Integrating search in macroeconomics: the defining years

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Integrating search in macroeconomics: the defining years[*]

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Abstract

Our paper studies two attempts at integrating unemployment in macroeconomics. The first, due to Diamond, consists in a search model exhibiting multiple equilibria. The second is due to Andolfatto and Merz who, more or less simultaneously, were able to integrate the matching function in RBC modeling. As a common thread of these two attempts is to be based on the search approach as developed in labor economics, we recount the birth and further development of the search paradigm in a first section. We then analyze Diamond's, Andolfatto's and Merz's contributions. Our interest lies specifically in how they made their way in the development of the field. We show that Diamond's model, which ambitioned to rival Lucas's Expectations and the Neutrality of Money model, did not live up to its author's expectations. We propose an interpretation as to the reason this was so. As to Andolfatto and Merz, while their project was less ambitious, we show that they were able to establish what they were striving at, namely an harmonious integration of one particular search model within the RBC paradigm. The price to be paid, however, was to abandon several constitutive traits of the search approach.

Keywords: Search and Matching models, Diamond, Lucas, Real Business Cycle models, Unemployment

JEL codes: B21, B40, D83, E24, J64

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I. INTRODUCTION

While unemployment has been a central feature of capitalist economies for more than a century, surprisingly enough, economists have had a hard time integrating it in their theoretical discourse. Among the first economists having tried to address unemployment, the names of Hicks (1932) and Pigou (1933) must be mentioned. While they pinpointed that the existence of frictions and monopoly power were the main causes of the phenomenon, they were unable, however, to theorize this insight. Batyra and De Vroey (2011) argue that this is due to these economists failing to realize that, by construction, Marshallian supply and demand analysis precluded the possibility of a rationing outcome. Keynes's *General Theory* (1936) was the next milestone. In view of the peaks to which unemployment had risen in the wake of the Great Depression, Keynes proposed to split unemployment into frictional and involuntary unemployment, the former considered normal, the second abnormal. Taking (wrongly) for granted that the first type was well understood, Keynes zeroed in on elucidating the latter. To this end, he took the bold standpoint of arguing that the causes of unemployment needed to be looked for elsewhere than in the labor market; in other words, unemployment needed to be understood as a problem of interdependency across markets or, to use a more modern terminology, as a case of coordination failure. Keynes's insight has, to this day, a definite ring of veracity. Unfortunately, translating it into a consistent theoretical argument was a task for which the adequate tools were lacking. As a result, Keynesian economists, more or less grudgingly, ended up falling back on the more trivial assumption of wage sluggishness. In the late 1960s and early 1970s, Keynesian macroeconomics came under heavy attack first by Milton Friedman, later by Robert Lucas, the outcome of which was the dethroning of the Keynesian by the Lucasian paradigm or, to borrow from Christiano, Eichanbaum and Evans (1999: 67), the ascent of the 'Lucas program'.[2] This went along with a redefinition of the object of macroeconomics, from the study of unemployment to that of business fluctuations. In the first years of existence of this program, the attention was focused on the level of activity, i.e. the number of hours worked, their distribution between employed and unemployed people being left aside. Thus, unemployment *per se* was left out of the picture.

This is the context in which the search paradigm saw the light of day. Its aim was to restart the study of unemployment from square one, i.e. abandoning Keynes's split between

[2] To date, the latter has evolved over three stages: firstly, new classical modeling, secondly, RBC modeling and, thirdly, DSGE modeling.

frictional and involuntary unemployment and deciding to reason exclusively in terms of the first category. Another departure from Keynes was to return to a labor market explanation of unemployment. Finally, the analysis, it was argued, needed to consider unemployment as an equilibrium phenomenon. All this indicates that in the beginning the search theory of unemployment evolved in total disconnection from macroeconomics. Our paper is concerned with later attempts at reconnecting the two.

We will concentrate our attention on what are to us the two main initial attempts at an integration of search in macroeconomics, associated with the name of Peter Diamond (1982a, 1984a) on the one hand, and those of David Andolfatto (1996) and Monika Merz (1995), in papers written independently yet close in content, on the other. These works differ in at least two respects. The first is the context. Diamond conceived of his model, which combines a search and a coordination failure perspective, at a time where the Lucas program was not yet holding sway. The other two papers were written when this program, in its RBC variant, was well established. The second difference relates to profile and motivation. Diamond had played a pioneering role in the launching of the search program, in its initial form, but then decided to explore macroeconomic themes and construct a search-grounded macroeconomic model.[3] The objective he pursued was ambitious; it consisted in no less than offering an alternative to the Lucas program. For their part, Andolfatto's and Merz's aim was to improve the RBC paradigm rather than to question it. Beyond these differences, the three models have in common that technically, i.e. in terms of consistency, and abiding by basic methodological principles, they were all successes. Their fate, however, differed. Diamond's model, while widely hailed, remained a one-shot achievement and few people followed the line he had opened. In contrast, Andolfatto's and Merz's work got the status of a well-established addition to RBC modeling.

In Section Two, we focus attention on the search paradigm. In Section Three and Four, we put the spotlight on the two attempts mentioned above. We assess these in the last section.

II. THE ASCENT OF THE RANDOM SEARCH AND BARGAINING PROGRAM

In this section we undertake two tasks. First, we briefly narrate the birth of the search program. Second and mainly, we zero in on the development and stabilization of one particular branch of this program, the random search and bargaining (RSB) sub-program. The

[3] Okun (1981) was an earlier attempt (of a traditional Keynesian kind) at introducing search in macroeconomics.

latter is important for our purpose because, unlike the others, it contains the ingredients allowing it to be crossed over with the RBC variant of the Lucas program.[4]

The rise of the search approach

The search literature grew out of the realization by a number of economist, Stigler (1961, 1962) most notably, that many observable situations could not be explained using the neoclassical, frictionless view of the market. The inability of the perfect competition model to address rationing, i.e. heterogeneity of treatment of similar individuals, in an internally consistent way has struck economists for a long time. Another problem with the classical representation concerns the question of adjustment to equilibrium. How do markets converge to equilibrium? Are adjustments instantaneous, or is there a transition process that eventually yields the outcome? Information problems and search frictions stood out as features that could explain these facts.

At first, one-sided (sometime referred to partial-partial) models of search were proposed by McCall (1970), Mortensen (1970), and Gronau (1970). In those papers, emphasis is put on one side of the market, very much as outlined by Stigler in a static framework. One side of the market, typically the employer side, is represented by an exogenous wage distribution. Workers randomly face wage offers and must decide whether to accept these offers, or reject them in the hope of subsequently getting a better offer. Though fruitful both theoretically and empirically, this partial-partial approach suffers from a double drawback.

