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A Model of Unemployment with Matching Frictions and Job Rationing: Dissertation Summary

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Large fluctuations in unemployment frequently recur across the United States and Europe, most recently in 2009, and remain a major concern for policymakers. Many different macroeconomic theories of unemployment have been offered. These theories deliver conflicting results about the welfare cost of unemployment and the impact of various labor market policies, which makes it difficult to develop policy recommendations. In fact, there seems to be no consensus on how much governments should spend on unemployment-reducing policies, and which specific policies they should implement. Therefore, it is critical to identify the main sources of unemployment over the business cycle in order to develop effective unemployment-reducing policies. This is what I attempt to do in this dissertation.

Overview

This dissertation proposes a model of the labor market that integrates two important sources of unemployment. The first source is a matching friction, which is a friction in matching unemployed workers to recruiting firms. The second source is job rationing, which is a possible shortage of jobs in the economy. To examine how these two sources interact over the business cycle, I decompose unemployment into a component caused by job rationing—*rationing unemployment*—and another component caused by matching frictions—*frictional unemployment*. Formally, I define rationing unemployment as the level of unemployment that would prevail if matching frictions disappeared, and frictional unemployment as additional unemployment due to the matching frictions.

The main theoretical result of this dissertation is that during recessions rationing unemployment increases, driving the rise in total unemployment, whereas frictional unemployment decreases. Intuitively, in bad times, there are too few jobs, the labor market is slack, recruiting is easy, and matching frictions contribute little to unemployment.

I specify a model in which job rationing stems from a small amount of wage rigidity and diminishing marginal returns to labor. In the model calibrated with U.S. data, I find that when unemployment is below 5 percent, it is only frictional, but when unemployment reaches 9 percent, frictional unemployment amounts to less than 2 percent of the labor force, and rationing unemployment to more than 7 percent. These results suggest that cyclical fluctuations in the composition of unemployment are quantitatively large: in expansions, all of unemployment is due to matching frictions; on the other hand, a very large share of unemployment can be explained by job rationing alone in recessions.

I then show that in recessions, job rationing generates inefficiently high unemployment, which leaves room for labor market policies to improve social welfare. I evaluate three labor market policies—1) direct employment, 2) placement services, and 3) a wage subsidy—over the business cycle. First, I compute fiscal multipliers (the increase in social welfare obtained by spending one dollar on a policy) as a function of the state of the labor market to determine the effectiveness of these unemployment-reducing policies. I show that placement services are more effective in good times than in bad times, while direct employment and wage subsidy are more effective in bad times than in good times. Then, I characterize the optimal mix of policies that could be implemented by a benevolent government. The optimal unemployment-reducing policy evolves over the business cycle: its puts more weight on policy instruments reducing matching frictions in good times than in bad times; conversely, it puts more weight on policy instruments creating jobs directly in bad times than in good times. Intuitively in expansions, unemployment is caused by matching frictions, so policies reducing these frictions are effective and should be implemented in priority; unemployment is caused by a lack of jobs in bad times, so policies creating jobs directly are effective and should be implemented in priority.

Below, I justify my focus on matching frictions and job rationing as sources of unemployment. I then describe in detail my model of unemployment, delve into the results of the dissertation, and relate my work to the literature.

The Importance of Matching Frictions and Job Rationing

The dissertation proposes a model of the labor market that integrates two important sources of unemployment: matching frictions and job rationing. It studies how these two sources interact over the business cycle to shed new light on the mechanics of unemployment fluctuations and the role for unemployment-reducing labor market policies. The focus on these specific sources of unemployment is motivated by two observations described below.

First, labor markets see constant job destruction and job creation, as well as large flows of workers (Blanchard and Diamond 1989; Davis, Haltiwanger, and Schuh 1996). So, frictions constantly hindering matching of workers and firms are bound to influence the mechanics of the labor market.

