Minimum Wages and Youth Employment

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24 June 2010

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June 24, 2010

Abstract

Significant employment differences between the US and Europe are concentrated among young workers. This paper constructs a labor search model that accounts for age patterns of employment. Work experience reduces the probability that workers lose their jobs. By introducing minimum wages, the model explains empirical findings on the effects of minimum wage laws. In addition, the model shows that minimum wages can account for about half of the differences in youth employment between Europe and the United States.

*Preliminary, comments welcome. Previously circulated under the title: "Labor Market Connections, Minimum Wages, and Youth Employment." I would like to thank Galina Hale, Lee Lockwood, Derek Neal, Ezra Oberfield, Richard Rogerson, Robert Shimer, Nancy Stokey, participants of the Capital Theory Working Group at the University of Chicago, the 2008 North American Summer Meeting of the Econometric Society, the 2008 SED Summer Meetings, and the 12th Annual SCIIE International Economics Conference for helpful comments. All mistakes are my own.

1 Introduction

Why do people in Europe work less than people in the United States? Most of the existing literature explains aggregate time series data by focusing on the effects of labor market policies on a representative worker. This framework overlooks several sources of heterogeneity in work decisions both across individuals and for a given individual at different ages. Heterogeneity across age is particularly important in explaining differences in labor supply across countries. Figure 1 plots employment to population ratios in 2000 for five age bands for the US, Canada, France, Portugal and Spain[1]. The difference in European employment relative to the United States is concentrated in the 15-24 and 55-64 year old age groups. While a compelling literature has examined retirement policies and unemployment insurance to understand the differences in retirement across countries, not much work has been done to understand the even larger employment differences among young workers. To fully explain employment differences across countries the observed patterns of employment among young workers must be accounted for.

Minimum wages provide a potential explanation of large employment differences among young workers across countries. In the United States, minimum wages have been low and declined in real value over time until recent increases starting in 2007. Many European countries have had much higher levels of minimum wages[2]. This paper quantitatively assesses

[1]Data is total male and female employment in each age group divided by the population in that age group from the OECD Corporate Data Environment Labor Market Statistics Database. Further discussion of the data and time series evidence is presented in the appendix.

[2]Evidence on minimum wages over time is presented in the appendix. Most countries have consistently higher minimum wages than the US. France has had dramatic increases in the minimum wage since 1960 compared to a decline in the US value.

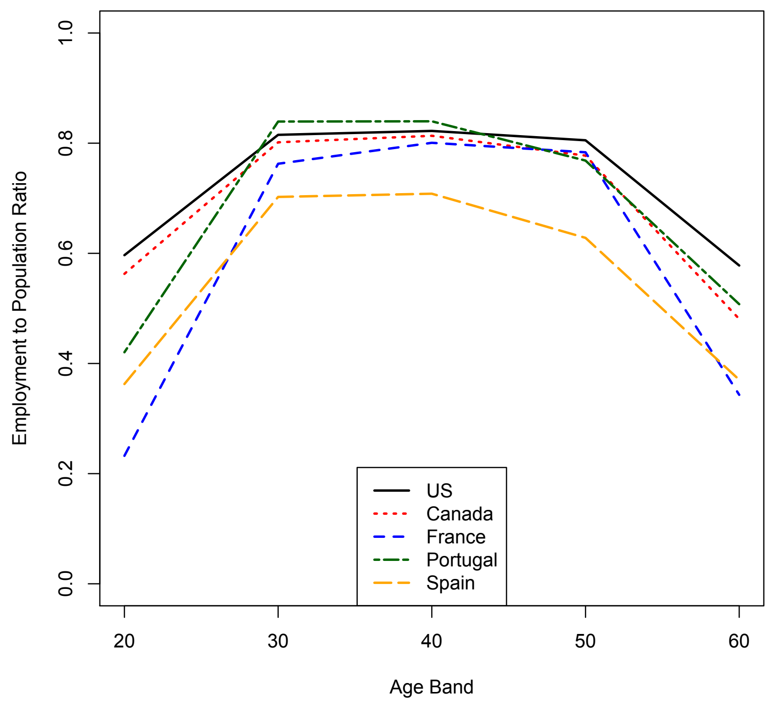


Figure 1: *Average employment to population ratio by age in 2000.*

how much of the differences in youth employment across countries in 2000 can be accounted for by differences in minimum wage policy.