First, in an important paper, Diamond (1971) showed that, in a goods market setting, under a set of assumptions and considering the Nash equilibrium, producers would set the price at exactly the buyers' reservation price. This, of course, is to the typical result in the one-sided search model. In this light, the issue of the efficiency of search equilibrium clearly needed to take center stage, and Diamond was certainly not the only who thought so. Second, there is no reason to believe that only one side would exert effort to search. Clearly, this is not the case for the labor market. Therefore, several bright minds started to work on building models where rationing is observed on both sides of the market. Constructing them required making two important modeling assumptions pertaining to the meeting process and price setting. There are two possibilities for each decision: meeting can be assumed as random or not, the power to set prices can be given to one side, or left for negotiations. Four modeling strategies ensue. However, only three of these have been active: (a) directed search with wage

[4] Others have surveyed the field. See, for instance, Albrecht (2011), Rogerson *et al.* (2005), and Yashiv (2007).

posting (Butters 1977, Burdett and Judd 1983, Mortensen 1990, Burdett and Mortensen 1998), (b) random search with wage posting (MacMinn 1980, Albrecht and Axell 1984), and (c) random search with bargaining (Mortensen 1982, Diamond and Maskin 1979, Pissarides 1979, 1990). In *directed search with wage posting*, ex ante homogeneous workers search for a job by sampling wages decided by firms. Firms compete to attract workers. Setting a higher wage offer results in workers directing their search to the most attractive alternatives. For wage dispersion to arise, one requires on the job search and search frictions. In *random search with wage posting*, the query bears on understanding 'pure wage dispersion', i.e. why workers with identical productivity can be paid different wages. It is assumed that workers are heterogeneous with respect to some element unrelated to productivity. Firms with monopsony power may then be indifferent, in equilibrium, between setting high or low wages. It can be shown that, in general, the distribution of wages will coincide with some subset of worker reservation wages. Firms' heterogeneity may be required for robustness. Workers do not search on the job. These two modeling strategies are very active fields of research but, they are of little concern for our purpose since attempts at an integration of a search perspective in macroeconomics have been based on the third strategy, the RSB strategy. Only the latter is discussed in the rest of this section.

Building the foundations of RSB modeling

Three steps must be taken. First, the concept of random meeting needs to be rendered operational. Second, it is necessary to give an account of how the surplus a pair yields in such a setting is to be shared. Analyzing how jobs are created is the third and final step.

Foundations: first step

Given searchers on both sides of the market, and the number of each type, the issue is how defining the conditions of an encounter. This founding stone was laid out at the same time in contributions by Pissarides (1979) and Diamond and Maskin (1979) in quite different contexts. While attracted to search models because of their realistic definition of unemployment, Pissarides was dissatisfied with one of their features, namely that the long-term unemployed were deemed to be in their situation only because of a persistent failure to locate high enough wage offers. His hunch was that characterizing job offers as mere wage offers was misleading; much more was involved, the problem of matching jobs with workers having each different attributes. To this end, he imagined a meeting mechanism, which he dubbed the matching function. Wage distribution was absent from it, but unemployed and vacancies co-existed. In Pissarides 1979 paper, the matching function was meant to represent

a specific labor market institution, namely the British Employment agency. Unemployed workers, the story run, can apply to the agency, and firms with vacancy can post said vacancies in the agency repository. But workers and firms can also sidestep the agency, with firms posting privately advertising for jobs, and workers randomly encountering advertised jobs. This was Pissarides's initial way of positing the issue; it would subsequently evolve.

For their part, Diamond and Maskin built a model of bilateral contracting, focusing on contracting and breaches of contracts. Their objective was to study how agents come in contact, i.e., as stated in their paper's abstract, to analyze "steady state equilibria in models where individuals meet pairwise in a costly stochastic search process and negotiate contracts to produce output" (Diamond and Maskin 1979: 282). In such a framework, matches can be good or bad, and agents may want to breach contracts. Investigating the impact of different damage rules on equilibrium search and breach behavior, Diamond and Maskin decided to separate two types of meeting technology: a quadratic and a linear one. In the quadratic case, the aggregate number of matches increases in a quadratic fashion with the number of searchers. Additional searchers create a positive externality by raising meeting probabilities for all. In the linear case, the meeting probability is independent of the number of searchers, but the chance of meeting a free partner is affected by it. In this case, there is a negative externality imposed by searchers who are in a match. Given the search externalities, search and decisions to breach in general are inefficient. Multiple equilibria may also exist. Thereby, in their own way, Diamond and Maskin also stumbled on the matching function.

Foundations: step two

In this second step, two issues are addressed. First, a relationship between agents in a decentralized market yields a surplus, which needs to be divided. The second issue, on which we want to delve, pertains to efficiency. The fact that individual agents located on one side and on the other of the market engage in search generates externalities upon other agents. Hence the need to investigate the conditions under which conditions (if any) the solution is efficient and under which conditions it is not. The main contributions on these topics are due to Mortensen (1982a,b) and Diamond (1982b), building on Mortensen (1978) and Diamond and Maskin (1979).

Diamond's specific concern was unemployment and the labor market He used the matching function introduced in Diamond and Maskin (1979) together with a full-fledged two-sided setting. He also adopted Nash bargaining as a more sophisticated assumption on negotiation: bargaining is used as a proxy for contracting and negotiation issues. Diamond

proved existence of Nash equilibria for all possible sharing rules, and showed that, in the linear matching case, the Nash equilibrium is unique. He also stressed that, in general, the equilibrium wage will be inefficient because of its dependency on bargaining power.

On his part, and roughly at the same time, Mortensen also tackled the problem. His take was to add a matching function and a division of the surplus via Nash bargaining to a two-sided search model. In such a set up, the increased recruiting effort of one firm reduces the probability of finding a worker for the others yet is beneficial to the workers. Similarly, more search effort by workers is beneficial to firms posting vacancies but detrimental to the other workers. Like in Diamond (1982b), in Mortensen's models decision makers fail to internalize these costs and benefits. Thus, there is no reason to expect the equilibrium to be efficiency.

In the continuation of their respective articles, Diamond and Mortensen went on to work out special cases in which the outcome of their models is efficient. Mortensen did so for particular shapes of the matching function (linear or quadratic), shapes which he motivated, in a microfoundation way, using ball and urn models. For his part, Diamond was able to elicit the existence of one particular sharing rule inducing efficient search incentives in the case of a linear matching function. These efficiency results were further extended by Hosios (1990), and centered on one condition commonly referred to as the Hosios condition. This condition can be summarized as follows. The sharing rule to which workers and firms agree must be such that the share of the match surplus accruing to the firm corresponds to the elasticity of the matching technology with respect to recruiting effort (i.e. the parameter weighting the surplus share in the generalized Nash bargaining solution must be equal to the power parameter on vacancies in the matching function.)

Foundations: step three

Given the matching function, bargaining as wage setting, and the possibility of unequal numbers of unemployed and vacant jobs, the last element needed for having strong foundations consisted in figuring out how the relative number of job openings is set. The key contribution, here, was laid out in two papers by Pissarides (1984, 1985). Abandoning the institutional realism of the matching function from his earlier paper led Pissarides to a decisive breakthrough. It followed from realizing that in its most simple expression, the matching function constitutes a template of one of the central concepts of economic theory, the production function. Therefore, all what economists had long learned about the production function could be extended to the matching function. In particular, one could consider the inputs of the matching function as assets accumulating, exactly as is done in the case of the

production function. Pissarides's insight was to consider a vacant job as an asset to the firm. It is then easy to imagine that the financial arbitrage arising in financial markets could also be present in this setting: given free entry, if opening a vacancy yields a positive value, new vacancies will be posted. In equilibrium, therefore, the value of a vacancy must be zero, and this determines the number of vacancies opened.

