In *Economie Appliquée*, tome XLVI, 1994,
n° 4, p. 5-22

A New Perspective on Decentralized Trade*

Nicolaas J. Vriend

Santa Fe Institute, USA

This essay discusses the appropriate methodological point of view on how to explain the outcomes of a decentralized economy. We expose the perspective of the Walrasian general equilibrium models, showing that the structure of these models is inconsistent with the Walrasian claimed methodology, and argue that this inconsistency is not simply due to a shortcoming of the current Walrasian models, but is inherent to the Walrasian methodology. We argue that the time is ripe for a new methodological point of view on the modeling of a decentralized economy.

Le présent essai discute le point de vue méthodologique adéquat pour expliquer les résultats d'une économie décentralisée. Nous exposons la perspective des modèles d'équilibre walrasiens, démontrant que la structure de ces modèles est inconsistante avec la méthodologie walrasienne prétendue, et nous soutenons que cette inconsistance n'est pas simplement le résultat d'une imperfection des modèles walrasiens courants, mais qu'elle est inhérente à la méthodologie walrasienne.

* I wish to thank Pierre Dehez, Marjan Hofkes, Maarten Janssen, Alan Kirman, PierCarlo Nicola, and Martin Shubik for critical comments and helpful discussions. All errors and responsibilities are mine. The paper is largely based on research done at the European University Institute in Florence. The Santa Fe Institute's stimulating environment, a grant from the Niels Stensen Foundation, and financial support from the Deutsche Forschungsgemeinschaft through Sonderforschungsbereich 303 at the University of Bonn, are also gratefully acknowledged.

Nous soutenons que les temps sont mûrs pour un nouveau point de vue méthodologique sur la modélisation d'une économie décentralisée.

INTRODUCTION

One of the main tasks of economic theory is to explain the outcomes of a decentralized economy. The most fully developed models addressing this problem are the general equilibrium models; further referred to as the "*Walrasian models*". Very few people have ever claimed that such models give a realistic description of a decentralized economy, and the founders of general equilibrium theory never made any claims to realism (see Punzo [1989] for a survey, but also Negishi [1962] for an exception). Therefore, in this essay we will restrict our attention to the domain of pure theory. In this field, then, something similar to the following is frequently claimed: "*Take a pure exchange economy $\mathcal{E}$ consisting of a set A of autonomous agents with given preferences $\succeq \in P$ and endowments $\omega \in \mathbb{R}^l_+$: $\mathcal{E}: A \rightarrow P \times \mathbb{R}^l_+$, let these individual agents freely choose their demands, given the prices, then it can be proved that, having made only the appropriate assumptions about the primitives of the economy, there exists an equilibrium in which the choices of all these agents may be realized.*" Note that this would be a remarkable result, as each individual agent was considering only his *own* preferences and endowments. Therefore, the first question to address in this essay is whether such a claim, which we will call the Walrasian claim, is right.

An answer to this question is, first of all, of theoretical importance. Within the social sciences there is a continuing debate about the appropriate explanation of social phenomena. There are considered to be only two possible, diametrically opposed, basic subject-matters of social theory, or in other words, two ultimate determinants of social phenomena (see. *e.g.*, Giddens & Turner [1987] for a systematic account of this debate). On the one hand, there are those who claim that all social phenomena must eventually be explained by the given structures, rules, and conventions of the society in which the individual agents happen to find themselves. On the other hand, there are those who claim that individual agents are autonomous subjects. An autonomous subject is an agent whose set of possible actions and outcomes is not predetermined by any form of a given structure, a set of rules, a certain context, or anything that transcends the level of the agents. Moreover, a theory that

considers the overall outcome of these individual actions is a theory based upon autonomous subjects if this overall outcome is, in one way or another, thought to depend only upon the behavior of these agents. The methodological points of view related to these two positions are sometimes referred to as "*Methodological Holism*", or "*Structuralism*", resp. "*Methodological Individualism*". To simplify matters in economics terms, there is deemed to be a spectrum of possibilities ranging from the micro to the macro level, where the intermediate positions are simply a mix of the two pure form explanatory factors at the extremes of the spectrum. The Walrasian claim means that one can explain both the behavior of individual agents and the overall outcome of their actions in a decentralized economy, by adopting the methodological point of view of the second of the extremes of the spectrum, that is, by starting the analysis at the level of autonomous subjects. If the Walrasian claim were right, then that would be a major theoretical achievement.

But an answer to the question is also of practical importance. For example, a popular idea among both economists and policy makers is that the purely theoretical, mathematical economic theory, although dealing with unrealistic and abstract models, has at least proved that a decentralized economy is Pareto optimal, as long as there are no real world complications in the form of external effects, public goods, increasing returns, etc. Such an idea induces both researchers (*e.g.*, Hahn [1982a]) and policy makers to focus attention exclusively upon these complications. However, if the Walrasian claim were unjustified, then statements about the acceptability or optimality of decentralized trade could not be defended at all by reference to theoretical results concerning Walrasian models. The crucial point to note, then, is that such a conclusion would not imply a negative judgement about decentralized trade as such, but only about the currently most fully developed theories aimed at explaining what is going on in such an economy.

