

# Difficulties with the Element of Time and the 'Principles' of Economics or Some Lies My Teachers Told Me

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"The Hatter was the first to break the silence. 'What day of the month is it?' he said, turning to Alice: he had taken his watch out of his pocket, and was looking at it uneasily, shaking it every now and then, holding it to his ear . . .

'Two days wrong!' sighed the Hatter. 'I told you butter wouldn't suit the works!' he added, looking angrily at the March Hare.

'It was the *best* butter,' the March Hare replied."

Lewis Carroll

As a child of the 50's and 60's I never learned to read originals—we were taught to be in a big hurry. Consequently I accepted the many second-hand reports which alleged that the contributions of Robinson, Sraffa, Keynes, Chamberlin, Triffin, et al, represented major or revolutionary advances in economic science. If the truth were told, economic theory is no better off—maybe it is even worse off.

With respect to Marshall's *Principles* the only apparent accomplishment of more modern writings is a monumental obfuscation of the problem that Marshall's method of analysis was created to solve. A clear understanding of the methodological problem that concerned Marshall is absolutely essential for a clear understanding of the Marshallian version of neoclassical economics. Unfortunately, due to our technically oriented training we have lost the ability to appreciate Marshall's approach to the central problem of economic analysis which is based on the

methodological role of the element of Time. Laying a new foundation for the appreciation of "the element of Time" and its role in Marshall's neoclassical economics is the aim of this paper.<sup>1</sup>

Unlike neo-Walrasian equilibrium models which take time for granted, Marshall's economics allows time to play a central role. Simply stated, the recognition of the element of time is Marshall's solution to the problem of explanation which all economists face. That problem can only be appreciated in relation to a specific explanatory principle or behavioural hypothesis. Such a relationship was introduced in the preface to Marshall's first edition where he refers to the *Principle of Continuity*. But he does not explain either the role of continuity in the problem of explanation or the problem itself. The problem, it turns out, results primarily from a second explanatory principle, the *Principle of Substitution* which he introduces later (in Book V). I will argue here that Marshall saw an essen-

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<sup>1</sup>For a discussion of the problem of time in neo-Walrasian and Austrian models, see [Boland, 1978].

tial role for time in economic explanations for the simple reason that he wished to apply only these two principles to all economic problems.

### The Explanatory Principles

Surprisingly, there are only two explanatory principles stated by Marshall—the Principle of Substitution and the Principle of Continuity. These two explanatory principles are distinguished from “laws” (or tendencies) which also play a role in his explanations. The former are assumptions (we assume because we do not know) but Marshall considers the latter to be beyond doubt.

The Principle of Substitution is easily the more familiar of the two. It says, *everyone is an optimizer* (i.e., a maximizer or minimizer) *given his or her situation* (including his or her endowment). But *by itself* it is not sufficient explanation; the Principle of Substitution presumes the truth of the Principle of Continuity. Since Marshall wished to apply the Principle of Substitution to everything, he needs to show that the Principle of Continuity applies to everything. In simple terms, the Principle of Continuity says everything is a relative matter of degree. Consequently, for Marshall there are no class differences, only matters of degree. He takes the same attitude towards the differences between “city men” and “ordinary people,” between altruistic motives and selfish motives, between short-run and long-run, between cause and effect, between Rent and Interest, between man and his appliances, between productive and nonproductive labour, between capital and non-capital, and even between needs and non-essentials. In all cases whether the degree in question is more or less is relative to how the distinction is being used *in an explanation*. For example, “what is a short-period for one problem, is a long-period for another” (p. vii).<sup>2</sup>

<sup>2</sup>All page references enclosed in parentheses are from [Marshall, 1964].