Solidifying the foundations

Pissarides's *Equilibrium Unemployment Theory* (1990, first edition) was an exception to the generalized phenomenon that in economics monographs have lost their earlier power to impact. In this book, he spelled out all the elements present in a piecewise way in the papers mentioned above, using a single thread and unifying notation. Perhaps more importantly, the book revealed Pissarides to Mortensen. While Pissarides was clearly aware of Diamond's and Mortensen's contributions, his own earlier work was not cited in Diamond's or Mortensen's steps 1 and 2 papers. After publication of Pissarides's book, things changed radically:

> Although I was aware of and followed his work with interest in these years, only after the publication of the first edition of his book *Equilibrium Unemployment* in 1990, which fully articulated the first generation of the Diamond Mortensen Pissarides model, did we collaborate in a string of coauthored papers, initiated by "Job Creation and Job Destruction in the Theory of Unemployment," published in 1994. This paper extended the model in the first edition of his book to include endogenous job separation as well as creation. (Mortensen 2011).

Mortensen and Pissarides started collaborating on a number of extensions to the model, chief of which was the endogenization of job destruction. Those extensions were incorporated in the second edition of the Pissarides book (2000), further establishing the framework we describe next. Until then, and in part because of timing, Diamond and Mortensen were the two leading figures in the field. This changed, Pissarides taking Diamond's place as Mortensen's twin leading figure. As to Diamond, stimulated by the changes that were occurring in the field of macroeconomics with the arising of what at the time was called the "rational expectations revolution", he decided to engage in a new research line. It consisted in constructed a macroeconomic model embodying search and aiming at offering a research line alternative to the Lucasian one.[5]

The basic RSB model

After presenting the genesis of RSB modeling, it is time for a brief presentation of the mature model. Under study is an economy inhabited by many workers and many firms; the

[5] In 2010, all three men received the Nobel prize for their contributions to what has since then been dubbed as the 'Diamond-Mortensen-Pissarides model'. From our examination above, and while recognizing that Diamond contributed greatly to two of the three foundation elements of the model, it is easy to see why, earlier on, the model was known as the Mortensen-Pissarides model.

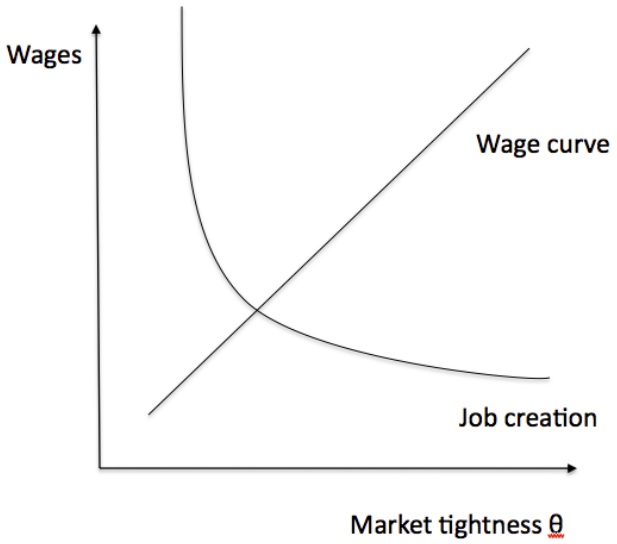
latter consist of just one job. The labor market of this economy is decentralized and uncoordinated. Hence both workers and firms have to engage in a costly search before being able to trade. Workers can be in one of two states, employed or unemployed. Firms can be in three situations: (a) being engaged in production, (b) have an open vacancy, or (c) be in an ethereal state, i.e. existing only virtually. Agents take their decisions rationally. Searching for a partner takes time, and firms may, in addition, incur a search cost when posting a vacancy. Pairs in production exogenously separate with a certain probability. Given the decentralized nature of the market, two modeling decisions must crucially be made: explaining how workers and firms meet, and how wages are set.

The matching function gives the number of jobs formed at any point in time as a function of the number of workers and firms searching for a partner. It is typically denoted $m = m(v,u)$, where v denotes the ratio of vacant jobs to the labor force and u denotes the unemployment rate. It is a reduced-form modeling device that summarizes all the choices available to workers and to firms. It captures the idea that that the time needed for a match being made will vary across workers and firms (there is a luck component), while in parallel the total number of vacancies and total number of unemployed affect the average amount of time needed to find a good match. It captures heterogeneity, but allows dispensing from it.

Once a pair is formed, the need for the price setting assumption kicks in. Here, using advances in the modeling of bargaining, it is assumed workers and firms split the pair surplus following a Nash bargaining process. Assume constant returns to scales in the matching function, add to this an assumption of free entry of firms, and it becomes possible to determine an equilibrium ratio of vacancies to unemployment, referred to as *market tightness*, $\theta = v/u$. A wage equation can be derived from the pairwise interaction of firms and workers through the Nash bargaining process. It tells us that, whenever the ratio of vacancy to unemployed workers increases, workers are able to bargain their way to higher wages or hold out for better offers. It follows from the free entry assumption that vacancies with a negative net value shut down. It can also be observed that, if the net value of vacancies is positive, new vacancies get posted. As a result, the net value of a vacancy must be zero in equilibrium. There is thus an inverse relation between market tightness and the wage rate: the expected value of a vacancy increases as the wage rate decreases, and thus the number of vacancy to unemployed increases. On the one hand a positive relationship between the wage rate and market tightness has to hold, due to the wage setting mechanism. On the other hand a negative relationship between these variables has also to hold given the free entry assumption. It is

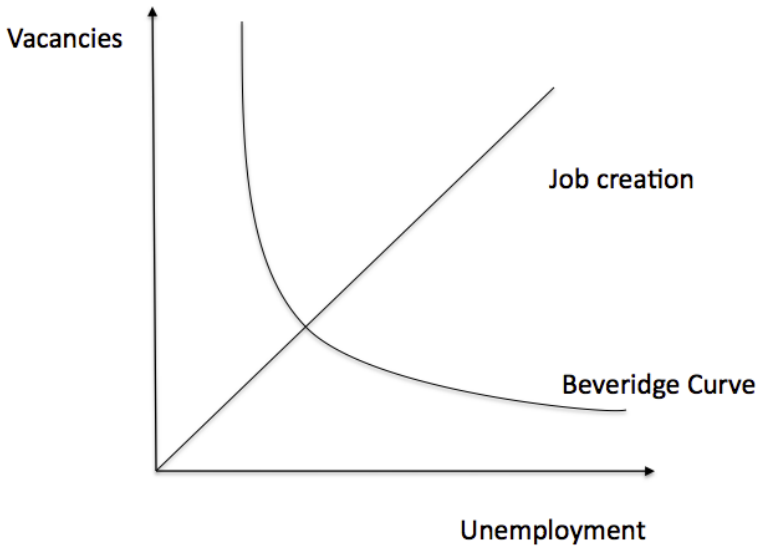
then easy to derive a wage rate and a level of market tightness at which equilibrium is achieved. Figure 1 illustrates.