Therefore, this essay offers four contributions to the forming of a theory of decentralized trade. First, in section I, we expose the structure not only of the basic Walrasian flexible price model, but also of a number of so-called "*non-Walrasian*" models, such as fixed price models, imperfectly competitive models and temporary equilibrium models. We will show that these share the same general structure and reveal a common approach to or view on how to model a decentralized economy. We will call this methodological point of view the Walrasian perspective.

Secondly, in section II, we will argue that the structure of Walrasian models is such that these are inconsistent with the Walrasian claim. The

reason is that these models, in order to explain anything, have to make resort to a number of concepts and structures that transcend the level of the autonomous subjects. As it is even the case that these explanatory factors are taken from the *opposite* extreme of the sketched spectrum, it seems obvious that the Walrasian models cannot be considered as ideal representations of decentralized economies.

The third contribution is that we will try to make plausible where such a paradoxical situation stems from. We will argue that the fundamental problem is not the actual Walrasian *practice*, which does not yet stand up to the high standards claimed for it, but the Walrasian *perspective* itself; in other words, one level of abstraction higher.

The fourth, and as far as the methodology of a theory of decentralized trade is concerned most consequential, contribution will be presented in section III. Drawing our conclusions as to the modeling of a decentralized economy, we will argue that a different methodological point of view, paying explicit attention to the real interaction between individual agents in a decentralized economy, is necessary. We will show that combining recent methodological insights with the analytical tools emerged in the study of complex systems, appears to be a promising new line of research for the explanation of the outcomes of decentralized trade.

Before starting our contributions, it may be useful to remind that the issue of an explanation of the outcomes of a decentralized economy goes back, at least, to Smith [1776]. While Smith leaves many things implicit, and each individual is thought to act simply out of self-interest, the conclusion that this behavior will lead to an optimal overall outcome can only be thought with help of the transcendental "*invisible hand*", a concept that embraces the whole economy, but stands itself above the level of the subjects. It should be stressed that, according to Smith, individual agents *are* led by an "*invisible hand*", and that he *never* uses any kind of "*as if*" argument (see Vaughn [1989]).

I. THE WALRASIAN PERSPECTIVE

A description of the Walrasian approach to the modeling of decentralized economies may seem superfluous, but it appears that sometimes economists do not know exactly what is implied by this perspective. Usually, the adjective *Walrasian* is related to a market-clearing equilibrium in all markets, accomplished by fully flexible

prices. Sometimes even something like an auctioneer-cum-tâtonnement construction is mentioned, but, for example, the fact that the auctioneer and the tâtonnement process are two logically separate concepts is not always apparent (*e.g.*, Laroque [1987] or Benassy [1987]). *Non-Walrasian* is then simply understood as less than fully flexible prices, resulting in non-market-clearing, i.e., non-Walrasian, equilibria. Such contributions are often called "*non-Walrasian*". In this section, we will show that a broad class of contributions, including numerous "*non-Walrasian*" elements, adhere to the same perspective, the Walrasian perspective.

1. The Basic Model: Flexible Prices

The most frequently recounted Walrasian "*stories*" [1] start with the existence of an auctioneer. He publicly announces prices for every good. Taking into account endowments, preferences, and technologies, each optimizing agent, believing the economy is in equilibrium, states the amount of each good he wants to demand at the prices announced to him. If the auctioneer, after aggregation over all individual agents, finds out that some market excess demands are not equal to zero, he applies a simple price adjustment rule, changing prices proportionally to the aggregate excess demand, so that if excess demand is positive, he raises prices. Given these new prices, agents express their revised plans to the auctioneer, who considers these again. This process of "*groping*" (tâtonnement) continues until the auctioneer has found the vector of prices at which excess demands equal zero in each market. Only then do transactions take place, and every agent will indeed be able to transact exactly as much as he had planned at the given prices. When all the transactions have been executed, the time for consumption and production starts. The future can be divided into a finite number of elementary periods and *states of the world*, and markets for all commodities in all future periods and all *states of the world* exist at one point in time, *i.e.*, at the beginning of economic history. Contracts will be concluded at that moment. In the future they have only to be executed.

In order to demonstrate the meaning of the Walrasian perspective further and to illustrate its logical distinction from a Walrasian

(1) The broadest treatment of economics as a discourse can be found in Samuels [1990]. At this point, we are not referring to any specific contribution to the Walrasian discourse. In particular, we do *not* yet refer to the land-mark work by Debreu [1959], which will be discussed in section II.2.

equilibrium as such, we will now discuss some classes of models that may yield non-Walrasian equilibria, and which are often, somewhat misleadingly, called non-Walrasian models.

