

The "Base Camp" Nonparadox:  
Reflections on the Tatonnement Idealization in Walrasian Economics

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D. Wade Hands  
Department of Economics  
University of Puget Sound  
Tacoma, WA 98416

## 1. Introduction

Michael DeVroey (1990) has recently argued that Walrasian general equilibrium theory contains a paradox: the so-called "base camp paradox." His position is that the Walrasian competitive model, the "base camp" for the study of decentralized economic systems, actually requires a centralized coordination mechanism. This would mean, rather paradoxically, that "the Walrasian economy ends up being a special type of socialist economy" (p. 236).<sup>1</sup>

The paradox, according to DeVroey, arises because of the tatonnement adjustment mechanism in the Walrasian model. In its most familiar form the tatonnement (hereafter TAT) describes the behavior of competitive prices outside of equilibrium; it specifies that when there is a positive excess demand for any particular good (demand > supply) the price of the good will rise, and when there is a negative excess demand (demand < supply) the price of the good will fall. Since the "agents" in the Walrasian model behave as competitive price takers -- they take prices as parameters rather than as choice variables -- the TAT must be independent of, and in a sense prior to, the behavior of the individual agents. The supplies and demands are generated by the maximizing behavior of the individual agents, but the TAT -- the mechanism that allows the trades to be coordinated -- must be a metamechanism (sometimes an auctioneer) that guides the price system to its equilibrium position. This produces the "base camp paradox;" what "should be a decentralized system is subtly converted into its opposite, a centralized economy" (p. 241).

One approach to dissolving this paradox would be to sever the connection between Walrasian equilibria and the TAT mechanism. Some suggestions in this regard will be made in the penultimate section, but such suggestions are not the main thrust of what follows. The approach that will be taken in the following discussion will be to dissolve the paradox given DeVroey's presupposition regarding the importance of the TAT to the Walrasian program. Two separate arguments will be made. In the first section the TAT will be carefully examined as a particular type of theoretical idealization; more specifically, the terminology introduced in Maki (1991) for classifying various types of isolations and idealizations will be applied to the question of the Walrasian TAT. In the second section a different approach will be taken -- the TAT will be characterized as an emergent phenomenon that supervenes on the underlying behavior of the individual economic agents. In the third section some alternatives to the TAT

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<sup>1</sup> Page numbers without additional reference information refer to DeVroey (1990).

will be discussed and it will be concluded that while the "base camp paradox" really isn't a paradox after all, the Walrasian TAT remains an extremely problematic notion.

## 2. TAT as Idealization

As Maki (1991, p. 9) argues "idealizations" are particular types of "isolations." In his usage isolations are ways of (materially or theoretically) "sealing off" certain elements of the universe (the isolated field) from the rest of the universe (the excluded field). The types of isolations that are used in Walrasian general equilibrium theory are theoretical, rather than material, isolations, since the isolation occurs as the result of a "thought experiment" (Maki, 1991, p. 11) rather than an actual physical isolation in a laboratory.

Within the general category of theoretical isolations some are "internal," they isolate certain elements from influences within the system, while other isolations are "external," they isolate the system from outside factors. General equilibrium theory contains both internal and external isolations.

For some examples of such isolations one only needs to consider a pure exchange Walrasian economy. In such an economy the behavior of each trader is fully determined by the individual's preferences (usually given by a utility function) and their initial endowments. The agent's demand (or supply if a net seller) for each good is the result of maximizing their utility function subject to an income constraint (determined by the value of the agent's initial endowment). This pure exchange model clearly entails an external isolation since many other factors, from the weather to the government, are excluded from the agent's decision making. The model also entails internal isolations since even the few factors that are considered, preferences and endowments, are restrictively defined and assumed to be unchanged throughout the maximization (and equilibration) process.

An idealization in Maki's scheme (1991, p. 14) is a limiting isolation, that is an isolation where a particular variable takes on the limiting value of 0 or 1. One example of such an idealization is the notion of a "competitive agent" in neoclassical economics. In the limiting case of a monopoly, "the market" is composed exclusively of a single agent. As more agents enter the market: two, three, four, etc., the "impact" of each agent on the market decreases. As the number of agents approaches infinity the impact of each individual on the market approaches zero. Thus the "competitive agent" is an idealization where each agent "is so small relative to the market that they have no impact on the market price." Since these competitive agents have no impact on the market price they treat prices as parameters, something beyond their control, rather than as decision or choice variables. Once the "competitive agent" idealization is

made it can be included in general equilibrium models without an infinite, or even large, number of agents. The standard 2-good textbook model of pure exchange where the choice space is given by an Edgeworth box becomes a "competitive model" whenever the agents take prices as parameters, even though there are only two such agents.

