# Search and Learning in Markets

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## Abstract

Search is a process of learning and discovery. Consumers search for goods that fit their requirements and budgets, and workers search for jobs commensurate to their skills. Learning can vary by domain—whether a person learns about herself, about the other market participants, about the fit between both, or about the conditions in the larger economic environment; and it can span several domains at the same time. While the search process has traditionally been modeled as a black box where it simply takes time to locate the desired opportunity, recent work and future research will break up this process to be more explicit about the source of the problem. This has been missing partly because it is easier to model environments where everyone and everything is identical. Once it is acknowledged that people, firms and goods are different, that they learn over time about their type, and that the differences interact in important ways, new avenues for research open up. While much of existing work has focused on quantity (i.e., number of jobs found), future work is likely to focus more on the quality (i.e., how valuable is this job to society). This essay discusses which elements might shape the research in this area, and highlights the new lessons that are likely to emerge from this work.

## INTRODUCTION

Search and learning are deeply linked. The innovative process of learning and discovery is usually preceded by a period of search in which several alternatives are considered and discarded until the right one is found. This applies to job search by unemployed workers, where alternatives are potential job opportunities. It applies to product markets where consumers search among different objects to find the most suitable one. It applies to research and development, where alternatives might concern ideas or venture partners. It applies to partner and mate search, where the discovery is about the right match. All of these are domains of large economic and social importance.

   In the simplest view of the search and learning process, a person searches without learning anything until at some point the right alternative appears. This has been the predominant modelling tool because it is tractable and

still allows statements about the duration of search and the amount of people finding the right alternative. Nevertheless, the learning part of this process—nothing learned until everything is revealed—is so simple that it neglects important phenomena: People who are unemployed over a longer period of time might learn that they are less desirable than they initially thought and become discouraged; their skills might change over time and so the alternative they are looking for might change as well; firms who cannot hire (or who cannot sell a good) might learn that the market conditions are different than they thought; and learning might even lead to search as when firms learn that a worker is not suited for the job and therefore both have to continue searching.

   Modeling these considerations requires a shift in focus towards the real source of search: people, jobs, and goods differ, making it important to find the right counterpart. Modeling the idea of a "right" match naturally requires to model heterogeneity in the market. This opens exciting new avenues for research. Possibly the most relevant one is to shift attention from simple statistics such as the number of successful searches (e.g., changes in the employment rate) to the quality of the matches that are created (e.g., whether a lot of value is created in any given job). This applies to the labor market, but also to marriage and mating, as well as to consumer product markets. Since the number of matches is easier to see than the quality, careful modeling becomes increasingly important. This essay highlights some recent trends in this research, outlines new avenues, and highlights important open questions. It will use the labor market as illustrative example, but similar ideas apply to other areas. Since the literature in this field is large, references in this essay reflect only a small selected subset, and for each listed reference at the very least also the references therein and thereof should be considered.

## FOUNDATIONAL RESEARCH

### SEARCH AS A PREREQUISITE FOR LEARNING

In economics, the importance of the search process was highlighted most strongly in the area of unemployment. Whereas the long-standing view of unemployment was one in which people are idle, two contributions by Edmund Phelps (1967) and Milton Friedman (1968) early on highlighted the role of unemployment as a *productive* process. In particular, they outlined the view that the unemployed engage in a process of searching for a new valuable activity, and explicitly highlighted the link between (lack of) information about open vacancies and unemployment. George Stigler (1961, 1962) had shown earlier that the price for identical consumer products such as coal or new cars (as well as the price of seemingly similar labor services)

varies substantially, and argued that this might be as a result of informational problems that search can overcome. That search is a productive process has been acknowledged in other fields as well: For example, in biology Anthony Janetos (1980) proposed to model mate choice as an information-gathering decision, in sociology Mark Granovetter (1974) explicitly highlights the information acquisition through social networks, and in marketing Phillip Nelson (1970) highlights several search channels for information gathering in the product markets.

THE DIFFERENT DIMENSIONS OF SEARCH AND LEARNING

To understand the process of search and learning, it is useful to classify what the nature of the underlying search and learning process is. Pointing out the differences is useful both to understand the different strands of the search and learning literature, but is also of high importance because much interest in future work might be precisely at the borders between these theories. The reason for this is that in many markets several of these features might operate at the same time.

