natural value’ or its ‘just value’ or its ‘labor value’, etc. From the standpoint of explaining social institutions, it is strict holism that is specifically rejected when traditionally we reject ‘natural’ causes (such
as labor embodiment) as sole determinants of prices.

Since most neoclassical economists today would immediately reject the holist view of institutions, their primary philosophical task is to reconcile a methodological-individualist concept of social institutions with the concept of equilibrium prices. The concept of an equilibrium price must be shown to be a strict methodological-individualist institution – that is, one which can be shown to be the result of the interaction of all individuals yet determined by no single individual or by no natural cause [cf. Arrow, 1951/63].

Almost all modern analytical studies of neoclassical equilibrium models are concerned with this task. Everyone seems to agree that the analysis of a static equilibrium alone will never be sufficient to explain prices in a manner consistent with methodological individualism. Instead, what is needed is a clear understanding of the process of reaching an equilibrium. Expanding our view of prices to include disequilibrium states as well as equilibrium states allows for individualism (the price tag marker) and at the same time recognizes prices as holistic and endogenous givens which constrain individual actions (e.g. by determining opportunity costs). The individual sellers can pursue what they think is in their own interest but in the long run (a run long enough for equilibrium to be obtained), they will find it in their own best interest either to all charge the going equilibrium price or to demand or supply the quantities that are consistent with the equilibrium price.

2. General Equilibrium and Psychologism

This brings us again to the point of looking at the methodological problem of determining what are acceptable ‘givens’ in our theories of the consumer and the producer. There seem to be two types of givens although the difference means little in the usual neoclassical short run. These are: (a) those endogenous variables that are social givens (e.g. going prices, income distributions, wage-rates, etc.), and (b) those exogenous variables that are supposedly ‘natural’ givens (e.g. tastes, availability of resources, learning abilities, biological growth rates, etc.).

In the neoclassical definition of the short run, individuals are unable to change any of the givens. However, beyond the short run, individuals can influence the social givens, (a). The solution to the ‘holist vs. individualist’ dilemma apparently lies here. In the short run, prices are holistic givens; in the long run, they are the consequences of individual choices. But what about the ‘natural givens’, (b)? Are they not the ‘natural causes’ or ‘forces’?

Let us consider a simple world consisting of two inputs (L and K), two outputs (X and Y), and two individuals (A and B). The equilibrium view of any such economic system claims to describe the determination of the following variables which are not givens:

- **Prices:** \( P_X, P_Y, P_L, P_K \)
- **Quantities:** \( X_X, Y_Y, X_A, Y_B \) (total demands and supplies)
- \( X_A, Y_A, X_B, Y_B \) (individual demands)
- \( L_X, L_Y, K_X, K_Y \) (individual demands)
- \( L_A, L_B, K_A, K_B \) (individual supplies)
- **Industry sizes:** \( n_X, n_Y \) (the number of respective firms)
- **Incomes:** \( I_A, I_B \)
- **Utility levels:** \( U_A, U_B \)
- **Transformation rates:** \( MRS \) (marginal rate of substitution)
- \( MRTS \) (marginal rate of technical substitution)

When we say ‘determine’ we usually mean ‘explain’ in the sense that for the given values or states of the exogenous variables and our behavioral assumptions relating all variables and givens, we can show that each of the above twenty-six variables have particular values.

On the basis of our behavioral theory, in this simple world the explained set of values are said to be the only set which corresponds to the one particular set of values (or states) of the following ‘givens’: ‘tastes’ (which are represented by a preference map for each of the individual consumers); ‘technology’ (which is represented by appropriate production functions relating the individual outputs to the levels of inputs); available resources (the total amount of K that exists in the world); and the wealth distribution (the portion of K owned by each individual consumer or lender). Sometimes there is an additional natural given in the form of an ‘interest rate’, i, which may represent the opportunity costs of consuming today rather than using one’s capital to produce something for tomorrow (e.g. it may represent the biological growth rate which follows planting of seeds).

So long as the (exogenous) ‘givens’ do not change and the long-run equilibrium has been reached, the long-run equilibrium values of the determined variables will never change! In other words, so long as the exogenous ‘givens’ do not change, our analysis is essentially static even though individuals may be thought of doing things continuously – such as changing inputs into outputs. Every week, each individual buys or sells the same quantity in the market because in this world there is no change in the endogenous demands or supplies without a change in at least one exogenous variable. Clearly then, any interesting ‘dynamic’ analysis must somehow deal with changes in the exogenous ‘givens’.

Leon Walras is famous for attempting to specify the behavioral
assumptions that would ensure the existence of a set of prices consistent with a general equilibrium of price-takers for any set of exogenous givens. He was interested in a state of equilibrium where each individual is maximizing subject to their personal constraints and facing the same set of prices as everyone else. In effect, the determination of any set of equilibrium prices amounts to solving a set of simultaneous equations where the equations correspond to the maximizing conditions for each individual decision maker. Initially Walras thought that it was enough to ensure that the number of equations equaled the number of endogenous variables. But, the question is much more complicated [see Boland, 1975]. If for no other reason, any real economy usually has a very large number of individuals and so the system of equations would be difficult to solve except in very special cases. Nevertheless, theorists still refer to such a set of equilibrium prices as Walrasian prices.

Even in the simple two-person model of the economy presented above, there are problems for the methodological-individualist interpretation of the neoclassical explanation of prices. No matter what decisions individuals made in the process of reaching an equilibrium, there might be only one set of determined values for the set of exogenous givens. (If there is more than one set of equilibrium values, we will not have explained why one equilibrium state is reached rather than another.) Does this mean that the givens are the ‘causes’ of the determined values and thus that our explanation of prices denies ‘free will’? Unfortunately, it is difficult to see how the answer is not affirmative whenever the givens are considered unalterable by any individual involved. Clearly this is a serious problem for methodological individualism. Can this obstacle be avoided or dismissed? Most economic theorists seem to think so. For example, some theorists [e.g. Samuelson, 1947/65, p. 49; Stiglitz, 1975] accept ‘multiple equilibria’, that is, more than one set of values which correspond to the one set of givens. This unfortunately is a defeatist position – no matter how liberal it may appear to be. Any hope of explaining the variables in question in terms of individual choices is conceded. But worse, if it is argued that there are many possible sets of equilibrium values then each individual’s set of choices is arbitrary. For some of us, such arbitrariness is just as bad as a denial of ‘free will’.

Another approach to this individualist dilemma is to admit that the ‘givens’ are not really given, since each can be influenced by individuals in the economy. Unfortunately, if carried too far – that is, if all the givens are made endogenous within our model of the economy, then the explanation of all variables becomes circular. One way to avoid circularity is to explain the ‘givens’ outside of the model in question. This approach, similar to that suggested by Thorstein Veblen at the turn of this century, has been for the most part avoided except by a few economists who call themselves ‘institutionalists’ since they are willing to take some institutions as exogenously determined [cf. Boland, 1979b]. Neoclassical economists reject institutionalism, if for no other reason than because it would undermine the methodological individualism of neoclassical theory by allowing elites, power groups, government controls and other such holistic variables to influence the ultimate long-run equilibrium state. Such holistic influence means that the long-run equilibrium may not be the ‘best of all possible worlds’ since it may only be the best for those with holistic influence.

The most commonly accepted approach to allowing certain givens to be explained outside the model is to confess that since ‘we are all humans’, everything reduces to psychology. This seems to have been the explicit view of both John Stuart Mill and Vilfredo Pareto. In particular, it is often held that strict methodological individualism would require us to explain even the impersonal givens such as technology, resource availability, interest rates, or wealth distributions, within any neoclassical model. However, some or all of the nature or variability of individual tastes would have to be explained outside the model to preserve a minimum degree of exogeneity and avoid circularity. This ‘psychologistic’ method of allowing economists to explain everything except the natural givens goes virtually unchallenged in economics textbooks and literature since it still seems to be the only way to accommodate the demands of methodological individualism.

3. An Equilibrium as a Necessary Optimum

Let us examine the psychologistic world where everything about the economy is a matter of individual choice except natural givens and psychological states of individuals. We need to know why economists would ever claim that it is the ‘best of all possible worlds’. In a world where (1) there are no constraints on entry or exit from any market, (2) there is a market for every variable in the production process (which implies all inputs are variable), and (3) all participants are independent optimizers (maximizers or minimizers), every participant must be optimizing and simultaneously, every market must be in equilibrium, for there to be a general equilibrium. If anyone were not optimizing then, necessarily, that individual has an incentive to change his or her behavior (i.e. his or her demand or supply of some good or service). Any general equilibrium is therefore an optimum.

If a world is in such a state of general equilibrium, how could anyone claim that it is not optimum, that is, not the ‘best of all possible worlds’? First, if we claim that it is not we would be saying that we know better
than the market participants themselves; that is, we would have to claim that at least one individual is not maximizing even though he or she may think otherwise. Unless we have access to some variables which are not already recognized in this general equilibrium world, there is no reason for us to know more than any individual participant. These extra variables cannot be among the endogenous since the latter are already determined by the interaction of all individuals. Thus, they must be exogenous variables. If we are participants in the market, we would be in a position to gain by our privileged access. Such a potential gain would mean that our market was not actually in an equilibrium, anyway. If we have to be outside to be able to claim that a given general equilibrium is not an optimum, the given equilibrium may still be the best of all ‘possible’ worlds – that is, possible for the participants acting without outside help.

The question of the optimality of any given general equilibrium also concerns us with the implied coincidence of an optimum for the whole economy with the numerous personal optima of all independent and autonomous individuals separately. For example, if all individuals are maximizing, the (linear) sum of their maxima is itself a maximum. This is not in doubt as the linearity of the system of equations is assured by the conditions (1)–(3). Whenever each individual is at a point where being at any other point means non-optimality, the aggregate of all individuals’ choices will also be an optimum [Koopmans, 1957]. In this case, a general equilibrium in this world is a welfare optimum, in the sense that should any individual deviate, the aggregate welfare will be reduced. And again, for us to say that it is not the ‘global’ optimum requires us to have an outside perspective that is precluded by definition of the world of autonomous individuals.

All this is quite consistent with the idea of a market equilibrium. In the neo-classical theory of prices the demand curve is the locus of all price-quantity points, where all demanders are maximizing their utility at the represented price or quantity. Similarly, the supply curve is the locus of respective profit maximizing points of suppliers. When a market clears (i.e. demand equals supply), the price is one where each individual (by maximizing) is choosing the correct quantity to demand or to supply. At market-clearing prices, aggregate supply and aggregate demand are equal, even though no individual has to calculate such aggregates.

Generally speaking, for any particular market to be in equilibrium virtually all other markets would have to be in equilibrium. If they are not all in equilibrium it would mean that at least one participant in the market is not successfully maximizing. For example, in the world described above in Section 2, to be maximizing with respect to the purchase of good X, the price for the other good, Y, must be an equilibrium price. If it is not, then just what price is it? If it is the equilibrium price for Y, in principle the optimum choice for X already implies the optimality of the demand for Y as well [see Hicks, 1939/46].

4. A Disequilibrium State as a Sub-optimum

If we consider any state of disequilibrium we must be looking at a state where at least one individual is not maximizing and at a state which is sub-optimal. This observation gives new meaning to what Arrow was saying in 1959. If the explanation of how prices adjust requires an analysis equivalent to imperfect competition, then what is an equilibrium in an imperfectly competitive market? Following Robinson [1934/69], textbooks clearly show such an equilibrium as an output level where marginal revenue equals marginal cost (because profit maximization is assumed) and where total revenue equals total cost (because competition is assumed to be sufficient to eliminate excess profits).

If we look at the typical view of the firm in such an imperfectly competitive equilibrium, we will see the usual ‘U-shaped’ average cost curve with the marginal cost curve rising and intersecting at the lowest point on the average cost curve. We will also see that the firm’s effective average revenue curve is downward sloping (since imperfect competition means each firm’s output level affects the price). The equilibrium implies the average cost curve is tangent to the average revenue curve at the level of output where the marginal cost equals the marginal revenue – that is, at the profit maximizing point. Since the average revenue curve is falling at that point, the marginal revenue is less than the average revenue, thus the marginal cost is less than the average cost. The profit maximizing point is to the left of the lowest average cost, that is, where average cost is falling – see Figure 1.1.

Observing this state of competitive equilibrium in an imperfectly competitive market we see that all producers are necessarily producing at a level of output for which the average cost (and the price) is above the lowest possible. So, some theorists argue that the imperfectly competitive equilibrium is sub-optimal [e.g. Stiglitz, 1975]. In one sense the firm in this equilibrium is facing increasing returns, since marginal cost is less than average cost. If the firm’s average cost curve accounts for all costs – that is, for the costs of all inputs – then it cannot be maximizing with respect to all inputs! Since this is an important point let us make sure it is correct by being a little more formal.

Consider again our simple two input world of Section 2. If, say, L and K are truly the only inputs into the production of good X, then the
production function, $X = f(K, L)$, is formally ‘linear-homogeneous’ [see the above quotation from Samuelson, 1947/65, pp. 84–5], that is,

$$X = (MPP_L)(L) + (MPP_K)(K) \text{ at all } L, K \text{ and } X = f(L, K), \quad [1.1]$$

where $MPP_L$ and $MPP_K$ are the appropriate marginal products. Let us now add that marginal revenue is less than average revenue while, as always, average revenue is just the price, $P_X$. Profit maximization requires that the marginal revenue be just equal to the marginal cost, $MC$. For profit maximization to occur these relationships imply that the price must be greater than marginal cost. To express this formally, let $j$ be a negative number between zero and minus one (for positive prices and positive marginal cost) such that

$$P_X = MC/(1+j).$$

The meaning of (short-run) marginal cost depends on which input is being varied to calculate marginal cost. Usually, labor, $L$, is the input considered sufficiently variable. The marginal cost then is the cost of the additional labor required to produce the additional unit of the output:

$$MC = P_L/MPP_L.$$  

When we say that the firm is maximizing with respect to labor then the following is also true.

$$MPP_L = (P_L/P_X)/(1+j) \quad [1.2a]$$

and alternatively, when capital is the variable input,$$
MPP_K = (P_K/P_X)/(1+j). \quad [1.2b]
$$

Furthermore, if we say the firm producing $X_0$ with inputs $L_0$ and $K_0$ is in a competitive equilibrium where total excess profits (over costs) are zero, then the following is also true,

$$(P_X)(X_0) = (P_L)(L_0) + (P_K)(K_0). \quad [1.3]$$

which is the same as

$$X_0 = (P_L/P_X)(L_0) + (P_K/P_X)(K_0). \quad [1.3a]$$

Now considering [1.2a] and [1.2b], [1.3a] can be represented as

$$X_0 = (1+j)(MPP_L)(L_0) + (MPP_K)(K_0). \quad [1.1a]$$

We can compare this with equation [1.1], which is true whenever the production function is linear-homogeneous. If $j$ is not zero then the production function for the profit maximizing imperfect competitor in equilibrium must not be linear-homogeneous with respect to $L$ and $K$ alone. Furthermore, it must exhibit increasing returns to scale to compensate for the $(1+j)$ term which is between zero and one if equation [1.1a] is also to be true. But, if [1.1a] is true, then [1.1] cannot be true! If [1.1] is true then excess profits are not zero or are not being maximized with respect to all inputs. If [1.1] does not hold, it could be that not all inputs are truly variable, or that not all inputs are recognized [Samuelson, 1947/65, pp. 84–5]. In either case, it means that there is a constraint on the production function which is distorting the usual equilibrium results.

So we see that for an imperfectly competitive market, if we insist that the market is in equilibrium then we cannot also say it is a general equilibrium as gains could be made either by expanding the firm or by adjusting the level of one or more of the inputs. If we insist that the production function is linear-homogeneous, it must be admitted that the firm is not maximizing with respect to all inputs and hence at least one input market is not in equilibrium!

Whenever firms are price-takers, that is $j$ equals zero, we do not have to choose. Any sub-optimal situation is always a disequilibrium. If we say that this price-taking firm is making profits (hence the price is greater than average cost and the market cannot be in long-run equilibrium), the firm must be producing where marginal cost is greater than
average cost (since price will have to equal marginal cost) – that is, at a point to the right of the lowest average cost. In this case, when average cost is not minimum, it means that there is at least one input which the firm is not using optimally. In this price-taker case clearly sub-optimality is coincident with disequilibrium. This is most clear in the case of a linear-homogeneous production function. If we say there are positive excess profits then

$$X > (P_L/P_X)(L) + (P_K/P_X)(K).$$

If we also say the price-taker is at least maximizing profit with respect to $L$, equation \[1.2a\] holds (noting that $j$ would equal zero for a price-taker). In this case, using \[1.1\] to substitute for $X$ and \[1.2a\] we conclude that

$$MPP_K > (P_K/P_X).$$

This shows that the price-taking firm cannot be maximizing with respect to all inputs whenever it is making profits, and at the same time it does face a linear-homogeneous production function. This is the clearest case where a disequilibrium is necessarily a sub-optimum. We cannot discuss disequilibrium states separately from sub-optimal states. Any disequilibrium economics must be about the behavior of people who are not optimizing. How can we explain disequilibrium states as demanded by so many theorists if our primary behavioral hypothesis in neoclassical economics is that everyone is a maximizer or optimizer?

### Optimization vs Equilibrium

Involuntary unemployment has nothing to do with any metaphysical conundrum about ‘free will.’ It is a technical term used to describe a certain kind of (Walrasian) market failure.

Frank Hahn [1983, p. 225]

Should one think of the labor market as mostly clearing, or at worst in the process of quick return to market-clearing equilibrium? Or should one think of it as mostly in disequilibrium, with transactions habitually taking place at non-market-clearing wages? In that case presumably the wage structure is either not receiving any strong signals to make it change in the right direction or is not responding to the signals it receives. My own belief in this case lies with the market-failure side. That is to say, I believe that what looks like involuntary unemployment is involuntary unemployment.

Robert Solow [1980, pp. 2–3]

Theology in the thirteenth century presented the story of man and the world according to the divine plan of salvation. It provided the men of that age with an authentic philosophy of history, and they could afford to ignore the factual experience of mankind since they were so well assured of its ultimate cause and significance.

Carl Becker [1932, p. 17]

Discussing disequilibrium states and sub-optima separately is made difficult by the common viewpoint that identifies the market equilibrium with the co-ordinated independent optimization of all individual participants. Just how can any sub-optimum ever be an equilibrium? Or, how can any disequilibrium ever be an optimum? Obviously, there are four possible cases to consider: (1) sub-optimal equilibrium, (2) optimal
disequilibrium, (3) sub-optimal disequilibrium, and (4) optimal disequilibrium. The last two were discussed in Chapter 1. As long as we insist that an equilibrium is possible if and only if all participants are optimizing, then either we have an optimal equilibrium or we have a sub-optimal disequilibrium. So, it would seem imperative to ‘explain away’ any sub-optimal equilibrium or optimal disequilibrium. Of course, to be acceptable any such neoclassical explanation must not ignore the requirements of methodological individualism. Specifically, any sub-optimal situation can only exist if there is at least one barrier that prevents individuals from exploiting the possibilities for improvement. We need to decide whether the barrier is an exogenous variable or an endogenous variable. If it is allowed to be an exogenous variable it must be a ‘natural given’, otherwise we would be inadvertently recognizing a non-individualist, non-natural given and would violate the requirements of methodological individualism. If we allow it to be endogenous, we beg the question as to why it is sub-optimal.

Any claimed optimal disequilibrium (i.e. a disequilibrium state which is optimal) must also be explained away. To do so we might consider what it would take to truly be in the best of all possible worlds. That is, a true equilibrium might never be possible because it would require impossible feats (such as the acquisition of perfect knowledge). So-called Keynesian ‘ involuntary unemployment’ is a typical example. The disequilibrium state might be ‘explained away’ by noting that the state is still optimal relative to the disequilibrium prices. Since disequilibrium prices are usually identified only by showing that they are not the general equilibrium prices that we would calculate with a typical Walrasian (price-taker) model, it can sometimes be shown that the alleged ‘disequilibrium prices’ are an illusion created by the tendency to examine only the properties of ceteris paribus maximization in an unrealistic methodological individualist world. For example, the decision about how much of a resource such as labor to supply, in the usual textbook case of a labor-leisure choice, requires a utility function or preference map. However, that map depends on knowing the equilibrium prices for the goods to be purchased with the desired income. The labor supply curve that is derived for any set of ‘disequilibrium prices’ may not be the same as the optimal labor supply curve derived when every supplier knows the equilibrium prices. Thus, the alleged ‘disequilibrium’ in the labor market may actually be an equilibrium for the supply curve based on incomplete knowledge of the true equilibrium prices [see further, Clower, 1965]. In this way, then, it may be possible to explain the ‘disequilibrium’ away.

There are other difficulties with the idea of a sub-optimal disequilibrium. On the one hand, as Solow [1980] points out, unless we allow for trading at disequilibrium prices there is no possibility of observing a sub-optimal disequilibrium. So, if we do not allow for trading at disequilibrium prices (non-market-clearing prices) then we will only be able to see optimal equilibria and nothing else! On the other hand, as Richardson [1959] argues, if we allow for trading at disequilibrium prices then we beg the question of why we would ever have an equilibrium in the first place. If both Richardson and Solow are correct, how could there ever be an economics of disequilibrium? In the remainder of this chapter we will examine how optimal disequilibria and sub-optimal equilibria are usually explained away.

1. Sub-optimality as Equilibrium: Externalities vs. Market Failures

It is all too easy for a bystander to think that what might pass for an equilibrium (simply because there is no on-going movement in the situation) is actually sub-optimal. The situation may be claimed to be sub-optimal because the bystander can imagine an optimum that is not being obtained. Typical examples include the usual complaints concerning traffic congestion, air and water pollution, over-fishing, etc. If there is room for more optimization, the question to be asked is, why have the decision-makers not made adjustments to obtain those conceivable gains? If we are to maintain the theoretical perspective required by any commitment to methodological individualism – that is, that all things not caused by nature are considered the results of decisions made by individuals and that only individuals make decisions – then our task is most difficult.

Whenever the bystander claims that the current equilibrium behavior of any individual is sub-optimal, implicitly the claim is that there are one or more non-natural constraints being imposed on the individual. This is because, if all constraints were natural, the situation may not be sub-optimal. The individual can only be expected to maximize subject to the givens that cannot be changed. So, how can the individual’s state of equilibrium ever be sub-optimal? If the constraints are not naturally given then they are changeable. If the situation is sub-optimal at any point of time then the individual should endeavor to change them to reach an optimum. The usual assumption of maximizing behavior does not deny the existence of constraints. Maximization is always subject to constraints. It is in precisely this spirit that Marshall saw virtue in recognizing that some things take longer to change than others.

Any situation may be temporarily sub-optimal – this sub-optimality is only relative to an optimal state which cannot yet be reached. That is, the situation is optimal relative to what is possible in a short run, but it is
sub-optimal relative to what is possible when enough time is allowed for
the individual in question to change the constraints. The Marshallian
theory of the firm is a paradigm of this distinction. The difference
between the short-run and the long-run rests entirely on the notion that
capital takes longer to change than labor. Of course, this is just a matter
of methodology and not something profound concerning the intrinsic
properties of labor or capital. One might claim today that contrary to
Marshallian methodology, in some situations, due to contractual
commitments, it is easier to change capital than labor. But the primary
point at issue is that some things can be changed faster than others. And
on this basis one might claim that a partial short-run equilibrium may be a
sub-optimal long-run equilibrium merely because a long enough run has
not been allowed to make all the necessary adjustments to reach the
optimal long-run equilibrium. In other words, an optimal long-run
equilibrium is one of many possible short-run equilibria – the one that
happens to be a long-run optimum.

To explain away the sub-optimality of a short-run equilibrium on the
basis of the claim that some variables can change faster than others still
begs the question of what determines the relative speeds of adjustment.
Unless the relative adjustment speeds are naturally determined then again
the explanation of the individual’s behavior is incomplete according to
our neoclassical commitment to methodological individualism. As many
Austrian economists argued years ago, the speed of adjustment for some
variables is naturally given. For example, trees only grow at naturally
given rates [see Wicksell, 1893/1954]. For this reason, Eugene Böhm-
Bawerk saw the neoclassical choice to be one of deciding how long to
wait before cutting the tree down, given that the rate of growth diminishes
over time. A similar question arises concerning how long to wait before a
bottle of wine is good enough to open.

The question here is whether the relative speeds are a matter of choice
or whether they are natural givens, i.e. are constraints. If they are a
matter of choice, under what circumstances would the individual in
question choose not to change a constraint? If the individual chooses not
to change a constraint in the short-run then any optimum subject to that
constraint cannot be sub-optimal when viewed from any realistic long-
run perspective. But this only begs the question about why the individ-
ual would choose not to change a constraint even though it is logi-
cally possible to change it. Does the necessary change (for the by-
stander’s concept of long-run optimization) cost too much? This is the
basis of the viewpoint often presented by the followers of Ronald Coase
[1960]. Often the constraint facing one individual is the behavior of
other individuals. Both individuals might be better off if they could find
a way to establish mutually beneficial constraints. The cost of transact-
ing a change in one of the constraints may exceed the benefits (i.e. the
difference between the optimal situation and the current situation). Such
transaction costs would have to be considered external to the individual
decision-making process when viewed from the perspective of strict
methodological individualism. The claimed sub-optimal state is thus
seen as being optimal with regard to the barrier of transaction costs.

What is presumed by externality or transaction-cost explanations for
the false appearance of sub-optimality is that the constraints can actually
be properly evaluated. That is, to say that the reason there is no
movement towards the bystander’s conceptual optimum is that such a
movement would cost too much, is to presume that the individuals all
know the relevant prices needed to calculate those costs. This presents
two problems. First, for there to be prices available there must be a
market for the goods or services required for the process of reaching the
optimum, since consumers are claimed to choose not to buy the needed
goods or services at the going prices. Second, to accommodate this type
of choice we have to have a vision something like Kelvin Lancaster’s
‘New theory of consumer theory’ [1966]. He claims to explain such all-
or-nothing choices based on given prices by noting that goods are
consumed to obtain specific characteristics and two different goods may
provide the same characteristics such that one of them may be
economically redundant. If we do not adopt such a view, then we must
say that either the price of the needed good is infinite or the consumer is
facing a ‘corner’ equilibrium that is insensitive to small price changes
(such as when the consumer has chosen a point at one end of the budget
line). In all three cases the equilibrium situation can be explained as
being the consequence of optimizing choices – not buying the goods or
services is preferred and hence optimization is taking place. If all
individuals are optimizing then, in accordance with methodological
individualism, the equilibrium in question must be optimal.

2. Sub-optimality as Market Failure

When we say a market exists we are implying that there is a finite price.
Similarly, when we say a market does not exist, one might wish to express
this as saying that the price is infinite. That is, the consumer cannot find
anyone who will sell the good at a finite price. The idea that a price might
be infinitely high is, nevertheless, difficult to imagine.

When there is no market for a good which is needed to reach the
bystander’s conceptual optimum, can the alleged sub-optimal equilib-
rium ever be explained away? How could any individual make an ap-
propriate optimizing choice when there is no price? The price is
important information for any decision-maker and the market is a means of supplying that information. In other words, it is important to recognize that the market is a social institution which exists only because individuals choose to make it exist.

Obviously, there is a danger of an infinite regress here – that is, whether there exists a market for a market for a market ..., ad infinitum. Whenever the perceived benefits from any conceivable market are less than the transaction costs of creating it, the regress will stop. In this sense, to say that the price of any good or service – even a market – is infinite may easily be interpreted as a market failure. But, also in the same sense, any claim of market failure can be explained away as an optimizing choice, a choice not to create the market in question.

The only methodological question here is whether there are any natural reasons why a given market for a needed good does not exist. Arrow [1974] claims that for some goods there are such reasons. The primary example is a good which is needed for almost all productive enterprises – namely, trust. Arrow claims that consideration of such a good reveals a very serious limitation of equilibrium-optimization analysis (and this is echoed by Hahn [1981]). The view is that it would be difficult to sell or buy trust since it immediately raises the question of infinite regress. As Arrow says ‘If you have to buy it, you already have some doubts about what you’ve bought’ [Arrow, 1974, p. 23].

While it might be easy to yield to Arrow’s point that there are exogenous (natural) reasons why there cannot be a market for some goods, it would be premature to reject neoclassical theory for this reason. After all, if the reason a market does not exist is exogenous, then this is a prima facia explanation for why the alleged sub-optimal equilibrium is really an optimum. The basis for this stronger-than-Coase conclusion is methodological individualism itself.

3. Disequilibrium as Optimality

If any apparent sub-optimal equilibrium can so easily be explained away as an optimal equilibrium, can one also show that any alleged optimal disequilibrium is really an optimal equilibrium? In some sense, one might see that this is just what Keynes was attempting in his General Theory [1936] – at least if we view it from Clower’s perspective [1965]. The question at issue is, can neoclassical theory (a theory constructed in accordance with methodological individualism) ever account for any optimal disequilibrium state. In particular, must a disequilibrium in the labor market (i.e. less than full employment at the prevailing wage-rate) always be seen as the result of sub-optimality, that is, of a failure of participants to optimize individually?