The Walrasian TAT can also be viewed as a particular kind of theoretical idealization. It is an idealization that starts with a story and ends with a model. In this usage a "model provides a more or less rigorous and skeletal representation of the relations within the isolated field, while a story attached to the model is a looser and thicker commentary which gives flesh to the thin skeleton" (Maki, 1991, p. 18). The relevant story for the TAT is both old and well corroborated. It is the story that in markets with a relatively large number of traders prices move in the direction of excess demand, that is, high demand relative to supply increases prices while low demand relative to supply decreases prices. In the pure exchange model with  $x(p)$  being the demand function for the good,  $x$  the (fixed) supply, and  $t$  is time, the above story becomes the price adjustment model,

$$\Delta p / \Delta t = x(p) - x. \quad (1)$$

It is often said that prices change on the basis of the model in (1) *ceteris paribus*, but the *ceteris paribus* clause seems unnecessary in this case. The specification (1) makes omitted factors out of everything except  $x(p)$  and  $x$ , and in the standard theory  $x(p)$  already contains its own *ceteris paribus* clause. To move from the model in (1) to the standard TAT "idealization,"

$$dp / dt = x(p) - x, \quad (2)$$

only requires "going to the limit" and considering an instantaneous rate of change in the price of the good.

It would be possible to continue the discussion and evaluate the "isolative strategy" (Maki, 1991, p. 24) behind the TAT idealization, but it is really not necessary. The point has been made. The standard Walrasian TAT does not represent a centralized coordination mechanism as DeVroey has argued; there is no "base camp paradox." The TAT is simply a theoretical idealization based on the familiar story about how prices change in relatively competitive markets. Of course this does not mean that the TAT is wholly without problems. As we will see below there are a number of difficulties associated with the TAT and its relationship to the other aspects of the Walrasian model. These issues will be postponed though until after the next section which provides an alternative way of characterizing the TAT.

### 3. Equilibrium Prices as Emergent Phenomena

While the previous section has demonstrated that it is possible to characterize the Walrasian TAT as a "theoretical idealization" in the sense of Maki (1991), this is not the only reasonable approach. An alternative is to consider the TAT an emergent phenomena. These two approaches are not mutually exclusive, but as Maki argues it is easier to apply the method of isolation and idealization to situations where the causes are combined "mechanically" (simply added together) than to cases where the causes are combined "chemically," that is where "emergent outcomes ensue" (1991, p. 46).

Microeconomic explanations are often characterized as intentional explanations, that is, they explain the phenomena in question on the basis of the beliefs and desires (i.e. intentions) of the individual economic agents. Economic agents have desires that are represented by their utility functions or profit functions and they act so as to maximize those desires subject to the constraints they face. In the philosophical literature such explanations are called "folk psychology" because they correspond to our common sense (folk) notions about why people do what they do.<sup>2</sup> It could in fact be argued that microeconomics is little more than mathematical folk psychology.

Even if it is the case that microeconomic explanations are based in folk psychology it can also be argued that "market" phenomena constitute something more than the intentional actions of the individual agents. As in chemistry where properties of compounds "emerge" from the combination of the elements that go into them, market prices "emerge" from the rational behavior of the individual economic agents that participate in the market. In this way it can be argued that market phenomena, including the TAT, are emergent phenomena. Folk psychology explains the intentional actions of individual agents, but the market phenomena that emerge from these actions are not "intentional;" they are the unintended consequences of these individual actions. Since they are the unintended consequences of individual rational action they are something other than merely the sum of these actions. The individual demands can be explained in terms of the beliefs and desires of the individual agents, but the unintended consequences of the interaction of these beliefs and desires are emergent and must be higher level kinds than the intentional actions that generate the demands.<sup>3</sup>

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<sup>2</sup> The intimate relationship between microeconomics and folk psychology is increasingly being recognized in the literature; see for example Maki (1991, 1990) and Rosenberg (1981, 1988).

<sup>3</sup> Such explanations are termed "supra-intentional" explanations by Hargreaves Heap (1989, p. 39). This general way of characterizing the relationship between individuals and social entities has been called "situational individualism" by Wisdom (1970).

Now one might suspect that by characterizing market phenomena as something other than the behavior of individual agents we have placed ourselves on a slippery slope with social wholes as agents and collective intentionality as the logical next step. Not so. If market phenomena such as the TAT supervene<sup>4</sup> on the actions of the individual agents (if the actions of the agents form the supervenience base for the market phenomena) then the ontological primacy of individual action can be preserved; the market will be "determined by" or "constituted by" the actions of the individual agents, but still retain its own unique emergent properties. The actions of the individual agents "fixes" the characteristics of the market phenomena (if the agents were exactly the same and behaved in exactly the same way then the market would be exactly the same), but this does not mean that the market phenomena can be "reduced to" the actions of the individual agents since the market is composed of unintended consequences as well as the intentional actions of the agents.<sup>5</sup>

When the TAT is viewed in this way market prices emerge as a result of the unintended consequences of the actions of the individual economic agents and they supervene on the actions of those agents. Supervenience implies, in the Walrasian context, that if the agents in two different pure exchange economies had exactly the same preferences and endowments then the same market prices would emerge in the two economies. On the other hand this supervenience of the market prices on the behavior of the economic agents does not imply that the emergent market phenomena can always be reduced to the actions of the economic agents. The argument is that the emergent "law of supply and demand" supervenes on the (intentional) "law of supply" and the (intentional) "law of demand" generated by the rational actions of the individual economic agents.