A model that accounts for the age heterogeneity in employment outcomes is needed to evaluate the effects of minimum wages. This paper constructs a search model to explain the pattern of employment for young workers. To generate lower levels of youth employment workers are one of two types: experienced and inexperienced. Workers enter the labor force inexperienced without a job and while employed can become experienced. The key assumption is that experienced workers separate from their jobs at a lower rate. This exogenous decline is used to calibrate the model so that it is consistent with the observed decline in job separation rates with age in the US economy[3]. The model assumes both types of workers draw jobs from the same productivity distribution. However, experienced workers have a higher reservation productivity level which leads to differences in job finding rates and wages between groups. The model matches the age employment patterns for young workers in the United States.

The model exploits the observed decline in job separation rates with age in the data to generate differences in outcomes for young workers. While the model treats the decline as exogenous, there are many possible explanations for the observed decline in separations. Neal (1999) argues that young workers first match with a career before searching for a job within a profession. This entails workers trying many jobs in order to find what they are good at. Once a worker finds a suitable profession, it is reasonable to think that she would be less likely to quit or be fired. Jovanovic (1979) constructs a learning model where workers sort themselves into better jobs that have lower rates of separation. Gorry (2010) extends this learning model so that workers with more experience are better at distinguishing between good and bad jobs. Older experienced workers are able to select into jobs that are likely to have longer durations. Other possible explanations include job training and on-the-job-search (see Mortensen (1988)). Any of these models can provide a micro level explanation for the decline in separation rates used in this paper.

[3]One potential concern with this approach is that separation rates are not invariant to changes in the minimum wage. However, in models with endogenous separations like Jovanovic (1979) and Gorry (2010) minimum wages increase the job separation rate and hence the employment effects of minimum wages. This approach provides a convenient lower bound for the observed employment effects of minimum wages. While providing an endogenous explanation of the decline in separation rates is of interest, the goal of this paper is to quantitatively assess the effects of minimum wages on labor market outcomes.

To assess the impact of minimum wages the model is simulated for levels of minimum wages and tax policy found in each country. This exercise focuses on individuals who enter directly into the labor market, abstracting away from potentially important differences in education. Adding minimum wages implies that these representative inexperienced workers have a more difficult time finding their first job and are less likely to become experienced. These negative effects decline with age as workers become experienced and the minimum wage no longer binds. The quantitative exercise suggests that minimum wages can account for about 50% of employment differences for young workers between the US and France and Portugal.

This paper relates to two major literatures. First, it complements the literature that attempts to explain employment differences between the US and Europe. Rogerson (2006) lays out a research agenda to quantitatively assess the impact of various labor market institutions on employment outcomes. While previous work focuses on explaining employment differences between the US and Europe, this paper studies factors that can explain why the differences are concentrated among young workers. Prescott (2004) and Ljungqvist and Sargent (1998) present two leading explanations for the differences in employment between the United States and Europe. Prescott (2004) concludes that differences in hours worked between the United States and Europe are accounted for by differences in labor tax rates across countries. While the representative agent model predicts a decline in total hours worked from higher taxes, it does not take a stand on which margin of work hours adjust. There are no implications from Prescott's (2004) model as to whether differences in hours are at the extensive or intensive margin or how these differences vary with age. Using linear taxes in a life-cycle model Rogerson and Wallenius (2009) show that an increase in taxes causes a decrease in both hours of work over the life-cycle and a decline in employment early and late in life. However, it is unclear if the life-cycle model quantitatively accounts for differences in employment across countries. Additionally, including progressive rather than flat taxes may reduce the decline in the extensive margin in favor of larger decreases on the intensive margin.

In a completing explanation, Ljungqvist and Sargent (1998) show that the combination of lost human capital when unemployed and generous unemployment compensation causes the longer unemployment durations found in Europe. They argue that increases in job turnover rates since the 1970s caused European economies with large unemployment benefits to experience increases in unemployment. This channel is consistent with a decline in employment for older workers who have accumulated human capital, but does not account for the decline in youth employment.

Second, there is a large literature that studies the effects of minimum wages on labor market outcomes. For a good survey of the literature see Neumark and Wascher (2007). This paper provides theoretical support for findings in the empirical literature about the effects of minimum wages on employment outcomes. It explains why the effects of minimum wages are only found among young workers. Moreover, the impact of minimum wages on employment is non-linear; low levels of minimum wages have little effect where high minimum wages cause much lower youth employment rates. This reconciles the literature that finds small effects of minimum wage laws in the United States where minimum wages are low with the literature that finds larger effects in Europe.

Flinn (2006) and Rocheteau and Tasci (2008) study the effects of minimum wages in equilibrium search models. Minimum wages are introduced in this paper in the same way as in Flinn (2006) who considers the efficiency of minimum wages for different bargaining environments. Unlike Flinn (2006), this paper assumes that the Hosios (1990) condition applies, so that the equilibrium is efficient. This paper extends the simple search framework to explore the cross-country implications of minimum wages on employment outcomes for young workers.

