Federal Reserve Bank of New York
Staff Reports

Subsidizing Job Creation in the Great Recession

Sagiri Kitao
Ayşegül Şahin
Joseph Song

Staff Report no. 451
May 2010

Subsidizing Job Creation in the Great Recession

Sagiri Kitao, Ayşegül Şahin, and Joseph Song

Federal Reserve Bank of New York Staff Reports, no. 451
May 2010
JEL classification: E24, J65

Abstract

We analyze the effects of various labor market policies on job creation, job destruction, and employment. The framework of Mortensen and Pissarides (2003) is used to model the dynamic interaction between firms and workers and to simulate their responses to alternative policies. The equilibrium model is calibrated to capture labor market conditions at the end of 2009, including the unemployment, inflow, and outflow rates by workers of different educational attainment. We consider the equilibrium effects of a hiring subsidy, a payroll tax reduction, and an employment subsidy. While calibrating parameters that characterize these policies, we try to mimic the policies in the Hiring Incentives to Restore Employment (HIRE) Act of 2010. We find that a hiring subsidy and a payroll tax deduction, as in the HIRE Act, can stimulate job creation in the short term, but can cause a higher equilibrium unemployment rate in the long term. Employment subsidies succeed in lowering the unemployment rate permanently, but the policy entails high fiscal costs.

Key words: employment, unemployment, hiring credit, employment subsidy, unemployment insurance

---

Kitao, Şahin, and Song: Federal Reserve Bank of New York. Address correspondence to Kitao (e-mail: sagiri.kitao@ny.frb.org).

1 Introduction

Since the beginning of the recession in December 2007 through the end of 2009, labor market conditions deteriorated substantially. The U.S. nonfarm payroll employment shrank by 6.1%, slashing 8.4 million jobs. During the same period, the unemployment rate—5.0% at the onset of the recession —rose to a peak of 10.1% in October 2009, its highest level since the 1981-82 recession.[1] The labor market started to gradually recover in 2010 with payroll employment increasing in total by 573,000 in the first four months of 2010.

It is well known that the key to a recovery in the labor market after recessions is a robust re-creation of jobs. This naturally brings up the issue of designing and implementing job creation subsidies as a remedy to high unemployment. The question is whether job creation subsidies can help the labor market recover faster by providing hiring incentives. If the answer is yes, how big are the effects and costs of these policies?

Recently, there has been a great deal of discussion about potential job creation subsidies to speed up the recovery in the labor market. In January 2010, President Obama announced a proposal to establish a $33-billion tax credit, including a $5,000 tax credit for every net new employee hired by small businesses in 2010, as well as reimbursement for the Social Security payroll taxes to small employers. The scope of the actual hiring credit significantly narrowed from what the President had initially proposed. In March 2010, the Hiring Incentives to Restore Employment (HIRE) Act was approved by the House and the Senate and signed by the President. The bill provides businesses, including small businesses, with an exemption from Social Security payroll taxes for every worker hired in 2010 who has been unemployed for at least 60 days, or has worked fewer than a total of 40 hours for someone else during the 60-day period. The maximum value of this incentive is $6,621, which equals 6.2% of wages paid in 2010, up to the FICA wage cap of $106,800. The businesses will receive an additional $1,000 credit for every new employee retained for 52 weeks. The estimated cost of the HIRE Act is $13 billion.

Job creation subsidies are popular especially after deep recessions like the most current economic downturn. However, relatively little is known

[1]The severity of the recession has led many to refer to the downturn as the *Great Recession* as we also do in the title of our paper.

about their effects on stimulating job creation, nor does there seem to be a clear consensus on the magnitude of the policy effect on job creation and employment.[2] Probably the most similar job creation subsidy program that one can compare with the HIRE Act is the New Jobs Tax Credit (NJTC) which was in effect from mid-1977 to the end of 1978. This program was designed to stimulate and speed up job creation while the U.S. labor market was recovering from the severe 1973-75 recession. The NJTC provided a tax credit of 50% of the first $4,200 of wages per employee (a maximum credit of $2,100) for increases in employment of more than 2% over the previous year. Essentially NJTC was a wage subsidy offered to new jobs that resulted in employment growth of at least 2%. Even though NJTC was not targeted to any specific groups, it provided a greater relative incentive to hire low-wage, low-skill workers.

Katz (1998) reviews the studies that examined the role of NJTC on job creation and finds some evidence that a NJTC had a positive impact in stimulating employment growth. Among the studies Katz (1998) reviews, Perloff and Wachter (1979) compare the employment growth of firms which knew about the NJTC to that of firms unaware of the NJTC. They find that firms which knew about the credit increased employment by over 3% more than similar firms that were inattentive of the program. Clearly, as Katz (1998) argues, fast growing firms had more incentive to find out about the program and the knowledge of the program was not random, biasing the estimates of job creation upward. Bishop (1981) estimates that the NJTC increased employment in construction and retail by 150,000 to 670,000 (equivalent to an economy wide employment increase of 0.2 to 0.8 percent) over the mid-1977 to mid-1978 period. Bishop (2008) argues that extrapolating from Bishop (1981) and Perloff and Wachter (1979) estimates, the NJTC probably generated at least a million jobs by the end of 1978.

One issue with these estimates is that it is very difficult to identify the number of jobs that are "marginal", i.e. jobs that would have not been created if they had not been subsidized. Not all estimates of the effect of the NJTC on employment are optimistic. The final report to Congress submitted by the Departments of Labor and Treasury in 1986 about the impact of the NJTC reviews the studies by Perloff and Wachter (1979) and Bishop (1981)

[2]Most of empirical work focuses on understanding the effects of "targeted employment subsidies". See for example Hamermesh (1978), Katz (1994), Katz (1998) and LaLonde (1995) and references within. These subsidies generally target certain disadvantaged groups to improve their labor market outcomes.

and concludes the evidence is not conclusive:[3]

The results of these studies do not imply that the NJTC increased aggregate employment. While it was in effect, the credit could have reduced the workforce of ineligible employers (or of employers for whom the credit's employment incentive was relatively small). The employment losses could have resulted from: (1) consumer substitution away from products made by these employers toward products of employers for whom the credit's direct employment stimulus was greatest, (2) increased wage costs, or (3) the cost of financing the subsidy.