The usual excuse given for persistent excess supply of labor is some alleged price rigidity which does not allow any adjustment to eliminate the excess supply. If one takes this line to explain unemployment then methodological individualism requires that reasons be given for any alleged rigidity – and the reasons cannot include any claim that the rigidity is exogenous since prices are not naturally fixed phenomena. But if the rigidity is not exogenous then it could be explained as an object of optimizing choice [e.g. Gordon, 1974]. Unfortunately, this line of explanation leads one to claim that all alleged unemployment is voluntary. In opposition, Solow claims that if it ‘looks like involuntary unemployment [it] is involuntary unemployment’ [1980].

Clower claims that the question of rigidity misses the point of what Keynes was complaining about. There is no need to give an explanation for any rigidity of prices since what we have here is an optimal ‘disequilibrium’. That is, we have a disequilibrium where every individual is actually optimizing and thus there is no reason for anyone to change their behavior such that the disequilibrium would be eliminated. Clower shows that if one gives up the necessity of Walrasian prices (ones which presume a general equilibrium among autonomous price-takers) then it is quite possible that at non-Walrasian prices (non-market-clearing prices) all consumers may be in equilibrium at the alleged disequilibrium wage rates. If the supply curve for labor is derived in the usual manner but now as merely the consequence of individuals’ optimizing labor-leisure choices with respect to the given disequilibrium prices for consumption goods, then the supply curve will not be the one based on equilibrium prices. At such non-Walrasian prices for consumption goods the supplied quantity of labor can equal the demanded quantity. Similarly, all consumers can be maximizing their respective utility given their respective incomes derived from the labor supplied. In other words, the alleged disequilibrium (unemployment) is really an equilibrium even though it is not the Walrasian general equilibrium corresponding to full employment.

What is interesting here is that, not only is all this consistent with methodological individualism since no non-natural exogenous variables have been introduced, but the end result is difficult to distinguish from the neoclassical explanations which explain away the appearance of sub-optimality rather than the appearance of disequilibrium. What makes Keynes’ viewpoint superior in the eyes of some is that it does not presume the existence of Walrasian (general equilibrium) prices to establish the existence of an equilibrium where all participants are optimizing. The key issue here is that it would be difficult to deny the possibility of Clower’s interpretation of Keynes unless one can give an analytical general (‘uniqueness’) proof that there is one and only one set
of prices and quantities (namely, full employment levels) where universal maximization is possible. But even worse, if there were such a uniqueness proof then the old philosophical ‘free-will vs. explanation’ problem would seem to appear again.

4. Disequilibrium as Information Optimality

More recent efforts to deal with either optimal or sub-optimal disequilibria attempt to explain them as being the result of imperfect information [e.g. Stiglitz, 1975, 1979; Solow, 1979]. A disequilibrium is claimed to be the result of natural constraints on any acquisition of the perfect knowledge supposedly needed to assure the achievement of an optimal equilibrium. What is supposed is that for any equilibrium to exist there must be perfect knowledge [Hayek, 1933/39; Richardson, 1959; Shackel, 1972; etc.]. Before questioning this supposition, let us examine the reasons why some general equilibrium theorists claim that the existence of imperfect knowledge is evidence of a state of disequilibrium.

Consider a closed economy or even the whole world. We know some general facts about any such economy. First, as a simple matter of accounting, aggregate excess profits must be zero. If any one individual is making excess profits, then at least one other individual must be suffering losses [i.e. no ‘Santa Claus’, see Samuelson, 1972, p. 477]. Second, if we think of the economy as being a very large firm then as a matter of elementary mathematics, the economy’s production function must exhibit constant returns to scale whenever all inputs and outputs are endogenous variables – that is, the production function must be linear-homogeneous (see Ch. 1). Whenever any individual firm is facing increasing returns, then at least one other firm must be facing decreasing returns. Third, in a state of either the Walrasian general equilibrium or Marshallian long-run equilibrium, whenever all individual firms are making zero excess profits while maximizing profits, all must be facing (local) constant returns to scale [see Baumol, 1977].

With these three facts in mind, let us examine what is claimed to be the role of information. Many general equilibrium theorists often claim that if information (and knowledge) is a produced good, then there must always be increasing returns in such an industry [see Arrow, 1962/71, pp. 150ff]. The primary reason for this view is that knowledge, once produced, can be duplicated without cost and thus cannot be appropriated. This inability to appropriate the full profit for the creation of information reduces the incentive to enter the information-producing industry. All this supposedly leads to an underproduction and underutilization of information. In this sense the information industry will never have enough producers to bring about perfectly competitive conditions. Even though it is always possible that more information could improve someone’s profitability (e.g. by reducing the costs of risk-bearing), the information is not produced. It is possible for someone to conclude here that any insufficiency of information means that there will always be an excess demand for information and thus even when all producers (and consumers) are optimizing with the available information, there will always be a disequilibrium in the information market.

Whether this is an optimal disequilibrium or a sub-optimal equilibrium is an arbitrary matter of viewpoint. If one accepts this pessimistic view of the information industry, then any state of general equilibrium will have some inconsistencies which may imply sub-optimality. If we are in a Marshallian long-run equilibrium with every producer making zero excess profits, then it will follow that not all producers are optimizing. To see this, consider a long-run equilibrium as shown in Figure 2.1(a), (b) and (c). Figure 2.1(a) represents the alleged imperfectly competitive equilibrium for any information producer. It will be maximizing (at $Q_i$)

![Figure 2.1. Increasing returns in competitive equilibrium](image-url)
where marginal revenue \((MR)\) equals marginal cost \((MC)\) and the absence of profits leads to a price \((P)\) equal to average cost \((AC)\). Figure 2.1(b) represents the situation facing an optimizing perfect competitor (i.e. facing any firm not producing information). This small commodity-producing firm will set its output at a level \((Q)\) where its market-given price \((P_c)\) equals its marginal cost and, since we require no profits for a state of equilibrium, marginal cost equals average cost.

If there is only one firm (or industry) that is in a state of imperfectly competitive equilibrium, Figure 2.1(a), then there must be at least one commodity-producing firm that is not facing the situation represented by Figure 2.1(b). Since the economy as a whole must have constant returns to scale (neither falling nor rising aggregate average costs) there must be one firm facing the situation represented by Figure 2.1(c) – one where the firm is producing at a level where its (short-run) average cost is rising even though it faces a linear-homogeneous production function like all other perfectly competitive firms. Now either the firm’s excess profits are zero but not maximum (at \(P\) marginal cost is above the price) or, if profits are at a maximum, they are not zero (which is contrary to our original requirement for a state of equilibrium) – compare Figure 2.1(c) and (d). If all other firms in this world are making zero excess profits then so must this firm be making zero profits (i.e. the world’s aggregate excess profit must be zero as a matter of accounting) and it follows that at least one firm is not optimizing. Taking this view we see why it can be claimed that if information production is always imperfectly competitive then the possibility of an optimum general equilibrium is precluded. If we define a state of equilibrium as the absence of incentives for industry growth or decay – that is, as the presence of universal zero profits – then at least one firm is not optimizing. If we define equilibrium to include universal optimization (which is how Walrasian general equilibrium theorists define it) then no equilibrium could ever exist. In order for this to be acceptable in accordance with methodological individualism, it must be demonstrated that ‘increasing returns to information’ can be explained as a natural phenomenon. Of course, this explanation via natural phenomenon presumes that perfect knowledge can only be achieved by (or is defined on the basis of) inductive logic or inductive learning.

Since the existence of increasing returns would mean that all possible gains are not exploited (average costs can still be reduced), it is claimed that any general equilibrium which includes information as one of the goods must not be optimal [see also Hollis and Nell, 1975, pp. 136–7]. Now, if we stick to the more general definition of an equilibrium where there is no incentive for growth or decay (every firm’s excess profit is zero), the question is whether the existence of increasing returns in the information industry should always be considered sub-optimal. After all, it might simply be claimed that the limitations on induction are a natural externality and thus, the equilibrium is still the best we can do in less than an infinite amount of time. But, the amount of information produced and acquired is endogenous and so this avenue for explaining away any apparent sub-optimality is precluded, except if we recognize that the production of information is costly. From the inductivist viewpoint, it is always too expensive to collect sufficient information to remove all possibilities of improving knowledge [e.g. Stigler, 1961]. It is important to recognize here that the claim that there is always room to improve knowledge is completely based on inductivism. Without a presumption that all learning is inductive, a decision-maker’s knowledge (or expectations) can be true – even if only by accident.

Inductivism will always lead to a view that the knowledge required for the achievement of an optimal equilibrium will necessarily be imperfect whenever knowledge is limited by real time and real space. Still one can claim that the degree of imperfection of one’s knowledge is optimal. The microeconomic version of the rational expectations hypothesis is an example of this. If one’s expectations are imperfect but to an optimal degree, then the consequences of making optimization decisions on the basis of this imperfect knowledge will still be optimal in any realistic sense of equilibrium (that is, without assuming an unrealistic amount of time or space). While believers in the usefulness of the rational expectations hypothesis will be quite satisfied with this concept of an optimal equilibrium, some general equilibrium theorists are not. This is because increasing returns in information still implies that the equilibrium is not optimal in the Pareto sense [see Fisher, 1983]. Pareto optimality merely defines an optimum equilibrium to be where there cannot exist any way for one individual to gain without making someone else worse off.

5. Methodological Costs/Benefits of Invisible Equilibrium Prices

An interesting alternative to explaining away sub-optimal equilibria is to claim that the appearance of decreasing average cost (such as claimed for the production of information) is misleading for two reasons. When purchasing any good, the price on the price tag never accounts completely for the total price paid by the consumer. The total price paid should include the transaction costs such as the time lost while waiting in the queue at a supermarket or an airline ticket counter. Some of these usually excluded transaction costs should also be included in the
calculation of the true average cost incurred by the producer [see DeVany, 1976].

What is claimed in this view of invisible prices and average costs is that if there really is an equilibrium in the industry in question then there should be no increasing returns – that is, no decreasing average costs. This means that, while it might appear that the demand curve is tangent to the average cost curve at some output level to the left of the minimum average cost as in Figure 2.1(a), the correctly calculated situation for the equilibrium output level has the true average cost curve at its minimum; and the true average revenue curve is tangent to the average cost curve at this same equilibrium level of output as in Figure 2.1(b).

We may be cavalier in calling these ‘invisible’ prices or ‘invisible’ costs, nevertheless, there surely are some methodological costs in this manner of explaining away apparent sub-optimality of an equilibrium. How would one ever empirically test such an explanation? Each consumer of the product faces a different (total) price even though they all face the same price-tag. In this world, what information is imparted by the price system? The usual general equilibrium analysis, typical of existence proofs and stability proofs will become excessively complicated and certainly no more testable. Certainly, all analyses of economic policies using benefit-cost comparisons based on measuring consumer surplus would be rendered virtually meaningless.

If the invisible-prices approach to sub-optimal equilibria is considered unacceptable, the problems concerning the implications of the role of information in any state of equilibrium is still lurking behind the scenes. But again, if there is a problem of implied sub-optimality of any equilibrium which requires a role for information and knowledge, it is only because economic theorists take inductive learning for granted. While rejecting a necessary role for inductive learning would avoid the problem and any need to consider invisible prices, there remains the question of how knowledge is acquired in the neoclassical conception of optimal decision-making.

In this chapter we have seen that it is often easy to explain away sub-optimal equilibria or optimal disequilibria. Once these aberrations are explained away, we are left either with the usual equilibrium situation to explain how any static equilibrium is just the situation that we want, or with the sub-optimal disequilibrium situation to explain any dynamics in the economy that follow from individuals realizing that they still are not optimizing. Either way the basis of our explanation is the concept of an optimal equilibrium and thus we now turn to examine this method of explanation more closely.
Individualism and Differential Calculus

The element of time is a chief cause of those difficulties in economic investigations which make it necessary for man with his limited powers to go step by step; breaking up a complex question, studying one bit at a time, and at last combining his partial solutions into a more or less complete solution of the whole riddle. In breaking it up, he segregates those disturbing causes, whose wanderings happen to be inconvenient, for the time in a pound called *Ceteris Paribus*.... With each step more things can be left out of the pound.... We thus approach by gradual steps towards the difficult problem of the interaction of countless causes. ... It is true that we do treat variables * provisionally as constants. But it is also true that this is the only method by which science has ever made any great progress in dealing with complex and changeful matter, whether in the physical or moral world.

-Alfred Marshall [1926/64, pp.304, 306, 315 (footnote 1)]

Fundamentally, our ultimate method of explanation in economic theory has not changed from that espoused by Marshall. It is merely the partial equilibrium (*ceteris paribus*) explanation of the behavior of any individual decision-maker based on the explicit use of the standard idea of a partial derivative. All non-natural and non-individualist variables (prices, gross national product, etc.) are explained as logical consequences of the behavior of all individuals. The only thing ever disputed is whether one can explain why the economy as a whole would be at an optimum equilibrium state whenever all individuals are in a state of partial equilibrium (i.e. they are maximizing something). Marshall’s proposed method for showing that this would be the case breaks the problem of explanation into a sequence of manageable parts such that the
problem can be solved in stages. His method of explanation starts with a very short run where the price is determined solely by demand and ends at a stage where all prices are determined by the natural givens (technology) and the quantities produced and consumed are determined by the given utility functions of the individuals.

It should be noted that the explanation of even one individual in the literal short-run equilibrium is never complete, according to methodological individualist principles, since by definition of the short run the individual in question faces non-natural constraints (income, prices, capital stock, etc.) which are considered changeable only in a longer run. A complete explanation of the individual must ultimately explain these non-natural constraints. Of course, in the long-run equilibrium they can be explained without giving up the idea of a partial equilibrium for the individual. It is important to recognize that any individual in long-run equilibrium is thereby also in a short-run (partial) equilibrium!

1. Long-run General Equilibrium and Individualism

Marshallian partial equilibrium analysis is without any serious problems if we restrict our interest to the state of long-run equilibrium. And when we do restrict our analysis to states of Marshallian long-run equilibrium it is indistinguishable from Walrasian general equilibrium analysis. Where the former postulates the isolated individual in a state of personal equilibrium facing long-run equilibrium ‘constraints’ and prices, the latter looks at any pair of individuals and postulates them in an exchange equilibrium facing exogenous ‘endowments’. Both methods of analysis support a methodological individualist view of the world.

1.1. Compatibility of Walrasian and Marshallian Explanations

For Marshallian analysis, a complete explanation of an individual decision-maker would see the economy in a long-run equilibrium. Any individual selected at random will always be in a short-run equilibrium facing long-run equilibrium constraints. The individual consumer, for example, would face an income that is a consequence of that individual’s supply of labor (or other resources) given long-run equilibrium prices. What is explained here is the individual’s demand decision. Since all other variables have long-run equilibrium values, the individual takes market prices as givens and thereby demands the quantity which, when added to the (optimal) demands of all other participants, just brings the total demand into equality with the supply. The important point here is that we can always explain the behavior of any single individual we select.

The Walrasian explanation of any individual would begin with a vision of an entire economy in a state of general equilibrium that is identical to a long-run equilibrium. There is no suggestion that we must see it in terms of a Marshallian long-run perspective. Here we are able to explain any two individuals (or two goods, two inputs, etc.) selected from a list of all individuals participating in the economy. If it is a general equilibrium then no matter which two individuals (or goods) we select, the two individuals will be in an exchange equilibrium. It is possible to interpret our simple model of Chapter I as such an exchange equilibrium. An exchange equilibrium is one where neither individual can gain without the other losing thus there is no mutually acceptable reason for any change. The paradigm of this analysis is the Edgeworth-Bowley box, which represents the allocation of two goods between two individuals (represented by opposing indifference maps) – see Figure 3.1.

Any exchange equilibrium is represented by a point on the contract curve, that is, on the locus of all points of tangency between the two indifference maps. Whichever tangency point will be the equilibrium allocation depends on the prior initial endowments, also represented by a single point, say G. Whenever there is an exchange equilibrium, the equilibrium prices (and the income distribution) are implicitly
determined. The equilibrium relative price must be equal to the negative value of the slope of the two indifference curves. That is, if our two individuals are Mr A and Mr B, our two goods are X and Y, and $MRS_A$ and $MRS_B$ are the respective negative slopes, then

$$\frac{P_X}{P_Y} = MRS_A = MRS_B.$$ 

If we have a dollar value for the income of either individual then we can also determine the dollar prices of each good. Already we see a result which is implicit in the Marshallian long-run equilibrium. It would not take much to show that all implications of a Marshallian long-run equilibrium are reproduced in a corresponding Walrasian general equilibrium and vice versa. We note that, like Marshallian analysis, Walrasian analysis can be based on an assumption that each individual calculates a partial derivative. In this case, the slope of the indifference curves is merely the partial derivative that results from holding the level of utility constant during a marginal exchange.

1.2. Individualism and Partial Derivatives

The major importance of explicitly recognizing the use of the partial derivative is that it is the basis for isolating and thereby analyzing the contribution of each individual to the state of equilibrium. For example, in the theory of the firm, the level of output can be analyzed, that is, broken down into separate contributions of the individual inputs.

If we are not careful, the partial derivative can also mask individualism from our sight. We will discuss this difficulty first since it will demonstrate how the use of partial derivatives allows us to fulfill the requirements of methodological individualism.

Consider an economy in a state of long-run or general equilibrium and consider any consumer's choice of two goods, X and Y. If the consumer is maximizing utility with respect to these two goods, then he or she will be choosing to consume these goods in such a manner that the marginal rate of substitution ($MRS$) between them equals their relative price, $P_X/P_Y$. But, remember that in the state of equilibrium everyone faces the same prices. Thus, in the state of equilibrium all individuals are choosing the same $MRS$ – everyone values the last units bought of every good relative to any other good in exactly the same way. So, is there any real individualism here if everyone is spending their last dollar in exactly the same way?

We must not panic. The appearance of non-individualism can easily be explained away or avoided. It might be said that while all individuals are identical with respect to the marginal demand for X relative to Y, they may differ significantly with respect to the total demand for X relative to Y. Some individuals may choose a point close to the Y axis and others choose a point close to the X axis. Even though everyone has the same slope for the indifference curve through their chosen point, they may choose different points even if they had the same incomes.

It is not clear whether this way of explaining away any appearance of non-individualism does not also explain away some of the individualistic information content in prices. We need not worry about this in any case since the difficulty, if there is one here, is due solely to the general equilibrium theorist’s concept of marginal rates of substitution. The idea of a $MRS$ allows us to see a single individual in a state of equilibrium with respect to any two goods by comparing marginal quantities of those goods rather than calculating the marginal utility of each good. In effect, the individual seems to be in a state of partial equilibrium consistent with the general equilibrium. This now standard conceptual tool was strongly promoted by Hicks in his *Value and Capital* [Hicks, 1939/46] and has dominated microeconomics over the last twenty-five years. The only reason for focusing consumer theory on assumptions about the equilibrium value of the $MRS$ was to avoid assumptions involving the concept of utility as the latter was alleged to be philosophically suspect. Samuelson [1938, 1948, 1950] promoted a method of analysis, Revealed Preference Analysis, which seemed to hold even more promise. With it, supposedly, we could forever avoid the concept of utility, or even the concept of a preference map, by observing and analyzing actual choices and assuming only that the individual, by always knowing what is best, never makes a contradictory choice. For example, if prices do not change, the choices will not change. The promise was forsaken by Houthakker [1950] who showed that any use of Revealed Preference Analysis that would reproduce the usual results of ordinary demand theory based on utility functions must of necessity imply that these two supposedly different approaches are logically equivalent [see further Wong, 1978]. Of course, as a trivial matter, the same holds for the older Hicks-Allen Ordinal Preference Theory based on an assumption of a diminishing $MRS$ rather than a diminishing marginal utility.

If we simply retain the idea of marginal utility – that is, use of the partial derivative of the utility function for each good – then any confusion between individualism and explainable free choice is avoided. To do this we simply recognize the elementary point that the marginal rate of substitution (which is the negative of the slope of the indifference curve) always equals the ratio of the two respective marginal utilities:

$$MRS = \frac{MU_x}{MU_y}.$$
With this in mind, we could easily say that no two individuals will necessarily have the same marginal utility for the same good and hence individualism would seem to be preserved even on the margin.

This is the most uncomplicated argument for the role of partial derivatives in the service of methodological individualism. It emphasizes that neoclassical explanations are based, not only on maximization, but on the idea of a partial \((ceteris paribus)\) equilibrium. Yet, so far it is not a very strong argument so we wish to dig deeper into the fundamentals.

### 2. Varieties of Individualism in Economic Theory

One of the more fundamental questions that we have just raised concerns how to conceive of individualism whenever it is shown that everyone is identical in some way (e.g. all end up with the same \(MRS\)). This would seem to put into question just what we mean by individualism. Usually, it is said that everyone has something distinguishing, such as their personal tastes, and that any uniformity between individuals, such as their marginal judgments, is unintentional. This way, it would seem, we can have it both ways. Such may not be the case if we consider the question of why, for example, the marginal productivity of labor diminishes as more labor is hired.

2.1. Liberal Individualism

If no two individuals are alike with respect to productivity then the employer can rank them according to their productivity. Figure 3.2 illustrates such a ranking. Let us say that the product produced is tomatoes. If the price of tomatoes \((P_t)\) and the price of each unit of labor \((W)\) is given such that the first person in the ranking harvests more tomatoes than he or she eats (i.e. the productivity of the first person hired is greater than \(W/P_t\)) then there is an incentive for the firm to hire the first person. The next ranked person will be less productive and if this person still produces more tomatoes than he or she eats, according to the going wage-rate and price of tomatoes, then this person will be hired too. The firm continues hiring people until the productivity of the next person is less than he or she will eat. Marginal productivity in this case is just the productivity of the marginal individual. And the ranking itself provides the needed display of diminishing marginal productivity of labor.

2.2. Egalitarian Individualism

Now, if we instead claim that all individuals are alike we do not have to give up any hope of explaining diminishing marginal productivity. However, to do so we must yield to effects of some other input which is fixed. For example, let us recognize that we have a fixed amount of land on which to grow our tomato plants – say, ten square meters. If all individuals are alike then no matter which individual is hired first, individual productivity will be the same. The question at issue here is how much will output increase if the input level is doubled – that is, the second person is hired. We know that since there is a fixed amount of land there is a maximum number of people who could stand on the land at the same time and with that maximum number we know the total output is zero since they will be standing on top of all the tomato plants. Since the amount of all other inputs (such as the number of tools) is given and fixed by the \(ceteris paribus\) requirement of Marshall’s method of analysis, when we double the number of people hired they still need to share the tools available and for this reason the output will not double when the input is doubled. So, we can say that whenever the input rises by a certain proportion, if the output rises it does so necessarily by a smaller proportion. This means simply that the ratio of output-to-input, or average productivity, is always falling. Since the average and the margin are the same for the first person hired, a falling average implies a falling margin. And since we know that at some level of input the average productivity is zero (the land is covered with people) we know explain it by postulating that all individuals are identical with respect to productivity – pure egalitarian individualism, in this case.
the marginal product must be falling from the initial level corresponding to the productivity of the first individual hired. In other words, even though all individuals may be alike we can still explain why the marginal productivity of their collective input is diminishing as more individuals are employed on the same fixed land or with the same fixed inputs.

2.3. Egalitarian vs. Liberal Individualism

There is no reason to choose between these two versions of individualism. Either way we can explain why marginal productivity is diminishing with input or output. But we cannot hold both views of the individual since they cannot both be true. The best strategy would be to deny both yet allow ranking where ranking is possible and recognize that the fixity of some inputs always forces a degree of diminishing marginal productivity on the variable inputs. However, we cannot think of all individuals as being identical and at the same time try to explain a world where all inputs are variable, since in this case marginal productivity is fixed and hence not diminishing. If we are going to maintain that prices are given, either we must give up egalitarian individualism or give up universal variability of inputs. It is interesting to note that Paul Samuelson explicitly chose to give up universal variability [Samuelson, 1947/65, p. 85]. By implication he chose to maintain egalitarian individualism.

The only difficulty with maintaining egalitarian individualism in this way is that we beg the question about why some inputs are fixed. Unless it is for some natural reason, our explanation of the individual decision-maker, of the firm in our example, is still incomplete. But even worse, if we give up egalitarian individualism, we have to explain why individuals are different which too easily leads us to psychologistic individualism and its many problems which we noted in the Introduction.

Liberal individualism has the exact opposite problem. If everyone is different, there is the possibility that we could never be able to show that any economy is stable. Since we are, at this point, only interested in seeing how individualism is usually supported in neoclassical models, we will postpone these deeper questions until Part IV where we will consider ways by which they can be overcome.

3. The Long-run Equilibrium as a Special Short-run Equilibrium

What is at stake here is the recognition that all neoclassical explanations of individuals are either partial equilibrium or short-run equilibrium explanations. But they are never complete with respect to methodological individualism unless or until they are also long-run or general equilibrium explanations. The best way to think of this is to see that the neoclassical explanation of an individual is that of an individual in a very special short-run equilibrium – namely, the one which would have to exist when the economy as a whole is in a state of long-run (general) equilibrium. The differences between the special short-run equilibrium and just any ordinary short-run equilibrium is most apparent in our explanation of the firm. What we need to see is how much our explanation of the firm depends on techniques of analysis which avoid being nonsensical only by being restricted to the special short-run equilibrium state.

3.1. Explaining the Firm in a Special Short-run Equilibrium

Partial equilibrium (or *ceteris paribus*) analysis is so well understood by almost everyone who has taken one or more economics classes that it is taken too much for granted. Some of its more subtle methodological details are often overlooked. Typically, we are taught to consider the individual to be in a state of personal equilibrium in the simple sense that the individual is maximizing his or her utility, wealth, profit, etc., subject to some specified constraints, such that any movement along a continuum away from the equilibrium position will only result in a less than optimum choice. The methodological question that we should always keep in mind is, ‘just what is being explained?’ The variables to be explained are, of course, all the endogenous variables. Which variables are endogenous in any typical economics explanation is not always kept clear. While some of the constraints are clearly exogenous, others are considered to be influenced in some indirect way by the actions of the individual who is often the same one whose behavior is being explained. For example, prices are given to the individual decision-maker but are also influenced indirectly by the demand or supply decisions that the individual makes. Marshall’s short- vs. long-run methodology is designed to keep such things clear. In the short run the individual usually only has one or two variables to choose. By definition of the short run all other variables are effectively put beyond the realm of the individual’s choice. As we noted above, such an explanation of the individual’s choices is incomplete whenever the given is not natural constraints.

For the moment we would like to avoid discussing the question of completeness of the general equilibrium explanation of the economy. Instead, let us narrow our discussion to the properties of the very special partial equilibrium – the one where there is a state of long-run (general) equilibrium, as well as one where every individual is in a state of short-run equilibrium. In this very special case, all the non-natural constraints
are explained by referring to the presumed state of general equilibrium. Now from the general equilibrium perspective, the essential nature of our typical partial equilibrium explanation is entirely a matter of calculus since the equilibrium choice is also the optimizing choice.

To keep the methodological issues as clear as possible, let us first examine a very simple application of partial equilibrium analysis. Even in the most simple models the methodological fundamentals are fully apparent. Consider, for example, the individual firm (typically treated as if it were a person) which we will claim is maximizing its profit with respect to its level of labor employment – that is, it is in a state of short-run equilibrium. On the basis of this claim alone it immediately follows, as a simple matter of calculus, that the firm’s marginal profit with respect to the quantity of labor employed is both zero and diminishing with labor input increments. It turns out that almost everything we have to say about the nature of the firm can be seen as something to support this simple matter of calculus.

Though it is not often stated, there is a presumption here that the possible levels of labor employment can always be represented by points along a continuum. The behavioral explanation is explicitly that the firm increases its level of labor input along a continuum until the marginal profit is brought down to zero, or the firm decreases labor until marginal profit is brought up to zero. What is being explained here is the individual firm’s choice of the level of labor input along with the resulting level of output while all other variables are given. The individual firm need not explicitly calculate its marginal profit but it must have some way of determining what it thinks is a maximum level of profit. For now let us simply assume that it does calculate the marginal profit. This way there is a direct connection between our theory of the firm’s behavior and its actual behavior.

If we think of the firm calculating its marginal profit, we can push our simple calculus analysis even further. Specifically, marginal profit is the difference between marginal revenue and marginal cost, and marginal profit is zero when profit is maximum. If we view the firm as deciding its level of output (within a small range of the level appropriate for general equilibrium) then the marginal revenue is just the given price. Narrowing our discussion here to the very special short-run equilibrium that exists at the given long-run equilibrium only means that the given price is just the long-run equilibrium price. Since the marginal revenue is fixed at the level of the given price, for the marginal profit to be diminishing we would have to have the marginal cost rising with output levels and equal to price when marginal profit is zero. Now this only raises the further question about why the marginal cost might ever be rising – that is, besides being an implication of our presumption of profit maximization with the prices as given. We must answer this question if we are going to complete even our short-run explanation of the price-taking firm’s choice of output level. Again, the explanation must ultimately be based on something exogenous to the firm.

To explain why marginal cost increases with any rise in the output level, we need only continue with our simple calculus analysis. If, in accordance with the Marshallian definition of the short run, the only variable input is labor, then marginal cost of producing more output is merely the cost of the extra labor requirements for the extra output. To calculate the marginal labor requirements we finally reach a fundamental exogenous constraint – namely, the firm’s production function which tells the firm its maximum level of output for each potential level of labor input – or equivalently, its minimum level of labor input for each level of output. Since we are examining the very special short-run equilibrium (i.e. the one corresponding to the existence of long-run equilibrium prices), we are assuming that the capital available is the long-run equilibrium amount. So long as the production function represents a natural constraint with the appropriate properties, the short-run explanation of the individual firm’s behavior will be complete. That is, the firm will be maximizing (rather than minimizing) profit given the price of labor, if its production function is such that the marginal labor requirements rise with the level of output. Again, we cannot simply assert that the marginal labor requirements must be rising merely because the firm is claimed to be maximizing profit since this assertion would make our explanation of the price-taking firm circular.