Such a TAT is consistent with the methodological individualism of neoclassical economics since it "holds that once all the facts about individuals, described solely in individualist terms, are set, then so too are all the facts about social phenomena" (Kincaid, 1986, p. 509). This process does not require an intentional social agent, such as the Walrasian auctioneer, to change prices and bring about the coordination of the plans of the individual agents. From this perspective there is no "base camp paradox." Market prices emerge as the unintended consequence of the individual actions of the economic agents; these prices are

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<sup>4</sup> See Kim (1978, 1984) on the concept of supervenience. Currie (1984, p. 347) summarizes supervenience in the following way: "let N be a class of facts, events or characteristics, and let M be another such class. The M supervenes on N (or, N is a supervenience base for M) if and only if sameness with respect to N entails sameness with respect to M."

<sup>5</sup> The argument expressed above, "that it is reasonable to hold that social phenomena supervene upon individual phenomena but that this does not imply that social concepts or social explanations need to be reduced to individual-level concepts and explanations" (Little, 1991, p. 195), can be found in a number of recent sources; Currie (1984), Kincaid (1986, 1988, 1990), Lennon (1990), Little (1991), and Nelson (1990) for example.

social phenomena but they do not require the presence of a social consciousness to come into being.

#### 4. The TAT in Modern General Equilibrium Theory

It has been argued that the "base camp paradox" disappears when the TAT is characterized as a theoretical idealization or when it is viewed as an emergent market phenomena that supervenes on the actions of the individual agents. Even though there is no "base camp paradox," the Walrasian TAT is not without its problems. In fact even without the paradox, the TAT remains one of the most troublesome notions in the general equilibrium research program.

First and foremost is the stability issue; regardless of how the TAT is characterized it must "lead to" equilibrium prices. Not only must it "lead to" equilibrium prices it must do so in a manner that is not inconsistent with the primitive assumptions of the Walrasian model – the standard restrictions on the behavior of economic agents. If the TAT is viewed as the theoretical idealization  $dp/dt = x(p) - x$ , then it must be that the behavior of the economic agents that generates  $x(p)$  is not inconsistent with the differential equation  $p$  conveying to the value  $p^*$  where  $x(p^*) = x$ . Alternatively, if the TAT is viewed as an emergent supervenient phenomenon then the individually rational actions of the economic agents should not be inconsistent with the emergence of equilibrium prices. In either case, if the primitive assumptions of the Walrasian model, assumptions that impose restrictions on the behavior of individual economic agents, are inconsistent with the stability of the TAT and thus the emergence of equilibrium prices, the entire Walrasian model represents an inconsistent framework.

This inconsistency is precisely the situation that currently exists in general equilibrium theory. The standard assumptions on the behavior of economic agents impose almost no restrictions on the excess demand functions that govern the behavior of prices outside of equilibrium. Since the excess demand functions are essentially unrestricted it is quite easy to construct unstable TAT processes that diverge from (rather than converging to) the equilibrium position.<sup>6</sup> Thus the standard assumptions on the behavior of Walrasian agents are inconsistent with the guarantee of convergence to (or emergence of) equilibrium prices. For some particular restrictive special cases there may be stability, but the condition that one really needs for the consistency of the Walrasian framework -- that "well behaved" individual agents will always guarantee the convergence to (or emergence of) a set of equilibrium prices – is simply not available.

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<sup>6</sup> Most of these problems stem from the Debreu-Mantel-Sonnenschein et al. results on aggregate excess demand functions (summarized in Shafer and Sonnenschein, 1982). The few stability results that are available are presented in Hahn (1982) and the whole issue is carefully examined in chapter 12 of Ingrao and Israel (1990).

Secondly, the many attempts to formally do away with the TAT have been unsuccessful. A number of these have been attempts to make price changes directly the result of the actions of the individual agents.<sup>7</sup> Had these efforts been successful, the TAT could be eliminated entirely and market prices would be the direct result of the intentional actions of individual agents. Suggestions regarding this approach go back to at least Arrow (1959) and if successful they would give the Walrasian model a type of methodological individualism stronger than the supervenience relation discussed above; under the assumptions of these models the market prices could be reduced to the actions of the individual economic agents rather than merely supervening on them.