Figure 1: Determination of wage and market tightness



In a steady state, the flow of workers entering the state of unemployment (i.e. losing their job) is exactly equal to that of the unemployed workers finding a job. The steady state assumption, together with the characteristics of the meeting technology, allows deriving a negative relation between unemployment and vacancies. This relation captures the concept of the Beveridge curve. It is then a trivial matter to pinpoint the relative levels of unemployment and vacancies that satisfy both the Beveridge curve and the equilibrium conditions stated before. Graphically, in the *(w, θ)* plane, the intersection of the wage relation and the job creation relation indicates the equilibrium level of labor market tightness. The Beveridge curve can then be depicted in the *(v,u)* plane. Finally, the set of equilibrium θ can be represented as an upward line in the *(v,u)* plane. The intersection of this line with the Beveridge curve gives the unique pair *(v*,u*)* on the Beveridge curve that can be an equilibrium (see Figure 2).

Figure 2: Steady state unemployment and vacancies



In the basic setting just described, identical individuals are treated equivalently and are able to negotiate the same wage. Moreover, although in general the equilibrium is inefficient, simple conditions for efficiency can be defined. Crucially to our purpose, it happened without it being intended that the line taken to develop the search program made the integration of the matching model in the RBC model possible. In other words, the RSB model was up for grabs for RBC economists, giving them a way of accounting for unemployment that could smoothly be made compatible with the premises of RBC modeling. This would not have been the case if the efficiency result had not seen the day of light. Nor was this the case for the other two branches of two-sided search, since they have wage/price dispersion at their core.

III. INTEGRATING SEARCH IN MACROECONOMICS, FIRST ROUND: DIAMOND

The nascent search theory and Keynesian macroeconomics shared the same aim of explaining unemployment and of drawing policy conclusions from their analysis. However, in spite of this communality of object, these two research streams and scientific communities were disconnected. In the 1970s, things started to change with Lucasian macroeconomics dethroning Keynesian macroeconomics. One aspect of this transformation was that unemployment almost disappeared from the agenda of macroeconomics, business fluctuations replacing it as the proclaimed object of analysis of the discipline. At this point Diamond decided to enter the fray.

He did not belong to the macroeconomics community. As can be drawn from his interview by Moscarini and Wright (2007) and his Nobel Prize lecture (2011), his education as an economist was strongly influenced by neo-Walrasian theory. His attitude towards neo-Walrasian general equilibrium theory was that of a reformer; he aimed at bringing it closer to reality. Two points about which he felt an urgent need of departing from it were time and trade technology. Having interacted at MIT with Franklin Fisher, the author of *Disequilibrium Foundations of Equilibrium Economics* (Fisher 1983), he was aware that neo-Walrasian theory, though a success as far as the determination of the logical existence of equilibrium was concerned, failed on the matter of equilibration. To him, the line of trying to build non-tâtonnement models, adopted in the 1960s by economists such as Fisher, Hahn and Negishi, was a dead end. Another route needed to be taken:

> Rather than asking whether a process could be found that would converge to a standard competitive equilibrium, I chose to work on the question of finding the allocation to which a plausible process would converge (Diamond 2011: 1047).

As to time, it may be presumed that his investment in search theory was also motivated by his desire to bring this element into the picture; in effect, search is by essence a time-taking activity. The years during which Diamond was working on search were also those during which Lucas's work was making its way in macroeconomics. This led Diamond to attempt to bridge the gap between search and macroeconomics.[6] His aim was to build on his search theoretical expertise to rescue the Keynesian tradition in macroeconomics. He did it in several contributions. The first and seminal one was his "Aggregate Demand Management in Search Equilibrium" article (Diamond 1982a). In this article, Diamond introduced the 'coconuts' model, an elementary macroeconomic model evolving at the same level of abstraction as Lucas's 1972 canonical Expectations and Neutrality of Money article. This paper has been widely praised — quite understandably: it stands out as an example of what neoclassical theory can do at its best, conveying a major insight with a simple yet elegant model. Its basic insights were further expanded in a 1984 book, *A Search-Equilibrium Approach to the Micro Foundations of Macroeconomics*, the publication of his 1982 Wicksell lectures (Diamond 1984a). Another development was his "Money in Search Equilibrium" article (Diamond 1984b). There, Diamond extended his coconut model to encompass money, transforming the model in a full fledge two-sided search model, and laying out the foundations of a Keynesian microfounded model in which both fiscal and monetary policy can have a role. Finally, a joint

[6] Search frictions as such could be foreseen as members of Lucasian macroeconomics. In fact Lucas himself, with Prescott, dabbled in the trade (Lucas and Prescott 1976).

paper with Fudenberg (Diamond and Fudenberg 1989) aimed at drawing a theory of business fluctuations on the basis of the coconut model.[7] Our attention in what follows will be focused on the 1982a article and the 1984a book, the two other articles being extensions of the basic model.

In his Nobel Prize lecture, Diamond commented his theoretical move in the following way:

> While I started working on search theory out of dissatisfaction with general equilibrium theory, I gravitated to seeing search also as a way to address my dissatisfactions with macro theory. My dissatisfaction did not relate to basic Keynesian concepts, but to the nature of modeling. I wanted to see a microfoundation that would enhance the ability to do normative analysis and to develop policy insights (Diamond 2011: 1056).

The coconuts model

In this paper, Diamond followed the Phelps/Lucas tradition of referring to the island metaphor. However, while the former used this parable to bring out communication problems between many islands, his was a single tropical island model economy. It comprises a continuum of risk-neutral self-employed identical agents living in an isolated island and having coconuts as their exclusive mean of existence. To be able to eat coconuts, they must find a tree and climb it, and the climbing has a cost c. Every coconut tree bears the same number of coconuts yet trees vary in terms of the effort needed to reach and pick them. The decision rule of this one-sided search takes the shape of a reservation cost c^*. Agents will get the coconuts from all trees for which the cost is below c^*, and wait for the next opportunity otherwise. Diamond gives the 'unemployed' label to those who fail to find a fitting tree and hence hold no inventory and the 'employed' those who found one and hence hold inventory.[8] A further trait of the model is that, because of some taboo, agents are forbidden to consume the coconuts they have picked. Thus, those agents with coconuts must find a trading partner, a second search operation, this time a two-sided search.[9] Trading opportunities arise according to a Poisson process. At this juncture comes the assumption that drives the model: the rate of arrival of trading partners, denoted b, is strictly increasing in the level of activity. That is, b is a function of the level of activity (e), $b(e)$, with $b' > 0$. Thus, trade technology exhibits

[7] This last paper must have been written much earlier than its publication date suggests since in the bibliography of Diamond's 1984 book, the article was announced as forthcoming in the *Journal of Political Economy*.

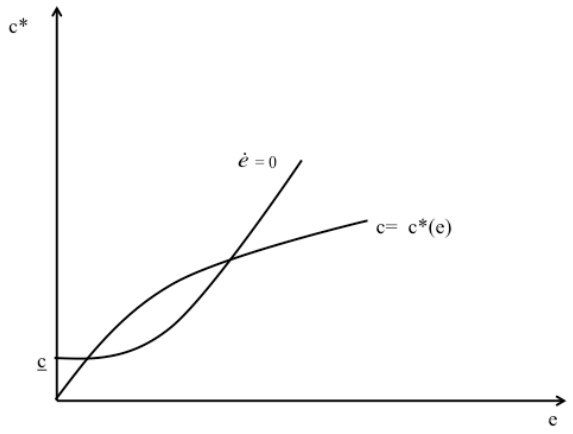
[8] This terminology is misleading since the model comprises no labor market ; the labels' attribution is also arbitrary. However, it reveals what Diamond must have had in the back of his mind.

