DOES SEARCH THEORY PROVIDE A MICRO FOUNDATION FOR KEYNESIAN MODELS AND A RATIONALE FOR POLICY ACTIVISM?
A Review of Peter Diamond's Wicksell Lectures

Steve J. DAVIS*

Graduate School of Business, University of Chicago, Chicago, IL 60637, USA

A Search-Equilibrium Approach to the Micro Foundations of Macroeconomics: The Wicksell Lectures, 1982 (MIT Press, Cambridge, Mass., 1984, 71 pp.) publishes two lectures that Peter Diamond gave in Stockholm. As the subtitle indicates, the lectures honor the memory of Knute Wicksell. In this review essay I describe the central features of Diamond's search-equilibrium models and relate several of their most interesting implications. I then turn to the question posed in this essay's title, considering both Diamond's views and my own. Lastly, I sum up my assessment of Diamond's analysis and interpretation of his search-equilibrium models.

In his first lecture, Diamond offers a leisurely development of the general equilibrium search framework that he has analyzed more fully in several recent and forthcoming journal articles. By focusing on the essential conceptual features of his general equilibrium search framework and clearly developing the intuition behind the major results, Diamond's first lecture provides a smoothly-paved introduction to many of the most interesting ideas in the equilibrium search literature. In the second lecture, Diamond elaborates on what he sees as the broader implications of his search-equilibrium framework, touching upon a number of topics. These topics include the prospects for integrating micro- and macroeconomics using a search-equilibrium approach; the logical relationship among Keynesian, new classical and general equilibrium search models; the adequacy of the rational expectations hypothesis as a modelling device and as a basis for policy prescription; and the desirability of activist government policy designed to improve the coordination of individuals' trade and production decisions.

The key characteristic of Diamond's search framework that distinguishes it from other approaches to the microfoundations of macroeconomics and from

*I thank Allan Drazen, Herschel Grossman and Peter Howitt for helpful comments on an earlier version of this essay.

other search-theoretic models is the complete absence of the Walrasian auctioneer or any other market institution that facilitates transactions. (Diamond does assume, however, that agents correctly forecast future prices and rates of trading opportunities, an outcome that he views as one manifestation of the trade-coordinating activities of the auctioneer.) Diamond assumes that all trade in the economy occurs between individuals who meet according to a random search technology. Furthermore, he assumes that this random search technology exhibits increasing returns to scale — the larger the number of agents engaged in search, the easier it is for any individual searcher to find a trading partner. Stripped of trade-facilitating market institutions and given the trading externality present in the search technology, the economy faces significant barriers to the successful coordination of individuals' production and trade decisions.

To illustrate the basic coordination problem that arises in Diamond's models, it is useful to consider a very simple, static, two-person production and search economy. Each person can produce, for inventory and possible trade, either one or zero units of the sole good in the economy. Production requires incurrence of the utility cost, \( c \). If a person chooses to produce, he stores his output as inventory and searches for a trading partner. The probability of finding a trading partner depends on the level of inventories in the economy: if both persons produce, then the probability of successful search is \( p \); otherwise, the probability of successful search is zero. Successful search results in consumption with a utility value, \( u \), and unsuccessful search results in no consumption with a utility value of zero. Two of the four possible outcomes in this economy are Nash equilibria, provided that \( pu > c \). The two equilibria are Pareto-ranked: each person has zero utility in the no-production equilibrium, and each person has (ex ante) expected utility of \( pu - c \) in the production equilibrium.

In addition to the multiplicity of Pareto-ranked equilibria, this simple economy illustrates two other salient features of Diamond's more complicated production and search models. First, the search technology exhibits increasing returns to scale. Second, the search technology implies a trading externality that causes a positive feedback between production for inventory and trade: 'Increased production for inventory makes trade easier; easier trade makes production for inventory more profitable and, therefore, justifies its increase.' The multiplicity of equilibria arises because of the positive feedback between production decisions and ease of trade.