I claim that it is because Marshall appreciates the methodological problem of the applicability of the Principle of Substitution, i.e., of what we now call the neoclassical maximization hypothesis, that he postpones its introduction until Book V. The first four Books are devoted to convincing the readers that the assumption of maximization is applicable by demonstrating the universal applicability of the Principle of Continuity—or specifically what modern theorists might call the connectedness of choice options. There must be available a continuous range of possible options over which there is free choice (i.e., substitutability cannot be completely limited), and the choice must not be an extreme (or special) case—otherwise the question would be begged as to what determines the constraining extreme limit. What Marshall stresses (e.g., in his Preface) is that the applicability of the Principle of Continuity (and consequently the applicability of the Principle of Substitution) depends heavily on “the element of Time.”

### The Element of Time

#### *Substitution Without Time*

By ignoring the element of time, our teachers (and their textbooks) would have us believe that the Principle of Substitution is the only hypothetical aspect of the ‘Principles’. Samuelson saw that even the notion of a stable equilibrium can be reduced to the Principle of Substitution [e.g., Samuelson 1965, p. 5], i.e., to the matter of constrained maximization. Time, if considered at all, is deemed relevant only for the proofs of the stability of equilibria. Most of us have been trained not to see any difficulty with the element of time—for fear of being accused of incompetence.

Marshall’s view was quite the contrary: the element of time is central. For instance, to presume that *at any point in time* a firm has chosen the best labour and capital mix presumes that the time elapsed since the rele-

vant givens were established (viz, the technology, the prices, the market conditions, etc.), and that there was sufficient time for the firm to vary those things over which it has control (viz, the labour hired and the capital purchased) prior to the decision or substitution. Even when its price has gone up the firm cannot respond immediately; nor can it stop production and its employment of labour merely because the price has fallen (cf. p. 298). Contrary to modern textbooks, in Marshall’s economics very short-run market pressures are more “the noise” than they are “the signal” *when viewed from the perspective of the businessman’s decision process*.<sup>3</sup>

### Time and Explanation

Time is an essential element in Marshall’s method of explanation. Marshall tells us quite a lot about explanation in economics. He stresses the need to recognize the role of fixed “conditions,” but he also stresses that the “fixity” is not independent of the defining “time periods”—remember, according to the Principle of Continuity everything is a matter of degree.

Because Marshall’s use of the term “conditions” can lead to confusion, it is relevant to examine his theory of explanation more specifically by distinguishing between dependent, independent and exogenous variables, and between fixed and exogenous conditions. These distinctions crucially involve the element of time.

The relationship between dependent and independent variables is supposed to be analogous to the relationship between causes and effects. But, Marshall cautions us that all such distinctions are relative. For instance, in the very short period the market price is the dependent variable and, given the demand,

<sup>3</sup>See (p. 314); the businessman must always make a judgement as to whether day to day changes in the market will be long lasting enough to justify investment and hiring decisions.

the quantity supplied is the independent variable. However, in the usual (expected) short-run, the market price is the independent variable and, given technology (i.e., the production function), the quantity supplied is the dependent variable.

In the Preface to the *Principles* Marshall recognizes the usual type of interdependence as being an instance of the Principle of Continuity. He specifically credits Cournot with teaching us to face the difficulty of “mutual determination.” Marshall calls this type of interdependence a mathematical conception of continuity although he refers this conception only to the relationship between causes and effects.<sup>4</sup> Today we might say that in Marshall’s short period price and quantity are both endogenous variables and are *simultaneously determined* by the exogenously given technology and demand. Thus, the distinction between independent and dependent variables is only a matter of verbal convenience since both are endogenous (see further [Boland 1975; 1978]).

What Marshall calls “conditions” are variables which are “exogenously fixed” during the period of time under consideration. It is their fixity which Marshall relies on in his explanation of behaviour (where the fixed variables are the constraints in a maximization process). The exogenous reason why they are fixed is the logical basis for their use in his explanation. Note, however, that exogenous variables need not be fixed, their fixity only makes things more convenient.