[9] It must be noted that this is not a full-fledged two-sided search, in that both sides of the market exchange identical goods. In Diamond (1984b), exchange will take place between holders of coconuts and holders of money, and search is then fully double sided.

increasing returns to scale. "If more people are attempting to trade, it becomes easier to carry out trades" (Diamond 1984: 4).

Diamond's next step is to look for steady state equilibria where the level of activity does not change over time, i.e. $\dot{e} \equiv \frac{de}{dt}$ is equal to zero. In every period, there are agents who have found a tree that is worth climbing, i.e. for which $c<c^*$, and other agents who, having found a partner, hold no longer any inventory. In a steady state, these two numbers are identical. Clearly, given a homogeneous distribution of trees, the probability of finding a suitable tree (with $c<c^*$) increases with c^*. Thus in the (c^*,e) quadrant, $\dot{e}=0$ is an increasing function. Moreover, the higher the number of potential partners with coconuts, the more worthwhile it is to have coconuts to exchange. Put differently, the cutoff cost c^* is an increasing function of e. A steady state equilibrium is a situation a situation in which the pair (c^*, e) satisfies both the locus of points for which $\dot{e}=0$ and the function c*(e). Graphically, $\dot{e}=0$, which depends on c*, must intersect c*(e). But both are increasing. For an equilibrium with a positive level of activity to exist, it is enough that one of these curves be concave and the other convex. Diamond is able to prove that it is sufficient for the arrival rate $b(e)$ to be increasing and concave to ensure concavity of $c^*(e)$. As for the $\dot{e}=0$ curve, as long as there is a c* at which the probability of meeting a tree with $c \leq c^*$ is one and it is reached asymptotically, it is convex. Finally, to guarantee existence of multiple equilibria with positive employment, Diamond assumes there is minimum level of production cost $\underline{c}$. This gives him the figure reproduced in Figure 3.

Figure 3 Different levels of activity in Diamond's search model



A shown in Figure 3, Diamond's model features multiple Pareto-rankable equilibria (in the figure they amount to three, the two intersections plus the origin). Put differently, the

economy exhibits several levels of 'natural employment' and it can get stuck in sub-optimal one, a situation that can be remedied upon by exogenous demand activation.

> One of the goals for macro policy should be to direct the economy toward the best natural rate (not necessarily the lowest) after any sufficiently large macro shock (Diamond [1982a] 1991: 32).

This reference to macro shocks indicates that Diamond is interested in macroeconomics *à la* Lucas, i.e. having business fluctuations as its object of analysis, rather than *à la* Keynesian, i.e. demonstrating involuntary unemployment. Of course, unemployment hovers at the back of his mind, but what counts first is to be able to picture business fluctuations. In his model, he writes, "there is also no hired labor. I am therefore claiming that it is possible for a barter economy of self-employed individuals to have business cycles" (Diamond 1984: 7). And also:

> The model I will present is a steady state equilibrium model. It has that form primarily for its simplicity. But I am interested in the model as a description of phenomena that are important in the context of a business cycle and must therefore evaluate the appropriateness of the assumptions to an economy that is subject to cycles (Diamond 1984: 4).

In the 1982a article, Diamond offers no explanation of what may explain fluctuations, but in his 1984 book he proposes one, based on waves of optimism and pessimism fuelled with self-fulfilling effects. The underlying idea is that the economy can bounce back and forth along different levels of activity, the result of changes in expectations about the future economic environment. Assume that agents are all optimistic, i.e. they expect easier trading. As a result, they will accept more production opportunities. The economy will then reach a higher equilibrium level of activity, thus warranting agents' initial optimism. The same is true for pessimism. Change in expectations will shift the $c^*(e)$ curve upwards when agents move towards more optimism and downwards in the opposite case. These changes in the economy's equilibrium points resemble the business cycle.

Diamond's model saw the light of day in a context of high theoretical effervescence. It is thus useful to compare it with contemporary related research lines. Two observations surface from such a comparison. The first is that Diamond's coconuts model is fairly different from both the RSB research line and most other so-called new Keynesian models. The second is that the model to which the coconuts model comes closest is Lucas's Neutrality of Money model, the very one that Diamond wanted to challenge. The next sections develop these observations.

Comparing Diamond's coconut model with the RSB model

The joint attribution of Nobel Prize in 2012 has led to talking about the 'Diamond-Mortensen-Pissarides' model while before one usually referred to the Mortensen-Pissarides model.[10] Such a merger is apposite when considering Diamond's early models but once his coconut model is considered, it makes less sense. In the coconut model, Diamond wishes to address an issue central to macroeconomics: the need or not of demand activation. With this objective in mind, he emphasizes the possibility of multiplicity of equilibria of the search model. The goal of the 'Diamond-Mortensen-Pissarides' model, on the other hand, is to produce a framework to explain (frictional) unemployment in equilibrium, the original focus being the labor market. Table 1 summarizes the involved differences.

Table 1 Comparing Diamond's coconut model with the stabilize search model

	Diamond's coconut model	**The RSB model**
Aim	Demonstrating the possibility of sub-optimal levels of activity as determined by cyclical factors (underemployment)	Explaining unemployment
Object of study	A self-employed workers barter economy with Walrasian prices	A decentralized labor market
Equilibrium	Steady-state equilibrium; *multiple* equilibria; agents maximize their lifelong utility function; rational expectations	Steady state equilibrium; *single* equilibrium; agents maximize their lifelong utility function; rational expectations
The model's basic features	– On-sided search for production opportunities with cost dispersion; two-sided search for trade contacts – The level of activity is an increasing function of the market thickness	– Two-side search for a match + Nash bargaining wage formation – The level of activity is determined by a constant returns matching function
Efficiency and policy conclusion	Any equilibrium other than the maximum one is inefficient; demand activation is the prescribed policy.	The market outcome is inefficient; employment subsidies and unemployment compensation are the policy instruments to be used.

Only the fourth line requires a comment. Vacancies are absent from Diamond's model. Nor has it room for the Beveridge curve. Nonetheless, Diamond's model falls back on Pissarides' reasoning. When constant returns are assumed, the function $m(v,u)$ can be transformed in the function $m(\theta)$, where θ stands for market tightness, the function that is instrumental in the matching reasoning. Assuming that 'thickness' and 'tightness' are the same (what is not obvious), we see that the $m(\theta)$ function is part of Diamonds model, with the difference that it is now specified to have increasing returns in its arguments. In Diamond (1984b), by assuming that agents either hold a special good called money or a coconut,

[10] Two examples are Nobel Prize citation article and Albrecht's 2011's survey.

Diamond introduces what can be seen as a complete matching functions, with coconut holders taking the place of unemployed and money holders taking the place of vacancies.