Given the mixed reviews, it is not easy to make an assessment about the potential impact of the HIRE Act by trying to extrapolate from the NJTC experience.[4] In this paper, we take a different route and evaluate the impact of the job creation subsidies proposed by the HIRE Act by using the workhorse labor market model developed by Mortensen and Pissarides (1994). In particular, we analyze the effects of job creation subsidies on job creation, job destruction and employment. We use the framework of Mortensen and Pissarides (2003) to model the dynamic interaction between firms and workers and to simulate their responses to alternative policies. The equilibrium model is calibrated to approximate the current labor market conditions including the unemployment, inflow and outflow rates of workers with different educational attainment at the end of 2009. We then consider the equilibrium effects of a hiring subsidy and a payroll tax reduction. While calibrating parameters that characterize these policies, we try to mimic the policies that are in the HIRE Act. In addition to comparing the effectiveness of these policies, we also compare their fiscal costs. We find that a hiring subsidy and payroll tax deduction can stimulate job creation in the short-term, but cause the equilibrium unemployment to be higher in the long-term. We then consider an employment subsidy and find that it succeeds in lowering the unemployment rate permanently. However, the fiscal costs associated to the employment policy would be prohibitively high making it unsustainable.

[3]See page 62 of The Use of Tax Subsidies for Employment, A Report to Congress by the Departments of Labor and Treasury, May 1986.

[4]One estimate we can cite is by Bartik and Bishop (2009), who argue that a well-designed job creation tax credit that will refund 15% of new wage costs in 2010 and 10% of new wage costs in 2011 could create 5.1 million additional jobs in the U.S. economy over these two years. Their estimates are for a subsidy program that they propose which is on a substantially larger scale than the HIRE Act.

The rest of the paper is organized as follows. Section 2 describes the model and section 3 its calibration. In section 4 we present the numerical results and section 5 concludes.

2 Model

The model builds on Pissarides (2000) and Mortensen and Pissarides (2003). Both job creation and destruction are endogenous. We choose this specification because both margins can play an important role in unemployment rate fluctuations. Especially, the most recent recession, which was the most severe post-war economic downturn, was characterized by major job destruction.

Denote the number of job vacancies by v and the number of unemployed workers u. Job-worker matches are created according to the following matching function that exhibits constant returns to scale.

$$m(v,u) = m\left(1, \frac{u}{v}\right) v \equiv q(\theta)v \tag{1}$$

where the ratio of vacancies to unemployment $\theta = v/u$ represents market tightness. Unemployed workers find jobs at the average rate of $\theta q(\theta)$ and vacancies are filled at the rate $q(\theta)$. The average duration of unemployment is $1/q(\theta)$. We assume that there are two types of workers that differ in skills, denoted by p. This choice is motivated by the observation that low-skilled workers face a higher unemployment risk, i.e., their unemployment rate is both higher on average and also more cyclical.[5]

The product of a job-worker match depends on two components. The first is the type-specific skill p and the second is the idiosyncratic productivity x. The productivity shock arrives at a Poisson rate λ and takes a value on the interval $[\gamma, 1]$ according to the cumulative distribution function of $F(x)$.[6]

Upon the realization of the idiosyncratic productivity shock x, a match is destroyed if the productivity falls below the reservation threshold denoted by R. All existing jobs face the destruction rate of $\lambda F(R)$ and the expected duration of $1/\lambda F(R)$.

The number of employed workers that become unemployed is given as $\lambda F(R)(1-u)$ at each point of time and the number of unemployed workers

[5] See for example Mincer (1991), Mukoyama and Şahin (2006) and Elsby, Hobijn, and Şahin (2010).

[6] In equilibrium, all jobs that are newly created have the highest idiosyncratic productivity $x = 1$.

who find a job is $\theta q(\theta)u$, which implies the equilibrium unemployment rate of

$$u = \frac{\lambda F(R)}{\lambda F(R) + \theta q(\theta)} \tag{2}$$

The timing of events is described as follows. A firm posts a job vacancy for a worker of skill p at a flow cost of recruiting cp. When a vacancy is matched with a worker of skill p, the employer and the worker bargain to agree on the initial wage $w_0(p)$. Output is produced and the agreed wage is paid every period until the productivity shock arrives at rate λ, upon which the wage is renegotiated and set at $w(x, p)$, which reflects the realized new productivity x. If the productivity is below the reservation level $R(p)$, the job is terminated.

We will consider the following three labor market policies. First, a hiring subsidy H is provided to the employer when a worker is hired. Second, a tax-subsidy schedule $a + tw$ is imposed on employers. If $t = 0$, it is a lump-sum employment subsidy (employment tax) when $a < 0$ ($a > 0$). Third, an unemployment benefit of $\rho\overline{w}(p)$ is paid to each unemployed worker that replaces a fraction ρ of the average wage for each skill group.

An unemployed worker values the leisure at an imputed income of b every period. It measures the incomes that have to be given up by moving from unemployment to employment and also captures the utilities associated with the state of unemployment.

Workers and firms maximize the expected present value of net income streams. A search equilibrium is given by a pair of reservation productivity R and market tightness θ for each skill type. As in Mortensen and Pissarides (2003), we assume market segmentation by skill groups, that is, a separate labor market operates for each skill type with its own matching function and employment-wage equilibrium. Given this assumption, in what follows we omit the dependence of equilibrium variables on skill level p.

The value of a continuing match for an employer with productivity x is denoted by $J(x)$.

$$rJ(x) = px - a - (1+t)w(x) + \lambda \int_R^1 [J(z) - J(x)]dF(z) + \lambda F(R)[V - J(x)] \tag{3}$$

where r is the riskless interest rate and V is the value of posting a vacancy as we describe below. The value of a match for a worker $W(x)$ is defined as

$$rW(x) = w(x) + \lambda \int_R^1 (W(z) - W(x))dF(z) + \lambda F(R)[U - W(x)] \tag{4}$$

where U is the value of unemployment.