The problem of explanation—in Marshall’s view—is one of carefully defining the fixity of the “conditions” by defining the relevant period of time for the operation of the explanatory Principle of Substitution. Of course, what is a relevant period of time depends conversely on what are the relevant exogenous

<sup>4</sup>His reference to Cournot has often misled modern commentators to think that the mathematical conception is all that Marshall was saying—rather than the more important methodological issue of relative degrees.

conditions for the application of the Principle of Substitution. For example, in Marshall's short-period—"a few months" (p. 314)—virtually everything but the level of output and the amount of labour employed is by definition fixed; but in his long period—"several years" (p. 315)—everything but technology and social conditions is endogenous.

The difficulty with Marshall's approach to explanation when there are many variables is that it is difficult to distinguish between the endogenous conditions which are exogenously fixed for the period of time considered but change as more time elapses (which permits more and more variables to be chosen, e.g., fixed capital) and the truly exogenous conditions that can never be made to submit to the Principle of Substitution (e.g., weather, social conditions, states of knowledge, etc.). In Marshall's economics the truly exogenous variables are the only "causes" in the strict sense. As Marshall views this, if one is to provide a long-run explanation, "time must be allowed for causes to produce their effects" (p. 30). Of course, this "... is a source of great difficulty in economics ..." because "... the causes themselves may have changed" (p. 30). Note however, that the changeability of "causes," i.e. of exogenous variables, is *not* the problem of explanation, but rather, it is the more narrow methodological problem of *verifying or refuting* one's explanation.<sup>5</sup>

I will argue that even when changes in the exogenous givens are assumed away, the fundamental problem for all explanations involving time still exists. The logic of explanation (for example, of all the co-determined endogenous variables) requires that we recognize at least one exogenous variable; and given maximization with exogenous tastes

<sup>5</sup>One must be careful to distinguish between the logical validity of an explanation and its truth status; see [Boland, 1978, pp. 246-9; 1979, Section 1].

and exogenous constraints, changes in endogenous variables are explained as being caused by changes in at least one of the exogenous variables. But this means that an explanation of long-run dynamic behavior requires an exogenous variable which is impervious to the amount of real time elapsed in the long-run (otherwise, the explanation might be circular). The explanatory element of time is then to provide a time-independent exogenous variable—i.e., one which does not change over the defined long-run.

#### Marshall's Strategy

It would be misleading to suggest that Marshall's problem of explanation is merely a matter of defining long-run equilibrium, for it is also a matter of how the long-run equilibrium is reached. Again, in Marshall's view (p. 304), the explanatory problem is that there are too many exogenous variables in the short-run during which most decisions are made. His strategy is intended to reduce the number of exogenous variables by increasing the number of variables to which the Principle of Substitution can be applied at later stages.<sup>6</sup> Marshall thus considers the problem of explanation to be solvable since he recognizes that there is a different degree of changeability for each variable (another application of the Principle of Continuity). In short, Marshall's strategy is to distinguish between short-run and long-run explanations. Any complete explanation must specifically *assume* which variables can be changed most quickly—i.e., variables must be ordered according to their changeability. Different orderings may yield a different path to the long-run equilibrium. Unless the assumption is very specific it may be impossible to distinguish between a long-run moving equilibrium and a short-run movement toward a new long-run equilibrium.

<sup>6</sup>The variables to be treated later, then, are "independent" variables.

Marshall's view of explanation recognizes yet another aspect of the element of Time. If the state of affairs at any point in time is to be *explained* as a consequence of someone's optimizing choice, it must *have been* possible to alter one's choices—and this possibility is both a matter of the time available and the continuity of options. Needless to say, it also presumes the ability to know what is the best *option*. Learning what is the best option takes time (p. 284). This question of learning, I would argue, is *the* explanatory problem involving the element of time. Of course, for Marshall, the inductive scientist, time is all that is necessary for the accumulation of the needed knowledge. Unlike the classical school Marshall sees no need to assume "perfect knowledge" because he explicitly wishes to recognize the period of time under consideration—a period he would consider sufficiently long to obtain any "necessary knowledge" [for more on inductivism in economics, see Boland 1982, chapters 1 and 4].

