Equilibrium in the Labour market with Search Frictions

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How I got into search theory

When I was in the final year of my degree studies at the University of Essex, in 1969, one of my lecturers gave me a pre-publication copy of a new book, with title *Microeconomic Foundations of Employment and Inflation Theory* by Phelps and others. My lecturer told me that the book was going to shape macroeconomics in the years to come. One of the book's young contributors was visiting Essex that year, and I should get to know him. I duly went to see him, and of course that was Dale Mortensen. After an illuminating conversation about search theory, the natural rate of unemployment, and the ins and outs of doing a PhD, I became convinced that I should do research in search theory for my PhD.

Robert Clower was also visiting Essex at the time, carrying with him a copy of Axel Leijonhufvud's *On Keynesian Economics and the Economics of Keynes*. The book by Phelps claimed that search theory provided the microfoundations for the Phelps-Friedman natural rate of unemployment, and the inflation-unemployment trade-off. The Leijonhufvud book claimed that search theory could provide microfoundations for Keynes's
concept of effective demand. It is rare that a student searching for a PhD topic comes across a new theory with so many claims made on its behalf. In that respect I was lucky.

The "Phelps volume", as the book became known, had many great papers in it. My main interest was in the first part of the book, with papers by Armen Alchian and Charles Holt, describing in detail the process by which individuals look and find jobs when there is imperfect information; and papers by Phelps and Mortensen putting everything together into a theory of the inflation-unemployment trade-off. My idea was to work harder on the microeconomic foundations of their papers and introduce price and wage stickiness to get the Keynesian dynamics that were discussed by Leijonhufvud. The outcome was my first book, *Labour Market Adjustment: Microeconomic Foundations of Short-run Neoclassical and Keynesian Dynamics*, based on my PhD thesis at the London School of Economics. Keynesian economics still ruled the world of macroeconomics when I was doing the research for my PhD, but it lacked microeconomic foundations.

**Searching for what?**

There were still many unanswered questions in the Phelps volume. The most important was about wage determination. There did not seem to be compelling reasons in the search model for either wage differentials for similar workers or for wage stickiness. There seemed to be compelling reasons to assume that wages were subject to monopolistic influences, but this was still a long way from showing that search theory could provide a microeconomic
foundation for either the natural rate hypothesis or Keynesian economics.

To me, search theory was appealing as a foundation for a theory of unemployment because it appeared realistic. The official definition of unemployment is one of workers looking for a job, and available to take one. From introspection, we know that if we are without a job we will look for one, and sooner or later we will find one. So what was at odds between the Phelps-Mortensen view of unemployment as one of rejecting poor offers, and the one that we see in the official definitions?

The view that I took at the time was that job search in the official definitions and in our intuition is not about looking for a good wage, but about looking for a good job match. Each worker has many distinct features, which make them suitable for different kinds of jobs. Job requirements vary across firms too, and employers are not indifferent about the type of worker that they hire, at any wage. The process of matching workers to jobs takes time, irrespective of the wage offered by each job. I felt that the view that the worker is confronted with a wage distribution, and she either takes or leaves wage offers, is not the best way to think about job search. A process whereby both workers and firms search for each other and jointly either accept or reject the match seemed to be closer to reality.

I was dissatisfied both with the purely "voluntary" view of unemployment, of workers choosing whether or not to work, and with the Keynesian "involuntary" view, according to which the worker is doing nothing waiting to be called to a job. It seemed to me that the two-sided matching view had a better chance of success, both in grounding itself in microeconomic theory and in
interpreting the facts about unemployment. It allowed one to study equilibrium models that could incorporate real-world features like differences across workers and jobs, and differences in the institutional structure of labour markets.

The step from a theory of search based on the acceptance of a wage offer, and one based on a good match is small, but has far-reaching implications for the modelling of the labour market. The reason is that in the case of searching for a good match we can bring in the matching function as a description of the choices available to the worker. The matching function captures many features of frictions in labour markets that are not made explicit. It is a black box, as my colleague Barbara Petrongolo and I called it in our survey, in the same sense that the production function is a black box of technology. But it captures the key idea of a good match: it takes time to find a good match, the length of time it takes varies across workers in unpredictable ways, and if there were more job vacancies available, on average workers would find a good job match faster. The same applies to firms looking for workers, the matching function treats workers and firms symmetrically.