The usual way to explain marginal labor requirements is to see them as the inverse of marginal productivity of labor. That is, marginal productivity is the extra output resulting from extra labor input. Being the inverse, a rising marginal labor requirement implies a falling marginal productivity. But this does not yet get us very far towards completing our explanation, since it only begs the question about why the marginal productivity is falling as labor input rises. Fortunately we have already seen above how we can explain diminishing marginal productivity of labor. For now it is enough to recognize that there are many ways we can approach the completion of any short-run explanation so long as they do not violate the requirements of methodological individualism. In the case of our tomato firm, it does not seem to matter since both of the opposing views of individuals’ productivities lead to a diminishing marginal productivity curve and thereby a rising marginal cost curve. Once we have explained why marginal cost rises with output levels, our explanation of the price-taking firm is completed. The firm does indeed face a rising marginal cost curve and thus there is a distinct
profit maximizing level of input and level of output. And thus we have a complete, albeit very elementary, short-run equilibrium explanation of the typical individual price-taker firm.

3.2. Analyzing the Firm in an Ordinary Short-run Equilibrium
We may have completed the short-run explanation of the firm – that is, explained the paradigm short-run decision concerning how much labor to hire – but what can we say about the employment of all inputs? It turns out that the only explanation we have for the employment of any other input involves a redefinition of the short run to make the other input the short-run variable input and make labor a fixed factor. This observation, if true, may mean that our ways of accommodating individualism are restricted to long-run equilibrium models. But such an observation may not be obvious in what we have said so far. To determine if it is true, we need to examine the use of calculus concepts that are hidden in some of our typical assumptions about the firm.

To do so, let us consider the analysis of a firm’s output into separate individual contributions of each input. And, let us continue restricting our discussion to the special short-run equilibrium which corresponds to a long-run (general) equilibrium. When looking at the firm in any long-run equilibrium we must continually keep in mind that the firm’s production function is linear-homogeneous (since all inputs are variable by definition of the ‘long run’) and thus equation [1.1] is necessarily true. The equation is true even apart from any question of whether profits are maximized or how many inputs there are. Equation [1.1] (which is a consequence of what mathematical economists call Euler’s theorem) simply says that whatever is the level of output (Y), it can always be calculated by adding together the separate contributions of each input – where each input’s contribution is ‘measured’ by adding together each unit’s marginal contribution and where each unit of an input has the same marginal productivity (MPP). This measurement is true only when we assume all labor inputs are identical (i.e. egalitarian liberalism), but certainly in this case the marginal product of any input is its contribution to output. Since there are no fixed inputs, their sum must be equal to the total output.

Although this analysis seems straightforward, there are some difficulties with the concept of a marginal product which are not often recognized. The marginal product of labor, for example, is always defined as the extra output that results from employing one additional unit of labor. Why should that unit of labor be credited with all the extra output when it is easily recognized that other inputs helped to produce it? Before answering this let us consider an analogous question for which the answer is widely accepted. If we had a production function with two outputs and one input, there is a well-known accounting problem for such joint products [see Hicks, 1973]. Namely, there is no way unambiguously to allocate the input cost to the two separate outputs except in special cases (i.e. linear production functions). So, we should ask what reason do we have to think that there should not be a similar problem when there are joint inputs? Of course, there is no reason; that is, there is no reason for crediting all resulting extra output to one input when that input is increased ceteris paribus.

The concept of marginal productivity is a fiction. Nevertheless, it may be a harmless fiction if we restrict our analysis to long-run equilibria where equation [1.1] necessarily holds, at least, locally. That is, we can still use equation [1.1] to calculate correctly the level of output if we know the inputs’ marginal productivities and levels of employment. But, this is true only in long-run equilibria.

There is an analogous conceptual problem whenever an individual consumer implicitly thinks that the following is true:

\[(MU_\bar{X})(dX) = -(MU_\bar{Y})(dY)\]

where \(dX\) and \(dY\) are the compensating changes to hold the level of utility constant at the point of equilibrium. But, calculating marginal utility (MU) using a partial derivative presumes that the change in the level of utility received when one changes the amount consumed of \(X\) is not influenced by the existence of the good \(Y\) and thus may be completely attributed to \(X\). Analogous to the question of marginal productivity calculations, so long as we are examining the individual consumer in the state of equilibrium there will be no chance of any calculation errors.

It may be said that the partial equilibrium method of explaining the economy by isolating each individual and calculating the relevant partial derivatives can avoid obvious errors (allowing for the fictions mentioned above), but this is true only when we focus on the very special short-run equilibrium that corresponds to the long-run equilibrium. For some theorists, the partial equilibrium method will still seem to provide a complete methodological individualist explanation as all non-natural givens or constraints facing the individual in question are also explained as having equilibrium values and are thereby results of all other individuals being in a state of short-run equilibrium (they are all maximizing). But for others, the idea of a partial equilibrium may seem
to be based on a fiction and thus may cast doubt on the realism of even
the very special case.

Some readers will undoubtedly think that if there is a methodological
problem here, it is only because we are restricting our method of
explanation to the use of calculus methods alone. But, in Chapter 5 we
will see that the problems discussed here arise also when calculus is
avoided in favor of set-theoretic analysis. For now we will continue to
discuss the neoclassical method of explanation exclusively in terms of
calculus – if for no other reason than that it is the method first presented
to most beginning students in economics.

By narrowing, as we have been so far, on the special properties of a
long-run equilibrium, and specifically on the individual’s partial (short-
run) equilibrium in that case, we are discussing a state of the economy
where everything and everybody is accounted for and thus our
explanation is logically complete. The next question to consider is, if the
long-run situation is as precarious as we think it is when we worry about
the empirical meaning of a partial derivative, can we ever expect to
apply the same partial equilibrium method of explanation to
disequilibrium situations?

4

Methods of Explaining Disequilibrium States

The theory of stable equilibrium of normal demand and supply helps indeed to give definiteness to our ideas; and
in its elementary stages it does not diverge from the actual
facts of life, so far as to prevent its giving a fairly trustworthy picture of the chief methods of action of the
strongest and most persistent group of economic forces. But when pushed to its more remote and intricate logical
consequences, it slips away from the conditions of real
life.... [I]t is especially needful to remember that economic
problems are imperfectly presented when they are treated
as problems of statical equilibrium, and not of organic
growth.

Alfred Marshall [1926/64, p. 381–2]

... it is a mistake to ground disequilibrium theory in the
equilibrium behavior of agents. Rather, the theory of the
household and the firm must be reformulated and extended
where necessary to allow agents to perceive that the
economy is not in equilibrium and to act on that
perception.... Agents in the standard theory react to given
prices and take no account either of the fact that prices
may change or of the possibility that they may not be able
to complete their own transactions. So long as the plans
which agents make are compatible, this presents no
difficulty; in equilibrium the equilibrium assumptions of
agents are fulfilled. If we are to deal with disequilibrium,
however, this will not be the case, and we must start at the
level of individual agents.

... Models of what is usually called disequilibrium behavior do not make sense and cannot serve as reliable guides to further theorizing or to policy unless they are consistent and coherent. No single equilibrium concept is valid for all situations.

Michael Rothschild [1973, p. 1283]

So far we have seen that we can have a complete explanation of prices and quantities if we restrict our understanding to that of an optimizing individual in a special short-run equilibrium where the endogenous givens (i.e., prices, income, capital stocks, etc.) are all the long-run optimum values. What does this mean for our explanation of prices or quantities whenever we examine something other than the long-run equilibrium?

This is not necessarily the methodological problem Arrow [1959] presented when he argued that we must have a different theory to explain prices or the adjustment of prices whenever we are examining individuals outside a market equilibrium. It is the same problem only when we are discussing a non-equilibrium long-run situation—that is, one where at least one person is not maximizing with respect to at least one choice variable, even though every endogenous variable is potentially adjustable. In this case, there would be at least one market that is not clearing. As noted earlier, the demand curve is the locus of price-quantity combinations corresponding to simultaneous utility maximization by all consumers. Similarly, the supply curve represents simultaneous profit maximization by all producers. In the disequilibrium situation where Arrow’s complaint does apply, we should be asking whether any imperfect competition theory of price adjustment that Arrow might recommend would ever satisfy the neoclassical requirements of methodological individualism. This question is not easy to answer without seeing explicit examples of such a theory of price adjustment, but if they are typical textbook examples then there will always be unexplained non-natural givens such as those constraints or externalities that limit the number of competitors.

Here we are interested in a more general methodological problem. The question is not just, as Arrow asks, whether we can use the same behavioral theory in disequilibrium as we do in equilibrium. Rather it is whether the same methodological tools and concepts that make complete sense in the long-run equilibrium explanation can be used in a situation that is not a long-run equilibrium.

### 1. Critiques of Partial Equilibrium Explanations

Some critics of neoclassical economics are not satisfied that partial equilibrium explanations are appropriate at any time. To appreciate the views of the critics, let us itemize the critical elements of the partial equilibrium explanation which are apparent even in this simple version. *First* is the question of the realism of the primary behavioral assumption of optimization or maximization. *Second* is the methodological question of whether the individual firm or consumer actually can ever calculate marginal profits or marginal utilities. *Third* is the question of why the firm or consumer would ever be price-takers, that is, be unable to affect the given prices.

#### 1.1. Realism of Maximization

Herbert Simon [1979] has directly disputed the realism of the maximization assumption of neoclassical economics. But it would be difficult if not impossible to determine empirically whether a decision-maker is a maximizer—particularly so where it is a question of maximizing utility. George Shackle [1972] offers an indirect way to dispute the realism of the maximization assumption by questioning its logical possibility. Following Hayek and Keynes, Shackle argues that maximization must presume that the knowledge necessary for the process of choosing the ‘best’ alternative has been acquired. That is, if maximization is a deliberate act, Shackle argues the actor must have acquired all the information necessary to determine or calculate which alternative maximizes utility, profit, wealth, etc. He argues further that such acquisition is impossible so deliberate maximization is an impossible act. Unfortunately, the only basis for Shackle’s impossibility argument is his explicit espousal of inductivism [Shackle, 1972, p. 407]. Since there is no necessary reason for any neoclassical economist to endorse inductivism there will be no reason to think that maximization is necessarily impossible. For a more detailed critique of these two criticisms of the neoclassical maximization hypothesis, see Boland [1981b].

#### 1.2. Necessity of Maximization

There is a related dispute which is concerned with whether the individual decision-maker is a calculating maximizer in the sense of explicitly calculating such things as marginal productivity [e.g., Lester, 1946, 1947; Machlup, 1946, 1947]. But this celebrated dispute missed the point. The question for the economic theorist is whether the decision-maker is maximizing only in the sense that the ‘best’ alternative has been chosen. How the individual makes that judgment is an entirely separate question. In many cases, the maximization may be unintentional. For example,
when the firm, with only two inputs, say labor and capital, and constant returns to scale, is maximizing profit with respect to labor and is forced by market competition to be producing where total excess profit is zero, by equation [1.1] the firm, regardless of its intentions, will be maximizing profit with respect to capital, too. That is, the firm’s marginal productivity of capital will just equal the real price of capital regardless of whether the firm actually calculates the marginal productivity of capital. (For our tomato firm, the real price of capital is \( \frac{P_K}{P_L} \).) It still should be recognized that even this possibly unintentional maximization with respect to one input depends on the intentional maximization with respect to the other input, as well as to the existence of a competitive equilibrium. Nevertheless, we can see that maximization per se does not have to be intentional.

### 1.3. Realism of the Price-Taker Assumption

Partial equilibrium analysis in its most direct form usually presumes that all but the choice variables are fixed and given. For the theory of the firm, it usually takes the form of choosing the level of one input and the consequent level of output while everything else is fixed. Specifically, all other inputs are fixed as are all prices. In the simplest case of the theory of the consumer, the variables in question are the single choice variable, such as the level of consumption of one good, and a consequential variable, such as the resulting level of utility or satisfaction, while the income constraint and the prices are fixed and given. The reason for only two actual variables is that the fundamental tool of analysis is the familiar partial derivative, which in the case of the firm represents either marginal productivity or marginal cost (i.e. marginal labor requirements). In the simple case of the consumer, the partial derivative represents marginal utility.

As was noted in Chapter 3, the use of the partial derivative is not restricted to the analysis of Marshallian partial equilibria since Walrasian general equilibria (where all endogenous variables are determined simultaneously) can be analyzed in a similar way. In the Walrasian case, the partial derivative for the various endogenous variables are dealt with simultaneously by considering how they interact. Since calculus is still calculus in both cases, we will restrict our present discussion to the more common Marshallian use — that is, to the idea that individuals are making constrained maximization choices while taking prices as fixed parameters given in the decision making process. In neoclassical economics the use of the partial derivative almost always takes prices as fixed parametric givens for the purposes of explaining the optimizing choice of some real variable, such as the level of inputs or the level of consumption of goods.

Now, if the price is to be determined by the resulting supply or demand decisions, somehow the actions of the firm or the consumer must affect the market price. So, why should the price be considered given? There are two justifications that are often given for the assumption that the decision-makers are price-takers. One presumes that the price is a long-run equilibrium price, in which case the firm would not want to offer a different price since at the equilibrium price total (excess) profits are zero, and if the firm charged a higher price no one would buy its product, and if it charged a lower price it would necessarily be making losses and would thus go out of business. The other assumes that prices are not decided by the firm in the process of deciding its level of output or input, but that prices are determined separately at market time (in Marshall’s very short run). This applies equally well to demanders and suppliers.

These justifications reveal a weakness in the partial equilibrium method of explanation. The former implies that the partial equilibrium method can only be used whenever the prices are fixed at long-run equilibrium levels. The latter begs the question of how the firm could ever know what the relevant price levels will be. If we are going to avoid these two questionable justifications, while at the same time relying on the partial equilibrium method of explanation where the individuals are considered price-takers, then we still have to explain why prices are fixed. It would seem that for the fixity of prices, relative to the variables decided by the firm or the consumer, the following is necessary. The quantity, either supplied by a single firm or demanded by a single consumer, must have no effect on the resulting market price whenever the individual changes his or her quantity in the market. This will be the case only if the individual decision-maker is very small relative to the market.

For some theorists [e.g. Sraffa, 1926; Koopmans, 1957; Arrow, 1959], this is much too demanding, since this requirement is either inconsistent or impossible. The individual cannot be both affecting the price by his or her demand or supply decision and expecting to take the price as a given since that is contradictory. Opting for the view that the individual is too small will be logically satisfactory only if there is an infinity of participants such that each individual’s share of the market is infinitesimal or zero. But, having to argue with a concept of infinity is really admitting that the assumption of fixed (given) prices involves an impossibility. Thus we might conclude that the only time we can have price-taking individual decision-makers is when we are in a state of long-run equilibrium. In this sense, there is an urgent need for understanding the limitations of the very special short-run equilibrium corresponding to the long-run equilibrium. Specifically, how can we ever explain a state of disequilibrium using the method of partial equilibrium analysis?
2. Disequilibrium vs. Individualism

We have seen how the role of any particular individual can be explained as being his or her marginal contribution to the state of the equilibrium. The marginal contribution is explained on the basis that the individual is in a state of partial equilibrium represented by one optimizing point along an implicit continuum of potential choices. We traditionally conceive of the maximizing individual as moving back and forth along a continuum to choose the optimum point. To validate the idea of maximization, the individual is supposed to calculate the appropriate partial derivative and it is for us to show that this calculable partial derivative is necessarily diminishing along the continuum and is necessarily zero at the optimum point. The fact that there are other points along the continuum is very important for the establishment of a necessary maximization condition (falling marginal utility or falling marginal profit). Our explanation thus must not only be why the individual chose the one point that he or she did but also why the individual did not choose any other of the potential points.

For there to be a general disequilibrium (with respect to the long-run equilibrium), at least one individual is not maximizing. The individual’s behavior is the basis for explaining the state of disequilibrium. One individual is not in a state of partial equilibrium because he or she has chosen a non-maximizing point along the continuum of possible choices. The key question here concerns our explanation of this individual who is causing the ‘disequilibrium’. Should we encounter an individual who is causing a disequilibrium by not maximizing, we can still use the partial derivative to describe this individual’s behavior, since the partial derivative also provides a frame of reference to argue that one of the above necessary conditions for maximization is not satisfied for the individual causing disequilibrium. If the partial derivative is diminishing, the individual has chosen a non-maximizing point, that is, one where marginal profit or marginal utility is not zero. How do we explain the individual’s non-maximizing choice if the maximizing choice is on the continuum of possible choices? Obviously we cannot say the individual’s choice is a maximizing choice whenever a maximizing choice was possible!

These considerations show that a state of disequilibrium cannot be explained in the usual way. We cannot explain it as being a slight deviation from an equilibrium state caused by just one individual’s choice while assuming that everyone else is in a state of long-run equilibrium. The only possible exception is when the individual causing the disequilibrium is somehow constrained from choosing the point which would be consistent with everyone’s long-run equilibrium choices. Thus, any disequilibrium must be explained by arguments where we are either retreating from the view that everyone is a maximizer or violating the requirements of methodological individualism. Methodological individualism would be violated because we would have to say that some individual is maximizing but subject to possibly unacceptable exogenous constraints. If we are willing to deviate from methodological individualism, perhaps there are many ways to explain the occurrence of a state of disequilibrium. All that is needed is to arbitrarily (i.e. without explanation) fix some of the many endogenous variables as if they were exogenous. Once we have selected an endogenous variable to arbitrarily fix, we can easily return to the use of partial equilibrium analysis. There are many examples of such arbitrarily fixed variables in present day disequilibrium models [see Drazen, 1980].

2.1. Disequilibrium as a Non-individualist Arbitrary Distortion

How can we explain a state of disequilibrium and still use the usual partial equilibrium method of explaining the behavior of individuals? One approach is to view the disequilibrium as a result of prices being fixed at non-market clearing levels. This is often called ‘non-Walrasian’ economics since no auctioneer is presumed to operate so as to suspend transactions until the equilibrium has been reached at market-clearing prices. Some versions of this approach merely give the auctioneer a different role, namely to ration the supply quantity when there is excess demand or ration the demand quantity when there is excess supply. Once the rationing scheme is set by the auctioneer, the individuals are thought to optimize with respect to the new quantity constraints as defined by the rations. The alleged theoretical issue is to define a rationing scheme which will produce an equilibrium for the given fixed prices [see Bennassy, 1975, 1976; Dreze 1975; Grandmont, 1977a].

Somehow, arbitrarily fixing endogenous variables (such as the real wage-rate) at disequilibrium levels, as has been done in so many macroeconomic disequilibrium models, only begs the question about why decision-makers would choose to fix it at such a level [see Drazen, 1980]. As always, any state of disequilibrium may be explained as temporary in the sense that not enough time has been allowed for adjustment to a new equilibrium after some exogenous variable unexpectedly changed [cf. Grandmont, 1977b]; and, either the insufficient speed of adjustment is a natural given or it, too, is a matter of choice. While the latter possibility seems to hold considerable promise, it really transforms the decision-making situation into one of choosing the optimum dynamic path towards the eventual equilibrium state. How would the individual know what is the optimum path unless he or she already knows what will be the eventual equilibrium state?
Unfortunately, answering this question may require that we assume that each individual possesses *a priori* knowledge of the eventual equilibrium state. Such a requirement would surely expect too much of any individual, except perhaps, in the close neighborhood of the eventual equilibrium.

The question at issue here is how the economy can reach a state of equilibrium when individuals do not have the eventual state of equilibrium in sight? This is not a difficult question whenever we try *not* to think of the individual interacting with other individuals, such as the people encountered in the market place. Whenever the individual is considered as being isolated, and just facing given prices (whether or not they are equilibrium prices), and so insignificant that any adjustment to the quantity demanded or supplied in the market would not cause a change in those given prices, then we can continue to use the partial equilibrium method of analysis. As we noted in the Introduction, this merely raises Arrow’s problem about how we are ever going to explain the determination of the price. Nevertheless, so long as we do not try to explain the given by showing that they are consistent with the remainder of the economy, we can show how an individual might appear to be maximizing utility by purchasing a specific amount of a good or is maximizing profit by producing a specific amount of a good. The explanation would be indistinguishable from the one employed when explaining the behavior of the individual in a state of equilibrium.

So, why is this explanation still considered inadequate by so many economic theorists (Fisher, Hahn, Arrow, etc.)? Surely, if the individual consumer is maximizing utility or profit subject to the specified given, then the behavior is as explained. Well, there is at least the possibility of a problem of logical consistency which concerns whether the given taken together make sense apart from the decisions made by the individual. Of course, the givens will make sense if we presume that all other individuals are in a state of equilibrium, such as in the case when the givens are equilibrium prices. But if we do presume this, the situation explained is really an equilibrium situation anyway. This leads us to conclude that if we want to examine an individual in a state of disequilibrium then the givens faced by the individual cannot all have equilibrium values – even if we are using the usual partial equilibrium analysis. Some of the givens must have disequilibrium values. This is why so many theorists insist that to discuss disequilibria we must allow disequilibrium transactions and hence disequilibrium prices [Solow, 1980; Clower, 1965; etc.].

The key issue here is whether there are any limits on what the disequilibrium model-builder can assume about the arbitrarily given non-equilibrium prices or non-individualist and non-natural constraints. The only conceivable limits are those corresponding to the necessary conditions for an equilibrium configuration of prices and the requirements of methodological individualism. If the prices are disequilibrium prices, yet the individual in question is assumed to be maximizing, it means some other individuals are not maximizing. We need to be careful here or we will return to the problem that there cannot be just one individual failing to maximize. To explain the existence of a disequilibrium, while at the same time explaining that the individual in question is maximizing, we need to explain why many other individuals are not maximizing, too. That is, if it is possible for the individual in question to be maximizing while facing the disequilibrium prices, why are the other individuals (those necessary for a state of disequilibrium) not maximizing? It was easier to explain a state of equilibrium since the method of explaining one individual’s behavior was consistent, in principle, with the explanation of all other individuals. When we have a state of disequilibrium to explain it appears that our explanation for one individual’s behavior will be inconsistent with our explanation of other individuals’ behavior.

How is it possible that a single individual’s marginal adjustments in search of the optimum quantity to purchase or produce has a zero effect on the price but the aggregation of many individuals does affect the price? The aggregate effect is shown by the downward slope of the demand curve or upward slope of the supply curve which together are the basis for defining any market. Put another way, how small must an individual’s adjustment be so as not to affect the given price yet still be a partial equilibrium adjustment in terms of the idea of a maximizing choice? If an individual consumer decides that the optimum amount to purchase requires an increase in demand, the total demand should increase too. Why does this not affect the given price? The given price cannot be the equilibrium price since the equilibrium price is determined by the intersection of the demand and supply curves. But those curves, by definition, require universal maximization by the demanders and suppliers in question. Again, so long as the individual is the only one deviating from a personal equilibrium then there is no difficulty in our theory, as long as that individual does not affect the price and thereby cause other individuals to make compensating adjustments. There is no telling where things would end up if every individual’s adjustments did affect the price.

We still have not explained how a single individual is supposed to be making small adjustments to act out the idea of a partial equilibrium and at the same time not affecting the market’s equilibrium price. While the idea of freedom to make such adjustments is important for our idea of individualism, the related idea that such partial equilibrium adjustments do not affect the equilibrium price puts into question the role of the
individual in the determination of the equilibrium price. But most important, not only are we unable to explain the role of the maximizing individual in the determination of the equilibrium price, but we cannot use such a method (ceteris paribus maximization) to explain the presence of a disequilibrium price.

There is an even more sophisticated problem lurking behind the need to explain why some individuals are maximizing and some are not. How many non-maximizing individual price takers do we have to have to be assured that there really is a state of disequilibrium? This concerns the usual presumption that all decision-makers are price takers, since each individual’s contribution to the market is insignificant or ‘infinitesimal’ (relative to the aggregate contribution of all other individuals). This is another way of saying that a disequilibrium cannot be the result of one individual’s choice alone. Somehow, we would have to provide a non-individualist explanation of the state of disequilibrium. Our explanation would be non-individualist because we would have to distinguish a group of non-maximizing individuals each of which is unable to affect the price, even though the group can be large enough to do so. It should be clear that to explain any state of disequilibrium we would have to deviate significantly from the requirements of methodological individualist explanations.

2.2. Disequilibrium as a Failure of Calculus

The source of this problem is not an inconsistency between equilibrium and disequilibrium price behavior as Arrow argues [1959], but the concept of the partial derivative itself. Let us consider again a firm that is not in a state of long-run equilibrium because it is unable to change one of its inputs to the long-run optimum value. Let the fixed input be $K$. Now, as is common practice in calculus textbooks, the total differential of a function such as the production function $f$ for good $X$ using inputs $L$ and $K$,

$$X = f(L, K),$$

is defined as

$$dX = \left(\frac{\partial X}{\partial L}\right) dL + \left(\frac{\partial X}{\partial K}\right) dK.$$  \[4.2\]

It is common to interpret this definition to represent the contribution of $L$ and $K$ to any change in $X$ due to a change in either or both of $L$ and $K$. The coefficients in front of $dL$ and $dK$ are, of course, the respective partial derivatives. If we were defining $L$ and $K$ here to be the only inputs, or if we were examining a point which is a long-run equilibrium, then $f$ must be linear-homogeneous and thus, as noted in Chapter 1, equation [4.2] can be used to show that

$$X = \left(\frac{\partial X}{\partial L}\right)L + \left(\frac{\partial X}{\partial K}\right)K$$  \[4.3\]

by simply setting $dL = aL$ and $dK = aK$ and remembering that the resulting $dX$ equals $aX$ for any arbitrary positive number, $a$. But here we have said that the firm is not at a long-run equilibrium as it cannot alter one of its inputs ($K$). Surprisingly, this implies a contradiction. It means that equation [4.3] does not hold unless $X$, $L$, and $K$ happen to have the correct long-run equilibrium values – which they do not by our initial construction. If there is something constraining the adjustment of $K$, that something must also be one of the inputs, and it too has a partial derivative. If we represent the constraint as $J$, then instead of saying equation [4.3] must be true, we say the following is true.

$$X = \left(\frac{\partial X}{\partial L}\right)L + \left(\frac{\partial X}{\partial K}\right)K + \left(\frac{\partial X}{\partial J}\right)J.$$  \[4.3a\]

What we are saying here is that if there is a constraint causing the disequilibrium, that constraint must be something affecting the level of output. And since the determination of the level of output is represented by equation [4.1], we should alter that equation to be as follows.

$$X = f(L, K, J).$$  \[4.1a\]

Of course, this only begs the question of the optimality of $J$, and if it is not optimal then why not? Is it also being constrained? There is an infinite regress hiding here.

If equation [4.3] does hold, but we are still looking at a disequilibrium situation, then the level of the output $X$ is not analyzable into the sum of separate contributions of $L$ and $K$. That is, each contribution cannot be measured by the size of the input weighted by its respective partial derivative. But, the disequilibrium means the partial derivatives do not truly represent the ceteris paribus contributions of the respective inputs since the effects of the variable $J$ must be impounded in the partial derivatives. This failure of analysis arises because of the way economists use functions and partial derivatives. A function, such as equation [4.1], is supposed to represent all things affecting the level of output through the production process; thus anything affecting the level by constraining one or more of the inputs must itself be an input in the process. The partial derivative is used solely because it is implicit in the calculus of a constrained maximization process. But given the way economists use partial derivatives – as parameters of the production function regardless of maximization – what does the partial derivative mean when the individual firm is not maximizing with respect to all inputs?
When equation [4.3] does not hold for the two recognized inputs, we can account for any discrepancy in only two distinctly different ways. First, since equation [4.2] is simply a matter of definition, there is nothing keeping us from claiming, as suggested at the end of Chapter 3, that the discrepancy is due to the fact that the partial derivative is defined for properties of equilibrium states and that their meaning does not carry over to disequilibrium states. Most economists will probably not like this claim since it would certainly appear to put our standard method of explanation into serious question. Second, apart from a spurious question of whether \( X, L \) and \( K \) are correctly measured, or defined, the only other way is to attribute all the discrepancy to a missing variable, such as we did above with the implicit constraint \( J \). This presents serious dangers of producing either tautological or circular lines of argument [see, once again, Samuelson, 1947/65, pp. 84–5]. At the very minimum it makes the analysis of the firm in a state of disequilibrium very mysterious – the mystery of the missing variable.

If a state of disequilibrium is ever going to be explained as a matter of choices made by a significant number of individuals, yet in a manner that does not explain the disequilibrium away (as discussed in Ch. 2), then either methodological individualism must be violated or the partial equilibrium analysis method of explanation needs to be critically examined starting with the concept of the partial derivative itself. To avoid the former, we are led to a critical examination of the foundations of calculus.

5

Proofs vs Conjectures in Analytical Economics

Zermelo [proved] in 1904 that every set can be well ordered and in doing so he called attention to the fact that he used the axiom of choice.... [The axiom of choice] is that, given any collection of sets, finite or infinite, one can [choose] one object from each set and form a new set.... It is used, for example, to prove that in a bounded infinite set one can select a sequence of numbers that converge to a limit point of the set....