Although Marshall gives a prominent role to the distinction between long and short periods, it is not sufficient to solve his problem of explanation—which, as has been said, is a problem concerning the methodological choice of exogenous variables that are impervious to time. Yet, most commentators seem to think that Marshall's "statical method"—namely the contents of Book V—constitutes his solution to the problem of explanation. This is a mistake.

The first point to be made is that Marshall's "statical" or partial equilibrium method of analysis yields incomplete explanations. The "statical" method is relevant only for decisions "on the margin" or in the neighborhood of an equilibrium position. By itself this method examines the necessary but not the sufficient conditions for equilibrium. The second point to be made is that Marshall does offer a more complete explanation which is based on the contents of Book IV. By itself, Book V deals only with the "noise" in order at

best to explain it away. A source of an explanation of an economy's true dynamics and its application of the Principle of Continuity to the element of Time is to be found in Book IV. These two points will be discussed in turn.

#### *The Insufficiency of Book V*

I do not think Marshall ever claims that Book V alone represents a complete explanation of an economy's behavior. Yet, judging by modern textbooks, one could easily think that Book V is "the principles of economics." What we call microeconomic analysis today can all be found in Book V. Nevertheless, implicitly Book V provides only the necessary conditions for any equilibrium. That is, on the *assumption* that an economy is in long-run equilibrium at a point in time, certain necessary relationships must hold whenever that assumption is true. It is a "statical" method because it may be relevant only for that one equilibrium position at one point in time. In effect, Book V examines the local stability properties of the *assumed* long-run equilibrium that are the logical consequences of definitions of equilibrium and the long period. But it will be argued below that the stability properties are heavily dependent on the empirical assertions of Book IV.

To be specific, before Book V can be considered relevant for anything, i.e., play a role in economic analysis, a key question must be asked: why should there ever be a long-run equilibrium? Marshall approaches this question in two ways. The most familiar is in Book V in which he defines an ordering of the changeability of the variables with respect to three periods of time—"the very short period," "the short period" and "the long period." The quickest variable in Marshall's world is the market determined price. In fact, his definition of a market is not the textbook one of a *place* where buyers and sellers meet to haggle over the price. Marshall makes the existence of a market depend on whether the price clears *quickly* enough for all producers

to face the *same price* regardless of their location. For Marshall then there is no market for any good whose price is either not uniform<sup>7</sup> or not quickly established. In effect, this axiom about market prices makes all firms price-takers since it takes longer to establish their (short-run) decisions than the price itself.

Marshall's definition of the market means that the market price (as opposed to the short-run or long-run equilibrium price) is the only *real time* observable price. This theory of market prices assumes that the supply quantity is fixed—virtually everything is fixed but the price. The remainder of the discussion in Book V is an examination of what happens to the market price over time when more and more of the fixed givens are allowed to change. For example, Marshall begins by allowing the firms to make substitutions in their quantity supplied in response to the current level of the market price (relative to costs). This “short-run” *process* of substitution requires some time—“a few months or a year” (p. 314).

Marshall says that he wishes to argue that demand determines the market price in one extreme—the very short-run—and technology determines the market price in the other extreme—the long-run equilibrium. Implicitly the real world is somewhere in between.<sup>8</sup> Again, the meaning of “determines” is only a matter of necessary relationships of the defined equilibria. If the economy is at a long-run equilibrium, it must also be at a short-run equilibrium, since if it were not there would be short-run incentives to change the givens which are the constraints in the determination of the market price. Similarly,

<sup>7</sup>Marshall allows for different prices as the result of transportation costs (p. 271).

<sup>8</sup>That is, the very short-run is not realistic (p. 304), and the logical consequences of a long-run equilibrium is a stationary state (p. 315, footnote 1); but, a stationary state is alleged to be “a fiction” (p. 305).

the short-run equilibrium presumes that the market is in equilibrium. In other words, every long-run equilibrium must also be a short-run equilibrium and every short-run equilibrium must be a market-run equilibrium. This “nesting” of the forms of equilibrium is the essence of Marshall's “statical method.”