2. Fixed Price Models

A development that has attracted much attention since the beginning of the 1970s is the literature about models in which prices are fixed (*e.g.*, Drèze [1975] or Benassy [1982]). In these models an auctioneer announces a vector of fixed prices that is not necessarily equal to that of the Walrasian equilibrium. Given the price vector, each individual agent, taking into account his endowments and maximizing utility, expresses a vector of demands, for all markets simultaneously, that may be called "*notional*" demands. Depending upon the expressed demands of all the other agents in the model, and given a set of functions that relates these notional demands to attainable transactions for every agent, *i.e.*, a set of rationing schemes, each individual agent might hear that he will be constrained in his transactions in some markets. Taking into account these quantity signals, every agent may express revised demands, "*effective demands*", for all markets, and consequently hear changed constraints. The auctioneer continues this quantity tâtonnement process until the newly expressed effective demands are equal to the former ones. Only then, when a K(eynesian) equilibrium has been reached, may transactions take place. As a result, the perceived quantity constraints that the agents have taken into account when determining their final effective demands are the same as those that will actually be generated by the exchange process. Generally, it is assumed that the rationing schemes have at least the following properties : Voluntary exchange and market efficiency, *i.e.*, if there is aggregate excess demand for a good, then no agent can have an unsatisfied supply of that good, and vice versa. Taken together, these properties provide the "*short-side rule*". This rule, saying that the "*short side*" of the market will always be able to realize its demand, implicitly presumes the performance of an auctioneer.

In the resulting K-equilibrium there may be aggregate excess demands not equal to zero. In this sense, the perfect coordination typical of a Walrasian equilibrium is not present. However, given the institutionally restricted space of prices, in a K-equilibrium every agent gets exactly what he expected when expressing his demands, and in this sense the plans of all agents are compatible.

3. Imperfectly Competitive Models

The essential characteristic of imperfect competition is that "*at least one agent in the economy has the right knowledge that the signals that he receives from his environment depend in whole or partially upon his own choices in a foreseeable way, and tries to exploit this dependence to his own profit*" (Gary-Bobo [1987], p. 2).

In a Cournot-Walras model (Gabszewicz & Vial [1972]), firms use quantities as a strategic variable, exploiting their objective knowledge of the demand function. It is assumed that firms know that, and how, a change in their own proposed demands influences the price vector. For the rest, the tâtonnement proceeds as usual.

The theory of general equilibrium with price making was first developed by Negishi [1961]. The most general treatments can be found in Benassy [1982] and Benassy [1987]. The former combines the theory of Negishi [1961] with the more recent theory about rationing. Commodities are distinguished by the agents setting their price, and a subset of prices is assumed to be fixed. Each price maker may choose the prices of a subset of commodities in order to manipulate his quantity constraints. Given the perceived demand curve, a price maker will set his price by solving the usual optimization problem, thus making equal marginal cost and marginal revenue. However, the quantity signals used to estimate the demand curve and the generation of these quantity signals by setting prices are, in fact, two simultaneous, interacting processes. To solve this problem, Benassy [1982] makes play with the cryptic characterization of an "*implicit instantaneous interaction*" (p. 95) of the two processes [2]. In other words, Benassy relies upon an auctioneer-cum-tâtonnement process in both prices and quantities. A K-equilibrium has been reached when every price maker is satisfied with all the price-quantity combinations obtained, and hence does not want to change the prices of the subset of commodities of which he is a price maker, or the quantities of the other subset of commodities of which he is a price taker. Only then do transactions take place. This procedure assures that perceived constraints are equal to actual constraints in equilibrium, thus satisfying the minimal coherence condition of the "*subjective*" approach. In the "*objective*" version of this approach, perceived and actual demand curves are equal everywhere. Such an analysis is performed by Benassy

[2] According to Benassy [1982], this ambiguous feature is inherent to the use of this framework and can be found, explicitly or implicitly, in all the literature on equilibria with monopolistic competition.

[1987], who makes use of a dual tâtonnement as well, although he claims that he has given an analysis of "*price making by decentralized agents in the absence of an auctioneer*" (p. 23).