The coordination problem in this simple economy is transparent and appears almost trivial. Yet, upon generalizing the model in several directions, the central coordination problem remains but no longer appears trivial. The prototype general equilibrium production and search model that anchors the discussion in Diamond's first lecture is a generalization of the static, two-person model to a continuous time setting with a continuum of agents who repeatedly
alternate between holding zero units while awaiting a production opportunity, and holding one unit while searching for a trading partner. Heterogeneous production opportunities arrive randomly according to an exogenous stochastic process. When a production opportunity arrives, the instantaneous disutility cost of that opportunity is revealed and the individual decides whether to incur the cost and hold inventory or wait for a better opportunity. When holding inventories, trading opportunities arrive according to an endogenous stochastic process that exhibits the increasing returns to scale property. Upon arrival of a trading opportunity, the two agents involved in the match exchange inventory holdings, reap an instantaneous utility benefit from consuming the traded good, and begin waiting for a new production opportunity.

Agents discount future utility, so that waiting for a production or trading opportunity is costly. The only individual choice variable in this model is the production cost cutoff level. Agents' choice of this cutoff level depends on the profitability of production, which, in turn, depends on the aggregate inventory level in the economy. The aggregate inventory level in the economy is determined by the willingness of agents to produce. Hence, the positive feedback between production decisions and trade activity present in the two-person model manifests itself in Diamond's more general models as well. The more general models also contain interesting implications not present in the static two-person model. I relate some of these implications here.

First, Diamond's prototype model and extensions imply the possibility of many more than two equilibria. The equilibria are Pareto-ranked, and typically all equilibria are inefficient. In the prototype model, for instance, the equilibrium production cost cutoff level always lies above the optimal production cost cutoff level. Because of the multiplicity of Pareto-ranked equilibria, the government can potentially improve the coordination of trade and production activity by increasing the profitability of production. One possibility along these lines that Diamond mentions is government pronouncements suggesting that there is nothing to fear but fear itself. The idea here is that government pronouncements affect perceptions of, and therefore the actuality of, profitability in production. Another possibility that Diamond (1982) considers is production subsidies that induce agents to choose socially optimal production cost cutoff levels. Most importantly, in Diamond's view, the government can adopt stimulatory fiscal policies that directly increase the profitability of production and 'launch the economy on the optimistic path'.

Diamond does not undertake an explicit analysis in a dynamic setting of government fiscal policies that would achieve this objective, although in his 1982 paper he formally investigates the potential for stimulatory fiscal policies by incorporating a publicly-provided good into a static version of his production and search model. Under the critical assumption that provision of the publicly-provided good facilitates transactions in the same manner as do larger aggregate inventories, Diamond shows that the publicly-provided good should
be supplied beyond the point where the marginal benefit of consuming another unit of this good equals the marginal cost of foregone consumption of the privately-provided good. This result follows because increased government demand generates a positive trade externality as does increased private production for inventories (and because the publicly-provided good is financed by non-distortionary taxes).

Second, Diamond and Fudenberg (1985) analyze the non-steady-state behavior of the prototype production and search model and demonstrate the possibility of completely endogenous production and inventory fluctuations in a rational expectations model. In this endogenous business cycle environment agents believe that the economy will alternate between expanding and contracting phases, and these expectations are fulfilled. The fluctuations arise from the interaction between the expectational behavior of agents and the inventory and search dynamics of the model. This endogenous rational expectations business cycle model contrasts sharply with rational expectations business cycle models that incorporate exogenous stochastic processes as the driving force behind business cycle fluctuations. The Diamond and Fudenberg result is reminiscent of a large, mostly pre-rational-expectations, literature that stresses the role of expectational behavior in endogenous theories of the business cycle. Zarnowitz (1985) discusses this literature and provides references.

The endogenous business cycle outcome is not the only non-steady-state rational expectations path possible in the prototype production and search model. Alternatively, starting from the same initial aggregate inventory stock, the rational expectations path of the economy may exhibit convergence to a low inventory/low production or a high inventory/high production steady-state equilibrium. This indeterminacy of the rational expectations path, given an initial inventory level, and the multiplicity of Pareto-ranked steady-state equilibria imply the incompleteness of the rational expectations hypothesis, argues Diamond, apart from any questions about learning behavior.

Third, Diamond (1984) distinguishes between buyers and sellers by introducing money holdings into the prototype model and invoking a cash-in-advance constraint. As in the prototype model, individual production decisions lead to an inefficient aggregate inventory level, but an increased willingness to produce (real money supply held constant) generates not only positive externalities by improving buyers' trading opportunities but also negative externalities by diminishing sellers' trading opportunities. Changes in the real money supply in this model involve similar externalities as well as direct wealth effects on the willingness to produce.