The value of posting a vacancy V is written as

$$rV = q(\theta)\left[J_0 - V + H\right] - pc \tag{5}$$

where J_0 is the value of a new match to the employer.[7] The value of unemployment is given as

$$rU = b + \rho\overline{w} + \theta q(\theta)[W_0 - U] \tag{6}$$

Given the initial wage w_0, the values of a new match for employer and worker satisfy

$$rJ_0 = p - a - (1+t)w_0 + \lambda \int_R^1 (J(z) - J_0)dF(z) + \lambda F(R)[V - J_0] \tag{7}$$

and

$$rW_0 = w_0 + \lambda \int_R^1 (W(z) - W_0)dF(z) + \lambda F(R)[U - W_0] \tag{8}$$

The free entry condition requires that the value of posting a new vacancy is zero.

$$V = 0 \Leftrightarrow \frac{pc}{q(\theta)} - H = J_0 \tag{9}$$

Nash bargaining and wage determination: The initial wage w_0 is determined as a result of bilateral bargaining after a match of employer and worker is formed.

$$w_0 = \arg\max \left\{[W_0 - U]^{\beta}[J_0 + H - V]^{1-\beta}\right\} \tag{10}$$

where β represents the worker's relative bargaining power. Similarly, the wage of a continuing match upon the realization of the productivity shock x is determined as

$$w(x) = \arg\max \left\{[W(x) - U]^{\beta}[J(x) - V]^{1-\beta}\right\} \tag{11}$$

With the sharing rules and the equations for the values, the wages of initial and continuing matches are given as

$$w_0 = (1-\beta)(b + \rho\overline{w}) + \frac{\beta}{1+t}[p - a + pc\theta + (r+\lambda)H] \tag{12}$$

[7] A newly created job has a productivity $x = 1$, but J_0 is different from $J(1)$ because of the hiring credit H.

and

$$w(x) = (1-\beta)(b+\rho\overline{w}) + \frac{\beta}{1+t}(px - a + pc\theta) \tag{13}$$

Market equilibrium: Substituting the wage equations to the value equations, we obtain two equations that characterize the equilibrium conditions for job creation and job destruction.

- **Job destruction condition**

$$R + \frac{\lambda}{r+\lambda}\int_R^1 (z-R)dF(z) = \frac{a+(1+t)(b+\rho\overline{w})}{p} + \frac{\beta}{1-\beta}c\theta \tag{14}$$

  The left-hand-side of the equation is the sum of the reservation product R and the option value of continuing the match. The latter would be higher if λ is high, that is, if productivities change more frequently and there is a higher likelihood that the job productivity might increase. The right-hand-side represents the opportunity cost of continuing the match. A higher market tightness θ implies a higher reservation productivity R since it implies more ease with finding a job for an unemployed worker and increases the value of an outside option for a matched worker.

- **Job creation condition**

$$\frac{c}{q(\theta)} = (1-\beta)\left[\frac{1-R}{r+\lambda} + \frac{H}{p}\right] \tag{15}$$

  The left-hand-side of the equation is the expected recruiting cost that the firm has to pay, which is equated with the expected surplus of a newly created job to the firm, the right-hand-side. A higher reservation productivity implies a lower market tightness, since the job is expected to last for a shorter period and the value of posting a vacancy falls.

The two equilibrium conditions of job destruction and job creation can be represented by two curves in the space of reservation productivity R and market tightness θ as shown in Figure 1.

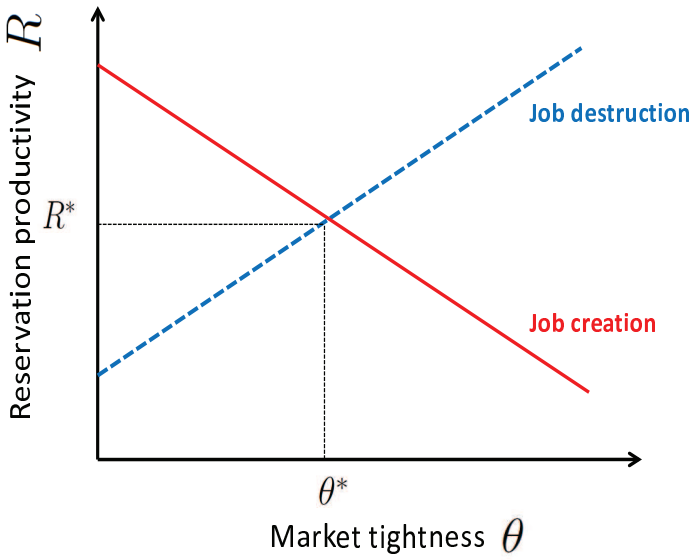

Figure 1: Equilibrium: job destruction and creation

The average wage of the economy is given as

$$\overline{w} = w_0 F(R) + \int_R^1 w(x) dF(x).$$

Using the wage equations (12) and (13),

$$\begin{aligned} \overline{w} &= \frac{b}{1-\rho} + \frac{p\beta}{(1+t)(1-\beta)(1-\rho)} \times \\ &\left[\frac{c}{q(\theta)}[(r+\lambda)F(R) + \theta q(\theta)] + \frac{r(1-\beta)}{r+\lambda}\int_R^1 (z-R)dF(z)\right] \end{aligned} \tag{16}$$

3 Calibration

The model is calibrated such that the benchmark model approximates the labor market conditions in the last quarter of 2009, which according to the

most recent data available, is likely to be the quarter when the payroll employment bottomed and the unemployment rate peaked. Then we introduce different types and amounts of job creation subsidies to our benchmark model and examine their marginal effects on the labor market outcomes.

Workers are heterogeneous ex-ante according to the skill level p. We assume there are two types, which we call "low" and "high" types. The high type in data corresponds to workers who hold a college degree or above and the low type covers the rest of the workers, who constitute approximately two-thirds of the labor force. We set the distribution of the two types of workers in population according to this ratio when we compute aggregate statistics such as the average unemployment rate. Figure 2 shows the unemployment rate for the two skill groups for 1976-2009 based on the CPS micro data for individuals of age 25 and above.