Importantly, because economists are skilful in writing economic models with aggregate functions summarising complex relationships, it became easy to write models of labour markets with frictions captured by the matching function. It also became possible to estimate these models with real world data. In 1986, in a paper published in *Economic Policy*, I estimated the key relationships with British data with encouraging results.
Towards an equilibrium model

I first used the matching function explicitly in 1979, making it the main building block of an economy-wide model, at about the same time that Peter Diamond and Eric Maskin used the similar idea of the "search technology". The model of my paper had no wage differentials but it had different methods of search. My main interest was to show that with a matching function one could get an interesting, simple model of equilibrium vacancies and unemployment without a wage distribution.

But my 1979 paper still had no theory of wages. Soon after, however, it seems that all three of us independently realised that since frictions imply that the firm and the worker in a good match enjoy some monopoly power, wages need to share it between them. It helped that in the early 1980s, independent developments in bargaining theory were working out solutions for the splitting of a "cake", and some of the pioneers in that research area were working at the London School of Economics. The rewards from a good match in the DMP model was the cake that workers and firms had to split.

I attempted the derivation of a wage equation in a search model using ideas in bargaining theory. The outcomes were some working papers that appeared around 1982, before the electronic era. Information travelled rather slowly back then, and I was unaware that Peter Diamond was working on similar issues and was one or two years ahead of me. I got to hear it when my friend Yannis Ioannides, who I am pleased to say is amongst you today, went to a seminar that Peter was giving at MIT, and he sent me Peter's working paper. Dale was also working on similar models,
applying bargaining solutions to search. Seeing their papers on wages and efficiency made me switch to another issue that needed to be dealt with in an equilibrium model, that of job creation. The wage equation that I was deriving from the Nash solution to the wage bargain had been derived and elaborated in Peter's paper.

**Job creation**

In Peter's 1982 paper the problem investigated was that of a fixed number of workers interacting with a fixed number of jobs. That was also very much in line with Dale's independent work published in the same year 1982. Yet, when looking at the workings of real labour markets over time, the most striking feature that one sees is how employment and job vacancies fluctuate; in other words, how the total number of jobs varies over time, depending on economic conditions.

In order to derive a theory of job creation, I made use of the idea that in our models employment is derived as the sum of distinct units called jobs, and not as an aggregate that can be chosen as a single unit. A job is an asset owned by the firm: if it is vacant it has some value because it can expect to recruit a worker and yield some profit in the future; if it is filled it is producing for profit. Vacant jobs are like nascent investment projects that have not started yielding a return yet. If their net value is positive the firm can create them for profit; if it is negative it is losing money from them, so it makes sense to close them down. It follows that an equilibrium number of jobs could be derived from the condition that the value of a new job vacancy must be zero.
I first used the "zero-profit condition" to close the model in my 1984 and 1985 papers. It has since become the standard job creation condition in the equilibrium search literature. Combined with the Nash wage equation it gives an equilibrium wage rate and job creation rate that depend on the frictions as summarised in the matching function, and on all the other variables that influence labour market outcomes in standard models, such as productivity and taxes. From this condition I can get the equilibrium number of vacancies in the market for each unemployed worker, called tightness and usually denoted by the Greek letter θ.

**Beveridge curve equilibrium**

You have already heard a lot about the Beveridge curve, the relationship between job vacancies and unemployment, first described by William Beveridge, working at the London School of Economics in the 1940s. One of the original motivations that I had to get into search theory was to explain an empirical phenomenon about it that was much discussed in Britain when I was a graduate student: the shifting UV curve. UV curve was the name given to the Beveridge curve at that time, and starting sometime in the late 1960s, the British curve shifted out. This implied that the labour market had become less good at matching workers to vacant jobs.

I show the Beveridge curve in the figure that you now see. To find equilibrium unemployment I need to know at what point on the curve the economy will settle. But since I already have an equilibrium value for the ratio of vacancies to unemployment from the job creation condition, I can find that point immediately. I draw a line through the origin with slope the equilibrium θ, and the
intersection of the Beveridge curve with this line is the overall equilibrium of this economy.