*Search and Learning only about Location:* Arguably the most tractable approach is to assume an all-or-nothing process of search and learning. In such a world, a person searches as long as no object is found and stops searching as soon as one of them is found, at which point all relevant information is learned. Think of finding a job as a process by which all jobs are identical but it is not known where a vacant job is. As soon as one is located, the person finds employment and the search is over. This approach essentially goes back to the Nobel-prize winning work of Peter Diamond (1971), Dale Mortensen (1982), and Christopher Pissarides (1984). These authors highlighted an externality—more workers that search means that each individually has a harder time of finding a job - and their work has fundamentally inspired the modelling of employment and unemployment. While this form of search and learning is usually captured in reduced form via an abstract matching function, Margaret Stevens (2004), Ricardo Lagos (2000), as well as Kenneth Burdett, Randall Wright and Shouyong Shi (2001) outlined how specific functional forms might arise in a natural environment.

This overall approach is arguably the workhorse model of search and learning. Nevertheless, the learning part is rather simplistic and constitutes a rather subdued element in these works. It is still the basis even for work that models the learning process more deeply, because it highlights an informational friction that explains why not all sides of the market immediately communicate with all others; that is, why not all information is immediately revealed through some centralized market mechanism.

*Search and Learning about the match:* Additional to possible problems of determining the location of a trading partner, an important component that has been analyzed is how the two sides fit together. Once a worker meets a firm, the productivity might be idiosyncratic to this relationship. In such a setting search is not only about finding anything, but also about making sure that what is found has high enough value. If the value of a match is too low, then search has to continue or has to resume again because what is learned about the current job does not make it viable any longer. Boyan Jovanovic (1979) outlined how this type of learning might unfold over time. Relative to the previous point the learning here happens ex-post after the worker has found a possible job, and models differ regarding how quickly the learning takes place (if it is instantaneously the job might not even be taken up, while with gradual learning the job starts and break-ups might arise later on).

*Search and Learning in the presence of heterogeneity:* Probably the most natural idea for search markets is that underlying objects are inherently different. In the labor market, workers and firms differ, and the objective of search is to find an adequate partner. Robert Shimer and Lones Smith (2000) show that this opens new considerations relative to the previous point: Some partners that I like might not like me, or even if they like me they might like someone else so much better that they rather continue to search. This leads to truly interesting effects as different agents search amongst different jobs. When market conditions vary over time, the average skill in the pool of unemployed workers may change, yielding different incentives for employers to create jobs (Lockwood, 1991). It should be noted that differences between identical objects can also arise endogenously. Kenneth Burdett and Dale Mortensen (1998) showed that identical jobs might differentiate themselves by offering different wages to attract workers at different rates. Again the timing of learning in these models differs: Most assume for tractability that the type of the partner becomes known immediately on meeting, but recent work combines it with slow learning along the following lines.

*Learning about yourself:* The preceding point highlights the idea that people and jobs (as well as consumers and products, etc.) are different and look for the right counterpart willing to match with them. Nevertheless, types also change over time: Workers might become more productive when they work and less productive when they do not work. This might happen stochastically and yield surprises for workers and firms. In fact, the true type might only be revealed slowly through time. These developments change the worker's search strategy while unemployed, and even when employed it can induce break-up of relationships not only because the workers skills become too bad but also if they turn out to be too good for the current job (Gibbons and Waldman, 1999).

*Learning about the environment*: Even if an individual is aware of its own type, there are many conditions about the market that he might not be aware of. In particular, he might not be aware of how many other workers and firms are looking for jobs at this point, and what wages are appropriate for the type of skill. Wolinsky (1990) highlights how this affects the wage bargaining process and how initial rejections leads to learning about the market conditions and adjustments in the bargaining behavior. Informational problems about the market environment seems particularly relevant for young workers and for workers that have held a job for a long time but were laid off and now have to find out the overall market conditions (Neal, 1999).

*Channels of Search and Learning*: There are many ways in which workers can search and learn. They might observe their own output and learn about their skills. They might search for new job opportunities by themselves through reading advertisements or proactive job applications. Alternatively they might use their social network to learn about market conditions. This essay abstracts from the additional issues of learning in social networks, even though this is an increasingly relevant field of on-going research (e.g., Galenianos, 2013).