Zermelo’s explicit use of the axiom of choice brought forth a storm of protest.... [According to] Zermelo’s only staunch defender ... the assertion of the existence of objects did not require describing them. If the mere assertion of the existence enables mathematics to make progress, then the assertion is acceptable....

The key issue with respect to the axiom of choice was what mathematics means by existence.... To some it covers any mental concept found useful that does not lead to contradictions.... To others, existence means a specific, clear-cut identification or example of the concept, one which would enable anyone to point to or at least describe it. The mere possibility of a choice is not enough.


Leibniz, unlike Aristotle, seemed to feel that his position was to be justified by an appeal to the principle of sufficient reason to determine, in this connection, the transition from possibility to actuality.

Carl Boyer [1949/59, p. 209]

[Calculus is] the art of numbering and measuring exactly a thing whose existence cannot be conceived.

Voltaire [1733]
Near the end of the last chapter we asked about the apparent contradiction between a single individual’s marginal adjustments, which do not affect the equilibrium price, and the aggregation of many individuals’ marginal adjustments, which does affect the equilibrium price. This apparent contradiction is not peculiar to economics. It has lurked in the halls of calculus for at least three centuries and is merely the relationship between the integral and the differential. To better understand the possible limitations of equilibrium analysis in the study of states of disequilibrium, we turn now to examine the apparent (but widely unrecognized) contradiction that is associated with the use of partial equilibrium analysis.

1. The Problem of the Integral vs. the Differential

Historians can still argue about who invented calculus, Newton or Leibniz, but it does not really matter. What does matter is that many mathematicians have been concerned about whether the basic tools of calculus – the derivative, the partial derivative and the integral – make any real sense. The problem that concerns us is most apparent in the idea of an integral. Consider Figure 5.1, which represents the marginal product for infinitesimal variations in labor input, and Figure 5.2, which represents the marginal product for discrete units of labor. Supposedly, we can calculate the total output by integrating the function represented by the continuous marginal productivity curve from zero to the point of input in question – that is, by adding up the contributions of each unit of labor from zero to a specific level of input (as noted at the end of Ch. 3).

While integration will always make sense whenever we are calculating the total output for discrete units of input (Fig. 5.2), there is a potential for significant discrepancies when compared to the calculated output for infinitely divisible units of labor (Fig. 5.1). The discrepancies in question would supposedly disappear if we were to make the finite differences in Figure 5.2 so small that for practical purposes the curve of Figure 5.1 would be indistinguishable from the line connecting the upper right-hand corners of the boxes in Figure 5.2.

From a crude practical perspective it is difficult to see any problem here, but the logical basis for the alleged equivalence of these two figures is not very satisfactory. In Figure 5.2 we see that calculating the area as the sum of all the boxes (each representing the marginal contribution of the $n$th unit of labor) ignores the little triangle at the top and thus the calculated area is always less that of the area under the corresponding smooth curve representing the partial derivative. So the question is, why do we learn to ignore the obvious discrepancy illustrated in the comparison of these two diagrams?

The usual argument explains away the apparent discrepancy. One very special case is when the marginal productivity curve is a straight
line that connects the midpoints of the tops of all the boxes. In this special case there appears to be no discrepancy since the two triangles between the marginal productivity curve and the top of any box are congruent triangles and hence the one that overestimates marginal productivity is cancelled out by the other one which is an underestimate – but this is a very special case and is only accurate for straight-line marginal productivity curves.

Students when faced with this situation ask, why would the third unit be hired? In Figure 5.1, where \((W/P)_1\) equals the marginal product of labor at three units of labor, the firm is said to hire three units of labor to maximize the net surplus (the area between the marginal product curve and the real-wage level line). But in Figure 5.2 there does not appear to be any incentive for the firm to hire the third unit. With a lot of hand waving teachers usually explain away the obvious discrepancy by claiming that, again, the unit of measure is so small that the difference between the second unit’s marginal product and the third’s does not matter or, if the teachers are really clever, they say the issue is only about why the firm does not hire the fourth unit.

Early critics of Newton’s and Leibniz’s calculus were quite aware of this logical problem – the sum of the areas of the boxes being positive yet the sum of the areas of the corresponding triangles being considered zero. Today, judging by calculus textbooks, it is widely believed that there is no problem here. The accepted proof that there is no problem resides in an argument that the area under a curve (such as that in Fig. 5.3) can be considered to be the ‘limit’ of the sum of an infinite series of units of labor as the unit of measure ‘approaches zero’ – or when the unit of labor is an infinitesimal. Now, this solves the logical problem only if we accept the idea of an infinite series or an infinitesimal – logically, these two options amount to the same thing. If we do not accept the idea of either a ‘limit’ or an ‘infinitesimal’, applications of calculus are left in a questionable state.

The more common form of explanation would have us see that each unit of labor is extremely small, such that the width of each box in Figure 5.2 is less than what we could show by even a single vertical line, and thus would have us pretend that the apparent discrepancy disappears from sight. Consider Figure 5.3 where there is supposedly no space between the vertical lines. In this sense the vertical lines would fill the area under the curve. Unfortunately, this is more a commentary on printing technology than on the alleged equivalence of Figures 5.1 and 5.2. So long as labor is measured in discrete units there will always be an empty triangle unaccounted at the top and the sum of the triangles will always be finite.

To avoid the discrepancy we are taught to believe in the idea of an infinitesimal. That is, we are to believe that it is logically possible to have the unit of labor be so small that it is as if it has a zero width so that the triangle at the top has a zero area (since its base would be zero), while simultaneously the area of the box (which also has a base of zero) is not zero. We cannot honestly avoid the contradiction here.

Many beginning students of economics are aware of this logical problem. Consider again Figure 5.2. If the real wage-rate were equal to \((W/P)_1\) then the third unit of labor produces neither surplus nor loss. Since the early 1950s economists have learned to look away from these potential problems of calculus by restating the familiar economic propositions in terms of set theory. For example, consider the usual indifference curve as shown in Figure 5.4 for goods \(X\) and \(Y\). In the 1930s the indifference curve was viewed as a differentiable function and the slope of the curve was the partial derivative which Hicks and Allen [1934] called the ‘marginal rate of substitution’ or \(MRS\) for short. They proposed to argue that most of the usual propositions of demand theory could be shown to depend on the assumption that this \(MRS\), or slope of the indifference curve diminishes (i.e. approaches zero) as points to the right along the curve are considered. At any consumer’s chosen point the \(MRS\) equals the ratio of the respective prices since that ratio is the slope of the usual price-taker’s budget line. The idea of diminishing \(MRS\) was supposed to be methodologically superior to the older assumption of diminishing marginal utility since the latter seemed to imply a cardinal measure of utility and the former did not. This was a bit misleading as the function representing indifference was just a special
case of the multi-good utility function where the utility is held constant. How can we hold utility constant without being able to measure its cardinal value? Without answering this rhetorical question, in the 1950s we were taught to abandon calculus in favor of set theoretical interpretations of the familiar concepts such as indifference.

In the set theory version of the indifference curve, the curve is a set of points between which the individual consumer is indifferent. And if the consumer is assumed to be spending all of his or her budget, the indifference curve drawn through the chosen point is also the boundary of two sets. On one side is the ‘worse set’ containing all points considered inferior to the chosen point. On the other side is a set of points all of which are considered better than the chosen point. The reason why the points in this ‘better set’ are not chosen is simply that they are all outside the set of affordable points which is represented by the area of the triangle whose hypotenuse is the budget line. The size of this triangle is determined by the size of the budget (or income) and the prices of the two goods in the usual way.

Defining these sets is still not enough of a description of the situation for the individual who is doing something like maximizing utility or, in the newer terminology, choosing the ‘best bundle or point that is affordable’. What is needed to complete the description is an assumption that the ‘no-worse set’ (which is the ‘better set’ combined with its boundary, the indifference curve) forms a convex set. A convex set is a set of points which if any straight-line segment is drawn between any two points in the set, all points on the line are contained in the set. This is still not enough if the chosen point is the only point the individual would choose when facing the budget line in question. That is, if the chosen point is unique, the ‘no-worse set’ must be strictly convex. With a strictly convex set, only the two endpoints of the line segment connecting any two points are allowed to be points on the boundary; that is, all points between the end points of the line segment must be in the set but not on the boundary. This rules out such cases of convex sets as that illustrated in Figure 5.5, while Figure 5.4 illustrates a strictly convex ‘no-worse set’.

We note that Figure 5.5 would not satisfy the Hicks-Allen assumption of diminishing \( MRS \) since between points \( a \) and \( b \) \( MRS \) is not diminishing. Furthermore, and more to the point, if the individual maximizer faced the indifference curve of Figure 5.5, we could not completely explain why point \( E \) was chosen rather than \( a \) or \( b \), or any other point on the line segment between \( a \) and \( b \). With respect to describing the unique choice option of \( E \), either we assume that each indifference curve always displays a diminishing \( MRS \) or we assume that the ‘no-worse set’ is strictly convex. So long as we maintain that the individual must be sensitive to all price changes, the two supposedly different assumptions are logically equivalent.

If, as we will argue, the two assumptions – diminishing \( MRS \) and strictly convex ‘no-worse set’ – are equivalent, why would anyone bother going to the trouble of reinterpreting all the propositions of economics into the language of set theory? Obviously, it must be because the two assumptions are not considered equivalent in some important way.

3. Continuity vs Connectedness in Choice Theory

Just as cardinality of utility was once considered too strong a requirement for any realistic analysis of consumer demand, continuity of any indifference curve is sometimes considered to be more than what is
necessary for a logically complete analysis of consumer demand. When we say that the consumer chooses the best point among those that he or she can afford, there is nothing obviously implied to indicate that the chosen point is on some continuum which allows for infinitesimal adjustments, as was implied by partial equilibrium analysis. For example, let us say that the individual considers the choice of how much to buy of a good that is available only in indivisible units. The question we must consider is about what we are going to do with a situation where the optimum bundle does not have integer values for the goods being purchased – that is, can an individual buy one half of a radio? Many responses are possible. The two obvious responses are that two individuals could choose to share one radio or one individual could rent half of a radio. Either way, the original choice problem is changed to create an effective continuum in the case of the rental or something close to a continuum in the case of the shares. But these responses are avoiding the original question [cf. Lloyd, 1979; Lloyd et al., 1979].

What is being considered is a choice of a particular integer from a set of integers. Such a set is considered ‘connected’ rather than continuous. A connected set is one which can always be separated into two subsets such that there is no point in the set that is not in one of the subsets [see Chipman, 1960]. For example, the set of integers can be separated between those less than or equal to \(N\) and those greater than or equal to \(N+1\). There is no integer in the set between \(N\) and \(N+1\), by the usual definition of an integer. Now the critical question here is whether a set being ‘connected’ is in any important way different from being ‘continuous’. Surely, the mere idea of recognizing the concept of an integer presupposes some number which is conceived not to be an integer. If not, then there cannot be any difference between the boundary of a connected set and a continuous function such as an indifference curve.

For reasons unclear to us, it is still maintained that by discussing set theory, in the sense of a set of integers, we are in some way not discussing continuous functions and hence, not discussing something for which calculus methods would be applicable. Even when discussing such things as a textbook ‘kinked demand curve’ or any continuous function which has a sharp bend in it, all that is begged is the question of why there are holes in the curve representing the derivative of that continuous function (or representing the partial derivative when there are many arguments in the function). Of course, what is really questioned here is the definition of a ‘sharp bend’.

Consider Figure 5.6. If Figure 5.6(a) represents a continuous total revenue function, \(f(X)\), that has a kink in it, then the usual idea is that the derivative appears as shown in Figure 5.6(b). The function representing the derivative, \(f'(X)\), may be continuous with respect to \(X\), in the sense

\[
\frac{df}{dX} = \begin{cases} \frac{df}{dX} & \text{if } X < X_0 \\ 0 & \text{if } X = X_0 \\ \frac{df}{dX} & \text{if } X > X_0 \end{cases}
\]

Figure 5.6. Apparent discontinuity
that there are no values of \( X \) for which the value of the derivative is not defined. However, while mathematicians are only concerned with whether the derivative is continuous over the values of \( X \), the derivative is not continuous with respect to its own value as there are conceivable values (between \( r \) and \( t \)) which are not represented by the derivative-function. As economic theorists we want to give meaning to the value of the derivative, such as when we set the value of marginal revenue equal to the value of the marginal cost for profit maximization. Of course, analytically we can have any kind of function we can conceive. But the question that might be asked is whether Figure 5.6(b) can actually represent a realistic process as, in the case where the (partial) derivative represents marginal revenue. What Figure 5.6(b) implies is that as \( X \) increases value from that below \( X_0 \) to that above, somehow the derivative instantaneously changes from \( r \) to \( t \) at \( X_0 \). The term ‘instantaneous’ really means infinitely fast and since an infinite speed of change cannot be represented by a real world process, the realism of Figure 5.6(b) is questionable.

What concerns us here is what is meant by a ‘real world process’. While we may be free to assume any analytical function we wish, we are just as free to say that anything requiring infinite speed or infinite time or space is something that is not of the real world. The case shown in Figure 5.6(b) is impossible but that in Figure 5.6(c) is possible. This is to say that the ‘sharp bend’ in the function of Figure 5.6(a) is one where the slope changes from \( r \) to \( t \) in a continuous way, such that there are no missing values between \( r \) and \( t \) as there were in Figure 5.6(b). We will have more to say about this view of ‘realistic’ functions in a later section of this chapter. For now all that we wish to establish is that we can always rule out any discontinuous functions as unrealistic functions and thereby say that any realistic boundary of a set of ‘connected’ points is also a continuous function. In this sense, there is nothing to be learned from set theory that cannot be discussed using calculus concepts.

4. Continuity, Convexity, Uniqueness and Choice Theory

Set theory has served as the medium for many sophisticated presentations of the logical foundations of the neoclassical theory of the consumer [e.g. Chipman et al., 1971]. Virtually all the sophisticated analyses of consumer theory fail to restrict the conception of consumer choice to one that is appropriate for price theory. They usually present a consumer theory without a purpose other than theoretical analysis for its own sake – that is, without regard for how it fits with the needs of any methodological individualist explanation of prices. If our interest in consumer theory is only the mathematical rigor of our representation of the idea of maximization or optimization, then there may very well be no significant differences between calculus-type analysis and set-theoretical constructs. But, if we require both that the consumer’s choice be completely explained and that our theory of the consumer be consistent with our theory of prices and of the economy as a whole, there is still a problem here. Particularly so, if we try to accommodate set-theoretical representations in the way explained above. We will discuss these two requirements in turn.

4.1. Completeness of Explanations

In Chapter 1 we discussed the methodological dilemma concerning complete explanations of an individual’s behavior and the question of whether a successful explanation denies the possibility of the individual’s exercising free will. Rather than worry again about ‘free will’, let us just focus on what constitutes a complete explanation of an individual’s behavior (i.e. of an individual’s choices or decisions).

The decisions or choices of direct relevance to an individual are his or her consumption decisions. Our usual neoclassical theory is conceptually rather simple in this regard. We say the individual chooses the ‘best’ point that he or she ‘can afford’ with the given budget (or income) and prices. The individual provides the subjective criterion used to define what is ‘best’ and the objective criterion determining what the individual ‘can afford’ is merely a matter of arithmetic. What is to be explained is the specific choice or decision made by the individual in question. Put this way the choice is necessarily unique and any explanation should entail such uniqueness. The question of what the consumer can afford is essentially an objective matter since the prices are public events and under certain conditions the income or budget is revealed by inference from the choice made. The conditions, however, are not trivial. To be able to infer the consumer’s budget for the choice made, we must assume that the individual is not completely satiated by the choice made and is not facing survival choices. In effect, neoclassical consumer theory is a theory that only applies to the middle class consumer! The consumer is assumed always to be facing scarce budgetary resources but is also assumed to have enough to give some freedom for matters of taste. The theorist need only conjecture what the individual’s preferences or decision criteria are to complete the explanation of the consumer’s unique choice.

The logic of explanation is as follows. Given the theorist’s conjecture concerning the consumer’s preferences (or subjective criteria) and given the objective prices and incomes, the chosen point can be shown logically to be the one and only ‘best’ point. If there were more than one affordable point that the individual would consider equivalently the ‘best’
given the theorist’s conjectured preferences, then the question is immediately begged about why the individual chose the one ‘best’ point rather than any of the other ‘best’ points. In other words, unless the conjectured preferences lead to the conclusion that there is only one ‘best’ point and that one ‘best’ point is the one that was chosen, then the theorist’s explanation of the individual consumer in question is clearly incomplete. To be complete the explanation must not only entail the chosen point but it must be the only point the individual would choose under the circumstances. We must explain why all other points are not chosen.

that it appears as a smooth curve exhibiting the usual assumption of diminishing MRS (see Fig. 5.8), the curve will be conjectured to be tangent to the budget line at only the chosen point. The other point, $b$, will be inferior. So, it would seem that in terms of explanatory completeness, calculus has a decided advantage over set-theoretic analysis.

Now what does this have to say about the differences between calculus and set-theoretic analysis? Consider Figure 5.7 where we are again having the consumer choose amounts of indivisible goods – that is, goods that must be purchased in integer amounts. Let us say that we are to explain why the individual chose point $a$ – that is, to buy two units of good $X$ and three units of good $Y$ – given a budget for which the individual could buy either five units of $X$ or five units of $Y$ or any linear combination (implying that the ratio of the prices is one). If the four solid points are on a conjectured indifference ‘curve’ then the individual in question would be indifferent between the chosen point and the non-chosen point $b$ (representing three units of $X$ and two units of $Y$). Since both points lie on the budget line and both lie on the same indifference curve, they are equivalent according to both subjective and objective criteria. Thus, even though the ‘no-worse set’ is connected (i.e. there are no conceivable non-integer points) and is convex, the explanation is incomplete.

If we allow the calculus-type analysis to define the conjectured indifference curve to be over the non-integers as well as the integers so

4.2. The Wider Role of Choice Theories
Defenders of set theory will surely claim that the comparative advantage of calculus here is due only to our conjecturing the particular disadvantageous indifference curve of Figure 5.7 rather than one like that in Figure 5.9. In the latter figure the chosen point is unique in a manner similar to a calculus based explanation – i.e. point $a$ in Figure 5.9 is preferred just as it was in Figure 5.8. So, what is wrong with Figure 5.9?

If we are constructing an explanation of the individual’s decision behavior that is to be used only to explain the uniquely chosen point, there is no significant difference between Figures 5.8 and 5.9. However, if we are constructing an explanation that is intended to be more general in terms of the circumstances to which it is to apply, both versions of an explanation suffer methodological difficulties – even though these difficulties are different.

The issue that we have to face concerns the purpose of any explanation of any consumer’s behavior. Again, every theorist is free to do whatever he or she wants. Nevertheless, the primary reason we discuss the consumer theory in the context of neoclassical economics has always been to see the consumer as a part of our larger theory of prices where the individual is conjectured to play a significant role. From the perspective of methodological individualism, the theory of the individual
consumer is the foundation for the theory of market demand which, when conjoined with the separate theory of market supply, explains the price in each market. Given this purpose, any representation of consumer theory must be adequate for this purpose. What is necessary for this adequacy? What limitations does the question of adequacy put on any analysis of an individual’s choice behavior?

**Uniqueness and price theory** Since the individual consumer is almost always seen as having an infinitesimal effect on the equilibrium price and the total supply – that is, being a price-taker and being able to buy as much as wanted – any requirements for the individual’s playing a part in a market equilibrium do not have an explicit role in the theory of the consumer’s behavior. The most important requirement is uniqueness since it is a primary requirement for a consistent role for the individual. By uniqueness here, we are referring to the choice made by the individual whenever the individual faces the same circumstances. That is, if at two different points in time the individual faces the same set of prices, income and indifference map (or preferences), the individual would be expected to make the same choice. If any explanation of the individual does not entail such a unique choice, two different choices are possible and thus, when we aggregate the explained behavior of all consumers, there will not be a unique quantity demanded at any point in time. In other words, the question of explanatory completeness, even if ignored at the level of the individual consumer, will remain at the level of market demand, and by remaining there will remain at the level of explaining the market price.

**Completeness and price theory** It should be evident from our discussion in Chapters 3 and 4 that questions about the completeness of explanations will always present difficulties for any consideration of uniqueness. There is another requirement that is almost as important and it concerns the completeness of the conjectured preference ordering of the consumer. If we are to use the theory of the consumer as a foundation for price theory, then we must be able to explain the consumer’s behavior no matter what prices are present in the market. This is because to explain prices we must not only explain why the price is what it is, but also why it is not what it is not [Nikaido, 1960/70, p. 268]. Thus, it is never enough to explain the individual’s choice given just one budget line [e.g. Batra and Pattanaik, 1972]. Whatever the prices may be, the individual must be able to make a choice. This means that the conjectured preference ordering or indifference map must extend indefinitely in all directions. That is, the individual must be able to compare any two conceivable points, or be able to attach a specific level of utility to any conceivable point. While uniqueness is not always seen to be a requirement, many analytical consumer theorists do see the need to have a complete preference ordering [e.g. Chipman et al., 1971]. Unfortunately, the analytical consumer theorists seldom, if ever, tell us why preference orderings must be complete.

### 5. Infinity and Induction in Analytical Economics

Certain questions are raised by these considerations. In effect, the conjectured indifference map or preference ordering must extend over an infinity of conceivable points. How does the individual learn what his or her preferences really are? Such knowledge might require an infinity of trials! But what is even worse, any sophisticated analysis of consumer preferences must also deal with preference orderings over an infinity of conceivable points regardless of how the individual learns. Some sophisticated consumer theorists rely on a so-called ‘axiom of choice’ to extend knowledge about the preferences from being over realistic finite subsets to being over infinite sets as is required for completeness [see Chipman et al., 1971, p. 250]. This is the axiom often used by mathematicians (as noted in the above quotation from Kline [1980]) and is to be distinguished from the axiom of choice discussed by economists [e.g. Frisch, 1926/71; Samuelson, 1938]. We will discuss the uses of the mathematical axiom a little later. The important point is that the question of completeness of preference orderings too easily involves us in a discussion of infinite sets. This is a problem since, in realistic terms, the meaning of ‘infinity’ always refers to an impossibility.

The common ideas of continuity, completeness, infinity and infinitesimals are all closely related, even though this is not always
obvious. The relationship between infinity and infinitesimals is the most obvious. Any ratio such as $\frac{A}{X}$ is said to become an infinitesimal (i.e. approach zero) as $X$ approaches infinity. We discussed above the direct relationship between completeness and infinite sets. What is probably in doubt is the relationship between continuity and completeness. Let us discuss this and then get to the real concern, which is the less obvious relationship between the complete preference orderings, infinite sets and inductive learning.

5.1. Continuity and Completeness
Continuity is very important for calculus considerations, as is well known. Nevertheless, establishing continuity always runs the risk of an infinite regression. We take for granted that Euclidian space (which is just ordinary rectilinear space named after the famous geometer Euclid) can be represented by real numbers along each of the coordinates. For example, we can conceivably plot a consumer’s choice point as being equal to one-half of a radio and two and one-third calculators, regardless of the question of whether such non-integer quantities make sense to us. Given the assumption that radios and calculators only come in whole units, the set of possible (as opposed to conceivable) choice points do not completely cover the Euclidian space representing quantities of radios and calculators. Now consider an indifference curve for radios and calculators such as the one in Figures 5.7 or 5.9. If one insists on using the Euclidian co-ordinates to represent quantities of these indivisible goods, when only integer points are possible in the eyes of the consumer, then the indifference curve will only be a sequence of points that are unconnected in Euclidian space – that is, points with large (Euclidian) spaces between them. The preferences represented by this integer indifference map will be neither continuous nor complete with respect to the Euclidian space that we commonly use as our co-ordinates. But from the viewpoint of the consumer, the non-integer points are irrelevant and thus the alleged discontinuities in the indifference map are misleading. This is why the question of viewing the set of possible choice options as a connected set rather than a continuous space can be important in any analytical treatment of consumer theory.

Switching from incomplete continuous-space indifference maps to connected sets of possible choice points solves the problem of misleading non-continuity but it may not ensure that all preference orderings of such connected sets are complete. What if the individual is, perhaps for mysterious psychological reasons, unable to evaluate the single point representing three radios and three calculators? The indifference map, whether for Euclidian space or the connected set of possible choice points, will have a hole in it at that point. On the one hand, if the prices and income facing the individual consumer are such that he or she cannot afford to buy three radios and three calculators, then the hole in the map would seem to be irrelevant for our theory of the consumer’s behavior. On the other hand, if the consumer can afford this point, our explanation of why he or she bought any other point will be incomplete, since we cannot explain why the point representing three units of each good was not chosen. Inability to evaluate the point is not a sufficient reason, since the point is still possible and since a non-evaluation is not the same as an underevaluation.

The idea here is simple. A continuous indifference map must also be a complete map – whether we mean continuous in the Euclidian space or in the restricted terms of the set of connected possible points. Any discontinuity (or hole) in the map is also an instance of incompleteness.

5.2. Infinity and Completeness
Much of what we have been discussing has been the concern of analytical consumer theorists who have tried to prove that demand curves with certain specified mathematical properties can always be shown to be ‘generated by the maximization of a utility function’ [Hurwicz and Uzawa, 1971, p. 114]. More generally, they have been concerned with the problem of how much must we know about the demand curves to be able to deduce the utility function that is being maximized. Since a demand curve is the locus of utility maximization by all demanders, its calculus properties are those of the various relevant partial derivatives in the close neighborhood of the maximizing points. However, any demand curve (or demand function, if we wish to stress that more than one good is being simultaneously chosen) is just a line connecting a subset of singular points drawn from all the points on the indifference map. One demand curve cannot tell us much about the entire indifference map from which it was derived. To determine the underlying map or utility function we would need many observations of many demand curves. This problem of deducing the general nature of the utility function from the singular marginal properties of any particular set of demand curves (i.e. curves for many different choice situations) has been identified by many theorists as the ‘problem of integrability’. But giving it a name does not make it solvable [see Wong, 1978].

For our purposes here, what is important is the following. All analytical theorems, which are ‘proved’ by the analytically sophisticated consumer theorists, involve some sort of infinity assumption. They do so either directly by referring to an infinite set or indirectly by referring to infinitesimals in the neighborhood of the consumer’s chosen point. The irony of this is that infinities must be invoked to explain the
finiteness (or discreteness) of the consumer’s unique choice or the market’s unique demand curve.

\[ f(y) \] be a function of \( y \) and let \( k \) be a constant. If there is a number \( L \) such that, in order to make the value of \( f(y) \) as close to \( L \) as may be desired, it is sufficient to choose \( y \) close enough to \( k \), but different from \( k \), then we say that the limit of \( f(y) \), as \( y \) approaches \( k \), is \( L \).

Now it is a mystery to many of us how defining a derivative in terms of the concept of a limit is in any significant way an improvement over an infinitesimal-based definition. Naive defenders of the limit-based definition will say that it is because the derivative is defined by a real quantity, namely \( L \), but this only begs the question of how we know we are at \( L \). Sophisticated defenders will enhance the definition by referring to the limit as the ultimate value of an infinite sequence of points where each additional point lies between the last point and the point representing \( L \). Again, we are no better off and maybe worse off since we are again referring to an impossibility – namely, an infinite sequence.

While the limit-based definition of a derivative is still widely accepted, some mathematicians have tried to express such definitions in terms of what they call the ‘axiom of choice’. This axiom is stated in the above quote from Morris Kline ‘... given any collection of sets, finite or infinite, one can [choose] one object from each set and form a new set.’ This axiom is trivial for any finite collection of finite sets, but there is no reason to accept it otherwise. Nevertheless, it can be used to define a limit along the lines of a paradox of Zeno [Boyer, 1949/59]. Namely, take the distance between the limit \( L \) and any point different from \( L \), form a set of the points representing one-third the distance and two-thirds the distance and choose the point which is closer to \( L \). Now repeat this process ad infinitum. Supposedly, we can use the ‘axiom of choice’ to prove that the ultimate result is to choose \( L \). Of course, this in no way escapes the criticism of relying on definitions and proofs which are impossibilities since they depend on infinite sets which are impossible.

It would probably be wiser to avoid trying to prove that the derivative of a function is the slope of a curve representing the function and accept the claim as a conjecture and move on from there.

5.3. Completeness and Inductive Learning

While accepting complete preference orderings as conjectures about infinite sets would seem to satisfy the requirements of analytical proofs, there are still questions begged when we turn to consider the implications of such conjectures for the capabilities of the individual whose behavior is being explained. If we say the individual chooses the
one best point out of the infinity of possible points, how does the individual know it is the best point unless he or she has knowledge of the infinity set? Again, the question arises because the concept of infinity is by definition an impossibility. Does this mean that such knowledge is impossible?

It would be only if we were to continue the neoclassical tradition of believing that all learning must be inductive. There is no need to do so. Unfortunately, most economic theorists still take inductive learning for granted and thus often ignore some difficulties involved in any assumption that the individual knows his or her preference ordering or indifference map.

Recall that inductive learning is based on the assumption that we learn with each new bit of information acquired. That is, with only singular observations of a particular instance of a general proposition, we are led to conclude that the general proposition is true. The typical illustration is that by repeatedly observing white swans flying south for the winter we are learning that all swans are white. Inductive learning is learning the truth of a general statement from observing numerous particular examples. It is in this sense that the individual might be conjectured to learn what his or her preferences are by merely tasting each conceivable point in the relevant goods-space. But, unfortunately this theory of learning fails for simple reasons of logic. No amount of finite evidence about the singular elements of an infinite set could ever prove that such a set has specific general properties [see further, Popper, 1972, Ch. 1 and Appendix] – the next swan to fly over may not be white.