Although it is now very easy to list the necessary conditions for the existence of a long-run equilibrium, the key question still concerns the sufficient conditions for the existence of a long-run equilibrium, which must be consistent with both a short-run equilibrium and a market equilibrium. The question of consistency has been a major source of controversy over the last 50 years. The logical problem is that the absence of excess profits in conjunction with profit maximization in the long period implies that the production function is locally linear-homogeneous (constant returns to scale); but this implication is inconsistent with a downward sloping demand curve, the ultimate constraint thought to be necessary to limit the size of the producer.

Marshall's only line of defense is his other approach, which is based on the Principle of Continuity. Given the continuous operation of the Principle of Substitution, it is quite possible for the price to be above or below the long-run equilibrium price. When it is above there are positive excess profits and when it is below there are losses and, logically, there must be a (long-run equilibrium) point in between where excess profits are zero. The apparent inconsistency is due only to the discussion of the hypothetical and heuristic “stationary state”—which is a very special type of long-run equilibrium that is supposed to hold for a specified period of time. The only inconsistency is between the previously mentioned nesting of equilibria and the stationary state. Specifically, the inconsistency is that the stability of each of the various equilibria that hold at the long-run equilibrium depends

on the one hand necessarily on the consideration of *different* periods or lengths of time for each whereas, on the other hand, in the stationary state they are all supposed to refer to the *same* period of time.

Leaving the stationary state aside, there is no reason why the stability of the various forms of equilibrium have to refer to the same set of “conditions” or variables or, equivalently, to the same period of time. Hence, the stability relations (e.g., the necessary slopes of curves) for one form of equilibrium will not be statically consistent with those relations necessary for the stability of another form. If one ignores the element of time it is only too easy to “see” an inconsistency where otherwise there is none.

#### *The Methodology of Book V vs. a Complete Explanation*

Once one recognizes the necessary element of time it might appear that there is no logical problem with Book V. But to the contrary, there still remains the matter of explaining *why* there should ever be a long-run equilibrium,<sup>9</sup> and this is a question which must be dealt with in an appropriate frame of reference. Like all explanations there must be something exogenous in Marshall's view of the economy—and it must be something whose exogeneity extends to a longer period of time than the “long period” under consideration. Marshall deals with this issue first in Book IV.

Particularly relevant to Marshall's explanation of an economy is what is now called his “life-cycle” hypothesis of the firm. In its most specific form it is an empirical assertion about the history of an individual firm with a life span of three generations [cf. Hague 1958; Loasby 1978]. In its more general form it says that at the beginning of its life the firm

<sup>9</sup>Book V discusses only the *logical* possibility of a long-run equilibrium.

benefits from learning so that its ability to produce increases with its size. Implicitly Marshall is only concerned with growing firms—their size is irreversible, hence time and size go together. At the end of its life every firm suffers from diminishing returns. In either case, the life-cycle trajectory is the needed long-run exogenous variable.

By itself, this hypothesis about the beginning and the end of the life of a firm does not seem very relevant. The addition of the Principle of Continuity, however, renders the desired result. This principle allows us to conclude that since returns change from increasing to decreasing, at some point in between there must have been “constant” returns. This point is a possible long-run equilibrium. Given the life-cycle hypothesis and continuity, every firm must pass through this point. Once it is reached the “statical method” can be used; but it remains merely a “snap-shot,” relevant only for that one point (in the history of the firm).

There is absolutely no reason why all the firms in an economy should simultaneously reach the point of constant returns—that is, reach the “turning point,” as Marshall calls it. It might be interesting for someone to explore such a fantasy world, but nowhere does Marshall seem to be suggesting that such a state of affairs is *necessary*. Book V nevertheless explores the nature of this turning point: Book V “. . . is not descriptive, nor does it deal constructively with real problems” (p. 269). However, Marshall does say Book V “. . . sets out the *theoretical backbone* of our knowledge of the causes which govern value” (pp. 269–70, emphasis added). However, this statement is qualified. He says “. . . it aims not so much at the attainment of knowledge . . .” but rather “. . . at the power to obtain and *arrange* knowledge with regard to two opposing sets of forces . . .” (p. 270, emphasis added).