The discussion of the implications of his general equilibrium search framework in Diamond's first Wicksell Lecture provides a convenient backdrop for his second Wicksell Lecture. In the second lecture, two main themes set the tone of Diamond's discussion: One, a search-equilibrium approach holds more
promise for satisfactorily integrating micro- and macroeconomics than a classical market-clearing approach. Two, a consideration of the potential coordination failures highlighted by Diamond's general equilibrium search framework implies a presumption in favor of activist government policies designed to promote desirable aggregate outcomes — in contrast to the presumption carried by classical market-clearing models with rational expectations.

In support of his first theme, Diamond points to microeconomic phenomena like the apparently stochastic nature of unemployment spell durations and macroeconomic phenomena like the starkly different cyclic behavior of quits and unemployment. Diamond also views a search-equilibrium framework — extended to encompass commitments to particular prices because of explicit or implicit long-term arrangements — as compatible with Keynesian macro models and, ultimately, as yielding a rigorous microfoundation for these models. In contrast, general equilibrium models constructed along classical market-clearing lines with rational expectations are clearly incompatible with Keynesian models. Since Diamond views Keynesian models as providing a reasonably good fit to aggregate time-series data, he interprets these observations as one more strike against the classical market-clearing approach and one more datum favoring the search-equilibrium approach.

Given this interpretation by Diamond and the widespread reliance on Keynesian macro models in formulating policy prescriptions and in writing undergraduate textbooks, it is worthwhile to evaluate Diamond's claim that an extended search framework is compatible with and supportive of Keynesian macro models. The *sine qua non* of the Keynesian paradigm is the perceived, but unrealized, gains from trade arising from nominal wage and price stickiness. Keynesian prescriptions about monetary and fiscal policy follow directly from this feature of the paradigm. But nothing in Diamond's search models explains nominal rigidities. His models do suggest the potential for difficulties in the coordination of economic activity in decentralized economies and a possible role for government policies that resolve or mitigate these coordination difficulties; hence, one might argue that the search-equilibrium approach Diamond advocates carries, like Keynesian models, a presumption in favor of policy activism. But this favorable light thrown on policy activism in Diamond's framework in no way involves nominal price stickiness. Indeed, Diamond's analysis suggests that the stress Keynesian models place on nominal wage and price stickiness as the source of macroeconomic coordination failures is misplaced. Howitt (1985) analyzes a model that incorporates many of the ideas in Diamond's search framework and reaches a similar conclusion.

To understand how Diamond anticipates constructing a micro foundation for Keynesian models based on a search-equilibrium approach, it is useful to consider his remarks on extending this framework to incorporate commitments to particular prices because of long-term arrangements. It is well known
from the implicit contracts literature that efficient long-term relationships explain sticky relative prices but not sticky nominal prices. Yet, in his discussion of an extended search-equilibrium framework, Diamond writes (pp. 45–46):

[The search-equilibrium] framework could readily be modified to have some trade possibilities passed over because of commitments to particular prices based on explicit contracts or maintenance of long-run relationships. Similarly, the price determination rule for completed transactions could be somewhat historically determined rather than a bargaining solution.

This departure from the bargaining solution that emerges under optimizing behavior in a situation containing bilateral monopoly elements would introduce nominal stickiness in a manner analogous to the introduction of price-stickiness in market models that assume an arbitrary wage or price adjustment process. As one can convert a market-clearing model into a non-market-clearing model by assuming nominal stickiness, so one can similarly convert a clearing version of Diamond’s model into a nonclearing version by assuming that prices are ‘somewhat historically determined’. Indeed, Diamond’s suggested research strategy for producing a micro foundation for Keynesian models is logically equivalent to introducing nominal stickiness into rational expectations market-clearing models along the Fischer-Gray-Taylor long-term nominal contracting lines: This strategy may well yield interesting insights, but it begs questions about the source of nominal stickiness and the ultimate foundation of Keynesian models.