These logical considerations raise doubts about all analytical models that presuppose that the individual consumer has sufficient knowledge. This not only criticizes the view that an individual could evaluate the point representing a million radios and a million calculators, it also criticizes the view that the consumer has the complete ordering needed to be able to evaluate a point representing one-millionth of a unit of tea and one-millionth of a unit of coffee. While it is easy to see that it would be difficult to learn about points approaching infinity, it should also be equally apparent that it is just as difficult to learn about the infinity of points in the neighborhood of the maximum of any constrained and differentiable utility function. And so, the use of (partial) derivatives to explain the shape of indifference curves or demand curves necessarily goes far beyond what is intellectually possible for the individual decision-maker. While this might not matter for analyzing the properties of a state of equilibrium, a disequilibrium analysis is predicated on at least one individual in some way being aware that he or she is not optimizing. If one insists on maintaining the common presumption of inductive learning, then disequilibrium analysis is impossible.

6. Proofs and Conjectures

If one rejects the idea that people learn inductively, one will find it difficult to appreciate the many published articles and papers which provide proofs of propositions about the general properties of preference orderings or about demand curves based on those general properties. It does not matter whether the proofs are based on calculus concepts or set-theoretic concepts, since the proofs must always deal with some form of completeness of the individual’s preference ordering and thus must refer to either infinite sets or infinitiesmally close neighborhoods of specific points. A way out is to treat the individual’s preference ordering or utility function as a conjecture on the part of the individual consumer. What is the cost of such an approach?

By viewing all individuals as inductive learners, theorists have been able to rely on the observability of the individual’s objective situation to ensure unique and consistent choices. For any given type of preference ordering (determined by specific assumptions on the part of the theorist), proofs could thus be reliably constructed. But what if one does not really learn inductively? Even if an individual still has a specific type of psychologically given preference ordering, the individual consumer does not know its true nature and thus has to conjecture about his or her preference ordering. Using a conjectured preference ordering may not always produce choices consistent with the true ordering. This is because there is no reason why, without reliable inductive learning, the individual has been successful in learning his or her true preference ordering. For now we will postpone discussion of the benefits of viewing the individual’s preference ordering as a conjecture. Later we will see that such an approach clears up some difficulties in the analysis of the stability of market determined prices and clarifies the arguments concerning the role of competition in the determination of prices.
Part III

Limits of Equilibrium Methodology
The most characteristic feature of the work of our generation of economists is probably the general endeavour to apply the methods and results of the pure theory of equilibrium to the elucidation of more complicated ‘dynamic’ phenomena. The realistic significance of the tendencies towards a state of equilibrium, traditionally described by pure theory, can be shown only when we know what the conditions are under which it is at least conceivable that a position of equilibrium will actually be reached.

Friedrich Hayek [1933/39, pp. 350 and 353]

Microeconomic theory is primarily about positions of equilibrium. The plans of agents ... are taken together, and certain variables – usually prices – are assumed to take on values that make those plans mutually consistent. Comparative static analysis then proceeds to compare equilibria corresponding to different values of underlying parameters.

The view that equilibria are the points of interest must logically rest on ... underlying properties about the dynamics of what happens out of equilibrium. ... If the equilibrium approached depends on the adjustment process, this needs to be studied...

In brief, the question of what, if any, disequilibrium stories have equilibrium endings like those assumed ab initio by economic theorists is a question of paramount interest for such theorists especially if the world is stable.


It is unlikely that economic theorists today who depend so heavily on mathematical techniques will ever consider the limitations of calculus or calculus substitutes to be obstacles in the way of explaining disequilibrium economics in terms of equilibrium analysis. It is even
doubtful whether we should ever want to explain disequilibria without equilibrium analysis as almost anything goes in such explanations. The interest in disequilibrium microeconomics stems mostly from the appreciation of Paul Samuelson’s ‘Correspondence Principle between comparative statics and dynamics’ [Samuelson, 1947/65, p. 5]. If the implications of a claimed equilibrium are to be used to explain the behavior of the individuals participating in that equilibrium, then the claimed equilibrium must be ‘stable’; that is, the idea of an equilibrium is necessarily a question of dynamics. For example, it is not enough to identify the market equilibrium with an equality between demand and supply, since it is possible for such an equality to exist accidentally in an ‘unstable’ market. We need to recognize always that the idea of an equilibrium claims that there are reasons for why, if the market is not clearing, there will be a convergence to market clearance. Those reasons are discussed under the topic of market stability or stability analysis. Unfortunately, the topic of stability analysis is too often mistakenly treated as a separate, secondary issue of interest only to sophisticated analytical theorists.

It would seem that the questions of stability analysis are precisely the questions of disequilibrium microeconomics. To explain how the market converges to a point where demand equals supply, we must consider points where demand does not equal supply – that is, we must consider so-called disequilibrium points. While disequilibrium analysis may be more concerned with why we are at such a state of disequilibrium, stability analysis is concerned with why we would move from there towards the equilibrium point. Thus, stability analysis is concerned with the logical adequacy of any equilibrium explanation of the behavior of individuals or the economy.

In the next chapter we will return to questions of stability analysis and the completeness of equilibrium explanations. The remainder of the present chapter will be devoted to a more fundamental question. Consider an equilibrium model for which the structure ensures that any defined equilibrium state is ‘stable’ (i.e. any endogenous movement from a disequilibrium point is always towards an equilibrium point). For any such model we ask: Is the movement towards an equilibrium fast enough to expect achievement of the equilibrium in a realistic amount of time? Should the answer be negative there is a serious question of the appropriateness of the model should it be used to form the basis of an equilibrium explanation. The only case where the answer is obviously intended to be affirmative is where the speed of adjustment is assumed to be instantaneous. But, the affirmative answer would, as noted above, amount to assuming an infinite speed of adjustment and, as always, the term ‘infinite’ really means ‘impossible’.

1. Exogenous Variables and Teleological Comparative Statics

We will, for now, accept the stability of any model in question. We wish to discuss models for which the equilibrium converges to the well-defined endogenous point when the exogenous variables change. Stability, however, is not enough – ‘convergence must take place relatively quickly’ [Fisher, 1983, p. 3]. Unfortunately, stability theorists do not always make clear what is meant by relatively quickly. But, with reference to comparative statics, Fisher does say that ‘reacting to a given parameter shift, [the system must get] close to the predicted new equilibrium before parameters shift once more’ [Fisher, p. 3]. In one sense this sounds arbitrary, since comparative statics is an artificial method of explanation – that is, any change in the ‘parameters’ (i.e. exogenous givens) is merely a thought experiment. However, if we keep Samuelson’s correspondence principle in mind, we can note that when we state how long the exogenous parameters will hold their value, the question of convergence is not arbitrary. But whenever we fail to specify the durability of the exogenous givens, the empirical content of the equilibrium explanation is surely in doubt.

Whenever we are dealing with long-run equilibrium models, the question of quick convergence would seem to be a serious source of methodological problems. But, again, recall that this is just the kind of problem that the Marshallian strategy of short- vs. long-run perspectives was all about. Certain exogenous variables do not change quickly relative to endogenous ones, such as prices. In this sense, the differences in changeability is a basis for defining exogeneity, but the definition depends on the time period under consideration. Specifically, individuals must take certain variables as exogenous givens whenever they cannot change them during the time period when the endogenous variables are being chosen.

While Marshall may have been satisfied with the distinction between the long and short runs, his method can be a bit troublesome. If we say that the short run is defined on the basis that capital is exogenously fixed, the explanation of short-run variables may make sense. But, if we say only that endogenous labor can change faster than capital, there may never be a short-run equilibrium to discuss. Specifying that, for any finite amount of time, one variable is changing faster than another will still mean that both variables are changing. However, by Marshall’s explanatory principles, the determination of the optimum amount of labor depends on a fixed and given amount of capital. Thus, the only equilibrium in this relative ‘speed of adjustment’ case occurs in a long-run equilibrium, since only when all variables converge into agreement will there be no further reason for labor to change. Unless the quantity of capital has reached its long-run value and thereby stopped changing,
labor will never be at a short-run optimum!

Marshallian methods of explanation are not highly regarded these days, so when it comes to the achievement of equilibria it is somewhat questionable what method Fisher has in mind when speaking of converging ‘relatively quickly’. If he is not advocating Marshallian methods, the speed of adjustment would seem to be determined by the slowest endogenous variable. But the speed of adjustment must still be relative to the speed of change of the exogenous variables. Even for the Marshallian method, the slowest endogenous variable must still change faster than the fastest exogenous variable. Otherwise, not only is there no short-run equilibrium, there would never be a long-run equilibrium. Before the slowest endogenous variable has changed to the optimum value for the given exogenous variables, the fastest exogenous variable would have changed. These considerations then give explicit meaning to Fisher’s term ‘relatively quickly’. The equilibrium must converge faster than the fastest changing exogenous variable. Nevertheless, it is still not clear what is meant by this term if it only makes sense in Marshallian terms. If the exogenous variables are always changing, what is an equilibrium explanation?

The Marshallian method of explanation does seem to make sense in terms of disequilibrium dynamics so let us continue to view equilibrium explanations using short-run equilibria and long-run equilibria. Consider again our discussion of Chapters 3 and 4, where the basis for explanation is the individual decision-maker’s effect on the state of equilibrium. Consider also the mainstay of neoclassical methodology, namely comparative static analysis. Both considerations are relevant only for states of equilibrium. In the former, the individual is thought to vary his or her choice around the equilibrium value and thereby determine that the equilibrium value is the optimum. In the latter, the theorist is thought to vary the values of any one exogenous variable to show its effect on the next equilibrium. In both cases, there is no explanation without a definable equilibrium which is reached ‘relatively quickly’. While the former does not necessarily involve disequilibrium dynamics, the latter does.

Comparative static analysis does not make complete sense in an environment where many exogenous variables are changing. The logic of any comparative static analysis is to calculate all endogenous variables after one exogenous variable is changed from one fixed value to another while all other exogenous variables are fixed. While this may be intellectually interesting to some, it does not seem to correspond to what we can see outside our windows.

Decision-makers in the real world can look outside their windows, too. The key question is: How do we model the decision-maker who is deciding when and how much to invest in a particular project that will be realized only in the distant future? That is, what is the optimum investment? As we usually explain optimum decisions, something is maximized subject to a specified set of exogenous variables. Unless one already knows the values of the eventual long-run equilibrium exogenous variables, the investment decisions made in the short run are unlikely to be appropriate for the long-run equilibrium values of the exogenous variables. These questions were considered by Hayek many years ago and they may still be worth considering today.

2. Hayek’s Contingent Equilibria

While we do not wish to identify with the ideological content of many of Hayek’s writings, clearly in the early ones he did recognize the many difficulties inherent in equilibrium models of the economy. For Hayek, the importance of economic theory was not captured in the logical requirements of a state of equilibrium but rather in the process that might, if given enough time, lead to an equilibrium. Just examining an equilibrium at one point of time can be very misleading. At every point in time, decisions must be made concerning investments and the correctness of those decisions is contingent on the fulfillment of expectations about future markets. Even if we adopted the view that today there are markets which deal in future transactions or future deliveries, an equilibrium today is still dependent on the absence of any unexpected changes in the exogenous variables facing future markets. This contingency calls into question the explanatory import of any real-time equilibrium.

In his early writings Hayek usually viewed the individual decision-making process as the formation of a ‘plan’ which is subsequently implemented in the market. Investment decisions are concerned with providing future supply capabilities but are transacted in current markets according to current plans [Hayek, 1933/39]. Let us say the investment is made at time $T_0$ and the capabilities are delivered at time $T_1$. And further, let us say that at $T_0$ the market for investment goods is in equilibrium – that is, the demand based on the planned investments equals the supply of those investments. The contracts are signed at $T_0$ to supply the demanded investment goods at $T_1$. If it turns out at $T_1$ that the future capabilities are not optimal for the actual conditions of the future market, then what does it mean for the market to be in equilibrium at $T_0$?

This raises the question of why the future capabilities might not be optimum at $T_1$. But such a question is easy to answer. Every optimum is contingent on the specific values or states of exogenous givens such as weather, resource availabilities, population, tastes, technology, etc.
Investment decisions at $T_0$ must be based on what is expected to be the values or state of the exogenous givens at $T_1$. The presumption is that the investment decision is always intended to provide the optimal production capabilities at $T_1$, and this necessarily must involve a presumption about the actual values and states of exogenous variables at $T_1$. There is, according to Hayek, no reason to think that at $T_0$ the individual investor could ever be guaranteed to form true expectations of the values of the future exogenous variables. At $T_1$, the investment goods are delivered and the capabilities established. If the exogenous variables are not as expected, the capabilities will likely not be optimum and thus the supply of final goods will not necessarily be optimum. While it is easy to say that at any time the production capabilities are exogenous (since it is too late to change them as they were decided at $T_0$), and at $T_1$ the supply may still be adjusted to the optimum for the actual values of the exogenous givens, the question is whether the profits were, for the capabilities provided, as expected at $T_0$. Had the actual values of the exogenous variables at $T_1$ been known at $T_0$, a different investment decision would likely have been made. In other words, we cannot always consider both markets to be or to have been in equilibrium. If the expectations at $T_0$ were wrong, either (1) the market at $T_0$ was not at the equilibrium (since the demand for investment was not optimum) or (2) the market at $T_1$ is not at the equilibrium (since the supply of the final good is not optimum).

This situation is a general problem for all general equilibrium models where knowledge (of future exogenous variables) is not perfect and yet there are decisions made whose optimality depends on the state of a future economy. If we opt for (1), the view that despite possible errors in past expectations the market at $T_1$ can still be in equilibrium in the sense that demanders and suppliers are maximizing for the given situations, then, paradoxically, we call into question that there really is an equilibrium at $T_0$. This is because, without perfect knowledge, whenever the future market is in equilibrium with what are likely to be sub-optimal capabilities, the prior market was in a false equilibrium, in the sense that the demanders of investment goods were not actually optimizing. The paradox arises because for the future market to be in equilibrium, the prior market must not be: but every future market, say for $T_1$, is eventually a prior market for an even later future market, say for $T_2$. Whenever we claim that the future market is always in equilibrium, if the market at $T_2$ is also in equilibrium we have to say the market at $T_1$ is not in equilibrium. This is contrary to the view held at $T_1$. For reasons like this, Hayek seemed to think that basing so much of our understanding of economics on the logical properties of equilibrium models is intellectually suspect, at the very least.

3. Calculus of Variations, Dynamic Programming, Control Theory, etc.

While Hayek may have seen the use of equilibrium models as inherently problematic – particularly when discussing decisions involving time and future markets – many other economists have seen this as only a puzzle to be solved. Since the early 1950s economists have been learning to see questions of investment decisions as merely instances of a more general viewpoint which is often called ‘optimal control theory’ [Dorfman, 1969]. The question we will eventually consider is whether this alternative way of looking at the problem of investment resolves any of Hayek’s problems, or whether it merely deceives us by offering a solution to a different problem. For now, let us briefly examine optimal control theory.

To understand optimal control theory we need first to consider the ‘control problem’ [Intriligator, 1971]. Rather than see the question of investment as a single decision made at time $T_0$, determining the state of the firm’s capabilities at just one later point in time $T_1$, let us consider a long sequence of such points, $T_0, T_1, T_2, \ldots, T_i, \ldots, T_n$. The object of concern is the state of capabilities, $K_i$, at each point in time, $T_i$. The decision problem is to make investments, $X_i$, at each point in time to control the time-path or ‘trajectory’ of the $K_i$ such that the optimum capabilities are provided at each point in time, $T_i$. In effect, the investment decisions ‘control’ the path of the capabilities.

The theoretical problem is to find the optimum path of the control variable(s), $X_i$. What the optimum path is depends on our objectives. We might want to achieve a target value of capabilities in the minimum amount of time, or we might want to maintain a certain level of capabilities at each point of time. Stated this way the control problem is a mechanical engineering problem which only depends on the mechanical relationship of the rate of change of $K_i$ to the control decisions, $X_i$, and the values of the initial and target capabilities. There are two versions of this problem depending on whether the intermediate values of the capabilities have an effect on the choice of the time-path for the control variable(s). If the intermediate values do not matter, this is called an ‘open loop’ control problem and can be solved at $T_0$. If the intermediate values matter, it is called a ‘closed loop’ problem and the intermediate values of the control variable(s) will have to be decided at each point in time. Unless there are unknown and changing exogenous factors affecting the outcome of the control decisions at each point in time, there is little reason to distinguish between these two versions [Intriligator, 1971, p. 302].

The basic approach to determining the optimal path for the control variables (and hence for the optimal path for the capabilities) is to
consider each conceivable path as an entity and somehow devise a mapping from the set of conceivable paths to a one-dimensional set (i.e. to one point on a line). Recall that the consumer’s utility function is also a mapping, one that maps a point in a multi-dimensional set (representing combinations of quantities of goods) to a point in a one-dimensional set (representing levels of utility). The only complexity introduced by the control problem is that, while a point in the consumer’s goods-set is just a multi-dimensional singular point, a ‘point’ in the control theory’s path-set is a multi-dimensional line, that is, a sequence of many singular points.

There are many techniques of analysis for dealing with the control problem and the related complexities of mapping paths to scalar points. The ‘calculus of variations’, ‘optimal control theory’ and ‘dynamic programming’ are the most familiar to economists. In the calculus of variations approach no mention is made of the control variable(s). In the dynamic programming approach there is a specific objective function recognized which is presumed to apply regardless of the time it takes to complete the program. Control theory is, in effect, a generalization of the well-known, calculus-based, Lagrangian multiplier technique of representing maximization problems. Control theory is interesting to economists because the control problem can be expressed as one involving an invented variable, much like a Lagrangian multiplier, which can all too easily be interpreted as a short-run optimum discount rate [see Dorfman, 1969].

We do not need to spend time detailing these techniques as there are textbooks that would do them more justice [e.g. Intriligator, 1971]. What is characteristic of all of them is the view that the decision process is a mere matter of mechanical engineering. If we can specify the static and mechanical relationships about the production of investment goods and the static objective or utility function, the problem is merely one of a mathematical analysis of the general solution. Such analysis depends only on the initial and target values of the capabilities. It is a wonder, given such techniques, that anyone would ever think there could be a problem concerning investment decisions.

4. Mechanical Solutions vs. Learning

There are many reasons why control theory and its variants are inappropriate for Hayek’s questions. If the technical relationships or the objective functions are not completely known in advance, it will not be easy to apply these techniques. Incomplete knowledge in this regard is not widely recognized by the proponents of these techniques. What is recognized is the uncertainty about future exogenous factors affecting the optimality of decisions concerning the path of the control variables [Intriligator, 1971, p. 302]. Unfortunately this is too easy to transform into a statistical decision problem and thereby mask all the interesting questions concerning learning and knowledge that Hayek was addressing. And, even worse, committing oneself to very special theories of learning – namely, versions of inductive learning – and restricting oneself to specific mathematical forms of production functions and utility functions, it is even possible for one to transform the question of our knowledge of these functions into a question of learning the values of their parameters as part of the process of moving along the optimum path.

Using the sophisticated technique of reducing a dynamic equilibrium problem to one of a static choice of an equilibrium path does not overcome the question of how one deals with errors in one’s choice of an optimum time-path. By using the usual techniques of optimization, theorists seem to be always looking for the optimum learning formula, one that precludes the possibility of making mistakes. Unfortunately, such a formula does not make much sense, if theorists think there is really something to learn at each point in time. If Hayek stressed anything about learning, it is that mistakes matter. Understanding the role of mistakes is a central issue in our understanding of the equilibrium process.

The promotion of techniques of analysis such as optimal control theory and dynamic programming unfortunately leads us to think about our problems of decision-making over time in a way that the convenience of mathematical techniques takes precedence over the accuracy of the representation of any problem at issue. What is lost in these mechanical engineering approaches is the recognition that decision-makers learn and may make decisions so as to maximize the possibility of learning. And, in a fundamental sense recognized by Hayek, learning always involves learning from one’s mistakes. Decision-makers can always choose time paths that may generate errors in order to learn more about the world in which they are operating.

The mechanical engineering approach of optimal control theory or dynamic programming is too much concerned with successful optimization. When one suspects that one does not possess perfect knowledge, sometimes the best path is to try to generate errors. A classic example of this was an early attempt to place a man-made machine on the Moon. The first American attempt was a failure because the machine successfully landed without any difficulty. The purpose of placing a machine on the Moon was, however, to learn the limits of our understanding, that is, to find out how things might go wrong. Had the machine’s landing revealed errors it would have reduced the chance of
errors that could endanger later efforts to put men on the Moon. In other words, the first attempt was a mechanical success but a scientific failure.

Since disequilibrium is a state where at least one decision-maker is making errors, and since some of those errors may be part of a process of learning, it would be grossly misleading to base our understanding of disequilibrium economics on ‘dynamic’ tools such as optimal control theory and dynamic programming. While they may be appropriate techniques for well defined mechanical engineering problems, they are not obviously relevant for the questions of equilibrium processes where, as Hayek argues, learning from one’s errors plays a central role.

7

Equilibrium vs Equilibrium Processes

In modern Austrian economics ... we find the problem of knowledge to be a matter of fundamental concern. In 1937 Professor Hayek divided the subject matter of economics into the pure logic of choice and the enquiry into the dissemination of knowledge. In 1946, in criticizing most modern theories of market forms, he pointed out that competition is a process, not a state of affairs, and that it reflects continuous changes in the pattern of knowledge.

Ludwig M. Lachmann [1976, p. 55]

When Professor Hayek, ... in presenting ‘Economics and Knowledge’, suggested that the most important task of economics as an empirical science consists in explaining how men come to acquire knowledge of the ‘data’ governing the markets in which they operate, ... the whole problem was stated in equilibrium terms. ... After what has happened in economics in the last 30 years we are today inclined to look askance at the whole notion of equilibrium, and even more so at the Hayekian version of 1936 in which we were told ‘It can hardly mean anything but that, under certain conditions, the knowledge and intentions of the different members of society are supposed to come more and more into agreement’.... But even if we discard the equilibrium terms in which the problem was first stated, it nevertheless remains. In a stationary world ... time will in the long run, ‘hammer logic into brains’ and teach its human pupils what they must do to achieve success and stave off failure. Why this should be so in a changing world is by no means clear.

While Hayek has long been closely associated with the ‘Austrian School of Economics’, his ideas still have a significance far beyond the narrow concerns of that school. The questions raised by Samuelson [1947/65] and Arrow [1959], about the relationship between the concept of equilibrium and the process that guarantees convergence to the equilibrium, were refinements of those introduced in the earlier work of Hayek. Everyone now agrees that in any equilibrium model the specification of the equilibrium process is no less important than the determination of the mathematical properties of an equilibrium point [Hahn, 1981; Fisher, 1983; etc.]. However, understanding the nature of an equilibrium process is more than a mere question of stating the logical requirements for equilibrium models.

Critics of neoclassical economics will call attention to the knowledge requirements for any state of equilibrium [Shackle, 1972; Lachmann, 1976, 1982]. However, the basis for such ‘requirements’ usually turns out to be a presumed theory of knowledge that is untenable [see Boland, 1978, 1981b, 1982b]. The important question is whether any theory of knowledge could be consistent with the knowledge requirements of a state of equilibrium [see Boland and Newman, 1979]. This question is not insignificant as there have been strong claims made that the information contained in any set of equilibrium prices is complete [e.g. Koopmans, 1957]. There is a related, and more fundamental, question that we must consider – one that addresses those questions raised by Samuelson and Arrow. Is the process of acquiring the necessary knowledge consistent with the requirements for a state of equilibrium? Perhaps, if the concept of equilibrium is properly specified, the necessary information for convergence to equilibrium can be provided automatically in any state of disequilibrium [Hayek, 1945/48]. We will examine these questions of the relationship between the equilibrium process and the learning process which would be consistent with a state of equilibrium.

1. Equilibrium and Theories of Knowledge

According to Tjalling Koopmans [1957, p. 53],

The [equilibrium] price system carries to each producer, resource holder, or consumer a summary of information about the productions possibilities, resource availabilities and preferences of all other decision makers. Under the conditions postulated, this summary is all that is needed to keep all decision makers reconciled with a Pareto optimal state once it has been established.

The conditions postulated are ordinary equilibrium conditions. But two questions need to be asked. How does the individual decision-maker acquire the information comprising the whole ‘price system’? Does the process of establishing the Pareto optimal state require information different from that which reconciles the independent decision making of individuals? Before we can consider these questions we need to examine the role of the information contained in an equilibrium price system with respect to the individual’s decision process.

From our previous discussions in Part I, if every individual knows the equilibrium price for every good that is considered, and if the individual actually faces those equilibrium prices, then maximizing behavior cannot yield a disequilibrium. But is knowledge of the equilibrium price system all that is required? Should we not also have some knowledge of the availability of the goods demanded [Hayek, 1937/48, 1945/48]? If we are really discussing an individual’s demand decision at an equilibrium point and all individual’s are facing the same price, the supply will be just enough to meet everyone’s demand. Viewed this way – that is, looking only at the quantities demanded and supplied at the equilibrium point where each individual knows all the relevant prices – there cannot be a problem of availabilities, since the additional knowledge of availabilities is redundant.

There are two more questions to ask about the sufficiency of the knowledge of the equilibrium price system. Is the number of equilibrium prices that the decision-maker needs to know more than what we would consider reasonable? And, how does any ordinary individual know that those prices are the equilibrium prices? Whether the number of goods for which the individual must have information is unreasonable depends on the specific equilibrium model under consideration. Clearly a model in which it is assumed that there are an unlimited number of goods is one which would put a considerable strain on the credibility of Koopmans’ claim. Perhaps a more modest model with a small number of goods might seem reasonable. What does seem reasonable will depend on the theory of knowledge presumed to apply to the individuals in question. We will return to this issue a little later. For now, let us assume the number is reasonable and proceed to the other question.

In one sense the question of how the individual knows the given prices are equilibrium prices is beside the point. If they are equilibrium prices, any individual’s planned purchase pattern will be fulfilled. But if the individual cannot be certain that the prices faced are equilibrium prices, why should we expect that the planned purchase pattern would be the same as the plan formed when the prices are certainly equilibrium prices? Consider a simple decision situation facing the consumer. If we
recognize that any individual cannot be in two places at the same time, then the individual must decide which market to go to first (e.g. the butcher or the baker). Obviously, if you thought there might be a shortage in a particular market you might want to plan to go to that market first. In this sense, knowledge of the equilibrium nature of the price system is essential. If the individual does not know that the prices are equilibrium prices, his or her plan will be a bit more complicated. Nevertheless, if the prices are the equilibrium prices, the extra complications should not matter since all aspects of the plan are fulfilled in the end.

If we restrict our view of the economy to equilibrium price systems, certain liberal ideological implications follow. If the decision-makers all face the same equilibrium price system, their independent decisions are perfectly coordinated (i.e. demand equals supply in every market) and it does not matter how the prices were established. The definition of an equilibrium price system “does not necessarily presuppose the existence of a competitive market organization” [Koopmans, 1957, p. 53]. As Koopmans claims, “[d]iscussions of pricing as a tool for planning and operating a socialist economy likewise derive from our [definition of an equilibrium price system]” [Koopmans, 1957, p. 53]. So, if we restrict our discussion to equilibrium price systems, we do not have to be concerned with whether competition as a process is a necessary, or even a good, thing. This is optimistic liberalism at its best, but it sure misses the point of why one would ever want to argue in favor of market competition following the tradition promoted by Adam Smith.

What is most interesting, in retrospect, is that while Koopmans and Hayek seem to be in complete agreement concerning the informational efficiency of a market price system, their ideological conclusions are just the opposite. Hayek argues that only the competitive market price system is efficient, and even when based on prices, the socialist planning system is virtually impossible, let alone efficient [Hayek, 1945/48]. While Koopmans’ view of the price system promotes open-minded liberalism, Hayek’s would seem to be based on a conservative view of the nature of the competitive market system. If Hayek had focused his view of the informational efficiency of the price system on the logical properties of an equilibrium point, his view would be difficult to sustain for the following reason. In a truly competitive equilibrium where, of mathematical necessity, all production functions must be locally linear-homogeneous (i.e. exhibit constant returns to scale on the margin), a labor-theory of value yields the same conclusions concerning income distribution as does any other theory of value (such as a capital-theory of value). For example, a firm’s total cost measured in dollars is the sum of two terms, $WL + P_K K$, and these two terms are what has been paid to the suppliers of the two inputs, $L$ and $K$, given the prices $W$ and $P_K$. These terms, in effect, represent incomes of the input suppliers. The income distribution between the suppliers of $L$ and $K$ is indicated by the ratio of the two terms, that is, by $(WL)/(P_K K)$. The value of this ratio does not change when we measure the total cost in units of labor as $L + (P_K/W)K$ or in units of capital as $(W/P_K)L + K$.

A competitive equilibrium is truly the domain of open-minded liberal economists [cf. Boland, 1977b, 1977d]. While we agree that open-minded liberalism is admirable, it is risky to base it only on the properties of conceptually narrow equilibrium models.

