Unemployment and Matching in the Labor Market

A Model of Search and Matching in the Labor Market
A Fully Competitive Labor Market Cannot Account for Unemployment

• In a fully competitive labor market, without uncertainty and frictions, employers would be indifferent about whether an employee leaves her job, since they can replace her immediately and at no cost, and at the same competitive wage, with another employee.

• Accordingly, an employee would be indifferent about losing her job, since she can readily find another one at the same competitive real wage.

• Moreover, in such a market “involuntary” unemployment cannot exist, because the excess supply of workers would cause an immediate decline in real wages, which would lead to the elimination of unemployment.
Unemployment and Vacancies

• In almost all economies there is a positive and non-trivial unemployment rate even in boom periods. There are many unemployed people seeking jobs similar to those held by workers with similar characteristics, at wages equivalent to those generally prevailing in the labor market.

• At the same time, there are many firms with vacancies, seeking to fill them with employees, possessing characteristics similar to those of the unemployed, and at prevailing real wages. How can then one explain the existence and the fluctuations of both unemployment and vacancies?

• The explanation of unemployment is one of the central tasks of macroeconomics. There are two types of questions that are being asked. First, what determines the equilibrium rate of unemployment in an economy, what are its implications, and to what extent the equilibrium unemployment rate reflects labor market distortions. The second key question concerns the cyclical fluctuations of unemployment during the economic cycle.
The Unemployment Rate in the USA

![Graph showing the unemployment rate in the USA from 1890 to 2013, indicating periods of recession.](graph.png)
European Unemployment: Germany and the UK

![Graph showing unemployment rates for Germany and the UK from 1950 to 2014.](image)
The Unemployment Rate in Greece

Greece

Euro Area
Alternative Views of the Labor Market and Equilibrium Unemployment

There are many alternative approaches to the modeling of the labor market that differ from the competitive model or the model of monopolistic competition. All these approaches offer an alternative explanation as to why, despite unemployment and vacancies, real wages do not adjust in order to absorb the unemployed and eliminate unemployment.

- Efficiency Wage theories.
- Theories of Long Term Labor Contracts.
- Search and Matching theories.
Efficiency Wage Theories

• In these theories there is *asymmetric information*. Firms cannot observe either the productivity or the effort of workers directly. Thus, firms offer wages above the average productivity of job seekers, or existing employees, in order, either to attract workers with above average productivity, or to provide incentives to their employees to work more intensively.

• They are therefore not prepared to reduce real wages, or to replace workers already in jobs with the unemployed, even if the unemployed offered to work at lower wages.

• Weiss (1980) and Shapiro and Stiglitz (1984) are the two most important early models based on this approach.
Theories of Long Term Contracts

- These contracts prevent firms from undertaking unilateral changes to wages in response to shocks, if this is not provided for in the long-term contract. The contracts can be explicit, such as collective, industry and individual employment contracts or informal and implicit.

- For the original implicit contract theories see Azariadis (1975), Baily (1974) and Gordon (1974). These theories viewed employment contracts as insurance contracts between risk neutral employers and risk averse employees, against adverse shocks to employment. For theories that are based on explicit negotiations see McDonald and Solow (1981). For theories that distinguish between insiders and outsiders in the labor market see Lindbeck and Snower (1986), Blanchard and Summers (1986), Gregory (1986) and Gottfries (1992).
Search and Matching Theories

• These theories highlight the search costs of looking for an appropriate job, by unemployed job seekers, and the search costs of looking for an appropriate employee, by firms with vacancies.

• In these theories, a costly search process is required for the matching of job seekers with appropriate vacancies in order to create a new job. Consequently, jobs entail rents, something that does not apply in fully competitive labor market models.

• The early search theories date back to 1970. See Pissarides (2000) for an extensive analysis of such models. Other relatively recent papers include, Mortensen (1986), Pissarides (1985) and Mortensen and Pissarides (1994).
Unemployment and Matching in the Labor Market: The Mortensen-Pissarides Model