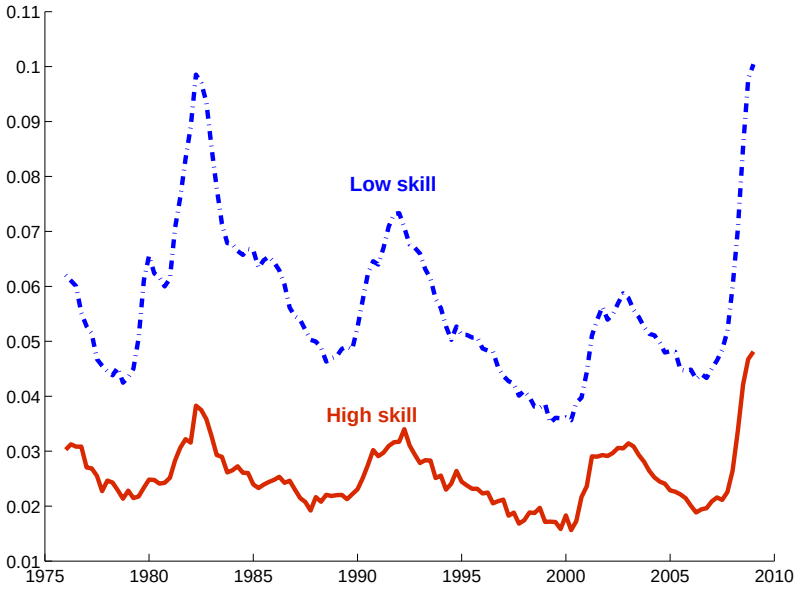

Figure 2: Unemployment rates for high-skill and low-skill workers, 1976-2009.

The model period corresponds to a quarter. The interest rate is set at

4% on annual basis. The matching function takes the Cobb-Douglas form

$$m(v,u) = v^{1-\eta}u^{\eta}$$

and we set the elasticity of the matching function with respect to unemployment η at 0.5. The bargaining weight of workers β is set at the same value of 0.5.

The productivity shock arrives with probability λ at 0.1 every period. The shock to the match productivity is uniformly distributed over the range $[\gamma, 1]$, where the lower bound of the support is type-specific. The value of leisure b also depends on the type of a worker.

The unemployment rates for high- and low-skilled workers are very different as can be seen on Figure 2. It is important to understand the underlying flows that cause the unemployment rate to vary by skill type. To this end, we compute the outflow and inflow probabilities by education using the method proposed by Shimer (2005, 2007), which uses monthly series on the numbers of employed and unemployed as well as the number of unemployed for fewer than five weeks to infer the rates at which workers enter unemployment, and unemployed workers exit unemployment. We use the CPS micro data to calculate the number of workers who have been unemployed for less than five weeks by their educational attainment and calculate the inflow and outflow probabilities. The unemployment evolves according to

$$\frac{dU_t}{dt} = s_t(L_t - U_t) - f_t U_t \tag{17}$$

where s_t and f_t are inflow and outflow rates, respectively and t indicates months. U_t denotes the number of unemployed and L_t the labor force. Following Shimer (2007), we compute the monthly outflow probability:

$$F_t = 1 - [(U_{t+1} - U_{t+1}^{<1})/U_t].$$

where $U_{t+1}^{<1}$ is the number of unemployed for less than five weeks. This can then be mapped into a Poisson outflow hazard rate $f_t = -log(1 - F_t)$. Once f_t is calculated, we can solve equation (17) forward one month to obtain:

$$U_{t+1} = (1 - e^{-(s_t+f_t)})U_t^* + e^{-(s_t+f_t)}U_t.$$

Here unemployment is a weighted average of the flow steady-state level of unemployment

$$U_t^* = \frac{s_t L_t}{s_t + f_t}$$

and last months unemployment U_t, with weight given by the monthly rate of convergence to steady state, $1 - e^{-(s_t+f_t)}$.

Note that as emphasized by Shimer (2007), this procedure for estimating implicitly corrects for a time aggregation bias arising from inflows within a given month exiting prior to the next months survey.

Figure 3 shows the estimates inflow and outflow probabilities based on the Shimer (2007) method.[8] One interesting feature of these flow rates is that the unemployment outflow probability is almost identical for high-skilled and low-skilled workers, which implies that the unemployment rate differences between skill groups are driven by heterogeneity in inflow rates.[9] These figures show that on monthly basis, the inflow rate into unemployment was around 2.5% for low-type workers, much higher than the rate for high type workers, which was approximately 1.0% in 2009. The outflow rate for both types of workers has fallen during the recession to approximately 20% at the end of 2009. We calibrate the two parameters γ and b for each type of workers to match these inflow and outflow rates.

The skill level p is set at $\{0.75, 1.5\}$ for each type, which implies the ratio of average earnings between two types at about 2.0 as in the data. The rate of recruiting cost c is set at 0.6, in line with the study of Hagedorn and Manovskii (2008).

The wage tax is set at 30%, close to the estimates of the effective tax rates in Mendoza et al. (1994). The replacement rate of unemployment insurance is set at 40%, to match the net replacement rate of the benefit (OECD, 1996). The calibrated parameters are summarized in Table 1.

[8] In these calculations we do not correct for the CPS redesign effects. According to Elsby, Hobijn, and Şahin (2010) redesign correction factor estimates calculated from the CPS microdata are very similar across education groups implying that the adjustment would not change the relative magnitude of flow rates between education groups.

[9] We also calculated labor flow rates from the longitudinally-matched monthly CPS microdata (the so-called gross flows data). The flows between unemployment to employment behave very similarly for the two education groups as well. This implies that both groups face similar job-finding prospects once they are unemployed and it is not the labor supply behavior (flows from unemployment to nonparticipation) that causes this similarity in unemployment outflow probabilities.

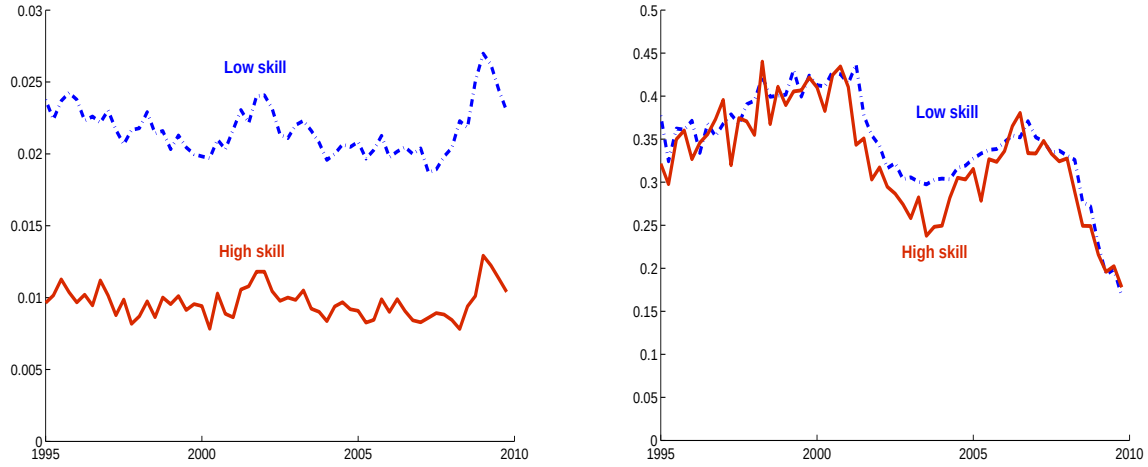

Figure 3: Unemployment inflow (left panel) and outflow (right panel) probabilities for high-skill and low-skill workers, quarterly averages of monthly probabilities.