Second, there are many hurdles to wage adjustment in the labor market. These hurdles sometimes force wages to remain above market-clearing levels, leading to job rationing. Unions and minimum wage laws are examples of

such obstacles to wage adjustment; internal labor markets are another. Two well-documented characteristics of internal labor markets are relevant to explain why they may lead to job rationing. First, the internal pay structure does not respond to competitive forces in external labor market. For instance, Doeringer and Piore (1971) emphasize that "the internal labor market is governed by a set of rules and procedure." They say that "the jobs within the internal labor market are shielded from the direct influences of competitive forces in the external labor markets [and] these rules are not consistent with pricing and distribution of labor which would prevail in a competitive market." Therefore, when aggregate demand for labor falls, wages are constrained to remain above market clearing levels, rationing the number of jobs in the economy. Second, wages in internal labor markets tend to be high to elicit effort and dedication from employees (Bewley 1999; Jacoby 1984). The internal labor market organization is pervasive today, to the point where any human resource textbook dedicates a chapter to the design of internal labor markets (for example, Billikopf [2003]).

A Model with Matching Frictions and Job Rationing

The model of the labor market described in the dissertation builds on Pissarides' (2000) search-and-matching model by relaxing two of its key assumptions: completely flexible wages and constant marginal returns to labor. These assumptions are critical because either implies that unemployment would disappear in the absence of matching frictions. To relax these assumptions, I develop a dynamic stochastic general equilibrium model in which large, monopolistic firms face a labor market with matching frictions, as in Blanchard and Gali (2008). All household members are in the labor force at all times, either working or searching for a job. Firms set prices and hire new workers each period in response to exogenous job destruction and technology shocks. Recruiting is costly because of matching frictions, especially in expansions when many firms compete to recruit from a small pool of unemployed workers.

In a frictional labor market there is no compelling theory of wage determination, which prompts the choice of a general wage schedule. Instead of deriving results for a particular wage-setting mechanism, I find conditions on the wage schedule for my results to hold. Furthermore, this generality allows me to nest as special cases various influential models of the search-and-matching literature, which provide valuable points of comparison.

Central to my analysis is job rationing. This assumption pertains to the behavior of the model at the limit when recruiting costs are nil. In search-and-matching models, firms and workers decide on a wage once they have matched. Any wage falling in the interval between the flow value of unemployment and the marginal revenue product of labor, which I call the *efficiency set*, could be supported when the labor market is in equilibrium. This is because such a wage respects the private efficiency of all matches: any worker-firm pair prefers accepting this wage to breaking the match (Hall 2005).

Equilibrium unemployment in the labor market is influenced by the distance between the wage and the upper bound of the efficiency set (the marginal revenue product of labor), because profit-maximizing firms enter until wage plus marginal recruiting costs equal marginal revenue product of labor. If wages are well below the marginal revenue product of labor, recruiting costs must be high in equilibrium, which implies that the labor market is tight and unemployment is low. If wages are close to the marginal revenue product of labor, recruiting costs must be low in equilibrium, which implies that the labor market is slack and unemployment is high. When recruiting costs fall to zero, determining equilibrium unemployment is even simpler: if the wage remains below the upper bound of the efficiency set for all employment levels, then the economy converges to full employment; if the wage remains below the upper bound until some employment level N*, and is above the upper bound for $N > N^*$, then the economy converges to N*.

In all existing search-and-matching models, we are in the first scenario: the economy converges to full employment absent recruiting costs. The canonical search-and-matching model assumes that the wage is the outcome of Nash bargaining (Mortensen and Pissarides 1994). By construction, the wage always falls into the efficiency set, which implies that the wage always remains below the marginal revenue product of labor. Therefore if recruitment costs fall to zero, firms will make a positive profit on each new match and will enter the labor market until there is full employment. Shimer (2004) and Hall (2005) introduce real wage rigidity into search-and-matching models, in the form of a constant real wage. A constant wage is not the outcome of any bargaining, so it could fall outside the efficiency set. However, since these models assume atomistic firms for simplicity, the efficiency set is simply the interval between the flow value of being unemployed and the level of technology (which corresponds to labor productivity), and it is independent of aggregate employment. Thus, if technology is above the constant wage, firms enter until there is full employment if recruitment costs fall to zero, as in the canonical search-and-matching model.[1]