2. Equilibrium and Theories of Ignorance

Let us consider further the plight of an independent individual who only knows the going market prices for the goods that he or she wishes to purchase; but now we will assume that the individual does not know whether they are equilibrium prices and hence cannot be sure that there will be enough of everything nor whether, when some market does not clear, the price will rise or fall [cf. Fisher, 1983, p. 46]. Following the leads of Hayek and Fisher (as well as Hicks [1979]), let us think of the individual as forming a ‘plan’. We want to specify the essential elements of a plan as well as consider what some might call an ‘optimal plan’ [e.g. Fisher, 1983]. We must, however, be careful not to presuppose the conception of a plan to be consistent only with the requirements of a state of equilibrium (as did Hayek [1937/48, 1945/48]) for that would make our explanation circular.

To keep the discussion simple let us focus on the plan of the individual consumer – consider Figure 7.1 which, let us say, truly illustrates the decision situation facing the individual. In accordance with traditional neoclassical theory we would assume that the individual knows his or her indifference map and budget, $B$; and what is in doubt is the individual’s knowledge of the prices, $P_x$ and $P_y$. But now, we wish to say just that Figure 7.1 illustrates the individual’s expectations of the decision situation.

The question to ask here is, what does the individual know before entering the market place, and about what does the individual, in his or her ignorance, have to form expectations or form a theory? As we said, prices depend on the behavior of all other individuals in the market, so it seems reasonable to think that it is unlikely for an independent individual to know what all other individuals will demand or supply and thereby to use such knowledge to calculate equilibrium prices. It is usually taken for granted that the individual knows his or her preference map (a
supposition that we will reconsider later). Some might question the *a priori* knowledge of the budget if the latter depends on income to be earned in another market. The other market may not be in equilibrium

![Diagram](image)

*Figure 7.1. Choice facing unavailability*

[Clower, 1965]. But for now, let us maintain the view that the budget, $B$, and the preference map are known.

Theories of an optimal plan are usually about the ability of the individual to form correct expectations of the equilibrium prices. Consider Figure 7.1. If the individual expects the prices to be $P_{x_1}$ and $P_{y_1}$, the plan is to go to the respective markets and buy quantities $X_1$ and $Y_1$. If the individual accidentally forms expectations of prices that happen to correspond to the equilibrium prices, these quantities will be successfully purchased. If they do not, the optimum point in the (*ex ante*) optimum plan, $E$, will not be the (*ex post*) optimum once the actual prices are known. How does the discrepancy between the expected situation and the actual one manifest itself? The individual must have a plan in mind which recognizes the possibility of erroneous expectations. Many strategies are possible, but for now let us just say that the individual thinks that if either market is to be short of supply it is likely to be the market for good $Y$ and thus plans to go to that market first. Let us further say that the individual successfully purchases the planned amount of $Y$, $Y_1$ at the expected price, but when the individual arrives at the market for $X$, things are not as expected.

There are two different ways the expectations could be wrong: There is the expected-price error where the actual price is not the expected price; and there is the expected-quantity error where the actual price is as expected but the supply is not sufficient. The unexpected shortage is the less obvious way, since it was not mentioned as part of the expected decision situation even though it is implicit in the view that the plan must recognize possible shortages (such as we said concerning the supply of good $Y$). Recognizing errors as expected-price errors is consistent with the theory of perfect competition where each individual is considered to have no effect on the market price. It is also consistent with the theories where the price responds instantly to shortages so that at the actual market clearing price there is a sufficient supply. But considering all errors to be expected-price errors may be predisposing the view of the plan to be one which is consistent only with an equilibrium model.

To illustrate the differences, consider again Figure 7.1. The expected-price error is viewed as follows. If the individual already purchased $Y_1$ amount of good $Y$, but the actual price of $X$ is $P_{x_2}$ when he or she arrives at the market for $X$, the planned optimum, $X_1$ is outside the budget line. The best that can be done is to buy the amount $X_4$, which is not only less than the planned optimum, but is also less than the optimum for the actual prices. If the individual knew the actual prices, he or she would have wanted to purchase point $S$ which represents $Y_2$ and $X_2$; but this is not possible since, as we said, the individual already purchased $Y_1$. Here we say the individual buys $X_4$ because the actual price of $X$ was not expected and point $R$ is the best that can be done.

The expected-quantity error is viewed as follows. Let us say the individual buys $X_4$ because that was all that was available on the shelf. (Of course, this may only beg the question about why this individual was the last one to find anything on the shelf.) Under these circumstances, $X_4$ is still the best that can be done, even though the prices may be as expected. But if the actual prices are as expected, $P_{x_1}$ and $P_{y_1}$, the optimum point is at $T$. Point $W$ may be a more efficient way to achieve the level of utility of point $R$, but it still requires more $X$ than is available – as before, the optimum point is not possible if the individual has already bought $Y_1$. From either perspective (expected-price or expected-quantity errors) the individual is not optimizing. While the optimum plan said to go to $Y$’s market first, it turned out that it was the expectations for $X$’s market that were erroneous.

This illustration highlights a major concern of economic theorists who wish to recognize disequilibria without giving up equilibrium models. How does the individual become aware that the market is not in
equilibrium? Through expected-price errors or expected-quantity errors? Unfortunately, recognizing ‘disequilibrium awareness’, as Fisher calls it, is not enough. It will be argued below that we must also explain how the individual learns to respond in a manner which will promote a movement toward equilibrium and thereby ensure the future ability to fulfill consumption plans. In other words, we must explain how the individual learns to form more accurate expectations.

3. Responding to Disequilibrium Awareness

For many economists, and particularly the followers of Hayek [1945/48], there is no methodological problem here, since the awareness of disequilibrium carries with it sufficient information to ensure that expectations will always be revised in the correct direction. Moreover, awareness of disequilibrium is automatic, since a disequilibrium implies that someone is not able to fulfill his or her optimal plan. From the above considerations of optimal plans we can see that the awareness may be automatic for one individual (e.g. the last one to go to the market for X) but it is not necessarily automatic for everyone. This makes the question of how an individual learns to respond to an apparent disequilibrium even more important.

Traditionally, there are two response patterns that are almost always assumed in arguments based on the properties of equilibrium prices. In one, the individual adjusts quantities in response to expected-price errors; and in the other, the individual adjusts prices in response to expected-quantity errors. Which behavioral pattern is invoked depends on the type of expectation error claimed to result from the disequilibrium. While both of the assumed response patterns are well known and widely used, they have been criticized. The criticisms have been that the usual assumptions are ad hoc [Fisher, 1983], incomplete [Gordon and Hynes, 1970] or inconsistent [Arrow, 1959]. But all of these criticisms are concerned with the adequacy of the concept of equilibrium prices rather than merely the desire to understand the equilibrium process on its own terms.

It is still widely recognized that ‘[w]henever economics is used or thought about, equilibrium is a central organizing idea’ [Hahn, 1973, p. 1]. For some it is merely a convenient way to explain the economy, and for others it is much more. To explain prices as outcomes of equilibrium processes is to appreciate the informational efficiency of the competitive price system [Hayek, 1945/48]. Many teachers see their primary task as that of convincing students that if we rely solely on the market system we will have the ‘best of all possible worlds’ – that is, we will achieve an optimum allocation of all of society’s resources, and that optimum will be determined solely by the individuals who choose to participate in the market [cf. Friedman, 1962]. Hayek argued that the competitive market system was more efficient than any other system in this regard. Hidden away in such normative claims for the superiority of the competitive price system over all other systems (except perhaps a benevolent dictatorship) is an empirical claim about the necessary stability of any market system. If that claim were false, a competitive price system might not be a superior form of social organization. Let us look closer at this by reviewing the presuppositions that underlie the claim that prices should be determined in the market and thus that we should be dependent on such market determined prices to organize society.

Consider the following dialogue between the economics teacher (ET) and the inquisitive student (IS):

IS: Why is the price of any good (e.g. apples) what it is?
ET: Because the observed level of the price for any good is an equilibrium level – see Figure 7.2 where the equilibrium price is $P^e$.

![Figure 7.2. Equilibrium price](image-url)
(1) The nature of the world is like this: either the price, $P$, equals $P_e$ and demand equals supply, or
   (i) anytime $P > P_e$ there will be ‘excess supply’ (ES), and
   (ii) anytime $P < P_e$ there will be ‘excess demand’ (ED).

(2) People are rational:
   (iii) demanders seek to maximize their utility, and
   (iv) suppliers seek to maximize their profits

(3) People are price-competitive:
   (v) anytime there is excess supply, someone will bid the price down, and
   (vi) anytime there is excess demand, someone will bid the price up.

IS: For me to understand your claim for the nature of the world, I need to be able to see how the world conceivably be otherwise. Consider Figure 7.3 where I have drawn all six possible configurations of the slopes of demand and supply curves at their intersection (I have left out the special cases involving vertical or horizontal curves or equal slopes to keep things simple). I now see that your claim about the nature of the world is that it must be as shown in Figure 7.3(a), (b) or (c) and thus your claim is really that the world is not as shown in Figure 7.3(d), (e) or (f). This is because, had the world been as shown in Figure 7.3(d), (e) or (f) then the competitive behavior you claim for people would cause the price to move away from the equilibrium and thus the least likely price to observe would be the ‘equilibrium’ price, $P_e$. But I fail to see how you or anyone else can distinguish between Figure 7.3(a) and (d) or between Figure 7.3(c) and (f) without violating the methodological individualist view that demanders and suppliers make their decisions independently. For example, if both curves are downward sloping (perhaps it is in a market where the sellers give quantity discounts) how do we know the world is like Figure 7.3(a) rather than like Figure 7.3(d) without presuming that the slope of the sellers’ supply is not in some way constrained by the slope of the demander’s demand curve?

ET: You are right. There would seem to be a potential methodological problem here, but there are some disequilibrium responses hidden in our theory of the individual supplier to take care of this. Specifically, by saying that the individual firm produces where profit is being maximized for the given (demand) price, we are in effect saying that the firm responds to any difference between the

Figure 7.3. Possible markets
price and marginal cost, since the marginal cost indicates the supply price. That is, we can add to the list two implicit behavioral conditions of the profit maximizing behavior of price-taking firms:

(iii) if there is an excess supply-price \( (P < MC) \), the firm will decrease the quantity supplied, and

(iv) if there is an excess demand-price \( (P > MC) \), the firm will increase the quantity supplied.

If I may use your Figure 7.3 to put things into your terms, we see that the implications of this are that my claim about the nature of the world is that additionally the profit maximizing behavior of the firm means that the world cannot be like Figure 7.3(a), (c) or (e). Thus, if people behave as I claim (as profit maximizers and price-competitors), then only Figure 7.3(b) could represent the possible world. So, the potential methodological problem that was bothering you disappears. My claim boils down to one that the world is like Figure 7.3(b) and in such a world profit maximizing with price-competitive behavior will always lead to equilibrium prices (and equilibrium quantities, too). And, given this necessary tendency towards states of equilibrium and the ability to show mathematically that any state of equilibrium can be shown to imply a Pareto optimum with respect to resource allocations, you can see why I am trying to convince you that we should all put a price on our services and get out there and compete in the market. If we all do so, it will be the ‘best of all possible worlds’.

IS: Not so fast, I am not so convinced. Although it might be conceivable that people can be so competitive, why might the world necessarily be only like Figure 7.3(b)?

ET: Well, you can see that Figure 7.3(b) has very convenient properties. If we can show that all demand curves are downward sloping as a consequence of consumers’ independent decision-situations and that all supply curves are upward sloping as a consequence of the firms’ independent decision-situations, then the requirements of methodological individualism are satisfied. Before you jump on me to say that these are market curves and not individual curves, let me say that we wish to show this for each individual’s demand or supply curve. Thus, if every individual’s demand curve is downward sloping, then necessarily when I add the individually demanded quantities together at each price, the resulting market curve will be downward sloping. The same is true for the sum of the individual supplies at each price. The key issue that must be stressed here is that there is to be no collusion between decision-makers.

IS: Leaving the question of collusion aside, you have not answered my question. You have told me what you want – a situation where everyone can be independent and still have the possibility that the unintended consequence is an equilibrium with all its Pareto efficiency benefits – but you have not yet told me why the world is like Figure 7.3(b).

ET: Very well, but you may still not be convinced. The reason all individual demand curves are downward sloping is because, psychologically, all individuals face given utility functions which have the common property that marginal utility is always diminishing. And supply curves are always rising because everyone’s productive capabilities on the margin must be diminishing. These two concepts of diminishing margins are facts of nature and when combined with rational decision-making (constrained optimization) will necessarily lead to the proper slopes as shown in Figure 7.3(b).

IS: I am still not convinced since I read in our textbook that diminishing marginal utility is not sufficiently limiting because with it all that we can say is that for a demand curve to be rising the good must be an inferior good (a good which one will buy less of when one’s income increases). Is there something more to your claim about the nature of the world?

ET: Does there have to be more? Even if some individuals have upward sloping demand curves, it is unlikely that all do and so when we add up their respective demand quantities we will find that the aggregate market curve is still downward sloping. In effect, if there are just a few perverse people, their behavior will be cancelled out by the dominant behavior of normal people.

IS: Now again you seem to be going for your convenience rather than trying to convince me about the nature of the world and why I should eagerly want to engage in the competitive market system. If some consumers have upward sloping curves and some have downward sloping curves, where do we draw the line? It is certainly possible that the number of people with downward sloping curves is just about enough to be cancelled out by the number with upward sloping curves and so, for the last person whose demand is to be added to the market total, how do we avoid violating methodological individualism if we have to exogenously constrain the last individual to have a downward sloping demand curve?

ET: I am beginning to wonder who the teacher is here since many of your questions are longer than my answers. You seem to be suggesting that either I violate methodological individualism in
In this dialogue we see the seeds of many research programs. The inherent stability of textbook neoclassical models which correspond to Figure 7.3(b) is clearly necessary for the normative conclusions often promoted in economics classes. Yet the logic of individual decision-making does not by itself ensure that only Figure 7.3(b) is the true representation of the real world. That is to say, the stability of the market is not obviously endogenous. If it is possible for Figure 7.3(a), (c), (d), (e) or (f) to be true representations, there must be another way to ensure stability beyond analytically specifying mechanical responses to (positive or negative) excess demands or excess demand-prices. A not-so-obvious alternative is to explain the stability as an outcome of the learning process which is implicit in the recognition that every decision-maker’s knowledge of the decision situation is limited and thus the correct expectations must be learned as part of the process of reaching the equilibrium. A too-obvious alternative is to ignore the difficulties of the microeconomic behavior and revert to the analysis of aggregates and thereby avoid the complexities of the questions of endogenous stability.

4. Learning vs. Knowing the Equilibrium Price

Providing a microeconomic explanation of disequilibrium behavior which is consistent with equilibrium behavior is admittedly a difficult and complex task. Besides retreating to macroeconomics, there is another way to avoid the complexities. We could give up any reliance on equilibrium models and equilibrium prices. This would seem to be the obvious advantage of Hayek’s earlier writings which stressed the need to recognize the role of information and knowledge. It is the optimality of the equilibrium process that shows the virtues of the competitive price system. If individuals could be seen to respond to the failures of their own unfulfilled personal plans, without having to consider what anyone else is doing, one might be able to agree with Hayek’s view of the competitive price system. Namely, one could optimistically agree with the view that the methodological-individualist conception of free-enterprise capitalism would necessarily have a distinct advantage over any social organization that might be based on a socialist planner. As is apparent in Koopmans’ liberal viewpoint, the socialist planner would have to calculate the equilibrium prices in advance.

The crux of Hayek’s argument for a significant role for information and learning in any competitive equilibrium system is his argument against the possibility of any informationally adequate general equilibrium model which would take the existence of equilibrium as its central methodological problem [e.g. Wald, 1936/51; Koopmans, 1957]. From this perspective, understanding economics is not a matter of a rigorous examination of the mathematical properties of a state of equilibrium, but rather it is an appreciation of the equilibrium process as being one that always points in the direction of an equilibrium. As a matter of theoretical convenience, Hayek’s view does find a certain degree of acceptance as it seems to deal directly with the relationship between learning and the equilibrium process. This relationship is recognized now as essential for the disequilibrium foundations of equilibrium economics [e.g. Arrow, 1959; Gordon and Hynes, 1970; Fisher, 1983]. Unfortunately, Hayek’s emphasis on studying the learning inherent in the equilibrium process, rather than the knowledge requirements for any claimed state of equilibrium, relies too much on a questionable presumption which amounts to assuming exogenous stability. Consider again Figure 7.3. Only when the true world is represented by Figure 7.3(b) can the followers of Hayek’s view be confident that the individual consumer or firm is learning to respond in the correct way, a way that will lead to a better allocation of resources. This is especially so whenever we give up basing our economic explanations on an assumption that eventually the optimum allocation is achieved.
Against Macroeconomics as Defeatist Microeconomics

If ... any configuration other than the equilibrium is assumed to exist, we have as yet discovered no way in which entrepreneurs could obtain any information about each other’s projected activities and therefore no way in which rational expectations could be formed.

G.B. Richardson [1959, p. 233]

Recent years have witnessed a small but growing strand of literature devoted to the examination of the implications of economic agents behaving reasonably rather than optimally. Embedded in such studies is the central notion that agents use ‘rules of thumb’ when taking decisions. One common ... feature of such rule is that they imply random behaviour. The natural analytical apparatus to employ ... is, therefore, the theory of stochastic processes.

John D. Hey [1981, p. 198]

You, of course, have heard the theory that if a room full of monkeys were allowed to type for a million years they would eventually reproduce all the Classics in the British Museum. This is not so. We have tried it. And, while the stories they wrote were quite good (and many of them publishable), they were not Classics – yet.

This gentleman [pointing to a monkey seated at a typewriter on stage] is one of our trainees. He types nothing but gibberish. But he is not to be faulted for this. His ideas are quite good and he has a flair for dialogue – he just can’t type!

Alfred Hitchcock [1955]

We wish now to consider all major ways of avoiding the methodological questions posed by stability analysis. Of particular concern is the question of how to provide an explanation of disequilibria that is both consistent with any view of the state of equilibrium and faithful to the usual neoclassical commitment to methodological individualism. There are three basic strategies of avoidance: stochasticism, instrumentalism and macroeconomics. By stochasticism we mean the view that each individual’s decision is too strongly influenced by random events ever to be completely explained. Stochasticism is compatible with macroeconomics as it relies heavily on macroeconomic probability distributions which are necessarily not individualistic and, as such, focuses more on the behavior of the average. By instrumentalism we mean the view that theories do not have to be true to be useful [see Boland, 1979a]. Instrumentalism avoids the demands for true individualist explanations of the economy simply by eschewing the question of truth of the microeconomic principles and thus minimizes any need to distinguish between macroeconomics and microeconomics. Proponents of instrumentalism willingly assume stability whenever stability is needed to produce what are thought to be useful propositions for the economy as a whole.

1. Macroeconomics and Rational Expectations

The macroeconomic approach to the questions of stability analysis centers on the role of rational expectations. The original interest in ‘rational expectations’ was based on the demands for a consistent equilibrium theory [e.g. Richardson, 1959]. A significant role for a concept of individual decision plans would require a recognition of expectations. But to be consistent with methodological individualism, any explanation of a state of equilibrium must include the explanation of the individual’s choices and thus must deal with how the individual forms his or her expectations rationally.

It is not always clear what economists mean by ‘rational’ since they use the term interchangeably with ‘optimal’. The rationality of an argument ensures that any two individuals who start from the same premises will reach the same conclusions. The optimality in any decision-making situation ensures an equivalent agreement about outcomes. For example, if any two consumers have the same utility functions and face the same prices and incomes, the choices they make will be the same whenever their choices are optimal. Note, however, that optimality implies rationality, but rationality need not imply optimality. The term ‘rational expectations’ can be used to indicate that if any two individuals form rational expectations, they will form the same expectations whenever they face the same information. But, does this mean that rational expectations are optimal expectations?
Any discussion of rational expectations must raise the question about how individual decision-makers learn or form expectations. This may be two separate questions. One question concerns theories about how people learn from objective information and thus about the extent to which facts (or "data" [Hayek, 1937/48]) matters. The other deals with the adequacy of the information set for the formation of any expectations. If everyone uses the same ‘set of information’ and everyone uses the same means of processing that information, the theorist might be able to predict and possibly explain what everyone is doing. The universal explanation is that individuals form their expectations by processing the same information set.

While the methodological requirement of explaining how individual decision-makers form their expectations is frequently recognized, not much has been accomplished at the level of microeconomics [see Gordon and Hynes, 1970]. The theorist could assume that there is one sure method of learning from the objective facts, and that every individual is guided by this method. This may avoid any complexities of dealing with each individual’s learning experience. Alternatively, the theorist could just examine the nature of the universal information set, since it is assumed to be the ultimate basis of every individual’s expectations. How people actually learn from the information set will not matter so long as their learning method is ‘rational’. Specifically, if the information set changes, the only remaining question concerns how each individual responds? Explaining an individual’s expectations is thus reduced to an exercise in comparative statics. If the economic model is one where the preferences and production functions are presumed to be known, the explanation is only a matter of understanding the exogenous changes in the information set. This is because when any exogenous given changes, it must appear to change. The appearance of change constitutes a change in the information set. Thus, if it is assumed that individuals form rational expectations, every specific change in the information set implies a specific change in expectations.

To make this claim the model-builder would have to rely on several methodological assumptions. Let us list them. First, and foremost, is the assumption that there is one and only one universal method of learning. Second, and almost as important, is the assumption that the method employed is a sure method: if we compare the expectations formed from two information sets, and if the two information sets are identical, then the expectations based on them must also be identical. The third assumption is that all the preferences and production functions are known to the model-builder; this one is only a matter of the convenience of the model-builder. Usually, no major theoretical question of interest involves this assumption, since, even if the model-builder knew all the preferences, questions would still be begged about the decision-maker’s learning method and its reliability. A fourth assumption is that there is an automatic connection between changes in the exogenous variables and changes in the information set.

None of these are trivial assumptions. Unfortunately, when economic theorists think there may be a problem with expectation formation, it is usually attributed entirely to inadequacies of the information set rather than to the reliability of the individual’s method of learning. That is, whenever it is possible to form two different sets of expectations given any one information set, it is presumed that such a possibility is evidence of the insufficiency of the information set rather than of any inadequacy of the learning method. This interpretation of such a possibility is really a symptom of the particular theory of learning that is always employed. It is the theory of inductive learning that we have mentioned many times. In simple terms, it is the theory that says ‘facts speak for themselves’. Given this theory, any uncertainty in the message of the facts is not to be attributed to an inability to process the information. The learning method is presumed to be infallible and unambiguous whenever the information is adequate. Thus, it does not matter who perceives the information set, the conclusions reached are the same. The inevitability of theorist and the individual decision-maker reaching the same conclusion regarding the individual’s optimum is the basis of the modern use of the Rational Expectations Hypothesis.

Given all these methodological assumptions it is easy to see why modern macroeconomic theorists can so easily assume that the individual decision-makers base their plans on rationally formed expectations. Even though perfect knowledge is not presumed, there is still a presumption of a perfect method of learning albeit a slow method. Whenever all individuals are presumed to be processing the same information set, it does not matter whether the theorist is explaining the ultimate general equilibrium or is explaining an aggregate variable which no single individual could ever determine. By concentrating on aggregate variables, one does not have to worry about explaining any individual’s expectations or learning method, since any individual’s decision based on an inadequate learning method is presumed to have little effect on the values of the aggregate variables for the reasons we discussed in Chapter 3. The only obstacle in the way of avoiding the microeconomic problems about how the individual makes a choice based on expectations of a future equilibrium is the troublesome question of how we can be sure that no individual’s errors will cause a disequilibrium or prevent an equilibrium.

As it was originally stated by John Muth, who introduced the explicit presumption of rational expectations: ‘Expectations, since they are informed predictions of future events, are essentially the same as the predictions of the relevant economic theory...’ [1961, p. 316]. There are
two reasons why the individual’s expectations would be ‘essentially the same’. One is that the ‘sameness’ is based on the assumption that we have been discussing. It is the innocent appearing assumption that ‘facts speak for themselves’ – which means, without any help from a priori knowledge. The other is that the ‘sameness’ is based on a belief that the ‘relevant economic theory’ has a solid and sufficient foundation of empirical facts which can be observed by anyone. These reasons contradict a popular criticism which claims that Muth’s so-called Rational Expectations Hypothesis lacks a theory of how expectations are formed [B. Friedman, 1979]. The belief in a solid foundation is a belief that the relevant economic theory has already been inductively established, using only observable facts with a learning method that is based on a presumably reliable inductive logic. As such, an individual using the same facts inductively to form his or her expectations cannot deviate much from the expectations based on the ‘relevant economic theory’.

The only way an individual’s expectations can deviate is when not all the available information is used – perhaps, only because processing all the available information may be too costly for one individual. In this sense, an individual’s expectations will not usually be perfect because of the inadequacies of the chosen information set. Thus we see Muth adding that, ‘The [rational expectations] hypothesis ... [is] that expectations of firms ... tend to be distributed, for the same information set, about the prediction of the theory...’ [Muth, 1961, p. 316]. If we retreat from believing there is a reliable inductive learning method, we have even more reason for deviations between those expectations formed by an optimizing individual and those expectations that a theorist would predict that the individual would form, given the relevant economic theory. But, when we give up the belief in reliable inductive learning, there is no reason to suspect that the relevant economic theory would give expectations that are any more accurate than ones which individuals form. Whenever inductive learning is imperfect, there is no reason for expectations to be distributed ‘about the predictions of the theory’ rather than about some other set of predictions. We must then conclude that Muth and the advocates of the Rational Expectations Hypothesis definitely believe in the reliability of inductive learning.

This is unfortunate since there is no reliable inductive learning method. The problem with the Rational Expectations Hypothesis is not that it lacks a theory of learning, but that it relies on a false theory of learning. For the Rational Expectations Hypothesis to provide a means of avoiding the difficult microeconomics questions about learning or expectations formation, facts must not only speak for themselves but they must say the same thing to every individual. But without a perfectly reliable learning method, we usually find that the method with which one interprets the facts is heavily influenced by one’s a priori theories [Boland, 1977a, 1980]. In other words, expectation formation depends on theories. Facts, if they speak at all, speak only with the help of one’s theories – all facts are ‘theory laden’ [Hanson, 1958/65, p. 19]. This raises many problems unless there is some reason given for why all individuals believe in the same a priori theories [see also Friedmann and Phelps, 1983]. Without a reliable inductive logic there is no reason to suspect that any two individuals would believe the same theory nor any reason for why they would react to the same information set in exactly the same way. We see now why some disequilibrium theorists see that this implies random behavior, and thus why they see a necessity of basing macroeconomics or general equilibrium theory on an understanding of stochastic processes [e.g. Hey, 1981].

2. Stochasticism and Macroeconomics

If one thinks that the only possible theory of knowledge and learning is one that says people must form expectations inductively while one also admits, either that inductive learning is unreliable, or that reliable inductive learning will always require more information than is possible in logical or practical terms, then it seems that one would have to conclude that a complete theory of microeconomics is impossible. Although some economic theorists recognize that there are other theories of learning, most economics students are taught to focus their attention on the problem of forming expectations with inadequate information. If one thinks information is necessarily inadequate, one can never be sure what expectations each individual will form. Thus, any macroeconomic theory will only be concerned with the behavior of the average individual on the hope that any uncertainty concerning one individual will be cancelled out by the simultaneous consideration of all other individuals. Furthermore, given that no individual’s expectations can be predicted exactly, the choices made by the average individual may be considered random variables much like those discussed in the typical elementary statistics textbook.

In effect, by diverting attention to the average individual the role of each individual is minimized. The only way to explain the behavior of the average is to explain the behavior of the whole economy – that is, to provide a macroeconomic theory based on the exogenous variables and information set available to the whole economy.

Stochastic macroeconomics has been very popular over the last fifteen
years. Particularly so since most graduate students find building stochastic macroeconomic models to be a much more convenient activity than trying to speculate about theories of how individuals make decisions based on supposedly inadequate information. The popularity is easy to explain. The students make a rational choice to spend their time collecting mountains of data, which is fed into computers to reduce the data to commonly understood parametric statistics. The explanation is that the students form expectations about benefits and the probability of success of such model building and compare them to the benefits and probabilities that are expected of theoretical speculations. Even if the model itself is not a major contribution, at least the process creates new data (presumably for a future inductive learner). Obviously, the retreat to stochastic macroeconomic model building is a defeatist position with respect to the many major questions posed by the microeconomic theorists concerned with how we are to explain the process by which individuals make decisions in a disequilibrium setting.

There is one group of economic theorists who think they have a way to avoid such defeatism. They would say that the individual learns by forming opinions about the likelihood of certain future states of the world and then the individual sets about updating those opinions in the light of new evidence. They call this the Bayesian learning theory [e.g. Hey, 1981, Ch. 6]. This is just a sophisticated version of the old inductive learning theory that was causing the problem in the first place. However, this version is thought to be an improvement because it relaxes the view that ‘facts speak for themselves’ by admitting that the learning process begins with something more than just facts. This modified inductive learning process begins with the individual’s opinion, and then the individual is supposed to learn from newly collected facts by systematically revising the original opinion. The source of the original opinion does not matter – it may even be a priori – but it is a necessary starting point.