Diamond and new Keynesian macroeconomists

Diamond's 1982a paper was included in the Mankiw and Romer volume of seminal new Keynesian papers (Mankiw and Romer 1991). Its inclusion can be justified on the grounds that it shared the common intention of new Keynesian models, i.e. to react to Lucasian macroeconomics. Diamond's paper, however, differs significantly from most of the other papers in the volume. It differs in method — theirs were partial equilibrium models, his was a general equilibrium analysis — but, above all, the way in which it reacts to Lucas is different. The majority of new Keynesian papers were geared to rehabilitate Keynes's or Keynesian insights —that wages are sticky and money non-neutral — while accepting the equilibrium discipline imposed by Lucas. Several of the best known ones, by Shapiro and Stiglitz, Akerlof, or Mankiw, took especially at heart the defense of the involuntary unemployment notion against Lucas's fierce dismissal of it. Pursuing these aims was a defensive strategy. For all their cleverness, these models did not evolve at the same level of generality and abstraction as Lucas's. Therefore, they hardly challenged Lucas's positive contribution of having produced an equilibrium model of the business cycle. On the contrary, Diamond's aim was to provide a model that could serve as the launching pad for another type of equilibrium business fluctuations modeling while hardly bothering to rescue Keynes or Keynesian theory.

Diamond and Lucas

We have just seen that Diamond differs on several score from those economists with whom one is tempted to affiliate him. Is there somebody else to whom he could be considered closer methodologically? We think so, and the person we have in mind is Lucas. Both Diamond and Lucas place themselves under the aegis of the Arrow-Debreu model, which is not the case for most labor market search theorists. They share the same preoccupation of making Walrasian theory amenable for macroeconomic purposes by simplifying it and modifying some of its assumptions. As a result, they have developed a keener interest for policy matters than traditional Walrasians. Although they both insist on empirical relevance, their two more important models (Lucas 1972 and Diamond 1982a) were theory without measurement. Finally, they both viewed their seminal models, each of which was not directly concerned with business fluctuations, as a fine steppingstone for broaching this topic. This commonality between Diamond and Lucas is summarized in Table 2.

Table 2. Comparing the Lucas and the Diamond approaches

	Lucas	**Diamond**
Aim of the model	1972: demonstrating that money non-neutrality does not warrant Keynesian policy conclusions 1976: extending the model to the study of business fluctuations	1982a: demonstrating the possibility of sub-optimal levels of activity related to business fluctuations 1984a: extending the model to the study of business fluctuations
Aegis	Neo-Walrasian theory	Neo-Walrasian theory
Equilibrium	General equilibrium analysis; single equilibrium; equilibrium discipline; rational expectations	General equilibrium analysis; multiple equilibria; equilibrium discipline; rational expectations
Labor market and type of economy	Absent (self-employed workers inhabiting separate islands)	Absent (self-employed workers inhabiting a single island economy)
Price/wages	Flexible	Flexible
Money	Present	Absent (yet present in his 1984b article)
Departure from the baseline Walrasian model	Misperception of price signals	Increasing returns to scale + self-fulfilling prophecies
Policy conclusion	Non-interventionism	Demand activation

The main difference between Lucas 1972 and Diamond 1982a lies in the direction taken in departing from the baseline mode and in the motivation underpinning it. When conceived his 1982a model, Diamond's had the firm intention to react to Lucas, whose model he dubbed the 'classical model', as well as to Prescott, by constructing a model incorporating a departure that would produce an inefficiency result.[11] He had no qualms admitting that he pursued a policy motivation. Like Keynes, he believed that the market system is susceptible to fall prey to malfunctioning, in particular under the form of coordination failures. Demand activation is then deemed to be the policy measures to be adopted when these arise. Diamond's problem was to translate this insight, and its ensuing policy conclusion, into an emendation of a simplified Arrow-Debreu model. Ideally, the new factor introduced needed to have the status of a compelling 'fact of life'. As already stated, Diamond was sensitive to the time dimension involved in the attainment of equilibrium, but he ended up introducing it only laterally, through the thickness idea: the thicker the market, the bigger the number of potential traders, the shorter the time spent in finding other traders. To Diamond, this idea was beyond dispute

[11] **"***Macro Dynamics*: Why did you take that direction—as opposed to, say, Lucas and Prescott's island model?
Peter Diamond: The island model, I believe, as Lucas and Prescott set it up, fits the Welfare Theorem of Arrow-Debreu. They've got efficiency properties, and I believe the route into seeing that would be to think about it from an Arrow-Debreu perspective where the role of the island is a constraint on your consumption possibility set. There you have the property that I was trying to get away from—there is some central mechanism, something similar to the Walrasian auctioneer, which is controlling the flows between islands in a way that is a central mechanism" (Moscarini and Wright 2007: 554).

in terms of real-world relevance, and its neglect hardly benign since by taking it into account the policy conclusion of the non-amended model are reversed.

> The importance of this basically different way of viewing the world is that it shifts the presumption from limitations on policy to the potential for good policy (Diamond 1984: 63).

Diamond's standpoint could be viewed as a normative bias. We do not see it this way. By construction, macroeconomics models lead to policy conclusion. The fact that the model builder has or not a policy motivation does not matter. Whether Lucas planned it or not, his model of the business cycle reaches a non-interventionist policy conclusion. The latter, as Lucas admitted (see De Vroey 2011), is embedded in its premises. Thus, Diamond and Lucas must be put on the same footing.

On top of our claim that Diamond was methodologically close to Lucas, we also want to make the further claim that he considered Lucas as his main interlocutor. Reading the second of his Wicksell Lectures makes clear that he regarded his model as an alternative to Lucas's. Few contemporary models could be deemed to belong to the same league as Lucas's "Neutrality of Money" paper in terms of originality, parsimony, and elegance, but Diamond's was certainly among these. If Diamond's paper was published in 1982, this means that he must have been working on it in the last years of the 1970s. In their entry on "Rational expectations Business Cycle Models" in the New *Palgrave Dictionary* (1987), Dotsey and King consider that four approaches in macroeconomics could be highlighted as being promising research lines. While Diamond's model was not among these, Dotsey and King's remark emphasizes that, in the late 1970s and early 1980s, the future of macroeconomics was still open. Hence it should come as no surprise that Diamond might have nurtured such an ambition.

In the Wicksell Lectures, Diamond also raised the question, "How can one decide whether competitive markets or search represents a better starting point for theoretical macro analysis"? (1984: 46). There was no mystery about his answer. On the one hand, he argued that his model had a better fit. On the other, he brought out the limits of the rational expectations assumption. With hindsight, none of these arguments was really biting. To limit ourselves to his criticism of rational expectations, Diamond walked on a tightrope since, after all, his model was also based on this assumption. This led him to make Salomon-like judgments, writing for instance that rational expectations are "still the right assumption to use for most, but not for all, analyses" (1984: 54). In his view, its main defect was that, as soon as multiple equilibria are present, agents are unable to pick up the equilibrium state that is

highest in welfare ranking, despite their being equipped with rational expectations. Moreover, making the rational expectations assumption forbids coming to grips with factors such as optimism or pessimism, mimetic behavior and self-fulfilling prophecies. Both remarks are well taken if one accepts that multiple equilibria is the route to be taken, but irrelevant for those who decide to take another one. In other words, Diamond's criticism rests on the premise that his starting vision is better than alternatives.