4. Temporary Equilibrium Models

Dynamic models within the Walrasian discourse are the result of the development of temporary equilibrium models; an idea usually attributed to Hicks [1939] and brought into fashion in the 1970s by Grandmont. These models can be characterized by two modifications of the models discussed above. First, the set of future markets is not complete, *i.e.*, not every conceivable forward commitment is possible. To determine an equilibrium, resort is made to one of the Walrasian auctioneer-cum-tâtonnement mechanisms as outlined above. That is, prices may be flexible, fixed or set by price makers, and thus an equilibrium may be Walrasian or, for example, K(eynesian). This concept of equilibrium applies only to a single period and is called a "*temporary equilibrium*". Because a non-empty part of the space of goods is unmarketable, at the beginning of time not all transactions can be executed, and not all the plans of all the agents are pre-reconciled. This has two interesting consequences. First, agents take the *a priori* given transaction constraints with respect to some future goods into account when deciding on their plans concerning other goods. Second, the individual agent's decisions depend not only upon current variables, but also upon his expectations concerning all not-yet-determined future variables. Thus, second modification, the temporary equilibrium model concerning only one period, logically requires an extension to future periods. This is rendered possible by considering a sequence of temporary equilibrium models. In each elementary period, markets have to reopen because not all forward commitments have been possible in preceding periods. Only at discrete intervals, at the junction of subsequent periods, do all agents simultaneously make new decisions, taking account of the decisions of the past and their consequences. Within each period only consumption and production as a result of concluded commitments take place. As Grandmont [1977] puts it: "*Once an equilibrium is reached, trading takes place, and the economy moves to the next period*" (p. 557).

5. Recapitulation of the Walrasian Perspective

Leaving to one side the relative merits or weaknesses of the models reviewed, we can conclude that all the sketched models have, explicitly or implicitly, the following related and partially overlapping characteristics. First, the existence of an omniscient and omnipotent auctioneer. The auctioneer collects and disseminates information, he adjusts prices and/or quantities, and he physically executes the actual exchange at the appropriate moment, thus taking care of a frictionless, orderly market. Moreover, the auctioneer must check that the rules are respected; thus, *e.g.*, each individual's budget constraint must be obeyed. Second, the importance of the tâtonnement process [3]. Only when this "*groping*" does not provide the auctioneer with new information, may exchange take place, but never before that moment. If transactions took place before, the endowments would change and so would the demands [4]. Third, time plays no real role. There is assumed to be a conceptual separation between the time in which adjustment and finally exchange take place (the auctioneer's time, or meta-time), and the time in which commodities are dated, and consumption and production occur (the agents' time, or real time). This implies that adjustments may be thought as taking place immediately. Fourth, as a result, all agents are justified ex post in expressing their choices under the assumption that they will never be constrained more in their actions than expected; in other words, under the assumption that the economy is in equilibrium. Fifth, as soon as the processes taking place in meta-time are finished, and an equilibrium has been found, all realizable exchanges are executed immediately and the end of economic history has been reached. All that rests is the enjoyment of the attained commodities or the obligation to fulfill the accepted commitments. Equilibrium, Walrasian or non-Walrasian, in this perspective is a terminal state [5].

---

[3] In a fixed price temporary equilibrium model, the auctioneer might change prices at the junction of two periods without a tâtonnement process.

[4] A discussion of the literature taking up this possibility (*e.g.*, Hahn & Negishi [1962] would go beyond the scope of this essay.

[5] Temporary equilibrium models partially form an exception in this respect, in the sense that each terminal state is temporary.

II. AN APPRAISAL OF THE WALRASIAN PERSPECTIVE

1. Appraisal

We are now in a position to answer the question presented in the introduction. The answer must be negative. That is, the Walrasian claim that it is possible to explain both the individual actions and the overall outcome in a decentralized economy, in which all individual choices may be realized as planned, by making assumptions only about the primitives of the economy [6], is not right. The Walrasian perspective leads to models that are paradoxical. They claim to base their analysis of a decentralized economy upon the actions of autonomous agents, pretending to discard any kind of external determination of the behavior of the individual agents. However, it turns out that in order to explain anything, resort must be made to concepts and structures that transcend the level of the individual agents, *i.e.*, that are taken from the opposite extreme of the spectrum sketched in the introduction. Hence, this approach is inconsistent with the Walrasian claim.

The following points support this conclusion. First, the existence of the auctioneer, the division of time into meta- and real time, and the rules of the game in these models are in no way the result of the behavior of autonomous agents [7]. Secondly, although the actions of the individuals are not predetermined (they may choose to express the demands or prices they individually prefer), their set of *possible* actions is predetermined by the rules and structure of the model. Depending upon the variant, the only thing individual agents may do is express some demands or prices to the auctioneer, but in no case are they allowed to trade, consume or produce without his explicit permission, and never will it be possible to obtain permission for any form of interaction between themselves. Thirdly, whatever the phase of the tâtonnement process, each individual takes the structure of the model into account in calculating his choices,

---

[6] That is, about preferences and the physical environment.