The key element of the Bayesian learning process is the nature of the original opinion. In the simple form of Bayesian learning, an opinion is an estimate of the probability of occurrence of a future event or of a future value of a specific variable. Since the initial opinion does not have to be based on facts, the opinion is said to be a ‘subjective probability’. Since the opinions are represented as probability estimates and learning is defined as the process of updating one’s estimates, the analysis of learning is usually performed using an appropriate mathematical tool called Bayes’ theorem. The detailed nature of Bayes’ theorem will be of no interest here since the theorem is only invoked to overcome the inadequacies of the strict inductive learning process – to overcome the view that only facts matter.

The problem with strict inductive learning is that unless one has inductively proven that one’s knowledge or expectations are true, one has not learned anything. One only has an incomplete proof, a short-run collection of observed facts. It would take a very long run to be able to claim to have learned anything. Practical decision-making cannot wait – expectations must be formed in order to make one’s plans. If knowledge is thought to be based on more than just the facts, then perhaps one has learned something even though the knowledge has still not been inductively proven true. In effect, the idea of a Bayesian learning process provides a short-run barometer of the progress being made toward an eventual inductive proof. In the simple form, the short-run barometer is represented by the probability estimate itself and the closer it gets to unity the closer one is to a proof that one’s estimate is true.

While the probability of a single event really does not usually make sense, economic theorists find the idea of a probability of a random variable more compatible with their training in calculus techniques. Random events either occur or they do not. When they do, the probability of occurrence is one, and it is zero when they do not. Random variables are thought to have a probability distribution which means that the probability of one (i.e. 100 percent) is considered to be divisible into quantities that can be distributed over a range of possible values of the variable such that any particular value of the variable will usually have a probability of occurrence that is between zero and one. Of course, this makes no more sense than the probability of a single event being between zero and one. The variable in question can only have one value at a time, so the probability of any specific value at any specific time is still either zero or one. Nevertheless, it is claimed that a very useful method of model building can be developed if we accept the fictitious idea of a subjective probability.

A more complex view of Bayesian learning has the individual form a subjective estimate of the true objective probability distribution for any variable in question. Learning, in this complex view, occurs as the subjective distribution converges to the objective distribution. This view, unfortunately, simply accepts an incomplete explanation of any variable. It also opens the concept of Bayesian learning to an infinite regress since the individual can have an opinion of the probability distribution of the probability distribution of the probability distribution ... ad infinitum.

The basic idea of Bayesian learning is that almost any new information will affect the opinion of the decision-maker [Chetty, 1968, Leamer, 1983]. In the simple form, Bayesian learners are only concerned with forming an opinion with the highest subjective probability after sufficient information has been processed. In the
complex form, Bayesian learners are concerned about the variance of their individual opinions as new information is continually collected. If new information causes a wider variance in the estimates, the individuals may reject the possibility of a particular value of a variable simply because their opinions are not reliable. One might question what has been learned with either form of Bayesian learning. In both cases learning is really only a reflection of *a priori* methodological opinions about what the *form* of the true opinion must be. Those that think the true opinion is a probability distribution with little variance will think they are learning in the short run whenever the variance is diminished with each new fact. Similarly, those that think the true value will always have the highest probability estimate, even for the short-run collection of information, may be missing the point. As is often pointed out, the boldest conjectures may be true but their boldness is usually against the overwhelming evidence that is pointing in some other direction.

The idea of Bayesian learning is easily accommodated in equilibrium models by claiming that learning is just a weak form of inductive learning based on the economics of learning. The basic idea in the economics of learning is that more information yields a higher subjective probability but at a diminishing rate – we call this the ‘inductive learning possibilities function’. If there is a given cost of each unit of information, there will be a rising straight-line cost curve that can be compared with the benefits curve represented by the inductive learning curve – see Figure 8.1. When viewed this way, there is an optimal amount of information at the point where the slope of the cost curve equals the slope of the learning curve – so long as the slope of the learning curve diminishes as information is collected. Clearly, this view of the economics of learning is consistent with the Rational Expectations Hypothesis in the sense that perfect knowledge (probability 1.00) is not rational whenever one has to pay for the information to achieve such knowledge. The optimally imperfect knowledge will thus necessarily have a subjective probability less than 1.00. As accommodating as this may seem for someone interested in building models which allow for a choice-theoretic view of knowledge, information or expectations, it depends too much on our familiar, questionable theory of knowledge and learning – namely, that all knowledge is acquired inductively – even though there is no claim that for knowledge to exist, it must be inductively proven to be perfect. Whenever the model-builder is willing to overlook this questionable dependence, there is no reason to reject the idea of subjective probability on the grounds of subjectivity alone, since subjective probability is no more subjective than utility.

In many ways, the assumption of Bayesian learning begs more questions than it answers. And worse, it is intellectually no more satisfying than the simple minded theory that one’s knowledge must be based on inductive learning such that new facts alone always constitute learning even though there is no guarantee that one has ‘learned’ the true expectations or true knowledge.

### 3. Stochasticism as Instrumentalism

Some economists will not like our use of the idea of *true* expectations or *true* knowledge as a basis for rejecting techniques of modelling learning such as the Bayesian approach. They may say that such a basis for criticism is misleading since nobody could ever have true expectations or true knowledge if they are learning inductively or in a Bayesian manner. They may say, in effect, that true knowledge or the formation of true expectations would require a virtual infinity of information which would at best cost far too much [e.g. Stigler, 1961]. They may say that what economic theorists must explain is why an individual chooses to have the idea of Bayesian learning is easily accommodated in equilibrium models by claiming that learning is just a weak form of inductive learning based on the economics of learning. The basic idea in the economics of learning is that more information yields a higher subjective probability but at a diminishing rate – we call this the ‘inductive learning possibilities function’. If there is a given cost of each unit of information, there will be a rising straight-line cost curve that can be compared with the benefits curve represented by the inductive learning curve – see Figure 8.1. When viewed this way, there is an optimal amount of information at the point where the slope of the cost curve equals the slope of the learning curve – so long as the slope of the learning curve diminishes as information is collected. Clearly, this view of the economics of learning is consistent with the Rational Expectations Hypothesis in the sense that perfect knowledge (probability 1.00) is not rational whenever one has to pay for the information to achieve such knowledge. The optimally imperfect knowledge will thus necessarily have a subjective probability less than 1.00. As accommodating as this may seem for someone interested in building models which allow for a choice-theoretic view of knowledge, information or expectations, it depends too much on our familiar, questionable theory of knowledge and learning – namely, that all knowledge is acquired inductively – even though there is no claim that for knowledge to exist, it must be inductively proven to be perfect. Whenever the model-builder is willing to overlook this questionable dependence, there is no reason to reject the idea of subjective probability on the grounds of subjectivity alone, since subjective probability is no more subjective than utility.

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For the last group of economists [e.g. Friedman, 1953] our theory has no other purpose than to serve as a instrument for forming economic policy or for forming predictions of the consequence of policies. Practical success is all that matters [cf. Boland, 1979a, 1980, 1981a]. Avoiding complex theoretical problems, such as those posed by all the considerations of disequilibrium economics or of stable equilibrium processes, is all too easy. Obviously, the time required to form perfect expectations is impossibly long, but the time required to benefit from a
Bayesian learning process may also exceed that available to make day-to-day practical decisions. It might even be argued that the benefits of incorporating all the sophisticated disequilibrium concepts (such as the rational expectations hypothesis) into the ordinary neoclassical equilibrium theory may be small when it comes to questions of improving the policy-maker’s estimates and recommendations.

If one thinks that economic theory is only an instrument for forming policies or making predictions, then obviously it is just as easy to say that expectations and knowledge do not have to be true for the individual decision-maker. Followers of instrumentalism reject the complex theoretical questions that are posed by the need for the disequilibrium foundations of any equilibrium model used in policy economics. For many theorists today such a bold rejection is considered a matter of bad taste. In this light most economic theorists claim they do not believe in instrumentalism – but somehow actions speak louder than words. There have been numerous articles published recently claiming that instrumentalism is not the methodological view that economists advocate [e.g. Caldwell, 1980; Fels, 1981; Wible, 1982; Hirsch and De Marchi, 1984; Hoover, 1984, as well as those critics listed in Boland, 1979a]. Nevertheless, it is difficult to distinguish instrumentalism from the defeatism implied by stochastic macroeconomic model-building.

It makes no difference whether the stochasticism advocated is in the form of elaborate econometric models of simultaneous equations where each equation includes an error term which admits that the equation does not have to be exactly true, or it is in the form of the stochastic decision processes where learning is always thought to be imperfect. The justification for stochasticism is ultimately the same as the argument given for instrumentalism. The usual reason given for advocating the development of stochastic macroeconomic models is that an accurate theory of the individual would be computationally too complex. The usual reason for opting for instrumentalism is that a true short-run theory of individual behavior (or of macroeconomic behavior) would be too complex for practical purposes. What is suppressed, both in stochastic macroeconomic models and in instrumentalist microeconomic models, is just the very methodological individualism that motivates almost all economic theories today. Stochasticism and instrumentalism, as well as macroeconomics in general, are all ways to avoid the difficult questions that have been raised by those economists interested in understanding the disequilibrium foundations of equilibrium economics or those interested in building a methodological-individualist view of the economy that does not depend on the narrow confines of long-run neoclassical equilibrium theory.

We now turn to a consideration of the three primary avenues for building disequilibrium foundations to suit equilibrium theorists and for generalizing methodological individualism to the satisfaction of non-equilibrium theorists. One avenue builds on the work of Samuelson and Arrow by pursuing the question of how prices adjust when our theory presumes that everyone is a price-taker. A second avenue tries to reconstruct the disequilibrium basis of the economics of Keynes. A third avenue attempts to go beyond the work of Hayek and Richardson by considering alternative theories of knowledge and learning, thereby avoiding the problems resulting from any dependence on the inductive theory of learning.
Part IV

Avenues for a New Microeconomics of Non-equilibria
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 presupposing the individual is a price taker while at the same time presupposing 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:

\[ D = f(P, R), \quad [9.1] \]
\[ S = g(P, K), \quad [9.2] \]

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:

\[ D = S. \quad [9.3] \]

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:

\[ \frac{dP}{dt} = h(D - S) \quad [9.4] \]

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

\[ h(0) = 0 \quad \text{and} \quad [9.5] \]
\[ d(h(D - S))/dt(D - S) > 0. \quad [9.6] \]

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 that 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 Shackele, 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 \( Q^*_f \); the firm will, in this case, set the price at \( P_f \). 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:

\[
MR = AR[1 + (1/e)]. \tag{9.7}
\]

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:

\[
P = MC[el/(1 + e)]. \tag{9.8}
\]

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

In 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 \( \frac{dP}{dt} \) 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.
There is an extensive literature about models that explain 'persistent unemployment' in the sense common to Keynesian macroeconomic models. The object of most of these disequilibrium models is to explain how persistent unemployment is possible whenever everyone is assumed to be an optimizer. Persistent unemployment is, of course, just one example of a non-clearing market. Traditionally, the persistence of the unemployment is explained as being the result of 'wage rigidities' but there is seldom any reason given for why the price of labor is not flexible [see Drazen, 1980].

Neoclassical macrotheorists cannot accept explanations of unemployment involving exogenously fixed prices since a fixed price violate, methodological individualism. Furthermore, even some Keynesians do not accept such a definition of Keynesian economics. There is no necessary reason to think that Keynes was arguing in favor of a fixed-price explanation of unemployment – all that might be required is that the wage-rate’s speed of adjustment cannot be as fast as that of the prices of final goods. Nevertheless, one can readily understand the neoclassical rejection of Keynesian macroeconomic models whenever the existence of a fixed price is used to distinguish Keynesian from neoclassical models.

Our concern in this chapter will not be limited to the question of persistent unemployment. We wish to consider the explanation of a disequilibrium in which the usual calculus properties of an equilibrium (which we discussed in Ch. 3) are not appropriate. We will also look at an alternative view of Keynes’ so-called macroeconomics to see whether he may have already introduced the means by which the methodological limitations of neoclassical economics can be avoided.

1. Exogenously Unintentional Disequilibria

The first question that must be addressed is whether any acceptable neoclassical model could ever explain the persistence of a disequilibrium. Of course, it is easy enough to explain away the appearance of disequilibrium. We could just say that it is only a temporary phenomenon which disappears once we broaden our perspective by asking whether the disequilibrium would persist in any long-run situation. This merely avoids the challenge and so we will ignore such a tactic. For the same reason, we want also to avoid the tactic of claiming that any observed unemployment is really voluntary. The task at hand is to consider how a state of disequilibrium such as ‘involuntary unemployment’ could persist for a significant amount of time and could still be explainable in terms consistent with methodological individualism.

The usual reason given for any market’s failure to clear is that the
price is being held rigid or that it does not change fast enough. Such an explanation will only beg the question of why the price is rigid or inflexible. So, when the disequilibrium theorist turns to explain why prices are rigid, what are the usual exogenous variables? Will they violate methodological individualism? When it is thought that we must explain the adjustment of prices by introducing the appropriate implications of imperfect competition models, we beg the question about why there is a barrier to entry into the industry. One might wish to explain the choice of market structure so as to render it endogenous [e.g. Coase, 1937; Williamson, 1967; see Loasby, 1976]. But, what new exogenous variables are introduced in this step? Usually, it is some sort of exogenous transactions cost schedule. This begs the question of what exogenous variables determine the transactions cost. If the transactions cost is in any way influenced by prices, the explanation becomes circular or at best incomplete.

No matter which variable is declared to be exogenous to explain why the prices fail to adjust fast enough, all that is usually created is a model with a so-called ‘temporary equilibrium’ which merely plays the same role as Marshall’s short-run equilibrium. In a temporary equilibrium either the price or the quantity is held fixed while the other variable is allowed to be the only means of adjustment. The question for models of this type is whether it makes sense at all to discuss equilibria when one is trying to explain disequilibria. This question arises for those models which try to base the rigidity of the price on an imperfectly competitive market structure. Presuming imperfect competition to explain the existence of a non-cleared market is a mixed blessing. Under certain interpretations (see Ch. 2), the explanation merely presumes another type of equilibrium, and thereby precludes the possibility of disequilibrium. Under other interpretations, such as comparisons with ideal states of perfect competition, the explanation of rigidity implies some sort of sub-optimality and hence that at least one market is not in equilibrium. While imperfectly competitive equilibrium models may imply a certain kind of disequilibrium, in the sense that there is an equilibrium amount of excess capacity, they are employing a static equilibrium to explain a dynamic disequilibrium. And, as already mentioned, there is still a question of why there should be such a market structure.

The primary reason why many theorists turn to imperfectly competitive situations to explain either price dynamics or a non-clearing market is that, as Arrow recognized [1959, p. 44] and we explained in Chapter 9, the knowledge requirements for an imperfectly competitive equilibrium are always much more demanding than those of a perfectly competitive equilibrium with equilibrium-price takers. The firm which is not a price-taker must also know the whole demand curve it faces.

Knowing the whole demand curve before putting one’s product on the market necessitates knowledge of what every consumer is going to demand at every conceivable price. Is this knowledge acquired inductively? Obviously, knowledge of the whole demand curve requires too much for any realistic imperfectly competitive equilibrium, but that is all right since, for many theorists, it seems to provide an essential reason for why, at any one point in time, there might be a disequilibrium [e.g. Fisher, 1983, p. 190]. Any disequilibrium is easily explainable as the failures of demanders or suppliers to optimize due to misperceptions of the relevant constraints.

2. Deliberate Disequilibria: Keynes-Hicks Generalized Liquidity

In neoclassical theory any disequilibrium always implies that someone is failing to maximize short-run utility or profit. For the labor market, an unemployment equilibrium means that some workers are capable of providing more labor than is demanded. Excess demand for labor would mean that some firms are using less labor than they desire and thereby are producing less than their capabilities. In a market for a good, a disequilibrium means either some consumers are being forced (because of excess demand) to purchase inside their budget-defined affordable set or that some suppliers are producing at a level that represents an excess of productive capacity. In other words, a disequilibrium failure to meet one’s objective in the market is always seen as one of being somehow forced to choose a point that is not optimum because it is not on the boundary of one’s capabilities. Is the reverse true? That is, whenever we see people operating inside their capabilities, must this be evidence of a disequilibrium?

Why should we think that the individuals who are not operating on the boundaries of their capabilities are actually failing? This is a question which is inherent in Keynes’ assault on what we now call neoclassical economics. It is a question which puts all the concern over disequilibrium model-building into an entirely different light. According to Keynes:

I doubt if many modern economists really accept Say’s Law that supply creates its own demand. But they have not been aware that they were tacitly assuming it. Thus the psychological law underlying the Multiplier has escaped notice. It has not been observed that the amount of consumption-goods which it pays entrepreneurs to produce is a function of the amount of investment-goods which it pays them to produce. The explanation is to be found, I suppose, in the tacit assumption that
every individual spends the whole of his income either on consumption or on buying, directly or indirectly, newly produced capital goods. But, here again, whilst the older economists expressly believed this, I doubt if many contemporary economists really do believe it. They have discarded these older ideas without becoming aware of the consequences.

[Keynes, 1937, p. 223]

Let us now examine the consequences that Keynes had in mind. What is still not appreciated is the contradiction between what Keynes called the ‘psychological law underlying the Multiplier’ and the neoclassical method of explaining the consumer. The ‘psychological law’ he is referring to here is simply the idea of an exogenously given marginal propensity to consume. As we learn in any elementary macroeconomics course, we are to assume that an individual never spends all of an extra dollar of income earned but just some fraction of it. That Keynes would take this ‘law’ as a psychological given might cause some concern, as it is not directly related to the microeconomics textbook idea of a utility maximizing consumer facing a given income or budget. The microeconomics textbook consumer is thought to spend all of his or her budget. If the consumer’s income increases, planned purchases will be expanded to fully spend the extra income so as to be on the boundary of the consumer’s capabilities, that is, to be operating on the boundary of his or her income constraint. This does not seem to be the case for Keynes’ psychological law as expressed in even a simple Keynesian macroeconomic model such as the following:

\[ Y_d = C + I \]  \hspace{1cm} \text{[10.1]}  
\[ C = a + bY_s \]  \hspace{1cm} \text{[10.2]}  
\[ Y_d = Y_s \]  \hspace{1cm} \text{[10.3]}  

where \( Y_d \) is the demand for aggregate output, \( Y_s \) is the income paid out to those who produced it, \( C \) is the demand for consumption goods and \( I \) is the exogenous demand for investment goods. Equation [10.2] is Keynes’ psychological law, where it is assumed that \( b \) is a positive fraction less than one. While this assumption is required for stability (as is the requirement that \( a \) be positive), for Keynes it is a psychological given. If we want to know the effect a marginal change in the one exogenous variable, \( I \), would have on the equilibrium solution, we would calculate the equilibrium aggregate output \( (Y) \) and then calculate \( \frac{dY}{dI} \). This derivative is the investment multiplier and is determined as follows:

\[ \frac{dY}{dI} = 1/(1 - b). \]  \hspace{1cm} \text{[10.4]}

We see immediately that his psychological law \((0 < b < 1)\) is essential if we are to have an investment multiplier greater than one, as well as ensure that an equilibrium \( Y \) exists. What is important for us to recognize here is that his ‘law’ requires all individuals to be operating inside their income constraints.

We have carefully glossed over any distinction here between micro- and macroeconomic definitions of the variables in this simple macroeconomic model. Of course, the variables are all aggregates, except for the psychologically given one, namely, the marginal propensity to consume, \( b \). It does not matter whether all individuals have the same \( b \) so long as Keynes’ psychological law is true. Whenever individuals differ regarding their personal marginal propensities to consume, the \( b \) in equations [10.2] and [10.4] is merely the average for all consumers.

What is important to remember here is that neoclassical equilibrium methods of explanation always see all individuals operating on the boundaries of their capabilities which implies \( a = 0 \) and \( b = 1 \). But, according to Keynes, it is important to recognize that individuals do not operate on the boundary of their individual capabilities. One could successfully operate on one’s boundary only if one was absolutely certain about the future. Given any uncertainty, it might be wise to leave a little room for error or for the unexpected. Many people save for this very reason and not just to earn interest on their savings since this reason is another form of optimization. Of course, saving is ‘not-consuming’ hence, Keynes claims, any psychological need to save yields a \( b \) less than one.

For the most part, Keynes’ famous book [1936] is about this contradiction’s consequences for those economists who wish to continue using the Marshallian-type neoclassical methods of explanation. Despite what he said in his 1937 article, most students are taught that the significant aspect of his book is his emphasis on ‘expectations’ or on ‘liquidity’. Unfortunately, most students are taught that Keynes’ ‘liquidity’ was only important for his considerations of monetary policy effectiveness. This misses the major point of his criticism of neoclassical economics. The essential importance of ‘liquidity’ is that it represents a deliberate choice to be inside the boundary of one’s capabilities and thus represents a direct conflict with neoclassical methodology at a fundamental level.

This aspect of the idea of liquidity is not easy to see in Keynes’ book because he presents it primarily in terms of financial liquidity. Of course, financial liquidity is closely related to the question of investment
that concerned Keynes. What we need is to see how important the concept of liquidity is for understanding what Keynes meant by 'the consequences'. But to do this we need a more general concept. John Hicks [1979] provides such a general view:

Liquidity is freedom. When a firm takes action that diminishes its liquidity, it diminishes its freedom; for it exposes itself to the risk that it will have diminished, or retarded, its ability to respond to future opportunities. This applies both within the financial sphere and outside. I have myself become convinced that it is outside the financial sphere (very inadequately considered, in relation to liquidity, by Keynes) that liquidity is potentially of the greater importance. ... Liquidity preference, for the financial firm, is a matter of marginal adjustments, as Keynes very rightly saw. But the liquidity problem of the non-financial firm is not, as a rule, a matter of marginal adjustments.

[Hicks, 1979, pp. 94–5]

Hicks is arguing that in a Marshallian world of comparative statics where there is always enough time to make marginal adjustments, there is no need for liquidity. In the real world where many things are happening simultaneously, the Marshallian method of explanation is usually misleading. The keystone of Hicks' argument is the idea that every decision maker forms a 'plan' based on the perceived givens, constraints and prices. If every decision takes time to execute, the passage of time means that the original givens might have changed, or may even have been wrongly perceived. This is the same idea we discussed concerning what we called Hayek's contingent equilibria (Ch. 6). By the time the decision plan is executed the resulting decision may not be optimal.

For example, car manufacturers might think that the future will always favor large fuel-inefficient personal automobiles. If they also think there is an unlimited amount of fuel, their optimal plan might be to specialize in the production and marketing of such autos. If, for any reason, the market should abruptly shift in favor of small fuel-efficient autos, or if the supply of inexpensive fuel disappears, the manufacturers' profit potential will be drastically altered. This example might be too dramatic for ordinary decision-making, but the same possibility would exist where a specific size of a market is anticipated by one firm, but where subsequently there is a sudden increase in its demand due to a strike or fire at a competing firm. In either case, if the previous level of planned output was the one corresponding to the usual neoclassical or Marshallian long-run equilibrium (i.e. the output was set to where price equals average costs), there is no extra capacity since it is not needed. Here, the firm would not be able to respond competitively to the new market potential by increasing output (even though the price may have risen above average cost). It could respond only if the firm were not actually producing on the boundary of its production capabilities, but this is contrary to the requirements of a long-run equilibrium. An increase in capacity would take time but, as always, even if the firm immediately invests to increase capacity, by the time the higher capacity is realized it might not be the optimum. The conditions that prompted the capacity increase, such as the strike or the fuel shortage, may be over. It would seem that zero excess capacity – that is, the absence of any liquidity in the non-financial sense – would be sub-optimal. However, in a changing world, a true optimum with respect to excess capacity or liquidity may not be knowable by the firm because its calculation depends on the unknown contemporaneous happenings and decisions of other people. Calculations are made even more difficult whenever their optimality depends on the unknowable future.

What is being argued here is that liquidity is a deliberate choice variable and that, from Keynes' viewpoint [1937], such liquidity is simply good business practice (as illustrated in our examples). It is not, however, just a matter of investment. Whenever the labor market is not clearing because the current real wage is above the one which would clear the market, there is excess supply and thus by neoclassical standards, we would have a sub-optimal disequilibrium. But, from this Keynes-Hicks viewpoint, such excess supply may very well represent a desirable state for the employer. For some firms the ability to expand production immediately whenever necessary is a desirable position. This may also be true for the employee. A thirty-five hour work week can be an optimum for an individual, even though he or she is capable of being satisfied working a fifty hour week at the going wage-rate. Leaving a little free time for picking up emergency money when it is needed may be more desirable than signing a contract to work to one's limits.

We do not want to restrict these considerations to just the questions of static capabilities. It may be desirable to have the ability to choose one's speed of adjustment to changing conditions. Sometimes, a fast response is more appropriate than a slow response and at other times it is the reverse. Flexibility is the key idea here. But is flexibility a variable that can be chosen in the same way one would choose a quantity of food or a quantity of capital required to achieve the current objective? Both Keynes and Hicks seem to be arguing that one's choice of liquidity, be it financial as Keynes discussed or non-financial as Hicks noted, is not a variable that is amenable to Marshallian optimization analysis. The type of flexibility or liquidity that is appropriate for any conceivable situation
always depends on the value of variables that cannot easily be determined. However, knowledge of the variables affecting the choice of an optimum plan would be essential for the usual neoclassical explanation even when those variables are thought to be merely stochastic distributions.

The point to stress here is that a consideration of a choice variable like the Keynes-Hicks concept of general liquidity may immediately explain the existence of a persistent excess-supply disequilibrium. For such an explanation we must continue to define the supply curve as that indicating the supply that would be chosen according to a neoclassical optimization explanation. If the firm were producing to its full capacity as might be required by a maximization process, the supply would be greater than what is supplied when a provision is made for a certain margin of liquidity. This viewpoint, of course, merely raises the question of whether there is an optimum amount of liquidity. If such an amount of liquidity could be defined, liquidity would be just another choice variable like capital itself; and so there would be no persistent excess supply since the amount supplied was the optimum output.

Liquidity is not usually considered in a typical neoclassical theory of the firm or individual. To appreciate the significance of stressing the desirability of liquidity we need to see why it is not part of the usual neoclassical model. Consider Figure 10.1 which merely represents the production function for good \( Y \) using the available input \( X \). What the production function really shows is the physical maximum amount of \( Y \) that can be produced, that is, it shows the productive capabilities [see Samuelson, 1947/65, p. 57]. The production function is the boundary of productive capabilities. But, it is the shape of this boundary (i.e. its slope) that is used to determine the optimum combination of input and output levels. The usual textbook assumes that the firm chooses the combination which maximizes the net difference between revenue and cost for the given prices. The cost here is the sum of the fixed cost, \( A \), and the quantity of input measured in terms of the output (i.e. multiplying the input by its price and dividing by the price of the produced good). That is, the firm facing an output price \( P \) and input price \( W \) chooses the input-output combination where

\[
\frac{dY}{dX} = \frac{W}{P}. \tag{10.5}
\]

In Figure 10.1 the optimum point will thus occur in the usual way where the slope of the production function and the slope of the real-cost curve are equal. And this is the essential point of this elementary discussion. When the firm chooses to allow for some liquidity, it in effect chooses to be below the boundary formed by its production function (such as output level \( Y_0 \) for input level \( X_0 \)). In doing so, we cannot use the slope of the production function to explain the firm’s choice of an input-output combination since we cannot be sure whether this is a decision to waste input \((X_0 - X_1)\) or to stay below the maximum output level, \( Y_{max} \).

If prices and price changes are to matter, as the price system requires, it is essential for the neoclassical firm to be operating on the boundary of its capabilities such as \( Y_{max} \). If either \( W \) or \( P \) change in our illustration there will be a predictable reaction along the boundary. While it is not shown in our illustration, being on the boundary is essential for all the arguments in favor of the ability of a competitive price system to produce a socially optimal allocation of resources in the long run. We can see that such optimality does require that inputs are not being wasted. Some might see that being on the boundary is a minimum requirement for efficient production.

The essential idea of a competitive market system is that everyone should use prices as appropriate information in making decisions about what to produce or buy. When the price of fuel-inefficient autos is falling relative to efficient autos, such a price reduction is important social information. If the firm responds to such a price reduction by reducing the output of inefficient autos, the firm is doing just what society wants. But what happens to the competitive market system when the firm is not operating on its capabilities boundary – that is, for example, when it is deliberately providing liquidity in the form of excess capacity? For one thing, equation [10.5] will not be satisfied and thus net revenue is not being maximized with respect to the available level of the input. Worse than this, the prices no longer act as appropriate information for other decision-makers. The competitive market system will not necessarily lead to the ‘best of all possible worlds’.
Despite what some critics of neoclassical economics might believe, the introduction of a variable representing liquidity or flexibility into an otherwise neoclassical model of the firm or household does not necessarily conflict with the assumption of optimization. When we say that the firm lacks sufficient information to calculate the optimum, we do not preclude the firm from inadvertently choosing the optimum amount and thereby inadvertently providing the equality of the marginal productivity of an input and its real price (i.e. equation [10.5]). Specifically, whenever the firm is allowing for liquidity, maximization cannot be logically precluded. Nevertheless, Keynes stressed the recognition of liquidity in decision plans which take time to be executed. There is no good reason for us to think that firms have consciously chosen the optimum amount of liquidity. Moreover, it is important to recognize that any claim that a firm is not optimizing does not deny a conscious attempt on the firm’s part to choose an optimum amount of liquidity. But, of course, given any ignorance about the future it would be unlikely for the firm to be successful in such a choice.