In contrast, I propose a model in which we are in the latter scenario. I assume that there is a range of technology and a nondegenerate range of employment for which the wage lies outside of the efficiency set; more precisely, when technology is low enough and employment is high enough, wages are above the marginal revenue product of labor. Under this assumption, jobs are rationed when technology is low enough: even if recruiting costs were zero, workers could not all be profitably employed, and some

unemployment, which I call *rationing unemployment,* would remain. This is because profit-maximizing firms expand employment to the point where the marginal revenue product of labor equals the marginal cost of hiring a worker, which includes wage and recruiting costs; in particular, firms do not hire past the point at which the marginal revenue product of labor equals the wage. When recruiting costs are positive, unemployment is higher than rationing unemployment, and the difference between the former and the latter is labeled *frictional unemployment*.

After an analysis of the general model, I specialize production function and wage schedule to propose a model in which the combination of diminishing marginal returns to labor and some wage rigidity yields job rationing. Intuitively, after sufficiently large negative technology shocks, the marginal revenue product of labor falls; wages only partially adjust downward, such that wage may now be higher than the marginal revenue product of labor for the last workers in the labor force. Accordingly, firms cut employment to increase the marginal revenue product of labor at least until it equals the wage. In this model, jobs are rationed because not all workers could be employed even absent recruiting costs.

The assumptions of wage rigidity and diminishing marginal returns to labor are appealing because they are standard in the macroeconomic literature, and because they have received convincing empirical support. At business cycle frequency, some production inputs may be slow to adjust; thus, short-run production functions are likely to exhibit diminishing marginal returns to labor. There are also substantial ethnographic and empirical literatures documenting wage rigidity. Hence, job rationing arises naturally in a search-and-matching model of the labor market.

The model of the labor market put forward in the dissertation is amenable to evaluating a number of labor market policies. In the last part of the thesis, I introduce three unemployment-reducing policies into the dynamic stochastic general equilibrium model. The first one is direct employment, which hires unemployed workers in public-sector jobs, or offers contracts to private-sector firms to produce goods consumed by the government. The second policy is placement services, which enhance unemployed workers' job search efficiency to reduce matching frictions. The third policy is a wage subsidy, which reduces the cost of labor faced by private firms. Studying these policies is especially relevant since governments have historically resorted to these policies on a large scale. These three policies are also among the most commonly used by European states.

Contributions

This dissertation develops a tractable model that distinguishes between two components of unemployment: rationing unemployment and frictional unemployment. By studying these components, I derive three results that improve our understanding of unemployment fluctuations: 1) I show that during a recession, rationing unemployment increases, driving the rise in total unemployment, while frictional unemployment decreases; 2) I construct historical time series for frictional and rationing unemployment in a calibrated model of the labor market to find that fluctuations in the composition of unemployment are quantitatively large; 3) I study the normative implications of these positive results to find that the optimal unemployment-reducing policy should evolve with the state of the labor market: the optimal policy aims at creating jobs directly in recessions, and at reducing matching frictions in expansions.

When do matching frictions matter? Not in bad times

I formally define the rationing component of unemployment as the part that would prevail if recruiting costs were zero, and the frictional component as additional unemployment due to positive recruiting costs. Rationing unemployment quantifies the amount of unemployment due to job rationing, whereas frictional unemployment quantifies the amount due to matching frictions.

This dissertation proposes a condition under which rationing unemployment is positive. It then proves theoretically that during a recession, rationing unemployment increases, driving the rise in total unemployment, while frictional unemployment decreases. This result suggests that job rationing trumps matching frictions to explain unemployment in recessions. These frictions, however, remain central to understand unemployment in expansions.

Intuitively, job rationing in recessions is more acute. Therefore, rationing unemployment increases, raising total unemployment. This means that a firm posting a vacancy will receive more applications from the large pool of unemployed workers, and it will be able to fill its vacancy more rapidly, and at a lower cost. So in recessions, because of matching frictions, the marginal cost of labor does not increase as much, monopolistic firms do not reduce production as much, and there is not much additional unemployment. Consequently matching frictions contribute less to unemployment, and frictional unemployment is lower in recessions.