IV. INTEGRATING SEARCH IN MACROECONOMICS, SECOND ROUND: ANDOLFATTO AND MERZ

At the end of the 1980s, the RBC modeling strategy had taken center stage. The baseline model performed well, matching many US business cycle facts. However, it did not score high in all dimensions. The quest, then, was to tweak the baseline model in ways that would improve the fit. It is in this context that Andolfatto (1996), Merz (1995), (and, to some extent Mortensen (1992)) came in.

While a clear success in many aspects, Kydland and Prescott's inaugural 1982 paper had a hard time replicating labor market facts. For one, in their model, agents' decisions are made on hours worked, and variations in the labor market only entail changes in hours worked. Unemployment and vacancies are left out of the picture. There is thus no way the model can replicate the negative correlation of unemployment and vacancies. Nor can it replicate the high persistence of unemployment. Disregarding unemployment can be justified if understanding the manner in which hours worked are distributed in an economy is not a crucial objective of the model. While the model is explicit about the cyclical properties of hours worked, the discussion about the portion of those movements attributable to the intensive or to the extensive margin is then left for labor economists to discuss. However, even when accepting this justification, the RBC model still misses on a series of other labor market cyclical facts. For instance, the fact that labor market productivity is more volatile than real wages, and is a leading indicator of employment, is contrary to the model's implications. In addition, there are some indications that the labor share of total income is countercyclical (although relatively stable). Finally, employment is much more persistent in the data than in the model, and more volatile than real wages. The need for improvement on these matters was high on RBC economists' agenda. An important step forward in this respect, Hansen (1985) and Rogerson (1988) introduced non convexities in hours, together with the extensive labor margin. In their framework, agents entering the labor market face an

employment lottery. The winners work, the losers stay home.[12] This change improved the model's performance with respect to the relative volatility of employment to real wages, and introduced the concept of unemployment in the framework. But unemployment, employment, and output were still not persistent enough.

At that point, many advances had been done in the search literature. The first edition of *Equilibrium Unemployment Theory* was out, and Mortensen and Pissarides had joined efforts to finalize the mature model. Qualitative evidence coming out of search models, for instance Wright (1986), pointed to the very possibility that search frictions could improve the fit of the RBC model. Thus, it was just a matter of time until attempts to crossover RBC and models in the search tradition were made.

As hinted above, the perfect bride existed, a model that had elements to allow for an almost perfect match with the RBC framework. At the center of the RBC model is the representative agent. This agent receives a real wage as a payment for his work effort, which he decides optimally. All individuals in the economy are paid at the same level. Equilibrium is Pareto efficient, allowing for solving the planner's problem to find the efficient allocations, then finding the competitive prices that support this allocation as a competitive equilibrium. Most search models were striving at explaining how it is possible for identical workers to be paid differently. They also delivered situations in which equilibrium is, in general, inefficient. All but one: the RSB model, in its bare bone version, allows for homogeneous agents to be paid the same wage. In addition, thanks to work by Mortensen, Pissarides, later generalized by Hosios, the precise conditions under which the equilibrium is efficient are known.

These are the features inherited by the Andolfatto-Merz economy. Like the RBC economy, it is inhabited by identical households in the unit interval. They have standard preferences over consumption and leisure, and face a consumption-saving decision problem coming straight out of the RBC framework. However, exchanges of labor occur in a search environment. Individuals are either working or unemployed and searching. In this last case, they get job opportunities at random. Meeting probabilities are determined via an aggregate matching function and thus depend on the numbers of unemployed and vacancies. The labor market is thus laid out as a RSB environment. There are also many firms mastering a constant returns to scale technology, so that one can consider each firm to consist in exactly one job. Matched pairs face separation with exogenous probability, and workers need to provide searching effort when searching. One can rework the discrete time version of the expressions

[12] With the implication that, in this model, the true winners are those who lose at the employment lottery.

that lead to the Beveridge curve in the RSB model to get dynamic equation guiding employment. It is then possible to solve a social welfare maximization problem in which vacancies are added as a choice variable, while adding to the economy wide constraint a constraint stemming from the labor accumulation equation. From this well-behaved problem, one backs out four optimality conditions that must hold in equilibrium (in addition to the resource constraint and the labor accumulation constraint). Two of these conditions are completely standard and govern the intra and inter-temporal allocations of consumption and labor/leisure and the consumption and saving/capital. A third condition insures that the cost of, and the expected return to, recruiting are equalized at the margin. A final condition insures that the household is indifferent when facing marginal changes in employment.

While the planner's solution is perfectly interpretable, it is not obvious that this can be decentralized (as is typically done in the case of a perfectly competitive RBC model.) The search economy embodies, after all, a completely decentralized market economy, or, at the very least, a decentralized market in an economy. Typically, one has to show that there exists a price vector that yields the Pareto optimal allocation. Given that the main difference is the presence of the labor accumulation constraint, the key problems to be solved are then, first, to find a wage equation such that there is appropriate vacancy posting, and, second, to find a way to deal with the agent heterogeneity that stems naturally from a model of the labor market with frictions. To solve the first problem, using the standard bargaining assumption, one can turn to the Hosios condition. To solve the second problem, it is sufficient to assume perfect insurance. This is equivalent, in fact, to using the extended-household device introduced by Hansen (and Rogerson) and mentioned above does the job. Under these assumptions, it is possible to solve the respective problems of firms and workers and finding the wage equation associated with it. Thereby the decentralized search equilibrium can be found. It can also be shown that the search equilibrium allocation satisfies the conditions and constraints that were key to the planner's solution.

And the job is done: a macroeconomic model is built in which the labor market exhibits frictions, and in which unemployment is naturally present. The model improves the fit of the baseline RBC model in some dimensions while, furthermore leaving the door open for further improvements.

V. ASSESSMENT

We are now able to bring together the threads developed in the earlier ones. We do not question that, technically, Diamond, Andolfatto, and Merz have all three achieved their aim of constructing a consistent model integrating search in macroeconomics. The issue we are interested in is different, i.e. whether these models made their way in the theoretical corpus or, more precisely, the extent to which they did. The answer differs according to the authors concerned. Diamond's aim was ambitious as he hoped that his model might constitute a substitute to Lucas model; this hope did not come through. In contrast, Andolfatto and Merz were pursing the more modest aim of bringing in a result from one branch of the search universe into the standard RBC model, an insertion amounting to a 'search-RBC synthesis'. Still today, this introduction is considered an established improvement. In a first subsection, we attempt to explain why the line opened by Diamond lost out to the Lucasian line. In the second, we ponder upon Andolfatto's and Merz's success.