In addition to these models that attempt to put price changes directly in the hands of the economic agents there have also been a number of models of "non-tatonnement" stability and "dual-decision making" (or spillovers).<sup>8</sup> Both the "non-tatonnement" and the "dual-decision" approaches generated a quite extensive body of literature during the 1970s but have since waned in popularity. The basic problem with these models, as with those where prices are adjusted directly by economic agents, is the paucity of positive results. In all of these cases the standard restrictions on the preferences of the individual agents are assumed, and then by some (sometimes rather elaborate) scheme involving behavior not grossly at odds with the self-interest of the individual agents, prices are supposed to emerge. The problem is that in general such prices do not emerge unless (as in the models of TAT stability) restrictive special assumptions are imposed on either the economic agents or the scheme that generates the prices. The bottom line is that no substitute for the Walrasian TAT has yet "emerged" that allows equilibrium prices to emerge from every economy where the economic agents are restricted in the standard neoclassical way.

The third approach to these issues is the approach of the New Classical economists and it simply amounts to assuming that the economy is always in general equilibrium. The economic agents are specified in the standard way and then only equilibrium prices are considered. In this way the question of the TAT mechanism or the way that the equilibrium emerges is simply neglected. As Hahn characterizes such models, "there is no nonsense here about the invisible hand doing any noticeable and comprehensive work: its task is accomplished by definition" (1983, p. 48).<sup>9</sup>

If the advocates of the "always in equilibrium" approach feel obligated to tell a

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<sup>7</sup> Fisher (1972, 1983) for instance.

<sup>8</sup> The foundational paper for the former is Hahn and Negishi (1962) and the foundational paper for the latter is Clower (1965).

<sup>9</sup> Hahn admonishes this general approach in the following way. "The Lucasian determination to consider only Walrasian equilibrium prices at each date leaves them with only half a theory. It is as if a physicist considered only objects when at rest on the ground and did not bother himself with a theory of gravity" (1983, p. 60).

story about price determination (often they do not feel any such obligation) the story that is told is basically an arbitrage argument. Disequilibrium would mean unexploited gains from trade -- it would mean that the potential for mutually advantageous trades existed -- but for some reason agents fail to take advantage of this potential. Since not taking advantage of utility increasing opportunities is a violation of the basic rationality assumption on individual economic agents, disequilibrium is simply disallowed.<sup>10</sup>

While it may be possible to reconcile such an "always at equilibrium" view with the "emergence" story from section three above, this is not the way the issue is addressed in the New Classical literature. The New Classical economists do not consider the TAT at all -- they simply assume full general equilibrium. The arbitrage argument is not provided as a version of the TAT story; it is provided as a story about why we need not consider the TAT or any other disequilibrium issues at all. The difference here is subtle and it seems to have escaped DeVroey in his discussion of the base camp paradox. DeVroey argues that the New Classical economists "are definitely to be counted among the defenders" (p. 245) of the TAT. This is not the case; the New Classical program is an attempt to do general equilibrium theory without any discussion of the TAT or any other disequilibrium mechanism.<sup>11</sup> Of course the question of whether this attempt has been successful or not is a separate issue.

## 5. Conclusion

In summary then it is clearly the case that all is not well with the TAT -- in particular, all is not well with the TAT and its relationship to the more primitive assumptions of the Walrasian model (the standard assumptions on the behavior of economic agents). There was a time in the early 1960s when it appeared that all of the issues surrounding the stability of the TAT and its relationship to the behavior of Walrasian agents would be worked out by the continued application of ever more sophisticated mathematical machinery. The problems have not yielded to the formal machinery and have in fact continued to accumulate as a result of its application. Despite all of these problems there still is not a "base

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<sup>10</sup> This type of arbitrage argument is reflected in McCloskey's Five-Hundred-Dollar-Bill Theorem: "there exists no sidewalk in the neighborhood of your house on which a five-hundred-dollar-bill remains" (1988, p. 394). It is also reflected in the following joke from Elster (1989, p. 109, note 9): "Two rational-expectation economists are walking down Wall Street. One of them sees a fifty-dollar bill on the sidewalk and bends down to pick it up. The other stops him by saying that if the bill was genuine someone would have picked it up already." A careful philosophical analysis of such arbitrage arguments is provided by Hausman (1989).

<sup>11</sup> Lucas is quite explicit in his denunciation of the TAT adjustment mechanism. He argues (1981, pp. 278-88) that when Samuelson introduced the formal TAT mechanism "free parameters" were introduced (essentially the speeds of adjustment in the markets) that accommodated the apparent "unification" of Keynesian and neoclassical economics. Of course for Lucas introducing such "free parameters" is exactly what one should not do in economics.

camp paradox." The Walrasian TAT, as problematic as it is, does not reduce to the proposition that "the Walrasian economy ends up being a special type of socialist economy" (p. 236).

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