Table 1: Parametrization of the model.

	Parameter	Value
Match product	$\{p_L, p_H\}$	{0.75,1.5}
Interest rate	r	4% (annual)
Productivity shock arrival rate	λ	0.1
Productivity shock support	$\{\gamma_L, \gamma_H\}$	{0.683,0.887}
Matching function parameter	η	0.50
Bargaining weight of workers	β	0.50
Recruiting cost	c	0.60
Value of leisure	$\{b_L, b_H\}$	$\{0.19, 0.40\}$
Wage tax rate	τ	0.30
UI replacement ratio	ρ	0.40

4 Policy experiments and numerical results

4.1 Benchmark equilibrium without subsidies

We solve the model numerically based on the benchmark calibration that we outlined in the previous section. Our benchmark does not include any of the subsidies we consider and the government operates only the unemployment insurance program and collects wage taxes. Table 2 presents the equilibrium outcomes of our benchmark model. High-skill workers have an unemployment rate of 4.8% while it is 11.1% for low-skilled workers.[10] This difference is driven by their different job loss probabilities faced by two types of workers as we discussed in section 3. High-skill workers also have higher wages as a result of their higher match productivity, which are converted from model units to US dollars by using the average wage in the data.

Table 2: Equilibrium outcomes for the benchmark model.

	High Skill	Low Skill
Unemployment Rate	4.8%	11.1%
Inflow Rate (monthly)	1.0%	2.5%
Outflow Rate (monthly)	20.0%	20.0%
Wage (in US$)	60,000	30,000

4.2 Hiring credit

The first job creation subsidy we consider is a hiring credit, which is defined as a payment made to the employer when a hire is made. As we discussed in section 1, the HIRE Act has two components that are designed to encourage hiring through subsidies. First, the Act provides businesses with an exemption from Social Security payroll taxes for every worker hired in 2010. Second, the businesses are provided with an additional $1,000 credit for ev-

[10]Note that this implies that, the overall unemployment rate is 9.0%, instead of the peak unemployment rate of 10.2%. We calibrate our model to match the statistics available by education. Since these statistics are available for workers at age 25 and above, the total unemployment rate corresponds to the unemployment rate of workers older than 25 years old.

ery new employee retained for 52 weeks. To capture the effects of these two policies we consider a lump-sum and a proportional hiring credit.

4.2.1 Lump-sum hiring credit

We consider a lump-sum hiring credit to mimic the effect of the $1,000 hiring credit in the HIRE Act. A hiring subsidy increases firm's expected net surplus from a newly created job. As a result the policy stimulates job creation and raises market tightness. In the (R, θ) diagram of job creation and job destruction curves, this first effect is captured by the rightward shift of the job creation curve and a horizontal shift in the market tightness from θ_0 to θ_1 in Figure 4. We call this effect "the job creation (JC) effect." This effect of job creation assumes a constant reservation productivity, which does not respond immediately to the policy change. The unemployment rate through the job creation effect is computed as $\lambda F(R_0)/(\lambda F(R_0) + \theta_1 q(\theta_1))$.

A higher labor market tightness would shorten the expected duration of unemployment $1/q(\theta)$. But it does not imply that the unemployment rate will necessarily fall since a higher market tightness improves employed workers' outside option value and affects the reservation productivity upon the arrival of a productivity shock. As a result, job destruction increases as well, raising the incidence of unemployment. This effect increases R, while reducing θ, a shift from (θ_1, R_0) to (θ^*, R^*) in Figure 4. We call this effect "the job destruction (JD) effect." The unemployment rate in the new equilibrium that takes into account both job creation and destruction effects is $\lambda F(R^*)/(\lambda F(R^*) + \theta^* q(\theta^*))$. Note that the job creation effect is not characterized as an equilibrium outcome, since it ignores the dependence of job destruction on improved labor market conditions. It is, however, helpful to separate the two effects. As we discuss further in section 4.2.3, factors such as wage rigidity and uncertainty about the underlying economic conditions, or the rise in labor participation during the recovery period might cause the job destruction effect to start with a delay. In other words, one can think about this effect as the maximum positive effect of a hiring subsidy that would have prevailed if the job destruction effect occurs with a delay following the first effect of job creation.

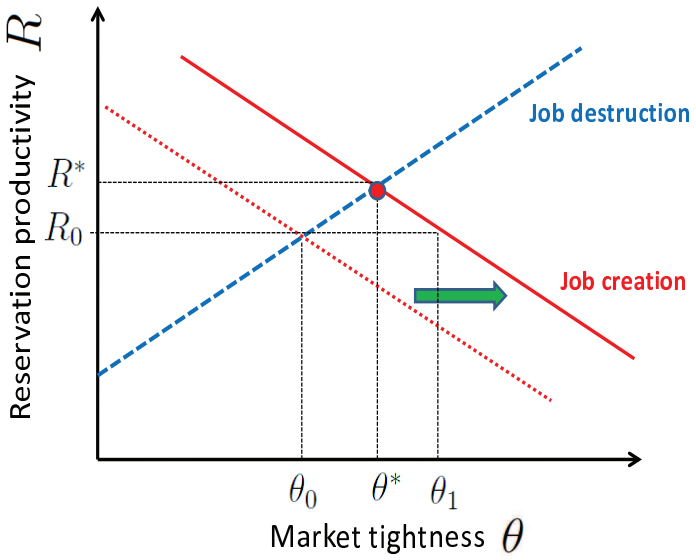

Figure 4: Effect of hiring credit

In the lump-sum subsidy experiment, we consider subsidies in the range of \$1,000 (equivalent to the lump-sum subsidy of the HIRE Act) to \$5,000 (the amount initially proposed by President Obama). Table 3 reports the effects of different amounts of hiring subsidy on the unemployment rate. When we only consider the job creation effect, a \$1,000 subsidy would reduce the average unemployment rate from 9.0% to 8.1%. Most of the effect is through the decline in the unemployment rate of low-skilled workers. Since the subsidy is lump sum, it affects the surplus for new unskilled jobs by a larger fraction than for skilled jobs. When we also take into account the effect of the subsidy on job destruction, the hiring subsidy no longer reduces the unemployment rate. The unemployment rate goes up from 9.0% to 9.4%. When the subsidy is \$5,000, the unemployment rate goes down to 5.8% through the job creation effect, but the total effect is a two-percentage-point increase in the unemployment rate to 11.1%. The analysis shows that if the U.S. government adopts a permanent hiring subsidy program, the equilibrium