[7] This first point is the most well-known and is thus relatively easily made. Note, however, that we do *not* argue in terms of "*lack of realism*", nor do we argue that, while every agent is assumed to exhibit optimizing behavior, there is no rationale why the auctioneer should, for example, change any prices at all (see *e.g.*, Weintraub [1979]). Including in the primitives of the economy an agent with preferences such so as to make him behave like an auctioneer (see *e.g.*, Arrow & Debreu [1954]) would not make any conceptual difference in this respect. The next two points are at least as important as the first, and may deserve some special attention.

trusting that the overall outcome will be such that he will be able to trade as much as he plans in any case. Clearly, the overall outcome still depends upon the preferences of the individual agents, but these agents are assumed to *anticipate* the equilibrium character of the overall outcome, which should, instead, be explained by their actions [8]. How can an individual agent in this model understand that the economy will turn out to be in equilibrium; unless he is God, the man with the invisible hand, or the auctioneer? Thus, Adam Smith's *transcendental* hand has been made visible, but it is still there.

With respect to the Walrasian perspective there are two more issues to get straight. First, often a distinction is made between the questions of existence and stability of equilibrium. However, the decisive point for rejecting the Walrasian claim is *not* the story of adjustment to equilibrium. If we abstract from the process of adjustment, *i.e.*, if we start immediately with the equilibrium values of the relevant variables, the entire analysis remains of importance. In fact, the standard Walrasian existence story is simply a one-step version of the adjustment story. Note, for example, that the auctioneer performs more tasks than only the tâtonnement process, and that the individual agents behave in equilibrium in exactly the same way as during any phase of a tâtonnement process. It is the structure implied by the Walrasian perspective as such that is the problem. Secondly, it might be argued that the Walrasian claim that there exists an equilibrium, *i.e.*, an overall outcome where each agent can realize his choice, *is* consistent with the axioms with respect to preferences, commodities, resources and technology on which the Walrasian practice is based. However, the argument that the Walrasian discourses are so consistently and firmly based upon such axioms is not relevant. We do not deny that the Walrasian construction is very robust. But while Hahn [1982b] states "*I still regard these constructions as useful scaffolding, but no more*" (p. xi), a point which will presumably be conceded by more Walrasians, this essay goes further, and argues that the Walrasian scaffolding may not even be the kind of scaffolding necessary for the construction of a theory of decentralized trade; the building of which some Walrasian economists claim that it has been constructed already. The reason is that the *implicit* rules, concepts and structures that are absolutely indispensable in the Walrasian discourses go substantially *beyond* the explicit axioms concerning the preferences and the physical

[8] Note that the agents rightly expect only *that*, when they will be allowed to trade, the outcome will be an equilibrium. As they do not need any expectation as to *what* such an equilibrium outcome will look like, this does not entail Rational Expectations.

environment, *i.e.*, the primitives of the economy. *That* is why the Walrasian practice is inconsistent with the claim to have constructed a theory of decentralized trade that explains the individual actions and the overall outcome based upon the concept of autonomous agents.

2. Other Walrasian Views

It should be noted that some authors have argued that the link between the perspective discussed in the sections above and the name of Walras does not do complete justice to the latter's insights (see *e.g.*, Morishima [1977] or, of course, Walras [1874]). Moreover, not every "*Walrasian*" economist would appreciate the auctioneer-cum-tâtonnement stories as told above.

Monetarist and new classical economists, for example, would prefer a more "*realistic*" story about individual agents wandering about, perceiving and pursuing every advantageous opportunity. However, if it is assumed that individual agents understand the full state of affairs in all markets simultaneously, an omniscience and calculating ability that seem characteristic only of a Walrasian auctioneer-cum-tâtonnement construction are imputed to the agents (see *e.g.*, Fisher [1983]). And indeed, in both monetarist and new classical theories it is assumed that the natural levels of employment and production are determined by a Walrasian model that takes into account some real world frictions. Consider, for example, the following quotation of Friedman [1969]: "*The 'natural rate of unemployment' ... is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is embedded in them the actual characteristics of the labor and commodity markets*" (p. 102). Sargent also considers the economy as organized by "*something that operates as a Walrasian auctioneer*" (Klamer [1984], p. 69). Clearly, such positions do not help to sustain the Walrasian claim.

A group of theoretical Walrasian economists, instead, would say that nowadays it is clear that the Walrasian perspective yields some unresolvable technical problems (see Kirman [1992] for a survey). Briefly, in a sentence, it is theoretically impossible to get the necessary characteristics of aggregate demand functions (needed in order to prove stability of the tâtonnement process) by imposing more and more restrictions upon individual characteristics. Because of this aggregation problem, the Walrasian claim should be stated much more precisely. Some economists claim only the following, usually with reference to

Debreu [1959]: '*Take an economy* $\mathcal{E} : A \to P \times \mathbb{R}^l_+$, *let the individual agents, for each price vector* p, *determine their demands by choosing the best point in their budget set, then, having made only the appropriate assumptions about the primitives of the economy, there exists a price vector* p^* *such that in each market the sum of the chosen quantities equals the total available resources*'. Thus, neither auctioneer nor tâtonnement enters the scene, and nothing is said about the structure of the economy. Debreu [1959] presents a mathematical proof of such a claim.