We should highlight that the word "learning" is often used in different ways. Often it refers to acquisition of new information. This can arise in two ways, either as gradual process following a statistical updating procedure (as is often used to model learning about worker's own ability), or as instantaneous learning (as is the case when a worker does not know about the location of a job and through the search gets fully aware of it) which usually follows a simple Poisson structure. The categories above differ both in the type of information that is learned and in how gradual the information arrives. An alternative meaning of the word "learning" is "learning by doing", which usually refers to the process of becoming more productive at a task. The reason for the latter could be new information, but it could also simply be a mechanical acquisition of skills. When looking at the classification above, "learning by doing" falls roughly into the category "learning about yourself". Even if the productivity of a worker increases mechanically with working at a job and he does not really "learn" anything new about himself, his type changes over time. The fact that the type is not constant, and the same person might make different choices over time because he has changed, is the main essence of models in that category.

It might also be worth mentioning that people might search across several markets at the same time. For example, they might simultaneously look for a new job and a new house. Peter Rupert and Etienne Wasmer (2012) consider the fact that both processes take time and require learning about the market,

one's preferences and the characteristics of jobs and houses. While the interaction might be important for some market phenomena and is part of recent work, we abstract from it here.

## CUTTING EDGE RESEARCH

Much of the cutting-edge research spans the boundaries between the areas above. It is concerned with how different types of search and learning interact, how it alters the market interaction, and how this can be teased out from existing data.

### INTERACTION OF SEARCH FOR "LOCATION" (1) AND HETEROGENEITY (3)

How the problem of finding a trading partner interacts with the type of trading partner that is chosen is one of the most active areas of ongoing research. The idea that waiting makes it costly to look for the most productive partner implies not only that some resources are not directly productive (because they are used in the search process, as is the case for the unemployed) but even those resources that are used in production might not be used optimally (a biologist who starts to work as a receptionist might not use all his qualifications in a socially optimal way). It is relatively easy to measure how many resources are used in production—in the labor market we have decades of experience in measuring the employment rate. It seems much harder to determine how valuable the work is once somebody is employed. Some jobs might be such a bad fit that the value relative to remaining unemployed is slim while for others the additional value is very large. This is one area of interesting on-going research.

Take a particular setting for illustration. Consider a market where jobs differ in the amount of capital (some jobs have larger machines associated with them than others). Moreover, workers differ in skills. Assume the output can be split in any way between the worker and the firm who owns the job. A biologist working in a research laboratory would constitute a high-skilled worker in a capital-intensive job, while his employment as a receptionist would constitute a high-skilled worker in a job with low capital intensity.

*One question that arises is who will be hired in which job*. This question goes back to the seminal work by Gary Becker (1973), who analyzed this question without any search or learning frictions, that is, everyone knows everything and the market behaves competitively. Consider a capital-intensive job, and determine how much output is increased by hiring a high-skilled rather than a low-skilled worker. Consider the same for a job with lower capital-intensity. If the capital-intensive job gains more by hiring the high-skilled worker, this job will outbid the other one and ends up hiring such workers. This logic

crucially relies on the idea of complete markets where a person knows that he can find a trading partner and only has to decide which one he wants. If the person first has to learn about the location of the trading partner (1) and possibly about his type (3), this logic is only part of the answer, since there is a chance of not meeting anybody or not learning enough about his type to want to hire him. If the cost of waiting for the most suitable worker is particularly high for capital-intensive jobs, they might also accept low-skilled workers to make sure that their capital is utilized at all, changing the overall interaction pattern towards low-skilled workers. The exact trade-offs depend on the nature of the search and learning process, but it involves a comparison of the waiting times with the increase in output (Shimer & Smith, 2000; Eeckhout & Kircher, 2010).

*The second question is how one could measure the value once the search process is finished?* This second point is a key question because the value that is created in a market is not just the number of matches but also how valuable they are. This is especially difficult to measure since existing datasets usually do not provide the value of the output of each job (usually output and profit data are provided on the establishment level comprising many workers of different skills ranging from receptionists to managers). Therefore, how much has been learned in the search process is not easy to infer. Yet it is extremely important because policies that decrease the amount of unemployment such as cuts in unemployment benefits might induce workers to accept low-value jobs. Daron Acemoglu and Robert Shimer (1999) argue that if only the numbers of unemployed people is measured such a policy might look promising, while a measure of the value of the jobs might show that such a policy is actually undesirable. To identify the value of a job, recent work relies on the assumption that worker and job types remain constant, and applies one of a number of strategies to measure the value of a job: Consider a worker who has multiple jobs throughout his life. If his wages change substantially with the type of the job, obtaining the right job must be very important, that is, not having the right job substantially reduces the value of the worker and this is reflected in his wages (Gautier & Teulings, 2006). The range of accepted wages and the probability of taking a job is also informative: If a person accepts a large range of wages but accepts employment only at a small fraction of firms, this indicates that only few firms are suitable and the value drops off quickly as one moves away from the optimal firm (this and other forms of identification are discussed in Eeckhout and Kircher (2011), as well as problems using popular two-sided fixed effect methodologies). If workers within the same job are very similar, that can indicate that finding this particular job is particularly valuable to them, while dispersion of similar workers across very different jobs means that finding a particular job type is