Table 3: The effects of lump-sum and proportional hiring subsidies.

	JC Effect			Total (JC+JD) Effect				Fiscal Costs (in $bn)		
Subsidy	u	u_H	u_L	u	u_H	u_L	Δw	Total	High	Low
$1,000	8.1%	4.5%	9.9%	9.4%	5.5%	11.4%	+0.6%	7.7	1.5	6.2
$2,000	7.4%	4.2%	8.9%	9.9%	6.1%	11.7%	+1.3%	16.2	3.3	12.9
$5,000	5.8%	3.6%	6.9%	11.1%	8.1%	12.6%	+3.3%	46.7	11.0	35.7
6.2% of wage	7.3%	3.8%	9.1%	10.2%	7.3%	11.7%	+1.4%	15.8	7.9	8.0

unemployment rate would be higher than the initial level. However, the goal of the stimulus policies is to provide countercyclical hiring incentives when the labor market conditions remain vulnerable and they are not likely to remain once the economy recovers. If job destruction does not immediately adjust to the temporary policy, they will help to stimulate job creation and could generate a temporary boost in employment and a reduction in the unemployment rate.

Table 3 also compares the fiscal cost of the subsidy. It is much more costly to stimulate the hiring of skilled workers. Moreover, the unemployment rate of skilled workers is at a much lower level and unemployment is a more serious problem among low-skilled workers. A hiring subsidy that is targeted to low-skilled workers would be less costly in terms of the fiscal cost per newly created job and able to generate more employment in the short run. Note that our calculations for fiscal costs are generally larger than official estimates since we assume that all firms which hire collect the hiring credit, which is a simplifying and extreme assumption in light of empirical evidence. As Perloff and Wachter (1979) found for the NJTC that we discuss further below, only 34% of the firms in their sample were aware of the tax credit. In addition, there are more detailed restrictions on the eligibility that our model abstracts from. Therefore our fiscal costs can be interpreted as an upper bound.

Table 4 reports the impact of the hiring subsidies on employment. We use the total private employment in December 2009 as our base number, which is 107 million and calculate how much payroll employment would increase through the job creation effect and decrease in the long-run through the total effect. A $1,000 hiring subsidy increases employment by almost 1 million in the short-run, while the long-run effect is a decline of 463,000. A propor-

Table 4: The employment effects of lump-sum and proportional hiring subsidies. Numbers in thousands of workers.

	JC Effect			Total (JC+JD) Effect		
Subsidy	E	E_H	E_L	E	E_H	E_L
$\$1,000$	963	107	856	-463	-249	-214
$\$2,000$	1,174	214	1,560	-891	-463	-428
$\$5,000$	3,414	428	2,994	$-2,247$	$-1,177$	$-1,070$
6.2% of wage	1,783	357	1,426	$-1,319$	-891	-891

tional subsidy in the amount of 6.2% of wage is more effective: employment increases by 1.8 million. However the long-run effects are also bigger causing a decline of 1.3 million in employment. Most of the employment increases come from low-skilled jobs: the increase in skilled jobs is much smaller compared to the increase in the unskilled jobs. When we take into account the job destruction effect, employment declines are similar across skill groups. Table 4 shows that hiring subsidies can be effective in increasing employment through mostly stimulating low skill jobs. This is consistent with the findings of Katz (1998) that NJTC mostly helped in creating low-skilled and part-time jobs.

4.2.2 Proportional hiring credit

The HIRE Act also provides businesses with an exemption from Social Security payroll taxes for every worker hired in 2010. This subsidy is equal to 6.2% of wages paid in 2010. This is a subsidy that is proportional to the wage of the worker rather than a lump-sum subsidy and the amount depends on the skill level of a hired worker. In order to assess the policy effect, we compute the equilibrium outcome of a hiring credit, which corresponds to 6.2% of the average wage of the two types of workers. The hiring subsidy is \$1,241 for low skill new hires and \$2,480 for high skill. The effects of the subsidy is analogous to those of the lump-sum subsidy studied above. The unemployment rate goes down through the job creation effect, but the total effect results in an increase in the unemployment rate. The lump-sum subsidy is more effective in lowering the unemployment rate of unskilled workers while the proportional subsidy affects the unemployment rate of skilled workers more.

4.2.3 Further discussion on hiring credit and empirical evidence

The empirical evidence on the effects of a hiring subsidy we summarized in the introduction suggests that a temporary, job creation subsidy has some potential for stimulating employment growth. One might argue that our model is at odds with the observation or the intuition on the effects of the stimulus policy. A close look at the mechanism of the model gives us some insights about these seemingly contradictory findings. Our model predicts that in the long-run subsidies cause the unemployment rate to be higher since they induce more job destruction. However, the policies we are considering are temporary, while the model focuses on the consequence of the policy in the steady state and assumes that all the adjustment takes place immediately. Workers in our model become immediately aware of the improving labor market conditions, which increases their wages and thus lowers the surplus of firms. As a result firms destroy the jobs that they would have kept at lower wages. In reality, however, there may be an adjustment period in which this channel start to become effective. The uncertainty surrounding the underlying economic conditions could prevent firms from immediately adjusting wages upwards and induce workers to accept low wages as they digest the positive effects on the outside options as a result the prospects of finding a job more quickly during an unemployment spell.[11] It is possible that for a short period of time, the job creation effect could dominate and cause the unemployment rate to go down.