This Debreu-ian version is not only more precise than the Walrasian claim presented in the introduction, but also more modest in two senses. First, Debreu [1959] confines himself *explicitly* to the problem of existence [9]. Secondly, the *significance* of his proof of existence of an equilibrium, characterized by its optimality, needs a careful consideration. It is a widespread belief that in Debreu's model it is assumed that all agents are able to communicate and trade freely with each other, but attentive readers will notice that words such as *communication* and *trade* are not mentioned in Debreu [1959]. There is *supposed* to be a central price vector p, and all individual agents are *supposed* to know this, but this is not explained, nor is the manner in which it will be so. Individual agents are *supposed* to determine their demands by choosing the best point in their budget set. That is, the notion *action* is taken as synonymous *a priori* to the notions *point in a budget set* and *demand*, but it is not explained that these notions will indeed be equivalent for each individual agent. Why should agents choose the best point in their budget set as demands, and why would they not take any other action? Moreover, in Debreu [1959] trade as such is not considered at all. That is, individuals choose the best point in their budget set as demands, but in no way whatsoever is the question of how these demands might be *realized* considered. This is important, because it is with respect to these realizations that a number of problems become manifest (see *e.g.*, Ostroy [1973]).

Thus, Debreu [1959] is not a theory describing the individual actions or the overall outcome in a decentralized economy; it still necessitates a theory of communication and a theory of trade in such an economy. Hence, although Debreu gives an important result that may serve as a bench-mark, one cannot claim that '*Debreu has finally proved mathematically what Smith argued two centuries ago*'.

---

[9] But, as we argued above, this is only of minor importance.

III. CONCLUSION : A NEW PERSPECTIVE

As far as future developments of theories of decentralized economies are concerned, there seem to be three possibilities [10]. First, one might simply ignore the above described inconsistency between the Walrasian practice and the Walrasian claimed methodology, continuing with models and equilibrium concepts that implicitly assume a Walrasian structure. Secondly, one might forget about the individual agents and the ways one might derive aggregate conclusions from their behavior, focussing, instead, upon macroeconomics as a purely empirical discipline: by simply observing regularities in aggregates (see *e.g.*, Fitoussi [1983]). However, leaving out of consideration the details, the impossibility of empirical knowledge that is independent of any theoretical structuring is well-known. As Hahn [1983] puts it: "*If we are interested in the behavior of aggregates then we must use economic theory to help us, and the only theory we have is one of rational and self-seeking agents*" (p. 223). Therefore, third possibility, assuming that it is important to have models of decentralized economies that are as sophisticated as the Walrasian models, one might change perspective altogether, and adopt a different view on how to model a decentralized economy.

Before sketching such a new perspective, it may be useful to question where the Walrasian inconsistency stems from. The *claimed* Walrasian methodology is based on the recognition of the spectrum of explanatory factors of social phenomena sketched in the introduction; a spectrum that, in fact, is derived from two diametrically opposing ultimate determinants of such phenomena. It seems exactly *because* the Walrasian perspective adheres so strictly and exclusively, but in vain, to the autonomous subjects as the ultimate explanatory factor of the actions and outcomes of a decentralized economy, that the Walrasian models are *forced* to use so many aspects of the other of the two ultimate determinants of social phenomena, to be found at the opposite extreme of the spectrum. Hence, the fundamental problem is not the actual Walrasian *practice*, which does not yet stand up to the high standards claimed for it, but the Walrasian *perspective* itself; in other words, one level of abstraction higher [11].

---

[10] Clearly, models of decentralized trade other than the Walrasian ones discussed here do exist, but this literature (*e.g.*, Fisher [1983]) or Goldman & Starr [1982]) deserves a separate discussion.

[11] Clearly, from the Walrasian perspective itself, making use of concepts belonging to the opposite extreme of the spectrum means a failure of the Walrasian project. But

Therefore, the most consequential conclusion of this essay is that it is time to abandon the whole idea that a theory of decentralized trade must necessarily be based upon autonomous agents. This does *not* imply that one should construct such theories from the other side of the spectrum mentioned in the introduction of this essay, that is considering given structures, institutions, etc. as the ultimate explanation of social phenomena. Rather, one should completely forget the spectrum based on the two diametrically opposing ultimate determinants of social phenomena. The point is, as Veyne [1978] argued, that the controversy between the views that claim the prevalence either of autonomous subjects or of given structures, is a *false* contrast. Clearly, what is of fundamental importance in a theory of a decentralized economy are the actions of individual agents. But if one wants to explain the overall outcomes of such an economy without making resort to Walrasian structures, one should allow for some forms of *real interaction* between the individual agents.