Marshall's use of the words “theoretical”

and "arrange" is slightly different than usual modern usage. His usage is related to Friedman's *as if* approach to explanation. There is no claim that the method of analysis—of arranging the facts of business—is a true explanation. There is only the claim that the nature of the inevitable turning point can be understood to be the result *if* the world were in a state of equilibrium at a moment in time—or more properly, in a state where forces are balanced.

Like most economists' adventures in methodology, Marshall wishes to be all things to all people; thus his is not a pure example of the Instrumentalism we associate with Friedman. Rather, the Introduction to Book V gives a classic example of what we now call Conventionalist methodology. We are offered a way of looking at things. What is offered is not claimed to be true; it can be judged only to the extent that it is better or worse than some other competing view. Book V is filled with conventions with no claim to their truth status (e.g., the representative firm, the stationary state, the market, the long-period, etc.). Only in those cases where we know that he thinks a particular convention is a fiction do we have examples of the "as if" methodology [cf. Boland 1979, pp. 512–3].

The methodology discussions of the *Principles* are not very interesting today but his theory of the firm should be. The point at issue is that Book IV is a foundation for a complete theory of the firm: the firm is always to be found somewhere on its life-cycle trajectory. Where it is is determined completely by the time elapsed, (cf. 258), but the value of that position can only be determined as a relative value, relative to its past and its future. There are simply too many contingencies to be able to determine the absolute value. But remember, the Principle of Continuity is only concerned with relative values.

Book V does offer a way of seeing the absolute value as a consequence of external forces, i.e., of competitive market pressures. But there is no reason why the actual, real-time, values would ever be "long period normal" prices. The existence of long period normal prices is merely, one might suggest, a beautiful fiction which lends itself to simple mathematical analysis having no bearing on "real problems" (cf. p. 269).

#### **Inadequacies of Marshall's Method vs. Problems Created By His Followers**

Over the last fifty years there have been two major problems in the application of Marshall's principles; both of them involve the element of time. The first concerns the meaning of increasing returns and the nature of the long-run equilibrium. The second concerns the artificial distinction between "historical" and "logical" time.

#### **Problems with the Firm's Long-run Equilibrium**

Marshall's Victorian style lends itself easily to distortion. What he meant by certain words in one place may not have the same meaning in another. For example, the term "increasing returns" is used in two different senses; both result from his implicit assumption that the firm is always growing; hence size and time go together. In Book V he uses the term to describe the observation that average productivity rises over time for any given input levels (p. 377). This use is at variance with modern usage. Earlier, in Book IV, he employs the term in the limited modern sense to mean an increase in output which is proportionally greater than the increase in the size of the firm (p. 266). A similar confusion derives from his use of the term "margin" when discussing his "representative firm." By definition, the representa-

tive firm is at the "turning point" on the life-cycle trajectory. At that point average and marginal cost both equal price; thus it is possible to use the average and marginal magnitudes interchangeably. But another use of the term "marginal" emerges when he refers to the representative firm's contribution to its industry's output.

These confusions are merely irritants. The major problem is ignoring the element of time inherent in the "static method" when applied to long-run equilibria (as noted above). Although the difficulty is primarily logical it results from conjoining four statements whose individual truth status depends on different periods of time. They are the following:

- (i) prices are determined before the firm makes its supply choice; hence prices are given.
- (ii) the Principle of Continuity applied to all inputs (all inputs are variable) means that the production function of the firm is locally linear-homogeneous and that the level of output is always equal to the sum of the marginal productivities each multiplied by the respective input.
- (iii) the Principle of Substitution (i.e., profit maximization) applied to all variable inputs means that the marginal productivity of each input multiplied by the product's price will always equal the price of that input.
- (iv) the firm is at the "turning point," i.e., its excess profits are zero.