Another important effect that could delay the job destruction effect is an increase in the labor force participation. The labor force participation rate is mildly procyclical: it declines during recessions and recovers after the recession ends. The most current downturn also seems to be following this pattern. The labor force participation rate stood at 66% in December 2007, declined to as low as 64.9% in November 2009, and started to recover in 2010. Our model is a two-state model of the labor market and thus abstracts from labor supply considerations. It is possible that as job creation takes place, the unemployment rate stays high due to an increase in participation. As a result, labor market tightness would stay low and delay the job destruction effect to take place. In this case, the economy can experience a period of increasing employment with a steady unemployment rate.

[11] For example the case of staggered wage contracting as in Gertler and Trigari (2009) or the alternating-offer wage bargaining as in Hall and Milgrom (2008) would create such a delay by shielding the wages to adjust to the market conditions fast.

This discussion also brings up the question of how a hiring subsidy should be designed in order to maximally benefit from the favorable job creation effect while minimizing the negative effect from the job destruction. Our model provides some helpful insights. An attempt to further delay the job destruction effect would be useful. For example, the HIRE Act only provides the tax credit if the workers is retained for 52 weeks, this is an attempt at restricting job destruction once a match is formed. The effect of such a condition on the subsidy is analogous to the effect of imposing a firing tax on firms, which provides disincentives for job destruction and reduces frictional unemployment. Another important lesson from the NJTC was that it provided a greater relative incentive for the hiring of low-wage and part-time labor than for the hiring of high-wage and full-time labor. It is clear that trying to subsidize hiring of high-skilled workers is more expensive. We also note, however, a potential risk is that even if these are marginal jobs that would not have been created otherwise they might be more likely to get destroyed once the hiring incentives come to an end.

4.3 Employment subsidy

An employment subsidy is an employment-contingent payment that is paid throughout the duration of a match. We consider two types of employment subsidies: a lump-sum employment subsidy and a proportional wage subsidy. A lump-sum employment subsidy increases the job surplus and shifts the job destruction curve as shown in Figure 5. As a result, at the new equilibrium (θ^*, R^*), the reservation productivity is lower and market tightness increases. Both the duration of unemployment and the inflow rate into unemployment decrease and the unemployment rate goes down unambiguously.

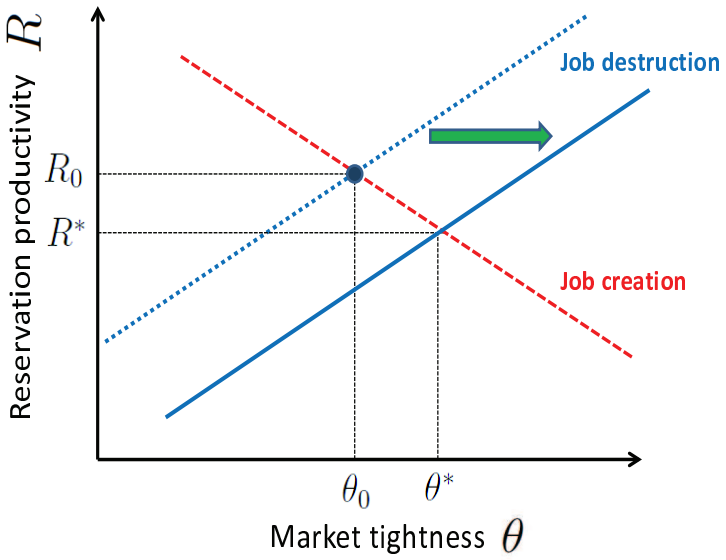

Figure 5: Effect of employment subsidy

Table 5 reports the effects of a lump-sum employment subsidy on the unemployment rate. The subsidy is at the annual rate, that is, one-fourth of the amount is paid every quarter. The policy is effective in lowering the unemployment rate, but the costs are much larger than the case of hiring subsidies studied above since employment subsidies cover all employment including existing matches instead of just new hires.[12] Results of a proportional wage subsidy are qualitatively similar as Table 6 shows. Quantitatively, however, the lump-sum employment subsidy is more effective in creating low skilled jobs and it can be more effective in lowering the overall unemployment rate for a given cost.

[12]We abstract from the adjustment in the government budget as a result of the policy change. If, for example, the rise in expenditures is financed by income taxation, the negative effect on employment could wipe out the decline in unemployment due to the employment subsidy.

Table 5: The effects of a lump-sum employment subsidy.

	Total Effect			Fiscal Costs (in $bn)		
Subsidy	u	u_H	u_L	Total	High	Low
$\$2,000$	8.3%	4.3%	10.4%	242.1	80.7	161.4
$\$4,000$	7.7%	3.8%	9.7%	487.7	162.6	325.1
$\$6,000$	6.8%	3.4%	9.1%	736.1	245.4	490.7

Table 6: The effects of a proportional wage subsidy.

	Total Effect			Fiscal Costs (in $bn)		
Subsidy	u	u_H	u_L	Total	High	Low
5%	8.6%	4.3%	10.8%	209.7	84.5	125.3
10%	8.3%	3.9%	10.5%	438.0	176.4	261.6
15%	7.9%	3.5%	10.2%	687.1	276.7	410.4

4.4 The role of Emergency Unemployment Compensation

Faced with the rapid deterioration of the labor market, the duration of unemployment benefit was extended through the Emergency Unemployment Compensation (EUC) in June 2008. In addition to the regular 26 weeks of benefits that are mostly state-funded, one could be eligible to receive 53 additional weeks of federally funded EUC as long as the Congress continues to extend it. EUC is divided into four tiers (20 weeks, then 14, then 13, and finally another 6 weeks); one must reapply when each tier expires. In addition to these 53 extra weeks, most states offer Extended Benefits (EB) of up to 20 weeks, which are also funded by the federal government. With the EUC, the fraction of unemployed workers collecting unemployment insurance reached almost 70% in 2009. The literature on unemployment insurance generally finds that generosity of the unemployment benefits causes the unemployment duration to increase, either because unemployed individuals do not engage in active search, or they become more selective in accepting an offer, or both. What we do in this subsection, is to take into account the change in the generosity of benefits when we analyze the effect of job creation subsidies. Table 7 shows the effect of two types of subsidies in the HIRE Act

Table 7: The effects of proportional hiring subsidies for different levels of unemployment insurance.