All kinds of information and coordination problems have to be handled by the individuals themselves, and questions arise concerning the influence of decisions of individual agents upon other agents. Each individual's activities will in a certain way be "*involved*" in the activities and decisions of some other agents. Thus, each agent will have a different relevant "*environment*" for different kinds of activities. Individuals are not autonomous agents in the sense that their possible actions and outcomes do depend upon their environment. However, the structure of these relevant environments is not fixed as each individual action might well influence the environments of some other individuals. It is also impossible to attribute the existing structures to one subject only, or to explain it by one reason. The structures are the result of innumerable individual decisions that interlock with each other, and may produce effects that were not in the minds of any of these individuals [12].

In the social science literature analogous methodological ideas have become known through Gidden's [1984] "*theory of structuration*", which argues that social structures are at the same time both the outcome of the actions of individual agents, and the medium that influences the individual agents' actions, constraining as well as enabling their behavior. In economics, this methodological point of view would appear

---

most probably, the in this analysis exposed Walrasian practice will be unacceptable in *any* perspective on decentralized trade.

[12] Note that, from the Walrasian perspective, these suggested discourses, with interacting individual agents, will be as unacceptable as the current Walrasian discourses, but the sketched alternative concerns one level higher, the level of the perspectives itself.

to approach what Prychitko [1989] argues to be the "*sophisticated individualism*" of Hayek and the Austrian School.

The recently emerged study of "*complex adaptive systems*" (see *e.g.*, Nadel & Stein [1991, 1992, 1993]) has shown that the *analytical tools* are becoming available to make these methodological insights concrete in rigorous quantitative analyses. A "*complex system*" is a system which consists of a large number of relatively independent parts that are interconnected and interactive. Such a system is '*adaptive*' if these parts are agents which change their actions as a result of the events in the process of interaction. An essential characteristic of a complex system is that its global properties cannot be derived directly from an examination of the individual components. Even when each individual agent is inherently simple, the behavior both of the system as a whole and the individual agents may become complex (see *e.g.*, Holland [1992], Langton [1989] or Kauffman [1993]). Rather than analyzing whether an equilibrium might exist for a system with some *given* structure, in this approach one analyzes how structures and patterns may *emerge* as regularities in the process of interaction of the individual agents.

Some examples of studies of decentralized trade within this new perspective are Marimon *et al.* [1990], analyzing the emergence of a medium of exchange, Bak *et al.* [1993], concerning emergent patterns in macroeconomic dynamics, Arthur *et al.* [1994] examining the emergence of trading rules and patterns in prices and volumes on a stock market, and Vriend [1994] studying the emergence of self-organized markets.

REFERENCES

Arrow K.J., Debreu G., "Existence of an Equilibrium for a Competitive Economy", *Econometrica*, 22, 1954, p. 265-290.

Arthur W.B., Holland J., LeBaron B., Palmer R., Taylor P., *An Artificial Stock Market* (mimeo), 1994.

Bak P., Chen K., Scheinkman J., Woodford M., *Aggregate Fluctuations from Independent Sectoral Shocks: Self-Organized Criticality in a Model of Production and Inventory Dynamics* (Working Paper 93-01-004), Santa Fe Institute, 1993.

Benassy J.P., *The Economics of Market Disequilibrium*, New York, Academic Press, 1982.

Benassy J.P., *The Objective Demand Curve in General Equilibrium with Price Makers* (research paper n°8719), CEPREMAP, Paris, 1987.

Debreu G., *Theory of Value: An Axiomatic Analysis of Economic Equilibrium*, New York, Wiley, 1959.

Drèze J.H., "Existence of an Exchange Equilibrium under Price Rigidities", *International Economic Review*, 16, 1975, p. 301-320.

Fisher F.M., *Disequilibrium Foundations of Equilibrium Economics*, Cambridge, Cambridge University Press, 1983.

Fitoussi J.P., "Modern Macroeconomic Theory, An Overview", in J.P. Fitoussi (Ed.), *Modern Macroeconomic Theory*, Oxford, Blackwell, 1983.

Friedman M., "The Role of Monetary Policy", in M. Friedman, *The Optimum Quantity of Money and Other Essays* (p. 95-110), Chicago, Aldine, 1969.

Gabszewicz J.J., Vial J.P., "Oligopoly 'à la Cournot' in a General Equilibrium Analysis", *Journal of Economic Theory*, 4, 1972, p. 381-400.

Gary-Bobo R.J., *Equilibre général et concurrence imparfaite: un tour d'horizon* (mimeo), 1987.

Giddens A., *The Constitution of Society*, Cambridge, Polity Press, 1984.

Giddens A., Turner J. (Eds.), *Social Theory Today*, Cambridge, Polity Press, 1987.

Goldman S., Starr R., "Pairwise, t-wise, and Pareto Optimalities", *Econometrica*, 50, 1982, p. 593-606.