• In this model, employers are investing in order to create job vacancies and the process of filling a vacancy involves matching of a firm, which has created a vacancy with an unemployed job seeker.
• At each instant, there are two flows into and out of unemployment. Some workers lose their jobs and move from jobs into unemployment, and some of the unemployed find jobs, through the matching process, with firms which have created vacancies.
• In the simpler versions of the model the probability of job terminations is exogenous. This parameter describes the structural or cyclical shocks affecting the economy, and leading to the destruction of jobs.
• The probability of filling a vacancy, as well as the probability of an unemployed job seeker to find a job, are endogenous variables in this model, and depend on the degree of labor market tightness, which is defined by the ratio of vacancies to the unemployed. The higher the tightness of the labor market, the greater the probability of an unemployed job seeker to find a job, and the lower the probability of a firm to fill a vacancy.
Equilibrium Unemployment in the Mortensen-Pissarides Model

- In the steady state, the flows to and from unemployment are equalized, and the equilibrium unemployment rate depends positively on the exogenous probability of job terminations, and negatively on the endogenous probability of an unemployed job seeker to find a job.
- The equilibrium unemployment rate therefore depends negatively on labor market tightness, and is, of course, determined endogenously.
- The negative relationship between the unemployment rate and the vacancy rate which is implied by this dependence is known as the Beveridge curve.
The Behavior of Firms and the Creation of Vacancies and Jobs

• Firms and the unemployed make their decisions rationally, maximizing the expected present value of their profits and income.

• Firms create new vacancies as long as the expected profits from the investment required to create a vacancy are positive. The condition for a vacancy to be filled, and for a new job to be created is that the real wage should be equal to labor productivity minus the cost of creating and maintaining a vacancy. By filling a vacancy, a firm must in equilibrium cover both the wage costs and the costs of its investment in the creation of the vacancy.

• The job creation condition implies a negative relationship between the wage that the firm is willing to pay and labor market tightness. The higher is labor market tightness, the lower is the probability of filling a vacancy and the greater the total cost of maintaining a vacancy, since vacancies remain unfilled for longer.
The Behavior of Unemployed Job Seekers and the Determination of Real Wages

• An unemployed job seeker will agree to get a job if the expected present value of income of an employed worker is greater than the expected present value of income of an unemployed job seeker. This condition is satisfied in this model, as long as the real wage is higher than unemployment benefits.

• Real wages are determined in equilibrium by decentralized bargaining between firms that have vacancies and unemployed job seekers. The equilibrium real wage is the result of this negotiation, and depends positively on the relative bargaining power of the unemployed, the level of unemployment benefits, labor productivity, the cost of maintaining a vacancy and labor market tightness.

• The equilibrium real wage depends positively on labor market tightness, as this increases the average recruitment cost per unemployed person, thereby increasing the “threat” point of prospective employees versus prospective employers, and weakening the effective bargaining position of prospective employers.
Equilibrium Real Wages and Unemployment

• The positive relationship between real wages and labor market tightness, resulting from the negotiation between firms with vacancies and the unemployed, and the negative relationship between real wages and labor market tightness implied by the job creation condition for firms, jointly determine the equilibrium real wage and equilibrium labor market tightness.

• For given equilibrium labor market tightness, the equilibrium unemployment rate is then determined through the Beveridge curve, which implies a negative relationship between the unemployment and vacancy rates.

• In the equilibrium of this model, the unemployed are worse off than the employed. Consequently unemployment is an undesirable and involuntary condition, and not the result of choice by the unemployed, as in competitive models of the labor market without frictions.
The Matching Function

A key assumption of this class of models is that the number of jobs created at each moment is a positive function of the number of firms looking for employees and the number of unemployed job seekers. The outcome of this process is described by the so-called matching function, determining the number of jobs created at each moment in time. The matching function is assumed to be increasing in every one of its arguments, concave and linearly homogeneous. Thus, it is characterized by constant returns to scale.

\[ mL = m(uL, vL) \]

- \( L \) size of the labor force
- \( u \) unemployment rate (unemployed as a proportion of the labor force)
- \( v \) vacancy rate (vacancies as a proportion of the labor force)
- \( m \) the job creation rate (new jobs as a share of the labor force)
The Probability of Filling a Vacancy

Assuming that all vacancies have the same probability of being filled, and that all the unemployed have the same probability of being employed, the probability of filling a vacancy shall be equal to the ratio of the number of new jobs created over all existing vacancies.