As Peter Howitt has indicated to me, there is a weak sense in which search-equilibrium models are compatible with, although they do not explain, nominal stickiness. The costliness of search implies that when two potential trading partners establish contact, they face a bargaining problem to determine the division of match surplus. Any rule for resolving this bargaining conflict that allocates some surplus to each party yields an equilibrium in which mutually perceived, private gains from trade are exhausted. (Further restrictions on the range of equilibrium bargaining rules may follow from agents’ market participation decisions, but this observation does not negate the point at hand.) A bargaining rule stated in nominal terms, when combined with the feasible range of movement in the nominal price level, implies a range of (real) rules for allocating the match surplus. Provided that every real allocation rule in this implied range results in the exhaustion of perceived gains from trade, the bargaining rule stated in nominal terms yields a clearing version of the search-equilibrium model. In general, because they affect agents’ choice of search intensity, different bargaining rules lead to different equilibrium outcomes. In particular, a bargaining rule stated in nominal terms
implies different equilibrium outcomes than a bargaining rule stated in real terms. One can interpret these observations as evidence that search-equilibrium models imply some scope for nominal rigidities. Alternatively, one might ask whether this apparent scope for nominal rigidities is simply an illusion that reflects the failure to impose enough structure on the model to pin down a particular solution to the bargaining problem.

In sum, I conclude that a search-equilibrium framework can help to integrate micro- and macroeconomics, but this framework holds little promise for explaining the nominal rigidities emphasized by Keynesian models.

In his second lecture Diamond advances several arguments for activist government policies designed to promote favorable aggregate outcomes. The most interesting arguments for an activist policy relate to the possibility that the government can move the economy from a low production equilibrium with relatively costly trade and low utility to a high production equilibrium with less costly trade and higher utility. Diamond does not analyze within the context of an explicitly specified model a government policy that accomplishes this move, but his models suggest that such a move requires some mechanism that increases the profitability of production. The central difficulty in attempting to evaluate this argument for activist policies based on possible coordination failures is that Diamond's theoretical analysis offers no insight into the determination of a particular steady-state equilibrium in his search economy. Diamond acknowledges this shortcoming of his analysis - and it is a shortcoming shared by other analyses of potential macroeconomic coordination failures in rational expectations models - but, undeterred, he proceeds to argue that 'in the presence of multiple equilibria and inadequate understanding of the determinants of the choice between them, short-run actions, even experimental ones, may sometimes be the right government choice'. Sometimes, perhaps, but this statement skirts perilously close to the maxim that ignorance is a prescription for government action. Even ignoring the costs of the type of stimulatory aggregate demand policies that Diamond seems to favor, a modicum of risk aversion argues for a restrained approach in all but the worst of times. A welfare comparison across steady-state equilibria accompanied by some informal discussion of how the government might move the economy to a preferred equilibrium seems (to this reviewer, at least) an inadequate substitute for a careful analysis of government policies in an explicitly intertemporal setting.

To close this review essay, I summarize my reactions to Diamond's work on general equilibrium search models. From reading this work I have acquired a deeper understanding of how certain types of transactions costs can cause difficulties for the successful coordination of individuals' trade and production decisions in a decentralized economy. I have also acquired a greater appreciation for the incompleteness of the rational expectations hypothesis as a device for modelling agents' expectational behavior. Accepting the (controversial)
proposition that the rational expectations hypothesis follows from individual rationality and maximizing behavior, one still confronts the non-uniqueness of rational expectations equilibria in simple, but interesting models. This non-uniqueness does not disappear in Diamond's search models (or other models of coordination failures) by ruling out sunspot-type phenomena. On a more critical note, one aspect of Diamond's work on general equilibrium search models that disappoints me is that I learned very little about the empirical significance of the coordination difficulties his models highlight or about how one might systematically draw inferences about their significance. While there seems little doubt that the trading externalities emphasized by Diamond's models are present in some real-world economic environments, it is also easy to find innovations in market institutions that apparently overcome potential trading externalities. To take an example close to home, the market for new Ph.D.'s in economics is rife with transactions costs and informational asymmetries, but this market has evolved to provide inexpensive means of contacting potential trading partners and to facilitate the evaluation of those potential trading partners. On balance, I find it difficult to discern whether significant trading externalities persist in the economy and whether they cause significant coordination difficulties.

The critical comments in this review of Diamond's work are not intended to downplay Diamond's achievement in developing and analyzing elegant, provocative general equilibrium search models. But the work by Diamond and others on models that highlight potential macroeconomic coordination failures is in its infancy. We need a much more explicit analysis of how government actions can effect an improved coordination of individuals' decisions, and we need to develop falsifiable predictions that allow us to confront models of coordination failures with observations in a systematic manner, before these theories can be said to constitute a satisfactory framework for macroeconomic analysis. Absent a great deal more progress along these fronts, claims for a presumption in favor of policy activism are premature.

References