Recognizing that ignorance of the future is likely, liquidity or flexibility is one means the firm can use to avoid the difficult task of calculating the optimum decision plan. Nevertheless, there still is the logical possibility that liquidity has been chosen optimally. However, there is one overwhelming exception – the idea of an optimal amount of liquidity is self-contradictory. If liquidity or flexibility could be chosen just as any other productive input, there would be no need for liquidity or flexibility [see further, Boland, 1983b]. So, it is quite possible that whenever we recognize a necessary role for liquidity, we thereby also recognize what amounts to a deliberately chosen disequilibrium relative to the equilibrium defined in the ordinary neoclassical explanation of demand or supply.

3. Methodological Individualism vs. Deliberate Disequilibria

An interesting dilemma faces anyone attempting to provide a methodological-individualist explanation of the persistence of a disequilibrium. Obviously, a disequilibrium can be considered either unintentional or intentional. The choice, however, is not arbitrary. When the disequilibrium is explained as an unintentional consequence of intervening exogenous variables, we have to explain them, if they are neither individualist nor natural givens. But, once we explain the exogenous variables, we have in effect explained the disequilibrium away. This, of course, is a violation of the original task which was to explain the persistence of the state of disequilibrium rather than explain why it does not exist.

All things considered, it is doubtful whether there could ever be an acceptable neoclassical explanation of a persistent disequilibrium. Every neoclassical explanation must view the disequilibrium as being the consequence of the intentional acts of autonomous individuals. In this regard, the Keynes-Hicks concept of deliberate liquidity is a denial of deliberate short-run optimization but it would seem to hold more promise of an internally consistent explanation of disequilibria than the neoclassical concept of deliberate maximization. And more important, the choice of liquidity instead of optimization is clearly an act of autonomous choice. By being inside one’s limits, one is not forced to make choices that are uniquely defined by circumstances, as would seem to be the case in so many neoclassical models [see Latsis, 1972].

We are using the term ‘autonomous’ here because we wish to stress that the individual does not have to be identified with his or her psychological state, as is commonly done in neoclassical economics. But we also stress this because distinguishing between ‘autonomous’ choices and psychologically determined choices (e.g. $0 < b < 1$) highlights an important aspect of Keynes’ criticism of neoclassical equilibrium models. Like most neoclassical economists, Keynes obviously accepts psychologism – the identification of individuals with their psychological states. Nevertheless, the deliberate use of liquidity, whether it be in the form of excess capacity or the marginal propensity to consume a fraction of any extra dollar of income, still directly confronts the neoclassical presumption that individuals are optimizing and thus operating on the boundaries of their capabilities (i.e. $b = 1$).

While any neoclassical explanation of disequilibria as intentional states of affairs is necessarily self-contradictory, such is not the case for the Keynes-Hicks explanation based on deliberate liquidity. But the question remains whether a Keynes-Hicks explanation can ever be both complete and consistent with the requirements of methodological individualism.
Learning and the Equilibrium Process: The Murky Mews

The fact that any satisfactory theory must be grounded in the theory of individual behavior has further consequences for some current work and for the way in which we view certain forms of analysis. To begin with, the stability problem is not satisfactorily solved by showing that there exists some adjustment processes which converge. However interesting certain adjustment processes may be, unless there is a reason to believe that they arise from the optimizing behavior of agents, they cannot be regarded as providing more than a computational algorithm for finding equilibria. Indeed, the situation here is worse than that involved in the ad hoc specialization of excess demand functions to achieve a stability proof. We know that such specialization can obtain under special circumstances. We often do not know that particular convergent processes are ever consistent with a sensible story about the behavior of individual agents.


What we clearly need is some higher-level theory, which shows how rules ['of thumb'] are modified in the light of experience. Of necessity, this learning process would have to be non-Bayesian; but equally it could not be one of those rather depressing psychological theories of learning which imply that people never behave optimally however much experience they have. What this new learning theory will look like, I do not know; but there are rich rewards to be gained from it.

John D. Hey [1983, p. 175]

Throughout our tour of questions about stability or disequilibria in this book we have repeatedly encountered questions concerning information and learning. We find disequilibrium theorists appreciating that a price-adjustment mechanism must include a role for learning and information, but they all seem to presume that there is only one way to learn. There are two problems with this presumption. One concerns why there is only one learning method to consider, and the other concerns the nature of the presumed learning method. As we have often noted, there is insufficient reason to claim that there is only one method let alone presume that the only learning method is the inductive method. Nevertheless, we still can understand why theorists (e.g. advocates of the Rational Expectations Hypothesis) presume the inductive learning method. Such a method always provides a strong natural connection between learning and information collection. The strong connection can be used to explain not only learning successes but also learning failures. Any failure to reach an equilibrium can be explained as the result of an insufficiency in the quantity or quality of available information.

The presumption that everyone learns inductively is difficult to justify even on its own terms. How does one learn to learn inductively? If we answer 'inductively', we have an infinite regress; and any other answer admits that learning involves something more than induction. So, there is no inductive proof that there is a necessary connection between the learning process and the accumulation of information. Relying exclusively on an inductive learning theory is self-contradictory! This is of critical importance for the recognition of a role for learning in the process of reaching an equilibrium or in the explanation for the absence of an equilibrium. If learning is still considered to be inductive and thus mechanically connected to the information collected, it will be virtually impossible to build a theory of stability or disequilibrium which is consistent with the requirements of methodological individualism. This is simply because inductive learning is considered an objectively 'rational process' that is so reliable that any rational individuals who collect the same information will reach the same conclusions. Learning in the usual neoclassical analysis is a universal process that is exogenously given.

These observations lead to some interesting questions for all equilibrium model-builders who are interested in the problems of stability. First, if there is no singular inductive learning method, is there a non-inductive method? Second, if there is more than one possible learning method, does this raise a choice-theoretic problem of how the individual chooses his or her learning method? Third, if there are many methods of learning, does the individual's choice of method affect the price-adjustment mechanism? And fourth, if one can choose one's learning method, can one choose the mechanism with which he or she will adjust the price? In this last chapter we will argue that there are
many methods of learning and that this fact must be recognized in any
type of the economy based on the behavior of autonomous individuals
if individualism really matters.

1. Learning and Individualism

We wish to argue here that learning is a very individualistic activity and
thus any commitment to methodological individualism requires a more
fully developed theory of learning. Such a theory may require a
reconsideration of methodological individualism itself. There is no good
reason for why any two people facing exactly the same information will
reach exactly the same conclusion. That is, there is no reason for why
two individuals would learn the same thing from the same information
set.

Consider the case of two individual consumers—see Figure 11.1—
observing, until time $T_0$, a falling price. The question, at time $T_0$, is
whether to wait for the price to fall further or to buy now before it starts
rising. One consumer might have the a priori view that prices cannot
fall forever and must eventually rise, such that at time $T_1$ they will be
higher. The other might have the a priori view that the price will
continue to fall, such that it will be lower at time $T_1$. The former
consumer will buy at time $T_0$ while the latter consumer will want to wait.
Yet, at time $T_0$ the evidence of a falling price is the same for both
consumers. The evidence is the same but the conclusions are different
simply because the consumers have different a priori views of price
dynamics in general. Without a reliable inductive learning method that
would preclude the possibility of different a priori views, such a
situation is not unlikely.

Situations as simple as this lie at the heart of disequilibrium
macroeconomics. If everyone expects that all prices are going to fall
further, there will be a significant deficiency of demand which yields a
self-fulfilling expectation. Likewise, whenever one expects that prices
are going to stop falling and start rising, one will find it wise to buy now
rather than wait. If everyone expects prices to rise and all attempt to act
accordingly, prices will be caused to rise by the sudden shift in the
demand curve. The issue raised here is not just that expectations matter,
but that any widespread agreement about expectations can have
significant effects on price dynamics. If there really were only one
learning method and it was entirely dependent on the available evidence,
whenever everyone used the same evidence (such as in our simple
example of a falling price) the expectations would be in widespread
agreement.

If the stability of any neoclassical model depends on such widespread
agreement to ensure equilibrium prices (as with rational expectations)
recognizing that there is no single reliable learning process may mean
that stability cannot be guaranteed, even when the available information
is sufficient for inductive learning. Even worse, whenever the
Keynesian models of persistent disequilibrium are based on a deficient
demand caused by a widespread agreement concerning expectations, the
absence of a reliable inductive learning method means that there is no
sufficient reason for the persistence of the disequilibrium. The question
raised here is why in the absence of a reliable inductive learning process
would there ever be widespread agreement concerning expectations?
Keynes seems to answer this question by saying we have three ways of
forming our expectations.

1. We assume that the present is a much more serviceable
guide to the future than a candid examination of past experience
would show it to have been hitherto. In other words we largely
ignore the prospect of future changes about the actual character
of which we know nothing.

2. We assume that the existing state of opinion as expressed
in prices and the character of existing output is based on a correct
summing up of future prospects, so that we can accept it as such
unless and until something new and relevant comes into the
picture.

3. Knowing that our own individual judgment is worthless,
we endeavor to fall back on the judgment of the rest of the world
which is better informed. That is, we endeavor to conform with
the behavior of the majority or the average. The psychology of a
society of individuals each of whom is endeavoring to copy the
others leads to what we may strictly term a *conventional* judgment.

[Keynes, 1937, p. 214]

Now Keynes claims that everyone basing his or her technique of expectation formation on these three alternatives leads ‘to sudden and violent changes’. That may be true in the long run, but in the short run it may be just the opposite. Let us apply Keynes’ alternatives to our simple example. If prices have been falling, the first technique leads everyone to expect prices to continue to fall. Of course, this cannot go on forever, but how long does it take to get people to stop expecting prices to fall? The second technique does not make sense because falling (disequilibrium) prices may already imply an *incorrect* ‘summing up of future prospects’. While the third technique begs the important question about why one individual is less able to form a judgment than the average individual, the short-run outcome is a very stable pattern of behavior, since everyone is following the same conventions – that is, the same ‘rule of thumb’.

2. Learning without Psychologism or Inductivism

Let us return to the paradigm of choice theory, the utility maximizing individual as illustrated in Figure 11.2. Our task is to reconsider how we would explain why an observed individual has purchased the quantities, \( X \) and \( Y \), represented by point \( E \). We start from the usual explanation which says the individual *knows* his or her utility function or preference map and is given the income, \( I \), and appropriate prices, \( P_x \) and \( P_y \). The observed individual is claimed to have chosen the one point on the budget line where the slope of the budget line equals the slope of the indifference curve through the chosen point. Now, let us change our story. Let us say that while the prices are public knowledge, and the income is in the individual’s pocket, the individual *does not know* his or her utility function. Again, the essential question is, why did the individual buy point \( E \) rather than any other point, such as point \( A \)? We could answer by claiming that the individual knows that \( E \) is better than \( A \), but this begs the question of how the individual knows this. Did the individual learn this by trying all possible points? Unless all goods are restricted to discrete quantities (see Ch. 5), complete knowledge of the utility function is unlikely in a finite amount of time. There are just too many points to consider – even along the budget line. In the textbook versions which presume perfect divisibility, complete knowledge would be impossible because it would require an infinity of trials.

If the possibility of learning by exhaustive trial and error is effectively denied, what are our options? We could claim that the individual tried two points, \( A \) and \( B \), and knew that they were not the optimum because
in each case the slope of the indifference curve was not equal to the slope of the budget line. This claim, however, would only beg the question of how the individual knows the slope of the indifference curve. Asking this question does not deny the individual’s ability to compare points A, B and E once they have been purchased. Once purchased, any point will yield the utility indicated by the true, but incompletely known, utility function. Thus, point E is better than either A or B. But how does the individual know point E is the best of all the points between A and B? How does the individual know the best point is between A and B, even when he or she has learned that point E is better?

What is usually taken for granted is that the individual does not have to learn his or her utility function because it is a psychological given. This presupposition is much too convenient. We concede enough to psychology whenever we claim that the individual can compare two points a posteriori on the basis of the derived utilities. Claiming that the individual can compare points that have yet to be consumed goes too far. This is so even for the individual’s perception of the slope of an indifference curve at one point, since in practical terms the slope amounts to the comparison of two points. To say otherwise brings up some difficult questions concerning the realism of infinitesimals and similar problems about the realism of calculus (see Ch. 5). Unfortunately, most neoclassical economists believe that a denial of psychology would be a denial of individualism. This belief, which we have called ‘psychologism’ (see Introduction), actually blocks the way to the neoclassical understanding of individual decision-making. While it may be possible to require that any neoclassical model exclude exogenous variables which are non-individualist and non-natural, the identification of the individualism with psychological states (we called such identification ‘psychologistic individualism’) reduces the role of the thinking individual to that of a simple mechanical link between his or her psychological state (e.g. tastes) and the optimum choice. There is neither autonomous thinking nor free will in this conception of the individual. We argued in Chapter 1 that the primary reason for building equilibrium models is that the concept of equilibrium allows individuals to make decisions freely (i.e. autonomously) yet it still permits us to explain the state of an entire economy. If our argument is correct, we need to avoid psychologism in future neoclassical models of stability or disequilibrium analysis.

The individual either learns his or her indifference map from experience alone or forms a conjecture about the map. Inductive learning, without the help of some sort of conjectures (Bayesian or otherwise), faces insurmountable problems in real time. If we are going to build realistic models of stability or disequilibrium analysis we must drop the reliance on Inductivism in the explanation of all expectation errors. We need instead to consider some form of autonomous conjectural knowledge. Unlike inductively based knowledge, where any insufficiency is supposedly due to problems with quality or quantity of information, conjectural knowledge has the potential of being wrong in many more ways. To deal with learning and expectations formation using conjectural knowledge we must come to grips with the many difficult questions of methodology [see Boland, 1978, 1979a].

Let us return to the simple paradigm of utility maximization as illustrated in Figure 11.2 where we continue to take prices and income as known givens. We want to continue considering an individual decision-maker who does not know a priori his or her indifference map even though there is a true map to be learned. That is, if one could try every point on the map, one’s true map could be plotted (by connecting the points with the same level of utility). But since generally that is an impossible task in real time, one must form a conjecture about one’s map. Each trip to the market is, then, a test of the individual’s conjecture. This immediately raises a primary question of methodological importance. What will be the individual’s response to a test which refutes his or her conjectured map? It is most important to note that when individuals have to base their demand or supply decisions on conjectures, whatever would have been considered a market equilibrium or disequilibrium is put into a different light. Even if the market clears today, unless the individuals are satisfied that their respective maps have been correctly conjectured, market clearance does not imply a (stable) equilibrium. If any individuals think they made a mistake even though the market cleared, there is no guarantee that the market will clear the next day.

### 3. Active Learning and Equilibrium Stability

For the most part, the assumption that decision-makers form conjectures does not dramatically affect our concept of a market equilibrium. Consider further our individual who does not know his or her indifference map and thus has formed a conjecture about his or her indifference map, has made the trip to the market, and is successful in purchasing the quantities planned. If the individual only has a conjecture about his or her indifference map and there have been relatively few trips to the market, how does the individual know that the chosen point is the one which maximizes utility. In simple terms, all that the individual has learned is the level of utility achieved for the chosen point, but he or she does not know whether that level is the best possible, since full knowledge of the map would at least require a very large number of trials.
Obviously there are many ways, each depending on the individual’s method of learning from trial and error [see Boland, 1978, 1983a]. How much or what kind of evidence would it take to convince the individual that his or her conjecture is correct? How does an individual learn that his or her tastes have changed? This second question puts in doubt even states of equilibrium where all individuals are convinced that their conjectures are correct that day. If we admit that tastes change, how does the individual know they have changed without trying points which are not optimal according to the currently conjectured map? Both questions raise an important issue. The neoclassical equilibrium model presumes that every individual is choosing the point which maximizes utility, but here we are suggesting that from time to time the individual might deliberately choose a conjectured sub-optimal point to test either whether the currently conjectured map is true or whether tastes (and thus the map) have changed. If such perverse behavior is possible, what are the implications for neoclassical equilibrium models?

While such perverse behavior might at first seem to be devastating for the usual neoclassical maximization hypothesis, it has some constructive implications for stability analysis. To see this we need to consider again the conceivable market configurations illustrated in Figure 7.3. In Chapter 7 we said that when individuals facing a disequilibrium can adjust the price in response to an insufficient demand or supply (i.e. Walrasian response behavior) and can also adjust the quantity in response to a difference between the demand price and the supply price (i.e. Marshallian behavior), the only configuration that has the possibility of ensuring stability is the market presented in most textbooks. Namely, only when the market is characterized by downward sloping demand curves and upward sloping supply curves, Figure 7.3(b), are we able to conceive of individuals facing a disequilibrium and making independent decisions that constitute stabilizing responses (i.e. convergence toward market clearance). If in Figure 7.3(b) the price were, for any reason, not the market-clearing price, the responses of the individuals facing the disequilibrium will (so long as they are small adjustments) always be in the right direction. Small adjustments will never be destabilizing, that is, never cause a greater discrepancy between demand and supply. This is obviously not so in the worst possible case, Figure 7.3(e), where both curves are sloping in the wrong direction; both ways of responding to a disequilibrium would make things worse.

Things are worse for anybody who wishes to argue that we should rely on the competitive market-system for social co-ordination [see Ch. 7 and Hayek, 1945/48]. Whenever people can opt for either Walrasian or Marshallian responses, it would be difficult to argue that prices are informative and thereby promote market equilibria unless the market appears like Figure 7.3(b) (or equivalently, Fig. 7.2). Whenever the market is otherwise, there is always the possibility that either type of response behavior could be destabilizing. In the worst case, Figure 7.3(e), unless demand equals supply when the market opens, either type of response behavior will cause the price to rise or fall at an increasing rate – that is, the market would virtually explode. A similar problem arises when the demand and supply curves slope in the same general direction. For example, if the market is configured like Figure 7.3(a) or (c), Walrasian behavior is stabilizing but Marshallian is destabilizing. Thus, whether the market is stable depends on which behavior dominates in the market. (We will leave this macroeconomic question for now.) Unless we have reasons to ensure that all markets are like Figure 7.3(b), we need to be very careful about recommending complete dependence on the market system as a means of organizing or coordinating society.

In the usual neoclassical model, if the price were accidentally set at the market-clearing price (perhaps with the help of an auctioneer), there would be no need to worry about the relative slopes of the demand and supply curves. When facing such a price, all demanders and suppliers would make the decisions that clear the market and the question of stability would not arise – even if the market were like Figure 7.3(e)!

But this is only because in the usual neoclassical model all individuals are assumed to be making the correct decisions and to know that they are making the correct decisions. Any shift from equilibrium would, however, cause an explosive disequilibrium.

Consider now a modified neoclassical model where all decision-makers base their decisions on conjectured objective functions, as in our simple example of the utility maximizer. While the market may be clearing one day, there is no guarantee that it will clear the next day, even when the objective evidence is the same on both days. For example, a consumer may try a sub-optimal point the next day to test his or her conjectured map. Such a test will cause the demand curve to shift from the one which intersected the supply curve the day before.

If we allow people to test their conjectures and allow people to respond to disequilibria with either Walrasian or Marshallian behavior, the only type of market that will guarantee stability is the textbook’s market with a downward sloping demand curve and an upward sloping supply curve, i.e. Figure 7.3(b). We must make such allowances if individuals are free to make any decision they wish. This means that the world outside our window, if it is truly populated by autonomous individuals as all neoclassical economists seem to think, must be a world like Figure 7.3(b) since if any other configuration existed it would have exploded by now.
This is a rather indirect argument for the textbook stability case and depends heavily on the predominance of the maximizing behavior usually assumed in neoclassical models. That is, only a small proportion of the market participants can be engaged in perverse testing of their conjectures, otherwise the usual concept of demand and supply curves would lose their meaning. If there is a small proportion of the market participants who are actively testing their conjectures everyday then the only stable market is the textbook market. These considerations emphasize the need to consider the macroeconomic question about which response behavior dominates the whole economy. Why should we expect that in configurations other than Figure 7.3(b) the dominant response will be stabilizing rather than destabilizing when people can behave in either way?

4. Macrofoundations of Microeconomics

Over the years there has been concern for providing microfoundations for equilibrium macroeconomic models – particularly in terms of the adequacy of explanations of disequilibrium phenomena [e.g. Phelps, 1970]. In many ways this may have missed the point. It may be argued that one thing we learned from Keynes is that we lack macrofoundations for equilibrium microeconomics [Boland, 1982a, pp. 79–94]. But surely the question of the stability of the whole market raises the macroeconomic questions noted at the end of the previous section. Which response behavior dominates must be explained using some sort of perspective on the economy as a whole which cannot be deduced from the behavior of individuals alone. Even if we allow for different types of rational response due to differing individual aims, we still must explain the macroeconomic distribution of those aims to ensure stability.

In Chapter 6 we considered a related issue. Hayek [1933/39] pointed out that a disequilibrium might require widespread expectational errors, thus begging the question of why so many people could be wrong. And as we noted above, Keynes [1937] raised questions of how individuals facing ‘uncertainty’ form expectations, and he answered that there are three different ways to form expectations. While he argued that all the noted ways were destabilizing in the long run, we argued that they may be stabilizing in the short run. Also, we could argue that his potentially destabilizing techniques were destabilizing only if they necessarily lead to false expectations. There is no reason why someone using one of Keynes’ techniques of expectation formation cannot happen occasionally to form correct expectations. To think uncertainty necessarily leads to incorrect expectations is merely an expression of a belief in inductivism. Nevertheless, whether the use of any particular technique of forming expectations is stabilizing or destabilizing may depend on how widespread is its use. Unfortunately Keynes’ only explanation of how widespread is the use of his techniques was entirely based on his ‘psychological laws’.

Earlier in this chapter we saw how expectations can be self-fulfilling in the simple case of price dynamics in Figure 11.1. Clearly it matters whether everyone expects prices to continue falling, but what happens when expectations are mixed? This question is not addressed in the stability literature because of the tendency to think that there is only one technique of expectation formation. If we were to address this question in terms of contemporary stability analysis, we would have to ask why rational decision-makers would have different techniques. Surely, it might usually be said, there is only one technique and it is psychologically given. Obviously, we are continually pushing this line of questioning because we think that not only are there many techniques, but that they are not psychologically given. It is time now to present the problem of expectation formation in different terms.

5. Expectations and Conjectural Knowledge

Without reliable inductive learning methods and without psychologically given tastes and techniques, individuals make decisions on the basis of theories they conjecture to be true. There are many theories involved in any decision. The most simple theories are those about price expectations. For example, we could ask the individual why he or she thinks the price will rise or continue to fall between time $T_0$ and time $T_1$ in Figure 11.1. One individual may believe in the theory of inductive learning and say that the reason prices are expected to fall is that they have been observed to be doing nothing but falling for some time. Another individual may believe in an a priori theory that average prices are determined by real costs and that the daily price may oscillate about the average such that whenever the price falls for a while it will surely rise to restore the average. The question of widespread agreement over expectations then becomes a question of widespread agreement over either inductive learning or price oscillations. Perhaps a strong argument could be made that this is a question about the sociology of knowledge. It is certainly not a question about any differences between the information sets, as many of the stability theorists might think, since in our example the information set is the same for both individuals.

The idea of basing expectations on conjectural knowledge can easily
be extended to all decision-making processes involved in neoclassical economics [see Boland, 1978]. The individual decision-maker operates on the basis of a conjectured theory of learning, a conjectured indifference map, a theory of how to change the givens such as prices or incomes, and so on. The question of learning, which so many stability theorists are eager to consider, will thus have to be extended to how individuals learn these theories. If we insist that there is no universal learning method such as induction, and that theories are not psychologically given, there is no reason for why everyone should agree about any one operative theory, let alone all of them. To the extent that widespread agreement matters for either stability or persistent disequilibria, there is certainly a need to explain the extent of the agreement. Such an explanation would be an important beginning for a macrofoundation for a new microeconomics.

6. Towards a Generalized Methodological Individualism

We have argued from the beginning that the dominance of equilibrium model-building in neoclassical economics can be understood by seeing how the idea of an equilibrium allows social coordination of free-willed independent decision-makers. An equilibrium model is one designed to foster methodological individualist explanations of the economy. In such explanations only individuals make decisions, and they make them while being ultimately constrained only by the limits of Nature and guided by their own personal aims. Two individuals facing the same circumstances may make different decisions if they have different aims.

The major theoretical problem of neoclassical economics over the last twenty-five years is how to prove that methodological individualism and diverse aims are consistent with the possibility of an equilibrium. So far, the possibility of both diversity and methodological individualism can be shown only in the very special case of a long-run general equilibrium (see Ch. 1). Methodological-individualist consistency proofs can be provided if we preclude diversity, but only at the expense of our concept of individualism (see Ch. 3). We think it would be better to develop a general methodological individualism which would allow for both the diversity of individuals and the possibility of price systems where individuals can reach their aims simultaneously.

Many neoclassical economists are deceived by the attempts to provide proofs of consistency (i.e. ‘existence proofs’) because it is always thought that ‘rational’ decision-making is a psychological process and thus beyond question – the individual always knows what is best for him or her. The rational decision-making process that they have traditionally had in mind is nothing but a calculus-type maximization. It is questionable whether a rational decision-making process is psychologically given or is learned. But, since learning itself has traditionally been thought to be a psychological skill given to everyone, the only question left is whether everyone learns fast enough. The sole element of individuality here is the presumption that some people learn faster than others even though they all use the same method.

While most neoclassical model builders over the last fifty years have been satisfied to think that learning and maximizing are processes beyond question, some have noticed that inductive learning methods are not reliable whenever the available information is quantitatively or qualitatively inadequate (see Ch. 8). Some critics were quick to abandon equilibrium methods on the grounds that learning or maximization would require too much of any available information. Other model-builders have instead seen all this as an interesting puzzle to be solved. How can we assume the economy is in equilibrium when there are insufficient grounds to assume that the individual participants are capable of making decisions that are perfectly consistent with a state of equilibrium?

Some optimistic model-builders may still like to create a workable psychologistic version of methodological individualism that is consistent with inductive learning theory. Can we reject psychologism yet maintain inductivism? If rational decision-making is not psychologically given, perhaps it is learned. But do people learn to be inductive? The infinite regress here should be obvious. Alternatively, maybe we should admit that psychologically given learning methods are informationally insufficient in providing accurate expectations for correct rational decisions. Perhaps, then, individuals can be assumed to know how to deal with such insufficiency of the information basis for their expectations. The Rational Expectations Hypothesis was invented to close this circle. Expectations are rationally chosen like anything else – perhaps, it is said, the rational decision process is more like a combination of econometrics and ordinary calculus. The circle is thus closed without having to give up on the assumption that adequate psychological skills are exogenously given.

Some less optimistic model builders may see a different problem. If equilibria are to be the basis of explanation in economics, the possibility of the existence of a consistent equilibrium is a different issue than whether such an equilibrium can exist. The idea of an equilibrium is not captured by static properties of a single point such as the one where demand equals supply. It must also involve a process of reaching that point. In other words, the textbook idea of an unstable equilibrium is self-contradictory! Not only does the neoclassical idea of an equilibrium require an explanation of the process of reaching the equilibrium but,
most important, that explanation cannot violate the requirements of methodological individualism since this after all is why we are interested in the idea of an equilibrium (see Ch. 1).

The explanation of the process of reaching the equilibrium has been seen as a puzzle concerning how individuals learn independently to make decisions in a manner that is unintentionally stabilizing. It is unfortunate that the solution of this puzzle is still thought by many to require a fuller understanding of the psychology of learning. This will never do, simply because any success will be a denial of methodological individualism, understood as the requirement that all explanations must ultimately be in terms of individual choices, because by definition individuals do not choose their psychological givens. But even worse, the stability of an equilibrium based on expectations which individuals are said to have learned is either a false stability or a false individualism, since the stability is due only to a presumed theory of learning (i.e. where any two individuals facing the same information are thought to form the same expectations). So, the problem of equilibrium stability analysis must be seen as a problem, not only of satisfying methodological individualism by having only individuals make decisions, but of allowing the individuals to be autonomous. The problem of stability needs to be seen as that of how the equilibrium can be stable when individuals facing the same information are systematically forming different expectations.

The possibility of autonomous individualism does not necessarily lead to chaos or anarchy. The reason for stability of an equilibrium in a present day economy may just be that there is considerable homogeneity in the accepted views of learning and proper behavior – even though the homogeneity is not a psychological given. Many neoclassical theorists find pleasure in building equilibrium models which allow both diversity of individual aims and the possibility of a methodological-individualist explanation of prices. This is all too easy since diversity is always provided by the liberal assumption that everyone has different aims. Such diversity is not explained, it is just assumed in neoclassical models. Moreover, inventing new techniques of models with exogenous diversity does not constitute a new microeconomics.

The preoccupation with building equilibrium models with exogenously diverse tastes has overlooked a far more important intellectual challenge. The major theoretical task for neoclassical economics is not to explain why people make different choices when they are given the same information but why so many of them make the same choices when there is so much room to be different. Such homogeneity is endogenous rather than psychologically exogenous. The stability of any given society or economy may be due to individuals choosing to conform rather than being due to the independent individualism on which we like to base our neoclassical theories. A truly new microeconomics must not make individualism exogenous but make it a matter of choice. This surely involves the possibility of heterogeneous learning techniques. While allowing that disequilibrium responses, decision plan formats and diverse tastes are important, we cannot be satisfied with models that fail to provide a truly endogenous basis for the questions of stability or persistent disequilibria. The problem of stability rightfully occupies center stage for anyone interested in intellectually consistent equilibrium models.
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