The probability of filling a vacancy is a function only of the ratio of the unemployed to job vacancies. This is due to the assumption that the matching function is linearly homogeneous. The more the unemployed per vacancy, the greater will be the likelihood of filling any particular vacancy.

\[
q = \frac{m(uL,vL)}{vL} = m\left(\frac{u}{v},1\right)
\]
Labor Market Tightness and the Probability of Filling a Vacancy

We define as $\theta$, the ratio of vacancies to the unemployed. $\theta$ measures the degree of tightness in the labor market. The higher the number of vacancies relative to the unemployed, the greater the tightness of the labor market.

$$\theta = \frac{v}{u}$$

The probability of filling a vacancy depends negatively on $\theta$.

$$q = q(\theta)$$

$$q'(\theta) \leq 0$$

$$-1 < \eta(\theta) = \frac{\theta q'(\theta)}{q(\theta)} < 0$$

$\eta(\theta)$ is the elasticity of $q$ with respect to $\theta$. 
The Expected Duration of a Vacancy

Because of the Poisson assumption that all vacancies have the same probability of being filled, the expected duration of a vacancy is equal to $1/q$ and depends positively on $\theta$. Thus, the higher is labor market tightness, the higher the expected duration of a vacancy.

$$\frac{1}{q} = \frac{1}{q(\theta)}$$
The Probability of Finding a Job for an Unemployed Job Seeker and the Expected Duration of Unemployment

\[
\frac{m(uL, vL)}{uL} = \frac{v}{u} \frac{m(uL, vL)}{vL} = \theta q(\theta)
\]

The probability of finding a job, for an unemployed job seeker depends positively on labor market tightness \(\theta\). The elasticity with respect to \(\theta\) is equal to \(1-\eta(\theta)>0\).

The expected duration of unemployment is given by,

\[
\frac{1}{\theta q(\theta)}
\]
The Price Mechanism and Adjustment in the Labor Market

• It is worth noting that, in models of this type, the price mechanism cannot lead the probability of filling a vacancy or the probability of finding a job to unity, as the labor market does not function only via the price mechanism, but also via the degree of tightness of the labor market, which determines the probabilities of firms to fill their vacancies or of the unemployed to find jobs in any particular instance.

• The dependence of the probability of filling a vacancy and the probability of finding a job on the relative number of vacancies to the unemployed (tightness) is an example of a trading externality. These search externalities are important for the properties of equilibrium unemployment in these models.
Flows Into and Out of Unemployment

- The model assumes that a proportion of existing jobs are terminated in every instant. The destruction of jobs and the flow from employment to unemployment, is due to either cyclical or structural real disturbances that make them unprofitable. It is assumed that at any instant the probability of destruction of any job is equal to $\lambda$, where $\lambda$ is an exogenous parameter.

- On the other hand, job creation occurs when a firm and an employee agree to sign a contract with a wage which is the result of a bilateral negotiation. This leads to a flow out of unemployment.

- Therefore, at any given moment there are two flows in the labor market. One flow is from existing jobs into unemployment, because of job destruction, and the other from unemployment to newly created jobs.
Changes in the Unemployment Rate

The change in the unemployment rate at each point in time depends on the difference between flows into unemployment and flows out of unemployment. In other words, it depends on the difference in the proportion of jobs destroyed from the proportion of new jobs created, the proportions being defined relative to the labor force.

\[ \dot{u} = \lambda (1 - u) - \theta q(\theta)u \]
The Determination of Equilibrium Unemployment

In the steady state, the unemployment rate will be constant. Consequently, the equilibrium unemployment rate is determined by the condition,

$$\lambda(1 - u) = \theta q(\theta)u$$

This condition implies,

$$u = \frac{\lambda}{\lambda + \theta q(\theta)}$$
The Beveridge Curve

• The equilibrium unemployment rate depends positively on $\lambda$, the exogenous rate of job destruction and negatively on labor market tightness $\theta$. Labor market tightness is an endogenous variable in this model, and is determined in the labor market.

• The negative relationship between the unemployment rate and labor market tightness $\theta$, or, equivalently, between the unemployment rate and the vacancy rate, is usually called the Beveridge curve.

• The Beveridge curve defines just a negative relation between vacancies and unemployment. In order for unemployment to be determined, one needs to know labor market tightness, which is one of the endogenous variables in this model.
The Beveridge Curve
The Beveridge Curve and Equilibrium Unemployment

• The Beveridge curve can determine equilibrium unemployment if we know how tight is the labor market.
• In order to examine how tightness in the labor market is determined we have to examine the behavior or prospective employers (firms) who create vacancies, and unemployed job seekers.
• The model assumes that both firms and unemployed job seekers behave rationally, maximizing the present value of their expected income.
Job Creation and Vacancies