	UI	JC Effect	Total Effect
Subsidy	Replacement rate	u	u
$\$1,000$	35%	9.9%	10.2%
$\$1,000$	40%	9.9%	11.4%
$\$1,000$	45%	9.9%	13.0%
6.2% of wage	35%	9.1%	10.5%
6.2% of wage	40%	9.1%	11.7%
6.2% of wage	45%	9.1%	13.2%

with different levels of unemployment insurance replacement.

If we disregard the job destruction channel, the unemployment insurance does not interact with the effectiveness of the policy. The unemployment rate declines by the same amount for all cases we consider, as shown in Table 7. However, once we take into account the job destruction effect, more generous unemployment benefits will increase the outside option of workers and their wages. The job destruction curve will shift up since it simply lowers the match surplus of a firm by increasing the wages of workers. As a result both the incidence of unemployment and the unemployment duration go up. A hiring subsidy coupled with a more generous unemployment insurance system can further raise the unemployment rates in the long run.

5 Conclusion

In this paper we analyze the effects of various labor market policies on job creation, job destruction and employment. In particular, we examine the potential effects of a policy that approximates the 2010 HIRE Act on employment. We use a variant of Mortensen and Pissarides (1994) model with various policy instruments. We calibrate the model to the U.S. economy and build a benchmark model that captures the labor market conditions at the end of 2009. We evaluate the policies by considering their impact on job creation and job destruction separately. We find that a hiring subsidy and payroll tax deduction can stimulate job creation in the short-term, but would cause the equilibrium unemployment to be higher in the long-term.

In particular, a $1,000 lump-sum hiring subsidy might result in a reduction of the unemployment rate from 9.0% to 8.1% without the job destruction effect. In terms of employment this would be equivalent to almost 1 million new jobs. If both job creation and job destruction effects are taken into account, the policy would increase the steady-state unemployment rate to 9.4%. A proportional hiring subsidy equivalent to 6.2% of wages also stimulates job creation and could lower the unemployment rate to 7.3%. In terms of employment, the subsidy would create 1.8 million additional jobs in the economy, most of which come from an increase in low-skilled jobs. But once the job destruction effect is taken into account, the policy would cause a net increase in the unemployment rate by 1.2 percentage points to 10.2%. We also study the potential impact of employment subsidies and find that the policy will succeed in lowering the unemployment rate permanently but they have very high fiscal costs.

Unskilled workers constitute a greater part of the labor force and their unemployment rate is much higher than high-skilled workers. In our simulations, the HIRE Act would reduce the low-skilled unemployment rate more so than the high-skilled unemployment rate in the short term. Our fiscal calculations show that it is more cost effective for subsidies to target low-skilled workers than high-skilled workers. Since high-skilled workers have higher wages, the subsidy would have to be more generous to be effective.

References

Bartik, T. J. and J. H. Bishop (2009). The job creation tax credit. *Economic Policy Institute Briefing Paper Briefing Paper 248*.

Bishop, J. H. (1981). Employment in construction and distribution industries: The impact of the new jobs tax credit. In S. Rosen (Ed.), *Studies in Labor Markets*, pp. 209–46. Chicago: University of Chicago.

Bishop, J. H. (2008). Can a tax credit for employment growth in 2009 and 2010 restore animal spirits and help jump start the economy? ILR Collection Articles & Chapters.

Elsby, M., B. Hobijn, and A. Şahin (2010). The labor market in the great recession. *Brookings Paper in Economic Activity*. forthcoming.

Gertler, M. and A. Trigari (2009). Unemployment fluctuations with staggered nash wage bargaining. *Journal of Political Economy 117*(1), 38–86.

Hagedorn, M. and I. Manovskii (2008). The cyclical behavior of equilibrium unemployment and vacancies revisited. *American Economic Review 98*(4), 1692–1706.

Hall, R. E. and P. R. Milgrom (2008). The limited influence of unemployment on the wage bargain. *American Economic Review 98*(4), 1653–1674.

Hamermesh, D. S. (1978). Subsidies for jobs in the private sector. In J. Palmer (Ed.), *Creating Jobs*, pp. 87–122. Washington, DC: The Brookings Institution.

Katz, L. F. (1994). Active labor market policies to expand employment and opportunity. In *Unemployment: Current Issues and Policy Options*, pp. 239–90. Kansas City: Federal Reserve Bank of Kansas City.

Katz, L. F. (1998). Wage subsidies for the disadvantaged. In R. Freeman and P. Gottschalk (Eds.), *Generating Jobs: How to Increase Demand for Less-Skilled Workers*, pp. 21–53. New York: Russell Sage Foundation.

LaLonde, R. J. (1995). Ihe promise of public-sector sponsored training programs. *Journal of Economic Perspectives 9*, 149–68.

Martin, J. P. (1996). Measures of replacement rates for the purpose of international comparisons: A note. *OECD Economic Studies 26*.

Mendoza, E. G., A. Razin, and L. L. Tesar (1994). Effective tax rates in macroeconomics: Cross-country estimates of tax rates on factor incomes and consumption. *Journal of Monetary Economics 34*(3), 297–323.

Mincer, J. (1991). Education and unemployment. NBER Working Paper, No. 3838.

Mortensen, D. T. and C. A. Pissarides (1994). Job creation and job destruction in the theory of unemployment. *Review of Economic Studies 61*(3), 397–415.

Mortensen, D. T. and C. A. Pissarides (2003). Taxes, subsidies and equilibrium labour market outcomes. In E. S. Phelps (Ed.), *Designing Inclusion: Tools to Raise Low-end Pay and Employment in Private Enterprise*, pp. 44–73. Cambridge: Cambridge University Press.

Mukoyama, T. and A. Şahin (2006). Costs of business cycles for unskilled workers. *Journal of Monetary Economics 53*(8), 2179–2193.

Perloff, J. M. and M. Wachter (1979). The New Jobs Tax Credit: An

evaluation of the 1977-78 wage subsidy program. *American Economic Review 69*(2), 173–79.

Pissarides, C. A. (2000). *Equilibrium Unemployment Theory, Second Edition*. Cambridge, Massachusetts: MIT Press.

Shimer, R. (2005). The cyclical behavior of equilibrium unemployment and vacancies. *American Economic Review 95*(1), 25–49.

Shimer, R. (2007). Reassessing the ins and outs of unemployment. NBER Working Paper No. 13421.