not so crucial (Lopes de Melo, 2008). Inclusion of on-the-job search and identification and estimation based in more detail on the model specification has recently been proposed (Lentz, 2010; Gautier & Teulings, 2012). Some of these contributions not only identify the value but also who is hired by whom as outlined in the previous section, that is, they make progress in identifying the full market interaction (Hagedorn, Law, & Manovskii, 2012)

This overall agenda is crucial as it allows a much clearer assessment of the costs of search and learning, but it so far applies only on stringent conditions about stationarity of the market and constancy of skills and job productivities, which are discussed below.

### INTERACTION OF SEARCH FOR "LOCATION" (1) AND "LEARNING ABOUT YOURSELF" (4)

More or less orthogonal to the previous point is recent work in which the type of the worker changes. This could be because of exogenous shocks to productivity, or because of learning by doing, but the most common assumption is that neither the worker nor the firm knows the worker's productivity and both slowly learn his type over time. Inference about the value of a match is now more difficult compared to the previous section, since a worker's type does not remain constant over time. The direction of movements can possibly be used to infer the value of the worker at a given point in time. Without other search frictions such as those about "location" the direction of job movements are a key source of variation, since workers moving to better types of jobs must have experienced improvements in their perceived skills (Gibbons, Katz, Lemieux, & Parent, 2005; Groes, Manovskii, & Kircher, 2010). Introducing search frictions leads to additional complications since new jobs cannot be immediately located and structural modeling of this process is on-going (Moscarini, 2005). This work also highlights the role of the speed of learning that might vary in different occupations.

Other research regarding different ways of learning about oneself is also very active. For example, Shouyong Shi highlights the role of learning about one's ability to find new jobs and how this can lead to discouragement in the market. His work also covers learning about one's productivity while searching for alternative jobs during employment.

### INTERACTION OF LEARNING ABOUT THE "MATCH" (2) AND LEARNING ABOUT THE ENVIRONMENT (5)

A crucial question that is usually suppressed in the work above is the question how the value of matches changes when the environment changes—especially in macroeconomic upturns and downturns. The reason

this is important is that most of our current knowledge is based on under-standing the amount of (un)employment over the business cycle, and how different governmental policies affect it. Ideally, one would like to have a better measure that takes into account the value of employment relative to the optimal benchmark, not just the number of employed workers. In the simplest settings, the value of employment might be determined by shocks to the match or to the local labor market. For example, van Rens and Herz (2012) and Violaute et al. (2014) shows how this varies over the business cycle. While he assumes that the aggregate market conditions are known immediately, Stefan Lauermann, Wolfram Merzyn and Gabor Virag (2012) highlight the role of slow revelation of market conditions.

INTERACTIONS BETWEEN MORE THAN TWO DIMENSIONS OF SEARCH AND LEARNING

The components outlined above do not stand in isolation. They interact with each other. In particular, to analyze data it might be important to take into account that workers and firms are heterogeneous but that types might change over time (either because they are not initially known and workers and the beliefs about them change, or because of shocks to ability and productivity). This is not only realistic, but also is important to understand changes in wages and employment that occur over time and that might be hard to reconcile with fixed types. Visionary work along those lines has started. Theodore Papageorgiou (2014) as well as Jan Eeckhout and Xi Weng (2010) lay out how slow learning about types might be combined with heterogeneous types on both markets sides and the need to locate them through a search process. Jeremy Lise, Costa Meghir and Jean-Marc Robin (2013) combined search for locations and heterogeneous agents with aggregate shocks to the environment (which are immediately known to the agents in the economy). This work breaks important new ground to understand the value and not just the number of jobs that are created, and how this changes with aggregate conditions. These works have not yet been combined, still rely on strong assumptions about the environment, and clear and generalizable identification results how to infer the value of matches from existing data-sources is yet outstanding. But these papers go a long way in bringing these elements together and connecting the models to the data, and set the stage for future work.