At the core of this economy are the frictions that characterise the labour market. These frictions are the forces that keep the Beveridge curve away from the origin. The frictions could be due to a number of factors, such as mismatch between the skill requirements of jobs and the skill mix of the unemployed, differences in location, the institutional structure of an economy with regard to the transmission of information about jobs, and others.

Because of frictions, jobs that compete for the same workers could have different productivities and yet survive in equilibrium. In frictionless markets only the most productive of these jobs survive, as competition drives the wages in all jobs to the wage offered by the most productive. Workers search for the best job that they can find. In models that allow for different productivities, the position of the Beveridge curve is also affected by the incentives that workers have to search for and accept jobs. The matching rate in these models depends on two factors, making a contact with a firm looking for workers and finding the firm's offer acceptable.

In an economy where workers do not have strong incentives to accept an offer quickly, for example because they are generously compensated without preconditions by the unemployment insurance system, the Beveridge curve lies further away from the origin. An income support policy that does not impose preconditions is called a passive policy. But policies that support the unemployed during search, and also provide incentives for more intensive job search, can shift the Beveridge towards the origin, and improve the performance of the labour
market in matching workers to jobs. In this case policies are called "active".

A leader in the implementation of active labour market policies is Sweden, which spends far more than other advanced countries on bringing unemployed workers to jobs. In contrast, up to the 1980s most countries supported the unemployed through passive policies, with poor outcomes in the recession of the 1980s. Most countries have switched from passive to active policies in the course of the 1990s, following the poor performance of their labour markets in the 1980s.

**Comparing economies over space and time**

Let us now compare two economies, one with more frictions and passive policies with one with fewer frictions and active policies. The first economy has a Beveridge curve further away from the origin, as I have just argued. It also has fewer job vacancies for each unemployed worker, because firms expect to take longer to fill a vacancy. The Figure that you now see compares these two economies. The economy with more frictions is shown with the broken lines. An important conclusion is that the economy with more frictions has more unemployment than the economy with fewer frictions, but the two economies may have a similar level of vacancies.

This conclusion can be contrasted with the comparison of two economies at different levels of aggregate economic activity, demand or supply. A lower level of aggregate activity implies lower profitability from new jobs. Job creation falls and this rotates the job creation line clockwise, but the Beveridge curve does not
move. Equilibrium unemployment increases and vacancies fall in response to this shock.

The different response of vacancies to more frictions and lower level of aggregate activity was used by a number of authors to identify the reasons for the rise in unemployment in different counties. My colleagues at LSE Richard Layard, Richard Jackman and I first used it in a paper in 1989 to argue that the rise in unemployment in Britain in the 1980s, after the initial big upsurge associated with Prime Minister Thatcher's restrictive monetary and fiscal policies, took place at more or less constant vacancies. This is shown in Figure 4. The underlying reasons must have been related to increased frictions in the labour market. These could be associated with increased mismatch, as the transformation of the economy from an industrial to a service one intensified, and to more generous income support for the unemployed.

It was also very likely due to the built-up of long term unemployment, which disillusions the unemployed and damages the incentives they have to look for work. Long-term unemployment, meaning unemployment that lasts for a year or more, is a serious consequence of recession that disenfranchises workers from the labour force, and prolongs the impact that recession has on the quality of the workforce. It can explain why the unemployment rate was not falling in the 1980s when the rest of the economy was booming. Governments realised the negative impact of long-term unemployment since then and they have tried to contain it with active labour market policies.

For this reason, more recent recessions do not exhibit the big shifts in the Beveridge curve and the long persistence of the negative shocks on the labour market.
We can see this contrast for Britain when we compare the economy’s responses to the recession of 2008, in Figure 5. Although other reforms took place in Britain following the recession of the early 1980s, active policy also played an important role in containing long-term unemployment. The path of the economy in the Beveridge diagram in the recent recession is a typical example of the response of an economy to a negative aggregate shock.

The British experience contrasts sharply with the experience of the United States. Abraham and Katz used unemployment and vacancy data for the United States to argue that the business cycles of the 1970s and 1980s were due to aggregate shocks and not sectoral shocks, as argued by David Lillien and others. Sectoral shocks would have similar implications to mismatch shocks. But the economy in the late 1970s and early 1980s was tracing a Beveridge curve in the south-eastern direction, as implied by an aggregate shock (see Figure 6).