• We have the creation of a new job when a prospective employer and a prospective employee get together and agree to an employment contract.
• Of course, before this happens, the potential employer has to create a vacancy and search for an employee and the prospective employee has to be unemployed and looking for a new job.
• All this involves time and costs and is described by the matching function.
• We assume that the instantaneous value of the product of a job is constant and equal to $p > 0$. The instantaneous cost of a vacant post to a prospective employer is equal to $pc$ where $0 < c < 1$. During the period of search, the employer faces a probability $q(\theta)$ of finding a suitable employee, which is independent of her actions.
• The number of vacancies is endogenous and is determined by profit maximization. Any firm can create a vacancy and search for employees.
The Present Value of Net Expected Profits from an Existing Job

We denote by $J$ the present value of a firm’s net expected profits from an existing job, by $w$ the real wage and by $r$ the real interest rate.

The instantaneous expected net profit from an existing job is equal to,

$$ p - w - \lambda J $$

Assuming a perfect capital market and an infinite horizon, the present value of this expected net profit is equal to,

$$ J = \int_{t=0}^{\infty} e^{-rt} (p - w - \lambda J) dt = \frac{p - w - \lambda J}{r} $$
Implications of a Positive Net Present Value of Expected Profits from an Existing Job

The present value $J$ of a job for the employer is thus defined as,

$$J = \frac{p - w}{r + \lambda}$$

This will only be positive, if productivity exceeds the real wage, $p > w$.

Rearranging the definition of $J$, we get,

$$w = p - (r + \lambda)J$$

This will only be positive, if productivity exceeds the real wage, $p > w$. The wedge between productivity and the real wage must reflect the capital and insurance costs of maintaining the job.
Prospective Employers and the Present Value of Net Expected Profits from a Vacancy

We denote by $V$ the present value of expected net profits from a job vacancy. The *instantaneous net expected profit from a vacancy* is equal to the probability of filling the vacancy, and earning the difference between the present value of a job and the present value of the vacancy, minus the maintenance cost of the vacancy $pc$. It is defined by,

$$q(\theta)(J - V) - pc$$

Assuming a perfect capital market and an infinite time horizon, the present value of expected net profits from a vacancy $V$ is defined by,

$$V = \int_{t=0}^{\infty} e^{-rt} \left( q(\theta)(J - V) - pc \right) dt = \frac{q(\theta)(J - V) - pc}{r}$$
The Condition for the Creation of Vacancies

In equilibrium with free creation of vacancies (free entry), all profit opportunities from creating new vacancies will be exploited, and the expected profits from the creation of an additional vacancy will be equal to zero. So in equilibrium with free entry, \( V=0 \). This, implies that,

\[
J = \frac{pc}{q(\theta)}
\]

This is an important prediction of this model. In equilibrium with free entry, the expected net present value of a job will be equal to the expected cost of hiring an employee. This is equal to the instantaneous cost \( pc \) of maintaining a vacancy, times the expected duration of the vacancy \( 1/q(\theta) \). Thus, competition for the creation of vacancies and free entry reduces the expected net present value of profits from a job to the level of the expected cost of hiring a worker.
The Job Creation Condition

Combining the implications of free entry, that the expected net present value of a job is equal to expected cost of hiring, and the definition of the expected net present value of a job, we get,

\[ w = p - \frac{(r + \lambda)pc}{q(\theta)} = \left(1 - \frac{(r + \lambda)c}{q(\theta)}\right)p \]

This is the second key equation of this model, and can be called the \textit{job creation condition}. The firm will only hire a new worker and create a job if the real wage is smaller than or equal to the productivity of the worker, minus the marginal hiring cost, which is defined on the RHS.
Real Wages, Productivity, the Marginal Hiring Cost and the Creation of Jobs

• Firms create vacancies as long as the expected present value of net profits from the creation of a vacancy are positive.
• The condition for the creation of a job is that the real wage must be equal to productivity minus the opportunity cost of maintaining a job. Because of free entry this is equal to the marginal hiring cost.
• The job creation condition implies a negative relation between labor market tightness and the real wage. The higher is labor market tightness, the higher the expected duration of a vacancy, and the higher the marginal hiring cost. Thus, the real wage that the firm would be prepared to pay, relative to productivity, will be lower.
The Job Creation Condition
The Behavior of Unemployed Job Seekers