## KEY ISSUES FOR FUTURE RESEARCH

There is a growing understanding that search and learning process is essen-tially about heterogeneous objects. For the labor market these might be jobs of different capital or of different complexity and workers of different skills.

In biological mating markets these might be males and females with different characteristics. The value that is created when two market participants meet might be described by a synthesis of the discussion: It depends on the type of both partners, some idiosyncratic shocks that capture unmodeled differences, and possibly the aggregate market conditions (economic booms and busts for labor markets, nutrition-rich or nutrition-low periods in biological models).

  A key question for future research will be to understand how to measure the value that is created in such markets, not just the number of matches that arise. For this, we cannot take for granted that types stay constant, nor that the environment stays constant. Workers who might not be suited for a management position early in their careers might become suitable after some years of experience. This depends on how much they gain by learning by doing, and how much talent they display while working (as initially both the workers and the employers are likely to be ill informed about the true productivity of a worker). In essence this requires further work on how to merge the isolated strands of literature mentioned in the preceding section. The ultimate goal would be to understand the key indicators that identify the value of a match through some of the following variation: whether a worker earns high wages on average, whether he is moving to better positions, and whether the market as a whole is moving. Using models to derive the key properties for identification, and finding estimation procedures that do not rely too finely on the exact details of the model are keys to progress on this agenda. In the short run, gaining insights on identification in situations where the productivity of the job or the worker type change over time seems crucial for the further development in this field and for the empirical assessment of the value that is created in the market. The long-run aim is to use this to assess labor market interventions. It requires both econometric techniques as well as a deep understanding of the driving factors that shape the interaction in labor markets with different types.

  The long-run goal of such an agenda would be to understand the value that is generated through learning and search by focusing more on the value of the relationships rather than solely on the number of such relationships. Focusing purely on the numbers (such as the employment rate) might give skewed ideas about the workings of a market. Think of the potential bias by considering the analogue in the product market: Measuring the number of goods sold in a market without considering the quality of the goods might lead to misleading results about interventions in the market.

  Finally, some learning in the market may be slow. One might have to stay in a job for a certain amount of time in order to learn a lot from it. One view might be that learning and skill accumulation is S-shaped: initially it is slow, after a few years it is rather steep and combined with promotion and other

decisions, and after that it slows down again. Different jobs and firms with different levels of internal hierarchies might make learning particularly fast. While this has been included in some works, more concern for the speed of learning should emerge in future works. Clearer modeling of the learning process might help to explain the duration of turnover in the labor market, where neither particularly short employment relationships nor particularly long ones seem to be valued highly.

The main role of measuring the value of jobs and the role of turnover in more detail will eventually be to assess labor market interventions. Consider again a reduction in unemployment benefits. We will understand not only how it affects aggregate employment, but also whether workers are so eager to get another job that they accept jobs with much lower value, and the consequences of this for future learning about their skills and their chances to move upwards in life. The availability of matched-employer-employee datasets in many countries of increasingly long periods of time make it possible to bring these advances to empirical application, which will be a large part of the future developments.

## REFERENCES

Acemoglu, D., & Shimer, R. (1999). Efficient unemployment insurance. *Journal of Political Economy*, *107*, 893–928.

Becker, G. (1973). A theory of marriage: Part I. *Journal of Political Economy*, *81*, 813–846.

Burdett, K., & Mortensen, D. (1998). Wage differentials, employer size and unemployment. *International Economic Review*, *39*, 257–273.

Burdett, K., Shi, S., & Wright, R. (2001). Pricing and matching with frictions. *Journal of Political Economy*, *109*, 1060–1085.

Diamond, P. (1971). A model of price adjustments. *Journal of Economic Theory*, *3*, 156–168.

Eeckhout, J., & Kircher, P. (2010). Sorting and decentralized price competition. *Econometrica*, *78*, 539–574.

Eeckhout, J., & Kircher, P. (2011). Identifying sorting—In theory. *Review of Economic Studies*, *78*, 872–906.

Friedman, M. (1968). The role of monetary policy. *American Economic Review*, *91*, 924–937.

Galenianos, M. (2013). Learning about match quality and the use of referrals. *Review of Economic Dynamics*, *16*, 668–690.

Gautier, P. A., & Teulings, C. N. (2006). How large are search frictions. *Journal of the European Economic Association*, *4*, 1193–1225.

Gautier, P. & Teulings, C. (2012). *Sorting and the Output Loss Due to Search Frictions*. Mimeo.