In the 2008 recession, the US economy started off on a downward south-eastern direction, but after the initial shock it traced an increase in unemployment at more or less constant vacancies. It is still too soon to conclude that this is a shift of the Beveridge curve to the right, but if it was it would be a feature of intensifying frictions in the United States labour market, which have not yet been identified (Figure 7). For sure, the fragile recovery is "jobless", despite the more recent rise in job vacancies.

Wage stickiness

The response of unemployment to shocks is bigger when wages are sticky. Do markets with frictions have anything new to say
about wage stickiness? I am talking here about real wage stickiness, although similar arguments should apply to nominal wage stickiness.

In frictionless markets there are no compelling reasons for wage stickiness. In contrast, in markets with frictions and Nash wage bargains there is a built-in reason for some wage stickiness. It is that the wage rate depends on the worker's non-market returns, which include unemployment insurance income, the value of home activities like home decoration or childcare, and the value of extra leisure, like more sleep. The payoffs from these activities are not cyclical. When the market payoffs go down because of recession, the home payoffs remain high, and this stops the Nash wage rate short of falling by as much as the market payoffs.

I explored this wage stickiness in my 1985 paper to derive cyclical fluctuations in unemployment in the model with frictions. But as Robert Shimer (2005) has shown, it is not enough to explain all the amplification of the shocks required to match the data. Subsequent work has shown that it can be enough but only if the firm's profit share from the match is very small, either because workers take most of the share or because firms have large labour hiring costs.

But markets with frictions can justify another form of wage stickiness, much more substantial than the one implied by the Nash wage equation. This was first explored by Robert Hall (2005), who argued that since the monopoly power implied by frictions implies that there are no conventional supply and demand functions to tie down the wage rate, the Nash wage is only one possible outcome consistent with equilibrium. Another is the wage that depends on the historical median hiring wage, and shocks to
demand do not change it by much. Hall showed that the wage stickiness consistent with this argument is enough to give an equilibrium that delivers all the amplification of shocks on job creation that we see in the data.

This analysis re-opens the issue of wage determination and it puts it into central stage as a topic for future research.

**Job destruction**

In the original equilibrium model in my 1985 paper, the flow into unemployment was assumed to be a constant fraction of employment. Since the model did not have a model of quits and new entry, by implication the destruction flow of jobs was also a constant fraction of employment. But soon after the paper's publication, establishment data were published that showed substantial variations in the job destruction flow.

In 1990 the first edition of my second book, Equilibrium Unemployment Theory, was published, which again assumed throughout that the job destruction rate was constant. Following the book's publication, Dale wrote a favourable review of the book for the Journal of Monetary Economics but pointed out that there is an inconsistency between the assumptions it made about job destruction and the new evidence on job flows, especially by Davis and Haltiwanger (1990), but also by others. When the review came out I was visiting the University of California at Berkeley and Dale invited me to go to Northwestern to give a talk on the topics of the book. That visit brought us together to talk about search for the first time since our Essex days in 1970, and we started a
collaboration that lasted for ten years (and a friendship that is still going strong!).

In our analysis of job destruction we assumed that once jobs are created, they cannot easily adapt to new technologies. In the simplest version of the model they do not adapt at all, so the firm keeps the job going for as long as it is still profitable. When shocks hit that make a job unprofitable, it is destroyed, the worker is made unemployed, and some new job is established elsewhere to take its place.

We have shown that like the job acceptance decision in the first generation of search models, the job destruction decision was governed by a reservation productivity. The firm and the worker agreed which jobs to destroy on the basis of their joint real return. Under our rules, most job destruction in the steady state is due to unidentified idiosyncratic shocks, as in the data. But over the cycle, job destruction goes up in recession, usually with a sudden upsurge of terminations when the news first breaks out, and goes down in the recovery phase. This introduces cyclicality in both the job creation and job destruction rate, very much along the lines of the times series that you see in Figure 9 for the United States.