Grandmont J.M., "Temporary General Equilibrium Theory", *Econometrica*, 45, 1977, p. 535-572.

Hahn F.H., "Reflections on the Invisible Hand", *Lloyds Bank Review*, n°144, 1982a, p. 1-21.

Hahn F.H., *Money and Inflation*, Oxford, Blackwell, 1982b.

Hahn F.H., "Comment on 'Keynesianism, Monetarism, and Rational Expectations, Some Reflections and Conjectures'". In R. Frydman & E.S. Phelps (Eds.), *Individual Forecasting and Aggregate Outcomes, "Rational Expectations" Examined* (p. 223-230), Cambridge, Cambridge University Press, 1983.

Hahn F.H., Negishi T., "A Theorem on Non-Tâtonnement Stability", *Econometrica*, 30, 1962, p. 463-469.

Hicks J.R., *Value and Capital*, Oxford, Oxford University Press, 1939.

Holland J.H., *Adaptation in Natural and Artificial Systems. An Introductory Analysis with Applications to Biology, Control, and Artificial Intelligence* (2nd ed.). Cambridge, MA, Mit Press, 1992.

Kauffman S.A., *The Origins of Order. Self-Organization and Selection in Evolution*, New York, Oxford University Press, 1993.

Kirman A., "Whom or What Does the Representative Individual Represent?", *Journal of Economic Perspectives*, 6, n°2, 1992, p. 117-136.

Klamer A., *The New Classical Macroeconomics. Conversations with New Classical Economists and their Opponents*, Brighton, Wheatsheaf, 1984.

Langton C.G. (Ed.), *Artificial Life: Proceedings of an Interdisciplinary Workshop on the Synthesis and Simulation of Living Systems*, 1988 (Vol. VI, Santa Fe Institute Studies in the Sciences of Complexity), Redwood City, CA, Addison-Wesley, 1989.

Laroque G., *On the Inventory Cycle and the Instability of the Competitive Mechanism* (Document de Travail nr 8704), INSEE, Paris, 1987.

Marimon R., McGrattan E., Sargent T.J., "Money as a Medium of Exchange in an Economy with Artificially Intelligent Agents", *Journal of Economic Dynamics and Control*, 14, 1990, p. 329-373.

Morishima M., *Walras Economics*, Cambridge, Cambridge University Press, 1977.

Nadel L., Stein D. (Eds.), *1990 Lectures in Complex Systems. Santa Fe Institute Studies in the Sciences of Complexity* (vol. Lectures III), Redwood City, CA, Addison-Wesley, 1991.

Nadel L., Stein D. (Eds.), *1991 Lectures in Complex Systems. Santa Fe Institute Studies in the Sciences of Complexity* (Vol. Lectures IV), Reading, MA, Addison-Wesley, 1992.

Nadel L., Stein D. (Eds.), *1992 Lectures in Complex Systems. Santa Fe Institute Studies in the Sciences of Complexity* (Vol. Lectures V), Reading, MA, Addison-Wesley, 1993.

Negishi T., Monopolistic Competition and General Equilibrium, *Review of Economic Studies*, 28, 1961, p. 196-201.

Negishi T., "The Stability of a Competitive Economy: A Survey Article", *Econometrica*, 30, 1962, p. 635-669.

Ostroy J.M., "The Informational Efficiency of Monetary Exchange", *American Economic Review*, 63, 1973, p. 597-610.

Prychitko D.L.,"Methodological Individualism and the Austrian School", *Journal des Economistes et des Etudes Humaines*, 1, n°1, 1989, p. 171-179.

Punzo L.F., "Von Neumann and Karl Menger's Mathematical Colloquium", in M. Dore, S. Chakravarty & R. Goodwin (Eds.), *John von Neumann and Modern Economics* (p. 29-65), Oxford, Clarendon, 1989.

Samuels W.J. (Ed.), *Economics as Discourse. An Analysis of the Language of Economics*, Dordrecht, Kluwer, 1990.

Smith A., *An Inquiry into the Nature and Causes of the Wealth of Nations*, London, Strahan and Cadell, 1776.

Vaughn K.I., "Invisible Hand", in J. Eatwell, M. Milgate & P. Newman (Eds.), *The Invisible Hand. (The New Palgrave)* (p. 168-172), London, McMillan, 1989.

Veyne P., *Foucault révolutionne l'histoire*, Paris, Seuil, 1978.

Vriend N.J., *Self-Organized Markets in a Decentralized Economy* (Working Paper 94-03-013), Santa Fe Institute, 1994.

Walras L., *Eléments d'économie politique pure*, Lausanne, Corbaz, 1874.

Weintraub E.R., *Microfoundations, The Compatibility of Microeconomics and Macroeconomics*, Cambridge, Cambridge University Press, 1979.