The model is presented in section 2. Section 3 calibrates the model to match the age patterns of employment found in the US. Section 4 documents the predictions from the model and section 5 uses the model to quantitatively assess employment outcomes between the US and several European countries. Section 6 concludes.

2 Model

This section describes the search and matching model that can mimic the age patterns found in employment. The model extends the matching models of Mortensen and Pissarides (1994) and Pissarides (1985) by allowing employed workers to become experienced. Experienced workers are less likely to become separated from their jobs. This feature enables the model to generate differences in employment outcomes between young and older workers. While experience makes jobs last longer, experienced and inexperienced workers still draw job offers from the same fixed underlying productivity distribution $F(y)$. Although equilibrium in this environment will entail a stationary distribution of experienced and inexperienced workers, the model can be simulated to generate hypothetical employment histories for individual workers that can be compared to data on employment outcomes.

2.1 Agents

There is a unit mass of workers who exit the labor market at rate δ. A new cohort of size δ enter the labor force at each date to replace the workers who have left. Hence, there is a constant number of workers alive at any given time. New workers enter the labor market inexperienced and unemployed. Workers have preferences:

$$\int_0^\infty e^{-(\rho+\delta)t} c_t dt$$

where c_t is consumption. Agents supply labor to the market inelastically when they are employed.

Additionally, there is a continuum of infinitely lived agents that will be called firms with preferences:

$$\int_0^\infty e^{-\rho t} c_t dt$$

Firms search separately for inexperienced and experienced workers and can post any number of vacancies, $v_t \in \mathbb{N}_0$, at a flow cost of k_i consumption units for an open vacancy of type $i \in \{e, n\}$ where e denotes experienced and n denotes inexperienced workers.

2.2 Production

Production occurs when a worker is paired with a firm. Experienced and inexperienced workers have separate constant returns to scale matching functions: $m_e(v_e, u_e)$ and $m_n(v_n, u_n)$[4]. A worker of type $i \in \{e, n\}$ meets a vacant job at rate $\lambda_i = m_i/u_i$. Symmetrically, an open vacancy of type i meets a worker at rate $q_i = m_i/v_i$. The standard boundary conditions are assumed: $\lim_{v/u\to\infty} \lambda_i = 1$, $\lim_{v/u\to\infty} q_i = 0$, $\lim_{v/u\to 0} \lambda_i = 0$, and $\lim_{v/u\to 0} q_i = 1$.

When a worker and vacancy of either type meet, the pair draw a match specific productivity y from distribution $F(y)$. Both workers and firms immediately observe the productivity draw. Given the productivity y both parties agree on whether to form a match and use Nash-bargaining to split the surplus. As is standard in the matching literature, the solution to this problem consists of a reservation productivity level for each type of worker. These reservation productivities are denoted by y_e^* and y_n^* for experienced and inexperienced workers. If a match is formed, wages are determined by Nash bargaining with weight θ given to the workers. This will result in wage functions $w_e(y)$ and $w_n(y)$ that depend on the type of worker in the match.

[4] Alternately, both experienced and inexperienced workers could draw jobs from the same matching function. The baseline version of the model calibrates the matching rate to be identical between the two types of workers. Two matching functions allow changes in minimum wages to alter the job offer rates for different types of workers as experienced workers become more profitable. This allows another potential channel whereby labor market policies can affect employment outcomes. While similar results can be generated by calibrating a model with a single matching function, such models generate a potential multiplicity of equilibria.

2.3 Equilibrium

Workers in the model can be in any one of four possible states. The value functions for unemployed inexperienced, unemployed experienced, employed inexperienced and employed experienced workers are as follows:

$$(r+\delta)U_n = \lambda_n \int \max\left\{E_n(y) - U_n, 0\right\} dF(y) \tag{1}$$

$$(r+\delta)U_e = \lambda_e \int \max\left\{E_e(y) - U_e, 0\right\} dF(y) \tag{2}$$

$$(r+\delta)E_n(y) = w_n(y) + p\left[\max\left\{E_e(y), U_e\right\} - E_n(y)\right] + s_n\left[U_n - E_n(y)\right] \tag{3}$$

$$(r+\delta)E_e(y) = w_e(y) + s_e\left[U_e - E_e(y)\right] \tag{4}$$

Unemployed workers are matched with firms at rate λ_i. When matched they get a draw from the productivity distribution $F(y)$ and either become employed with productivity y or remain unemployed. Employed inexperienced workers are paid a wage $w_n(y)$ based on their productivity y. Additionally, they separate from their job and become unemployed inexperienced at exogenous rate s_n and become experienced at rate p. When employed inexperienced workers becomes experienced they can choose either to become employed experienced with productivity y or they can quit and become unemployed experienced to search for a higher productivity match. Finally, employed experienced workers get paid $w_c(y)$ and become unemployed experienced at rate $s_e < s_n$. Note that becoming experienced is an absorbing state: experienced workers remain so until they leave the labor force.