The variable job destruction rate has implications for the dynamics of unemployment and the Beveridge curve, but it does not affect the dynamics of the job creation rate that I discussed earlier in this lecture. It also implies that there is now an incentive to search on the job and move from one job to another without experiencing unemployment. The reason is that workers have an incentive to leave the jobs that are becoming obsolete, or have low profitability for other reasons. The full model is set out in the second edition of my book Equilibrium Unemployment Theory,
published in 2000. Rather than discuss the full model here, I will discuss the implications of employment protection legislation for unemployment and job flows. This is one policy whose study needs the extended model with variable job destruction rates, since its objective is to make job destruction more difficult for the firm, with the objective of securing a longer-lasting employment spell for the worker.

**Employment protection legislation**

Although all advanced countries exercise some kind of employment protection, there are large variations in the type of restrictions implemented and there are also big differences in their severity across countries (see Skedinger, 2010, for a full analysis). At the risk of oversimplifying, we know from the OECD that the southern European countries have much stricter employment protection legislation than the northern countries, and especially than the United States and United Kingdom (OECD, 1999). I will discuss here the restrictions on dismissals that take the form of administrative procedures that cost the firm time and money. These can be represented in our models as a pure tax paid by the firm at the time of dismissal.

A tax on dismissals reduces job separations. Some low-productivity jobs that would have been destroyed before the imposition of the tax will now not be destroyed, as the firm reduces its reservation productivity to reduce the chances that it might have to pay the tax. So one implication of employment protection legislation is that the size of the flow into unemployment is lower than otherwise; but average labour productivity is also lower and
wages should also be lower to compensate the firm for the tax and the lower productivity.

Another important impact of employment protection legislation is on job creation. Intuitively, when the firm is creating a job it expects to have to pay the tax in some future date if it has to dismiss the worker. Job creation falls as a result, so just like the flow into unemployment, the flow out of unemployment at given unemployment also falls.

The net impact on unemployment depends on which flow falls more. If the flow into unemployment falls more than the flow out of unemployment, unemployment falls to compensate, and vice versa. Empirical work shows that the impact of employment protection legislation on unemployment is small and can go either way; but the size of the flows falls, there is less labour and job turnover, lower average labour productivity and longer durations of both unemployment and employment.

In extended versions of our models, with training, the longer durations of employment might encourage more training, as workers are more secure in their jobs and are more willing to undertake training that is specific to the needs of their firm. And in yet other extended versions with different kinds of workers, employment protection legislation tends to benefit primary workers, usually males over 25 years old, but hurts other workers, like women and youths, who go in and out of the labour force at more frequent intervals than prime-age males.

Concluding remarks: where do we go next?
Search and matching theory has come a long way since the three of us, with others who either collaborated with us or worked independently, formulated the first models thirty years ago. A recent book by Brian and John McCall that surveys the economics of search is 550 pages long, and I understand there was a second volume planned for the things left out (McCall and McCall, 2008).

But there is still a lot to do. We have discovered, just as Sir John Hicks did in 1932, that the theory of wages is key to understanding the functioning of labour markets. Sir John described in detail how frictions in labour markets, mobility costs and trade unions and other institutions influence wages, and how wages influence employment, very much along the lines that modern theory describes. But modern theory has still to explore more fully the role of institutions in its formal models, and this is an area of research that should attract a lot of attention in the future.

I have also argued that wage stickiness is as important an issue as it has ever been in macroeconomics. Markets with frictions open up many more possibilities for wage stickiness and future research needs to explore these.

The recent financial crisis has thrown open doors that we thought were firmly closed not so long ago. Our models were built on the assumptions of rational expectations and perfect capital markets. In our models, even the unemployed can borrow unlimited sums of money to finance their consumption and job search. These are good starting assumptions, and they have yielded important results. But future work needs to explore other assumptions about expectations and knowledge, introduce imperfect capital markets, and integrate the financial sector with the labour market. This might one day explain how shocks get
amplified, to the extent that we see in the data. Although progress has been rapid since the early 1980s, when our models were first formulated, I feel I can look forward to more interesting research within the search equilibrium framework that we initiated.
Figure 2
The Beveridge curve and equilibrium vacancies and unemployment

![Diagram showing the Beveridge curve and equilibrium between vacancies and unemployment.](image-url)
Figure 3
Comparing economies

Economy with more frictions

Economy with lower level of aggregate activity
Figure 8
Unemployment in Europe and America, 1963-2009

Figure 9
Job creation and job destruction rates, US non-farm sector