- An unemployed job seeker will accept a job offer if the expected present value of income when employed is higher than the expected present value of income when unemployed.
- The typical worker earns a real wage $w$ when employed, and is looking for a job when unemployed.
- For the duration of unemployment, she has an instantaneous real income $z$, which depends on unemployment benefits and any other income or benefit from the use of free time. For simplicity we shall call $z$ the *unemployment benefit*. 
The Expected Present Value of Income of an Unemployed Job Seeker

An unemployed job seeker has an instantaneous real income equal to $z$ and an instantaneous probability of finding a job equal to $\theta q(\theta)$. As a result, $U$, the expected present value of her income, is defined by,

$$U = \int_{t=0}^{\infty} e^{-rt} \left( z + \theta q(\theta)(W - U) \right) dt = \frac{z + \theta q(\theta)(W - U)}{r}$$

where $U$ and $W$ are the corresponding net present values of expected income of an unemployed job seeker and an employed worker. The permanent income of an unemployed job seeker is equal to $rU$. 
The Expected Present Value of Income of an Employed Worker

An employed worker has an instantaneous real income $w$, the real wage, but at each instant also faces the risk of losing her job, with probability $\lambda$. Therefore, the present value of her expected income $W$ is equal to,

$$W = \int_{t=0}^{\infty} e^{-rt} \left( w + \lambda(U - W) \right) dt = \frac{w + \lambda(U - W)}{r}$$

where $U$ and $W$ are the corresponding net present values of expected income of an unemployed job seeker and an employed worker. The permanent income of an employed worker is equal to $rU$. 
The Permanent Income of the Employed and the Unemployed

From the two equations defining the present value of expected income of the unemployed and the employed, we can solve for the permanent income of the unemployed and the employed as functions of the parameters of the model. These are defined by,

\[
    rU = \frac{(r + \lambda)z + \theta q(\theta)w}{r + \lambda + \theta q(\theta)}
    \]

\[
    rW = \frac{\lambda z + [r + \theta q(\theta)]w}{r + \lambda + \theta q(\theta)}
    \]

If \( w \geq z \), then \( W \geq U \), and the permanent income of an employed worker cannot be lower than the permanent income of an unemployed job seeker. In what follows, we shall assume that \( w \) exceeds \( z \), which indeed turns out to be the case in equilibrium. As a result, no worker wishes to leave her job and all unemployed job seekers wish to find a job. Unemployment is \textit{involuntary}.
Rational Behavior of Firms with Vacancies and Unemployed Job Seekers and Job Creation

• An unfilled vacancy implies a lower expected net present value of profits than a job, despite the fact that, with some probability, a job may disappear.
• Unemployment implies a lower permanent income for those who experience it, than for employed workers, despite the fact that even the workers who are employed may, with some probability, lose their jobs and become unemployed in the future.
• A firm with a vacancy will accept a job offer if the job creation condition is satisfied, i.e. if the real wage is lower than or equal to productivity minus the marginal hiring cost.
• An unemployed job seeker will accept a job offer if the real wage is higher than the unemployment benefit.
Real Wage Determination

• The real wage for a particular job is determined by a negotiation between a prospective employer, a firm with a vacancy, and a prospective employee, an unemployed job seeker.
• Because all jobs are equally productive and all the unemployed receive the same unemployment benefit, the real wage that is determined by an individual negotiation will be the same as the real wage that prevails in the rest of the economy.
• From the assumptions that we have made about productivity and aggregate disturbances, any one employer and any one worker, when they get together through the matching process, will certainly agree to an employment contract and create a job. Otherwise they must continue searching, with additional costs for both sides.
• An employment contract between an employer and an employee is defined by a real wage and the provision that employment will be terminated if there is a disturbance that makes the job untenable.
The Impact of Real Wages on the Opportunity Cost of a Job and the Permanent Income of a Worker

For a real wage $w_i$, the expected return for a prospective employer and a prospective employee are given by

$$rJ_i = p - w_i - \lambda(J_i - V)$$

$$rW_i = w_i + \lambda(U - W_i)$$

We have not made use of the assumption that competition has reduced the expected present value of a vacancy $V$ to zero. We have assumed though, as it appropriate, that the expected present value of a vacancy, and of the income of the unemployed $U$ depends on real wages in the rest of the economy, and is thus independent of $i$. 
Bargaining Over the Real Wage