There is no difficulty with the conjunction of these four statements if they only refer to a single point in time [Boland 1978, pp. 242–3]. Moreover, even over the short-run given (i) any two of the remaining statements imply the other one. So long as the theory of the firm is confined to the "short period" there

need not be any logical problems. The problems that are alleged to exist arise only when the theory (i.e., the Principle of Substitution) is applied in the long run period to the short-run *constraints*.

Applications of the Principle of Substitution involve some form of maximization (or minimization) facing fixed constraints. In the short-run, all the variables which cannot (by definition) be varied constitute the short-run constraints (e.g., the short-run may presume capital is fixed but labour is variable). In the long-run everything except the production function is supposed to be variable (by definition); but this raises a major methodological problem. Anything which is variable must logically be the object of the Principle of Substitution. This means that the variables that served as fixed constraints in the short-run become endogenous variables in the long-run. But, this also means that there are no constraints in the long-run and this leaves the Principle of Substitution inoperable in the long-run. In the long period, then, the conjunction of the assumptions of a price-taker, (i), of the changeability of all variables in the production function, (ii), and of profit maximization with regard to all changeable variables, (iii), seems to deny any limit to the size of the individual firms—as if size has nothing to do with time (this interpretation of Marshall's theory of the firm, by its focusing only on the internal logic of maximization, is quite contrary to the views expressed in Book IV).

The methodological problem of explaining the size of the firm (as a consequence of maximization) seems to have troubled many of Marshall's followers although it did not seem to trouble him since his Principle of Continuity discourages extreme viewpoints, such as long-run equilibria. The problem only arises when one attempts to apply the Principle of Substitution to the size of the firm in

the long-run. Today this problem is avoided (i.e., hidden under the rug) by saying that one should only explain the size of the industry. But this tactic merely raises other questions such as, what prevents any one firm from taking over the industry as a monopoly?

Although there is considerable discussion of industries in the *Principles*, Marshall's explanatory Principle of Substitution is applied only to the (short-run) decisions of the individual firm. The industry is merely an epiphenomenon—the logical consequence of what individual firms do. This is a standard neoclassical viewpoint. However, this viewpoint has always posed certain puzzles concerning the interaction of demand and supply in the market. The difficulty is that both the market and the industry are defined for a specific good but the market is related to the individual firm only through the going price. The price by itself says nothing about quantities except that aggregate quantity demanded must equal industry supply. But, if individual firms must determine the quantity supplied independently of each other, the aggregate quantity supplied is only an epiphenomenon. In terms of Marshall's individualistic methodology, this approach to the relationship between firm and industry appears rather mysterious.

In order to overcome the mystery, Marshall offers the infamous heuristic fiction, the representative firm. Unfortunately, whenever one tries to use the representative firm, instead of Book IV, to explain the size of the firm as another consequence of an application of the Principle of Substitution, another methodological problem is created. Recall that the representative firm is defined (p. 285) as a firm at the "turning point" and it is also a firm on the margin of the industry (older firms will be making less than normal profits). As a profit maximizer at the turning point (where profits are just normal), the

representative firm must face constant returns to scale (at least "locally," see Baumol 1977). On the other hand, as a representative of the industry, it must be constrained by the negatively sloped demand curve. This latter constraint means that we have a fifth statement which must be conjoined with the other four: namely (v) the representative firm's marginal revenue must be less than the price. The problem is that either (v) and (i) are mutually contradictory or one of the other statements must be denied. With respect to any one firm it is not possible for all five statements to be true simultaneously. For example, while profit maximization implies the equality of marginal cost and marginal revenue, zero excess profits implies an equality between average cost and average revenue (the price). Thus, when marginal revenue is less than the price, the firm must be operating where there are increasing returns (since marginal cost must be less than average cost) which is contrary to statement (ii). Note that a firm can still be a price-taker even when its average revenue is falling.