Historical time series for frictional and rationing unemployment

To quantify the fluctuations of frictional and rationing unemployment over the business cycle, I consider a special case of the general model in which the combination of diminishing marginal returns to labor and some wage rigidity leads to job rationing. Calibrating the model and imposing technology shocks estimated in U.S. data produces moments

for labor market variables that are close to their empirical counterparts. In particular, even a small amount of wage rigidity, such as that estimated in microdata with earnings of newly hired workers (for example, Haefke, Sonntag, and Van Rens [2008]), is sufficient to amplify realistic technology shocks as much as observed in the data. I also compare actual unemployment with the unemployment series simulated from actual technology. Model-generated unemployment matches actual unemployment closely. These results suggest that in spite of its simplicity, the model fits the data notably well, lending support to the quantitative analysis of unemployment and its components.

Exploiting the calibrated model, I decompose historical U.S. unemployment into historical time series for rationing unemployment and frictional unemployment. These series suggest that as long as total unemployment is below 5.2 percent, it can all be attributed to matching frictions. On average, total unemployment amounts to 5.8 percent of the labor force, frictional unemployment to 4.3 percent, and rationing unemployment to 1.5 percent. But in the second quarter of 2009, when total unemployment reached 9.2 percent, rationing unemployment increased to 7.6 percent, while frictional unemployment decreased to 1.6 percent. Next, I simulate moments for unemployment and its components. I find that rationing unemployment is more than twice as volatile as frictional unemployment.

Although concepts similar to those of frictional and rationing unemployment have long existed, this quantitative analysis has not previously been conducted.[2] As highlighted by Romer (2002), "We do not know if frictional unemployment is one-quarter or three-quarters of total unemployment."

State-dependent labor market policies

This dissertation shows that when job rationing generates inefficiently high unemployment, labor market policies can improve welfare significantly. Specifically, I evaluate three labor market policies over the business cycle: 1) direct employment, 2) placement services, and 3) a wage subsidy. I assume that the government can commit to these policies. Policies are financed by an exogenous, stochastic stream of income, and by issuance of state-contingent debt.

The fluctuations in rationing and frictional unemployment suggest that optimal unemployment-reducing policies should adapt to the changing state of the labor market. To formalize this intuition, I compute state-dependent fiscal multipliers—the increase in social welfare obtained by spending one dollar on a policy. I show that placement services are more effective in good times than in bad times. The converse is true of direct employment and wage subsidy. Intuitively, in bad times, frictional unemployment is low; placement services aim to further reduce this component and are therefore ineffective. The effectiveness of direct employment is a function of how much it crowds out private employment; in bad times, competition for workers is weak and crowding out is limited. Thus, this policy is effective. Finally, a wage subsidy reduces the marginal cost of labor, which leads firms to increase employment; higher aggregate employment increases the labor market tightness and recruiting costs until a new equilibrium is reached, at which point the new marginal cost of labor equals the marginal revenue product of labor. In bad times, recruiting costs are low and do not vary much with employment, so a wage subsidy triggers a large increase in employment. In good times, recruiting costs are high and increase rapidly with employment, so a wage subsidy will only achieve a small increase in employment; thus, a wage subsidy is more effective in bad times. In a calibrated model, when unemployment increases from 4 percent to 12 percent, the multiplier for placement services decreases from 2 utils per dollar to 0.5 utils per dollar, the multiplier for direct employment increases from 0.3 util per dollar to 1 utils per dollar, and the multiplier for wage subsidy decreases from 1 util per dollar to 3.5 utils per dollar.

Then I characterize the optimal mix of policies implemented by a benevolent government. The optimal unemployment-reducing policy evolves over the business cycle: its puts more weight on policy instruments reducing matching frictions (placement services) in good times than in bad times; conversely, it puts more weight on policy instruments creating jobs directly (direct employment and wage subsidy) in bad times than in good times.