Gibbons, R., Katz, L. F., Lemieux, T., & Parent, D. (2005). Comparative advantage, learning, and sectoral wage determination. *Journal of Labor Economics*, *23*, 681–724.

Gibbons, R., & Waldman, M. (1999). A theory of wage and promotion dynamics inside firms. *Quarterly Journal of Economics*, *114*, 1321–1358.

Granovetter, M. S. (1974). *Getting a job: A study of contracts and careers*. Cambridge. MA: Harvard University Press.

Groes, F., Manovskii, I., & Kircher, P. (2014). *The U-Shapes of Occupational Mobility*. Review of economic studies restud.oxfordjournals.org/content/2014/10/20/restud.rdu037short2rss=1.

Hagedorn, M., Law, T., & Manovskii, I. (2012). *Identifying Equilibrium Models of Labor Sorting* Working Paper 18661, National Bureau of Economic Research.

Janetos, A. C. (1980). Strategies of female mate choice: A theoretical analysis. *Behavioral Ecology and Sociobiology*, *7*, 107–112.

Jovanovic, B. (1979). Job matching and the theory of turnover. *Journal of Political Economy*, *87*, 972–990.

Lagos, R. (2000). An alternative approach to search frictions. *Journal of Political Economy*, *108*, 851–873.

Lauermann, S., Merzyn, W., & Virag, G. (2012). *Learning and Price Discovery in a Search Model*. http://ssrn.com/abstract=1780339.

Lentz, R. (2010). Sorting by search intensity. *Journal of Economic Theory*, *145*, 1436–1452.

Lise, J., Meghir, C., & Robin, J.-M. (2013). *Mismatch, Sorting and Wage Dynamics*. NBER Working Paper No. 18719.

Lockwood, B. (1991). Information externalities in the labour market and the duration of unemployment. *The Review of Economic Studies*, *58*, 733–753.

Lopes de Melo, R. (2008). *Sorting in the Labor Market: Theory and Measurement*. Yale Working Paper.

Mortensen, D. (1982). Property rights and efficiency in mating, racing, and related games. *American Economic Review*, *72*, 968–979.

Moscarini, G. (2005). Job Search and the wage distribution. *Econometrica*, *73*, 749–778.

Neal, D. (1999). The complexity of job mobility among young men. *Journal of Labor Economics*, *17*, 237–261.

Nelson, P. (1970). Information and consumer behavior. *Journal of Political Economy*, *78*, 311–329.

Papageorgiou, T. (2014). Learning your comparative advantages. *Review of Economic Studies*, *81*(3), 1263–1295.

Phelps, E. (1967). Phillips curves, expectations of inflation and optimal unemployment. *Economica*, *34*, 254–281.

Pissarides, C. (1984). Search intensity, job advertising, and efficiency. *Journal of Labor Economics*, *2*, 128–143.

Rupert, P., & Wasmer, E. (2012). Housing and the labour market: Time to move and aggregate unemployment. *Journal of Monetary Economics*, *59*, 24–36.

Stevens, M. (2004). New microfoundations for the aggregate matching function. *International Economic Review*, *48*, 847–868.

Stigler, G. (1961). The economics of information. *Journal of Political Economy*, *69*, 213–225.

Stigler, G. (1962). Information in the labor market. *Journal of Political Economy*, *70*, 94–105.

Shimer, R., & Smith, L. (2000). Assortative matching and search. *Econometrica*, *68*, 343–369.

van Rens, T. & Herz, B. (2012). *Accounting for Mismatch Unemployment*. www.thijsvanrens.com/SU/HVR_SU201107.pdf.

Violaute, G., Sahim, A., Soug, J., & Topa, G. (2014). Mismatch Unemployment. *American Economic Review*, *104*(11), 3529–3564.

Weng, X., & Eeckhout, J. (2010). "Assortative Learning,". In *2010 Meeting Papers 356*. Society for, Economic Dynamics.

Wolinsky, A. (1990). Information revelation in a market with pairwise meetings. *Econometrica*, *58*, 1–23.

## FURTHER READING

Mortensen, D. (2002). Job search and labor market analysis. In O. Ashenfelter & R. Layard (Eds.), *Handbook of labor economics* (Vol. 2). Amsterdam, The Netherlands: Elsevier.

Pissarides, C. (2000). *Equilibrium unemployment theory* (2nd ed.). Cambridge, MA: MIT Press.

Rogerson, R., Shimer, R., & Wright, R. (2005). Search-theoretic models of the labor market: A survey. *Journal of Economic Literature*, *18*, 959–988.

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