The real wage is determined by a (generalized) Nash bargain, that maximizes the weighted product of the surplus of the prospective employer and the prospective employee from the agreement to create a job. An agreement means that the surplus of the prospective employer is equal to $J_i - V$, and that surplus of the prospective employee is $W_i - U$. Thus, the real wage will satisfy,

$$w_i = \arg \max (W_i - U)^\beta (J_i - V)^{1-\beta}$$

$\beta$ is a measure of the relative bargaining power of the prospective employee, over and above what results from the “threat” points $U$ and $V$. In symmetric bargaining, like the one we analyze, a reasonable value of $\beta$ is $\frac{1}{2}$. 
First Order Condition

The first order condition for a maximum implies that the worker gets a share $\beta$ of the total surplus.

$$ W_i - U = \beta(J_i + W_i - V - U) $$

Substituting for $J_i$ and $W_i$, it follows that the employee gets a real wage which exceeds the permanent income of an unemployed worker by a multiple $\beta$ of the difference of productivity from the permanent income of an unemployed worker.

$$ w_i = rU + \beta(p - rU) = w $$
Real Wage Determination

From the first order condition for the determination of the real wage, and as due to free entry $V=0$, it follows that.

$$W - U = \frac{\beta}{1 - \beta} J = \frac{\beta}{1 - \beta} \frac{pc}{q(\theta)}$$

As a result,

$$rU = z + \theta q(\theta)(W - U) = z + \frac{\beta}{1 - \beta} pc\theta$$
The Wage Function

Substituting for $rU$ in the wage determination equation,

$$w = (1 - \beta)z + \beta p(1 + c\theta) = z + \beta(p - z) + \beta pc\theta$$

The real wage exceeds the unemployment benefit $z$. It exceeds it by a proportion $\beta$ of the difference between productivity and the unemployment benefit, plus a proportion $\beta$ of the average recruitment cost per unemployed worker.

Higher labor market tightness $\theta$ results in a higher real wage, as this increases the average recruitment cost per unemployed person, thereby increasing the “threat” point of prospective employees versus prospective employers, and weakening the effective bargaining position of prospective employers.

The wage function plays a role analogous to a labor supply function in a competitive labor market model.
Determination of Real Wages, Labor Market Tightness and Unemployment

• In this model, the level of real wages $w$ and labor market tightness $\theta$, is determined independently of the unemployment rate $u$. The job creation condition and the wage equation suffice for the determination of real wages and labor market tightness.

• Once labor market tightness $\theta$ is determined, we can substitute for it in the Beveridge curve, and determine equilibrium unemployment.

• Thus, the model has a recursive structure. The determination of real wages and labor market tightness is independent of the unemployment rate, and the unemployment rate is determined through the Beveridge curve.
Determination of Real Wages, Labor Market Tightness and Equilibrium Unemployment

In steady state this model determines the three endogenous variables, \((u, \theta, w)\) which satisfy the *Beveridge curve*, i.e. the condition of equality of flows in and out of unemployment, the *job creation condition*, and the *wage equation*.

\[
\begin{align*}
  u &= \frac{\lambda}{\lambda + \theta q(\theta)} \\
  w &= \left(1 - \frac{(r + \lambda)c}{q(\theta)}\right)p \\
  w &= z + \beta(p - z) + \beta pc\theta
\end{align*}
\]
The Model under the Assumption $z = \rho w$

If we assume that the unemployment benefit $z$ is a constant share of the real wage $\rho < 1$, then the wage equation is modified and the model takes the form,

$$ u = \frac{\lambda}{\lambda + \theta q(\theta)} $$

$$ w = \left(1 - \frac{(r + \lambda)c}{q(\theta)}\right)p $$

$$ w = \frac{\beta(1 + c\theta)}{1 - (1 - \beta)\rho}p $$
The Determination of Real Wages and Labor Market Tightness
The Determination of the Unemployment Rate

[Diagram showing the Beveridge Curve and Labor Market Tightness]
Implications of an Increase in Labor Productivity
Implications of an Increase in Unemployment Benefits or the Replacement Rate
An Increase in Unemployment Benefits or the Replacement Rate and Equilibrium Unemployment

[Diagram showing the Beveridge Curve]

- Labor Market Tightness
- The Beveridge Curve

Prof George Alogoskoufis, *Dynamic Macroeconomic Theory*, 2016
Implications of an Increase in the Real Interest Rate
An Increase in the Real Interest Rate and Equilibrium Unemployment

The diagram illustrates the relationship between the real interest rate and equilibrium unemployment. The curve labeled "Labor Market Tightness" and the line labeled "The Beveridge Curve" intersect at point E. The diagram shows a shift from E to E', indicating a change in equilibrium unemployment due to an increase in the real interest rate.
Implications of an Increase in the Probability of Job Destruction
An Increase in the Probability of Job Destruction and Equilibrium Unemployment
The Determinants of Equilibrium Unemployment

• If unemployment benefits are proportional to the real wage, labor productivity does not affect the equilibrium unemployment rate in this model.