Relation to the Literature

The search-and-matching framework

The decomposition of unemployment into rationing unemployment and frictional unemployment, as well as the characterization of the cyclical fluctuations in the components of unemployment, is new to the literature. In fact, existing models of unemployment only account for one single source of unemployment and are not amenable to unemployment decomposition.

For instance, in existing search-and-matching models, unemployment disappears when recruiting costs converge to zero. In other words, there is no job rationing and all unemployment is frictional. The canonical search-and-matching model features atomistic firms in which the marginal product of labor remains above the value of unemployment for workers (Mortensen and Pissarides 1994; Pissarides 2000). Once search costs are sunk, matches always generate a positive surplus, which is shared between firm and worker by Nash bargaining over wages. When recruiting costs converge to zero, the net profit from a match is positive for any level of employment. Consequently, firms enter the labor market until all the labor force is employed. The property that unemployment disappears when recruiting

costs converge to zero also holds when rigid wages are introduced into the model (Shimer 2004; Hall 2005). This is because rigid wages always lie between the marginal product of labor, which is independent of employment, and the value of unemployment for workers. As with the basic search model, with no search costs firms enter the labor market until all the labor force is employed. Lastly, this property holds in large-firm search-and-matching models with diminishing marginal returns to labor (Cahuc and Wasmer 2001; Elsby and Michaels 2008). This is because these models use Stole and Zwiebel's (1996) intrafirm bargaining mechanism to set wages. Thus, the wage is derived from Nash bargaining over surplus from the marginal worker-firm match, and the wage remains below the marginal product of labor for any level of employment. Consequently, employers expand employment until all the labor force is employed when recruiting costs fall to zero.

The absence of job rationing in existing search-and-matching models is critical. Without job rationing, all unemployment is frictional, which has several important implications for the impact of labor market policies on unemployment: policies improving matching always reduce unemployment significantly, direct job creation by the government has no effect on unemployment, and policies reducing the search effort of the unemployed always increase unemployment significantly. This paper offers a more nuanced theory of unemployment over the business cycle in which job rationing is the most important source of unemployment in recessions, and matching frictions are the most important source of unemployment in expansions. These results suggest that the effectiveness of labor market policies depends on the state of the labor market: policies improving matching reduce unemployment in expansions but not in recessions, direct job creation by the government has no effect on unemployment in expansions but reduces unemployment in recessions, and policies reducing the search effort of the unemployed, such as a generous unemployment insurance, increase unemployment in expansions but have no effect on unemployment in recessions. From a normative standpoint, these results imply that policymakers should adapt labor market policies to the state of the labor market.

The design of optimal fiscal policies

The policy results derived in the dissertation are related to two strands of literature. First, search models of the labor market have been specifically designed to study particular labor market policies, but these policies have never been compared (Mortensen and Pissarides 1999; Pissarides 2000; Cahuc and Zylberberg 2004). In addition, these studies do not emphasize the variations in the effectiveness of policies at different points of the business cycle. Second, raising revenue to finance policies could be distortionary. I abstract from these distortions and instead determine how to optimally spend a given amount of tax revenue. Therefore, these results complement the large literature on optimal taxation, which determines the least costly way to finance a given amount of government spending (Lucas and Stokey 1983; Chari, Christiano, and Kehoe 1991; Aiyagari et al. 2002).

Macroeconomic models of unemployment

More generally, this paper contributes to the unemployment literature by integrating two major strands of research: the search-and-matching literature, which has become the standard theoretical framework for analyzing labor market fluctuations, and the job-rationing literature.

The Mortensen-Pissarides search-and-matching model has become the standard framework to analyze unemployment and labor market dynamics (Pissarides 1985; Mortensen and Pissarides 1994; Pissarides 2000). This model generates unemployment because workers cannot obtain jobs by bidding down wages to their reservation wage: in the presence of matching frictions, it takes time and effort to establish contact with an employer. This model has been used widely in macroeconomics and related disciplines; it has been embedded into real business cycle models (Merz 1995; Andolfatto 1996), dynamic stochastic general equilibrium models with wage and price rigidities (Blanchard and Gali 2008; Gertler and Trigari 2009), trade models (Helpman and Itskhoki 2007; Helpman and Redding 2008), and has been studied to understand the impact of different policy interventions on unemployment (Mortensen and Pissarides 1999; Cahuc and Zylberberg 2004).