The demise of Diamond's program

At present, we know that the Lucasian program came out as the winner (not forgetting that in a field such as economics any victory, if one wants to use this terminology, is always temporary). However, at the time, this outcome was less obvious.[13]

It must be reckoned that, from the start, the Lucasian program held the edge. First, it was ten years older and this time span had been usefully used in strengthening it. Second, the Lucas model belonged to a well-established stream of literature pertaining to the real effects of monetary change. The model was innovative, but the subject was well trodden. In contrast, Diamond traveled an unknown territory; the theoretical study of coordination failure was nascent. Third, multiple equilibria may well be an appealing idea but, for sure, managing single equilibrium models is easier, not mentioning the conundrum of how to test a multiple equilibria model empirically. This is illustrated in the extension of his model Diamond did with Fudenberg. In that paper, the authors had the ambition to show how, from any initial conditions, one could find multiple dynamic paths to each steady state equilibrium. But, while the paper's goal seems to be general, in the end it limits itself to an illustration of possible examples. Fourth, Diamond admitted that his model differed from Lucas's on one main point,

[13] In a lecture given in 1986 at the Canadian Economics Association Meetings, Peter Howitt, probably the strongest supporter of Diamond's program, declared that he saw macroeconomics at an important crossroads, one route being RBC modeling, the other transaction externalities modeling. "Which of these two paths will be the main attractor of graduate students in the years to come is impossible to predict" (Howitt [1986] 1990, p. 79).

the increasing return assumption.[14] To him, this element was crucial and justified. In such circumstances, however, an easy way of dismissing the challenge consists of declaring the model to be a special case of the classical model, hence a mere extension rather than a radical alternative.[15] Fifth, while Lucas's 1972 model and Diamond's 1982a model might have the same degree of persuasiveness, this is not true for their respective extensions. Lucas's equilibrium model of the business cycle flew from his 1972 model in a straightforward way. This cannot be said of the Diamond-Fudenberg extension of Diamond (1982a). Finally, Lucas' non-interventionist policy conclusion has the advantage of neatness. In contrast, Diamond's policy conclusion, that demand activation should be undertaken for bringing the economy to a higher equilibrium suffers from the fact that this conclusion falls out of the blue; an agent or institution susceptible of implementing it is absent from the model.

All these factors certainly played a role. Nonetheless, we think that the clue for understanding the fate of these rival programs resides elsewhere. To us, the decisive factor is whether a new model, which always starts as a one-shot achievement, can be transformed into a progressive, workable research program — 'progressive' meaning that it gives rise to a succession of cumulative developments, 'workable' that the needed tools and recruits for such developments show up at the right time. Against this criterion, the Lucas program fared better than Diamond's. The crucial turn occurred more or less concomitantly with the publication of Diamond's model when Kydland and Prescott took over from Lucas, inaugurating the RBC variant of the Lucas program. But then, the 'victory' that took place was less that of the Lucas's model proper than the result of the ascent of RBC modeling. As aptly underlined by Woodford, Kydland and Prescott transformed Lucasian qualitative modeling into quantitative modeling.[16] Adding the 'replication discipline' to the 'equilibrium discipline', they were able to impose the idea, which had been put in practice by Keynesian macroeconomists but had somehow been put under parentheses when a Walrasian perspective came to be introduced in macroeconomics, that there is no salvation outside of applied validation. In addition, to econometricians' outcry, Kydland and Prescott were also able to force the widespread acceptance of a very specific empirical assessment procedure, the calibration technique. The

[14] "The model I presented in the first lecture looks a great deal like the classical market model if one removes the assumption of trade externalities. That is, if the relative availability of trading partners does not affect the length of time to find a trade, then the search model must behave like a classical market model"(1984: 49).

[15] This is, e.g. what Albrecht (2011) does.

[16] "The real business cycle literature offered a new methodology, both for theoretical analysis and for empirical testing. It showed how such models [of the Lucas type] could be made *quantitative*, emphasizing the assignment of realistic numerical parameters values and the computation of numerical solutions to the equations of the model, rather than being content with merely qualitative conclusions derived from more general assumptions" (Woodford 1999: 25-26).

latter implied that the search for a baseline model of business fluctuations was over since the stochastic extension of the Solow model was deemed 'established theory'. What remained to be done was applying it to different contexts and solving the puzzles that its application might bring out. RBC modeling was thus a game changer. It stabilized the Lucasian revolution into a precise research program providing the bread and the butter for regiments of economists for more than a decade. Modeling *à la* Diamond lost the favors of the macroeconomic profession. With such a rule change, Diamond's model was bound to be out of the game.[17] Diamond did not recognize it explicitly, but he voted with his feet, abandoning the search topic to devote his attention to matters of social security and pensions.[18]

The Andolfatto/Merz integration

The general opinion is that Andolfatto and Merz made a substantive contribution. The fact that the search idea had been integrated in the RBC model was considered good news. Their two models also improved the fit of the baseline model, the decisive assessment criterion in the RBC community. Thus, it was considered a significant step forward, though not a ground-breaking one. The rivalry dimension that characterized Diamond's enterprise was here absent.

In a sense, search economists could not be but flattered to have one of their central notions, the matching function being co-opted by RBC macroeconomists (and later by DSGE ones). Moreover, the evolution may be deemed mutually beneficial. Macroeconomists' gain has been described. For their part, until then, RSB theory had suffered from to drawback of being purely abstract, with little empirical counterpart. Closer contacts between the two communities led RSB economists to realize that they could fill the gap by importing quantitative techniques from RBC modeling. In some sense, search theory gained respectability.

However, in another sense, search economists have some good reason for being frustrated with the evolution that took place. First, the integration concerns only the RBS

[17] The coconut setting would be salvaged, however, and make a comeback in macroeconomics thanks to the money search literature, and most notably thanks to Kiyotaki and Wright (1989, 1991, 1993).

[18] "*Macro Dynamics*: Your continued working on search for quite a while, with Olivier Blanchard, for example, and that work influenced a cohort of students at MIT in the 1990s. But then at that point you stopped working on search. You moved on exactly when this was blossoming. Did you think that this was all done, and hence we're wasting our time? You have a record of choosing different topics and moving on to the next one. *Peter Diamond:* I do enjoy the "how do you set up a model to address a question or problem." To me, asking, "I got this model and now I have to work hard to make it more realistic and put in more features," I do not enjoy it as much as the thinking hard about how to get started. Some of that has to do with the laziness of doing hard math, that many people go through as they age. And of course you have to keep in mind that Social Security became a very hot topic" (Moscarini and Wright 2007: 557).

research stream. The work stream opened by the Burdett-Mortensen paper and which is based on job search, heterogeneity and wage dispersion, is very active; to many labor economists, it has significant advantages over the RBS line. In present circumstances, its integration in macroeconomics remains ought of sight. Second, the integration was possible because of Mortensen's efficiency result mentioned above. It is true that a case exists were the Nash bargain is efficient, but to many students of the problem, it is considered an occurrence of minor importance. Without adopting this special assumption, the integration of the matching function in RBC modeling would not have been possible. The third and probably more important reason for frustration is that the basic objective of search theorists was to understand real-world unemployment. In this respect, the idea of replacing the single agent with a family whose members are able to insure themselves against any loss in utility incurred as the result of being unemployed, cannot be considered otherwise than as a trick betraying the deep nature of the inquiry's *explanandum*. Deleting the view that the unemployed effectively suffer in utility because of their status runs counter a basic tenet of the search program. Of course, the lack of consideration for this feature has a technical reason, the difficulty of introducing heterogeneity in macroeconomic modeling. Still, our guess is that many search economists have a hard time in swallowing this bitter pill.

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