• The higher the percentage of real wages paid out as unemployment benefits, the higher the equilibrium real wage, the lower is labor market tightness, and the higher the equilibrium unemployment rate.

• Higher real interest rates also have a positive impact on unemployment in this model, because they increase the cost of maintaining a vacancy, resulting in the creation of fewer job vacancies.

• A higher exogenous probability of job terminations has a positive impact on unemployment for two reasons. First because it directly increases the flows from existing jobs to unemployment, and, second, because it, indirectly, reduces the flows from unemployment to jobs. The second effect takes place because the expected profit from the creation and filling of a vacancy falls, resulting in fewer vacancies and reduced flows from unemployment to jobs.
Dynamic Adjustment to the Steady State

Our analysis so far was only concerned with steady state unemployment, and almost nothing was said about the dynamic adjustment of the labor market in the short run.

Vacancies and real wages are non predetermined variables in the short run, since they depend on forward looking expectations of firms and job seekers. Unemployment is a predetermined variable, and in the short run evolves according to,

\[ \dot{u}(t) = \lambda - (\lambda + \theta_E q(\theta_E))u(t) \]

where \( \theta_E \) is the steady state labor market tightness determined through the wage negotiations of firms with vacancies and unemployed job seekers.
Convergence of the Unemployment Rate to the Steady State

Since vacancies are a jump variable, and θ is determined independently of the unemployment rate, θ and real wages \( w \) jump immediately to their steady state values. The vacancy rate jumps to maintain θ at its steady state value, and the unemployment rate converges to its steady state value according to,

\[
u(t) = u_E + \left( u_0 - u_E \right) e^{-\left( \lambda + \theta_E q(\theta_E) \right)t}\]

where \( u_0 \) is the unemployment rate at time 0, and \( u_E \) is the steady state unemployment rate, defined by,

\[
u_E = \frac{\lambda}{\lambda + \theta_E q(\theta_E)}\]
The Dynamic Adjustment of Unemployment and Vacancies
A Numerical Example

We assume the following form for the matching function:

\[ mL = M (uL)^\mu (vL)^{1-\mu} \]

which implies,

\[ q(\theta) = \frac{mL}{vL} = M \left( \frac{u}{v} \right)^\mu = M \theta^{-\mu} \]

We assume the following initial parameter values:

\[ \lambda=2.5\%, \ p=1, \ c=1/2, \ r=3\%, \ \rho=1/2, \ \theta=1/2, \ M=1/2, \ \mu=1/2 \]

Under these assumptions, it follows that,

\[ w=0.95, \ \theta=0.85, \ u=5.1\%, \ v=4.4\% \]
An Increase in the Probability of Termination of a Job

If $\lambda$ were to double from 2.5% to 5%, it follows that,

$w=0.93$, $\theta=0.79$, $u=10.1\%$, $v=7.9\%$

Relative to the original equilibrium, the real wage falls by 2.1%, to 93% of productivity, and the steady state unemployment rate almost doubles, to 10.1%.
Dynamic Adjustment of Unemployment and Vacancies Following an Increase in the Probability of Termination of a Job from 2.5% to 5%
An Increase in the Replacement Rate of Unemployment Benefits

If $\rho$ were to rise from 50% of the real wage to 70%, it follows that,

$$w=0.96, \ \theta=0.50, \ u=6.6\%, \ v=3.3\%$$

Relative to the original equilibrium, the real wage rises by roughly 1%, and the unemployment rate rises by 1.5 percentage points, to 6.6%. With a constant labor force, this is equivalent to a 29.4% rise in the number of the unemployed.
Dynamic Adjustment of Unemployment and Vacancies Following an Increase in the Replacement Rate from 50% to 70%
An Increase of the Real Interest Rate

If $r$ were to double from 3% to 6%, it follows that,

$$w=0.925, \ \theta=0.78, \ u=5.4\%, \ v=4.2\%$$

Relative to the initial equilibrium, the real wage falls by about 2.5%, and the unemployment rate rises by 0.3 percentage points, to 5.4%. With a constant labor force, this is equivalent to a 5.9% rise in the number of the unemployed.
Dynamic Adjustment of Unemployment and Vacancies Following an Increase in the Real Interest Rate from 3% to 6%
The Nature of the Matching Process and Flows into and out of Unemployment

• In this model, employers are investing in order to create job vacancies and the process of filling a vacancy involves matching of a firm with a vacancy with an unemployed job seeker.