The job-rationing literature, on the other hand, dates at least as far back as Keynes' wage floor. Researchers in this literature drew on field studies by psychologists, sociologists, social psychologists, and anthropologists to motivate their models. This literature includes work on efficiency-wage models (Stiglitz 1976; Solow 1979; Akerlof and Yellen 1990), gift-exchange models (Akerlof 1982), insider-outsider models (Lindbeck and Snower 1988), and social-norm models (Solow 1980, Akerlof 1980). These papers put forth different theories explaining why profit-maximizing firms may set wages above market-clearing levels. Generally, these theories postulate that higher wages increase effort and dedication to the firm, thus increasing productivity and profitability. These theories have received support from economists who have studied wage-setting practices in the field (for example, Okun [1981]; Campbell and Kamlani [1997]; Bewley 1999). In these models, unemployment is the equilibrium outcome of the shortage of jobs induced by excessively high wages.

This dissertation merges these branches of the literature to show that unemployment is best described as a combination of frictional and rationing unemployment: the search-and-

matching theory describes the labor market well in normal and good times, and job-rationing theory describes the labor market well in bad times, but only the integration of both theories provides a good understanding of business-cycle fluctuations in the labor market. This integration delivers novel and important policy recommendations as well.

Notes

1. Note that if technology is below the constant wage, the labor market shuts down and all workers are unemployed for any recruiting cost.
2. Rationing unemployment is similar to classical unemployment if rationing results from real wage rigidities. It is similar to cyclical unemployment if rationing results from demand shocks and price rigidity.

References

Aiyagari, S. Rao, Albert Marcet, Thomas J. Sargent, and Juha Seppala. 2002. "Optimal Taxation without State- Contingent Debt." *Journal of Political Economy* 110(6): 1220–1254.

Akerlof, George A. 1980. "A Theory of Social Custom, of Which Unemployment May Be One Consequence." *Quarterly Journal of Economics* 94(4): 749–775.

———. 1982. "Labor Contracts as Partial Gift Exchange." *Quarterly Journal of Economics* 97(4): 543–569.

Akerlof, George A., and Janet L. Yellen. 1990. "The Fair Wage-Effort Hypothesis and Unemployment." *Quarterly Journal of Economics* 105(2): 255–283.

Andolfatto, David. 1996. "Business Cycles and Labor-Market Search." *American Economic Review* 86(1): 112–132.

Bewley, Truman F. 1999. *Why Wages Don't Fall During a Recession*. Cambridge, MA: Harvard University Press.

Billikopf, Gregory E. 2003. *Labor Management in Agriculture: Cultivating Personnel Productivity*. University of California, Division of Agriculture and Natural Resources, Agricultural Issues Center, Davis, California.

Blanchard, Olivier J., and Peter Diamond. 1989. "The Beveridge Curve." *Brookings Papers on Economic Activity* 1989(1): 1–76.

Blanchard, Olivier J., and Jordi Gali. 2008. "Labor Markets and Monetary Policy: A New-Keynesian Model with Unemployment." NBER Working Paper No. 13897. Cambridge, MA: National Bureau of Economic Research.

Cahuc, Pierre, and Etienne Wasmer. 2001. "Does Intrafirm Bargaining Matter in the Large Firm's Matching Model?" *Macroeconomic Dynamics* 5(05): 742–747.

Cahuc, Pierre, and André Zylberberg. 2004. *Labor Economics*. Cambridge, MA: MIT Press.

Campbell, Carl M., and Kunal S. Kamlani. 1997. "The Reasons for Wage Rigidity: Evidence From a Survey of Firms." *Quarterly Journal of Economics* 112(3): 759–789.

