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The State of Equilibrium as an Optimum

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, Y	(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 tommorrow (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 neoclassical 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

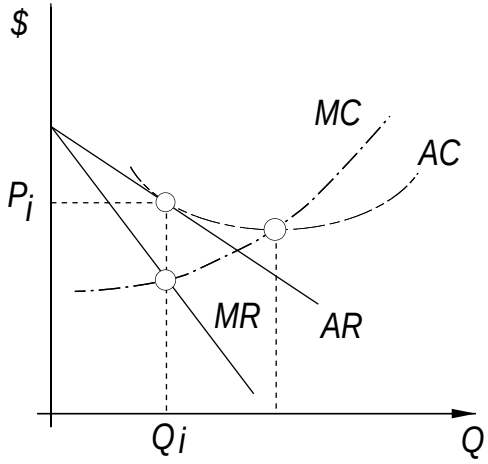

Figure 1.1. Imperfectly competitive equilibrium

production function, $X = f(K, L)$, is formally 'linear-homogeneous' [see the above quotation from Samuelson, 1947/65, pp. 84–5], that is,

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

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.

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

and alternatively, when capital is the variable input,

$$MPP_K = (P_K/P_X)/(1+j). \qquad [1.2b]$$

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,

$$(P_X)(X_0) = (P_L)(L_0) + (P_K)(K_0), \qquad [1.3]$$

which is the same as

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

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

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

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