I would speculate that all of the controversies surrounding the long-run theory of the individual firm are merely about which of the five statements should be dropped. Moreover, most of the controversies have ignored the element of time. There is no doubt that *if* one ignores the element of time (which differs according to the statement one is considering) and, instead, views the above statements as holding at a single (static) point of time, then logically some of the statements are mutually inconsistent. As argued by Sraffa and Robinson, something must give. A realistic interpretation is that the idea of a price-taker (i), must go, but Marshall's static method of dealing with his problem of explanation—distinguishing between very short periods and the short-run—blocks that avenue. Allowing that prices may not be market determined

would lead to a conclusion that is contrary to Marshall's objective. If prices were *not* determined in a market, then demand could only play a role in the determination of the size of the *industry*—i.e., given the life-cycle, demand determines the number of firms in an industry—in the long-run. Prices are left to be determined by technical and social considerations within and between firms (e.g., without "spoiling the market").

Such conclusions seem to be ideologically unacceptable or mathematically inconvenient for economic theorists—hence they simply have stopped talking about Marshallian economics since what he promised (a role for demand and utility maximization in the determination of prices) seems doomed. What is being suggested here is that things may not be as desperate as everyone seems to fear. Perhaps all that is required is a proper examination of the element of time.

#### *The Distinction between Logical and Historical Time*

Contrary to Marshall's view it is claimed by post-Keynesians one must carefully distinguish between "historical" and "logical" time [e.g., Robinson 1974]. Historical time is the usual calendar or clock time within which decision processes are irreversible. In logical time decisions are irreversible. For example, the life-cycle hypothesis is in historical time since it is assumed that the firm always gets older; it cannot get younger. One might say that this is because with the passage of time the firm is learning but it cannot "unlearn." The stability analysis of equilibrium theory is in logical time since the analysis is always conducted in terms of questions such as, what *if* the price were higher or lower than the equilibrium price? Logical time is concerned with conceivably possible alternative worlds (regardless of actual events) at any given point in time, whereas historical time may be

concerned with the (necessarily) singular event occurring at that time.

The distinction between historical and logical time corresponds respectively to Books IV and V. But, the intellectual separation of these concepts (and Books) into mutually exclusive classes is a direct contradiction of Marshall's Principle of Continuity. Marshall does not claim that these concepts or books should be separated. To the contrary, Books IV and V go together. Reality for Marshall is on the continuum *between* the two extreme concepts, i.e., reality involves both Books in full measure. Any explanation of the behaviour of an enterprise must be both grounded in history (i.e., irreversible past decisions) and explanatorily complete (i.e., it must at least imply a stable determination of the values of the variables to which the Principle of Substitution has been applied.)

#### *Some Closing Remarks*

Most of modern economic analysis concerns only the mathematics of Book V. The reason, I think, is simply that Book V is the only part of Marshall's *Principles* that is compatible with the methodological doctrine that dominates economic theory today—Conventionalism: the methodology that restricts research to questions of logical validity instead of empirical truth [see further, Boland 1982, chapters 7 and 8]. Economists today do not wish to discuss the "truth" of economic theories but only examine their logical validity. The reason why logical validity rather than empirical truth is the preferred object is because with the help of mathematical analysis the former can be established more quickly. Even though Marshall stressed the importance of gradual, slow change, those economists in a hurry will find the logic or mathematics of static equilibria more interesting. Logical analysis can be very quick but

real change takes real time and thus may not be disposed to easy analysis.

One is reminded of the story of the inebriated gentleman who one evening lost his only quarter far from the nearest streetlight; but he spent all his time looking under the streetlight—because the light was better! I think the profession has devoted enough time searching under the light of *Foundations*; it is time to go back to where the quarter was lost—Book IV of the *Principles*. I am not suggesting that *the* solution to the difficulties with the element of time is to be found in Book IV, but only that in Book IV at least the emphasis is on a realistic approach—an approach which still awaits development and constructive criticism. If teachers wish to be truthful with their students they will tell them where the quarter is.

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