Chari, V.V., Lawrence J. Christiano, and Patrick J. Kehoe. 1991. "Optimal Fiscal and Monetary Policy: Some Recent Results." *Journal of Money, Credit and Banking* 23(3): 519–539.

Davis, Steven J., John Haltiwanger, and Scott Schuh. 1996. *Job Creation and Destruction*. Cambridge, MA: MIT Press.

Doeringer, Peter B., and Michael J. Piore. 1971. *Internal Labor Markets and Manpower Analysis*. Lexington, MA: Heath Lexington Books.

Elsby, Michael W.L., and Ryan Michaels. 2008. "Marginal Jobs, Heterogeneous Firms, and Unemployment Flows." Working paper. Ann Arbor, MI: University of Michigan.

Gertler, Mark, and Antonella Trigari. 2009. "Unemployment Fluctuations with Staggered Nash Wage Bargaining." *Journal of Political Economy* 117(1): 38–86.

Haefke, Christian, Marcus Sonntag, and Thijs Van Rens. 2008. "Wage Rigidity and Job Creation." Discussion Paper No. 3714. Bonn: IZA.

Hall, Robert E. 2005. "Employment Fluctuations with Equilibrium Wage Stickiness." *American Economic Review* 95(1): 50–65.

Helpman, Elhanan, and Oleg Itskhoki. 2007. "Labor Market Rigidities, Trade and Unemployment." NBER Working Paper No. 13365. Cambridge, MA: National Bureau of Economic Research.

Helpman, Elhanan, and Stephen Redding. 2008. "Inequality and Unemployment in a Global Economy," NBER Working Paper No. 14478. Cambridge, MA: National Bureau of Economic Research.

Jacoby, Sanford. 1984. "The Development of Internal Labor Markets in American Manufacturing Firms." In *Internal Labor Markets*, Paul Osterman, ed. Cambridge, MA: MIT Press.

Lindbeck, Assar, and Dennis Snower. 1988. *The Insider-Outsider Theory of Employment and Unemployment*. Cambridge, MA: MIT Press.

Lucas, Robert Jr., and Nancy L. Stokey. 1983. "Optimal Fiscal and Monetary Policy in an Economy without Capital." *Journal of Monetary Economics* 12(1): 55–93.

Merz, Monika. 1995. "Search in the Labor Market and the Real Business Cycle." *Journal of Monetary Economics* 36(2): 269–300.

Mortensen, Dale T., and Christopher A. Pissarides. 1994. "Job Creation and Job Destruction in the Theory of Unemployment." *Review of Economic Studies* 61(3): 397–415.

———. 1999. "New Developments in Models of Search in The Labor Market." In *Handbook of Labor Economics*, Vol. 3, Orley Ashenfelter and David Card, eds.

Okun, A.M. 1981. *Prices and Quantities: A Macroeconomic Analysis*. Washington, DC: Brookings Institution.

Pissarides, Christopher A. 1985. "Short-Run Equilibrium Dynamics of Unemployment, Vacancies, and Real Wages" *American Economic Review* 75(4): 676–690.

———. 2000. *Equilibrium Unemployment Theory*, 2nd ed. Cambridge, MA: MIT Press.

Romer, David. 2002. *Advanced Macroeconomics*, 3rd ed. New York: McGraw-Hill.

Shimer, Robert. 2004. "The Consequences of Rigid Wages in Search Models." *Journal of the European Economic Association* 2(2/3): 469–479.

Solow, Robert M. 1979. "Another Possible Source of Wage Stickiness." *Journal of Macroeconomics* 1: 79–82.

———. 1980. "On Theories of Unemployment." *American Economic Review* 70(1): 1–11.

Stiglitz, Joseph E.. 1976. "The Efficiency Wage Hypothesis, Surplus Labour, and the Distribution of Income in L.D.C.s." *Oxford Economic Papers* 28(2): 185–207.

Stole, Lars A., and Jeffrey Zwiebel. 1996. "Organizational Design and Technology Choice under Intrafirm Bargaining." *American Economic Review* 86(1): 195–222.