• At each instant, there are two flows into and out of unemployment. Some workers lose their jobs and move from jobs into unemployment, and some of the unemployed find jobs, through the matching process, with firms which have created vacancies.

• The probability of filling a vacancy, as well as the probability of an unemployed job seeker to find a job, are endogenous variables in this model. They depend on the degree of labor market tightness, which is defined by the ratio of vacancies to the unemployed. The higher the tightness of the labor market, the greater the probability of an unemployed job seeker to find a job, and the lower the probability of a firm to fill a vacancy.
Equilibrium Unemployment

• In the steady state, the flows to and from unemployment are equalized, and the equilibrium unemployment rate depends positively on the exogenous probability of termination of a job, and negatively on the endogenous probability of an unemployed job seeker to find a job.

• The equilibrium unemployment rate therefore depends negatively on labor market tightness, and is, of course, determined endogenously. The negative relationship between the equilibrium unemployment rate and the vacancy rate which is implied by this dependence is known as the Beveridge curve.
Firms and Unemployed Job Seekers

• Firms and the unemployed make their decisions rationally, maximizing the expected present value of their profits and income.

• Firms create new vacancies as long as the expected profits from the investment required to create a vacancy are positive.

• The condition for a vacancy to be filled, and for a new job to be created is that the real wage should be equal to labor productivity minus the cost of creating and maintaining a vacancy. The job creation condition implies a negative relationship between the wage that the firm is willing to pay and labor market tightness. The higher is labor market tightness, the lower is the probability of filling a vacancy and the greater the total cost of maintaining a vacancy, since vacancies remain unfilled for longer.

• On the other hand, an unemployed job seeker will agree to get a job if the expected present value of income of an employed worker is greater than the expected present value of income of an unemployed job seeker. This condition is satisfied in this model, as long as the real wage is higher than unemployment benefits.
The Determination of Real Wages and Labor Market Tightness

• Real wages are determined in equilibrium by decentralized bargaining between firms that have vacancies and unemployed job seekers.

• The equilibrium real wage is the result of this negotiation, and depends positively on the relative bargaining power of the unemployed, the level of unemployment benefits, labor productivity, the cost of maintaining a vacancy and labor market tightness.

• The equilibrium real wage depends positively on labor market tightness, as this increases the average recruitment cost per unemployed person, thereby increasing the “threat” point of prospective employees versus prospective employers, and weakening the effective bargaining position of prospective employers.
Simultaneous Determination of Real Wages and Labor Market Tightness and the Determination of Equilibrium Unemployment

• The positive relationship between real wages and labor market tightness, resulting from the negotiation between firms with vacancies and the unemployed, and the negative relationship between real wages and labor market tightness implied by the job creation condition for firms, jointly determine the equilibrium real wage and equilibrium labor market tightness.

• Once equilibrium labor market tightness has been determined, the equilibrium unemployment rate is then determined through the Beveridge curve, which implies a negative relationship between the unemployment and vacancy rates.
The Dependence of Equilibrium Unemployment on Productivity, Unemployment Benefits, Real Interest Rates and the Frequency of Job Terminations

• If unemployment benefits are proportional to the real wage, labor productivity does not affect the equilibrium unemployment rate in this model.

• However, the higher the percentage of real wages paid out as unemployment benefits, the higher the equilibrium real wage and the higher the equilibrium unemployment rate. The reason is that higher real wages reduce incentives for creating new jobs, thus reducing the number of vacancies, reducing labor market tightness and increasing unemployment.

• Higher real interest rates also have a positive impact on unemployment in this model, because they increase the cost of maintaining a vacancy, resulting in the creation of fewer job vacancies, lower labor market tightness and higher unemployment.

• A higher exogenous probability of termination of a job has a positive impact on unemployment for two reasons. First because it directly increases the flows from existing jobs to unemployment, and, second, because it, indirectly, reduces the flows from unemployment to jobs. The second effect takes place because the expected profit from the creation and filling of a vacancy falls, resulting in fewer vacancies and reduced flows from unemployment to jobs.