Next, firms can choose to open vacancies for either experienced or inexperienced workers. Their value functions for inexperienced and experienced vacancies and filled jobs are as follows:

$$rV_n = -k_n + q_n \int \max\{J_n(y) - V_n, 0\} dF(Y) \tag{5}$$

$$rV_e = -k_e + q_e \int \max\{J_e(y) - V_e, 0\} dF(Y) \tag{6}$$

$$(r+\delta)J_n(y) = y-(1+\tau)w_n(y)+s_n[V_n-J_n(y)]+p[\mathbb{I}_{Stay}(J_e(y)-J_n(y))+(1-\mathbb{I}_{Stay})(V_n-J_n(y))] \tag{7}$$

$$(r+\delta)J_e(y) = y - (1+\tau)w_e(y) + s_e[V_e - J_e(y)] \tag{8}$$

If a firm posts a vacancy for an inexperienced worker, it pays a flow cost k_n for having the open vacancy and meets a worker with probability q_n. When the match occurs the firm decides to establish a job or remain as a vacancy depending on the realization of the productivity draw. Experienced vacancies are identical except that they pay flow cost k_e. The flow costs of vacancies may differ in the two markets either due to the type of work requiring more capital to be ready for an individual to start work or higher costs in seeking a more specific type of employee. The firm with an inexperienced worker gets the output from the match y less the wage and payroll taxes paid to employ the worker $(1+\tau)w_n(y)$. The match dissolves at rate s_n. At rate p the worker becomes experienced. If the worker keeps her job the match becomes experienced, otherwise the firm and worker separate. Finally, a firm with a experienced worker gets the output y and pays wage and payroll taxes $(1+\tau)w_e(y)$.

The firm and worker separate at rate s_e. Note that filled jobs are discounted at rate $r + \delta$ because when the worker dies the match ends.

To complete the notation for the model let the masses of unemployed inexperienced workers, unemployed experienced workers, inexperienced matches, experienced matches, inexperienced vacancies, and experienced vacancies be denoted by u_n, u_e, e_n, e_e, v_n, and v_e respectively. We can now define a steady state competitive equilibrium of the model:

Definition 1 *A steady state equilibrium consists of the value functions for the worker, U_n, U_e, $E_n(y)$, and $E_e(y)$, the value functions of the firm, V_n, V_e, $J_n(y)$, $J_e(y)$, the aggregate state variables, u_n, u_e, e_n, e_e, v_n, and v_e, the wages, $w_n(y)$ and $w_e(y)$, and the reservation productivity levels for each type of worker, y_n^* and y_e^* such that:*

1. *Value functions are satisfied: Given $w_n(y)$, $w_e(y)$, u_n, u_e, v_n, and v_e, U_n, U_e, $E_n(y)$, $E_e(y)$, V_n, V_e, $J_n(y)$, and $J_e(y)$ satisfy equations (1)–(8).*

2. *Match Formation: Given $w_n(y)$, $w_e(y)$, u_n, u_e, v_n, and v_e, the reservation productivity levels y_n^* and y_e^* are optimal decision rules.*

3. *Free Entry: Given $w_n(y)$ and $w_e(y)$, u_n, u_e, v_n, and v_e, the value of vacancies must be $V_n = V_e = 0$.*

4. *Bargaining: $w_n(y)$ and $w_e(y)$ satisfy the Nash Bargaining equations:*

$$E_n(y) - U_n = \theta[J_n(y) + E_n(y) - V_n - U_n] \tag{9}$$

$$E_e(y) - U_e = \theta[J_e(y) + E_e(y) - V_e - U_e] \tag{10}$$

5. Steady State: The following six equations hold:

$$u_n + u_e + e_n + e_e = 1$$

$$(1-\gamma)pe_n + s_e e_e = \lambda_e(1 - F(y_e^*))u_e + \delta u_e$$

$$\lambda_e(1 - F(y_e^*))u_e + p\gamma e_n = (s_e + \delta)e_c$$

$$\lambda_n(1 - F(y_n^*))u_n = (s_n + p + \delta)e_n$$

$$q_e(1 - F(y_e^*)) + p\delta e_n = (s_e + \delta)e_e$$

$$q_n(1 - F(y_n^*)) = (s_n + p + \delta)e_n$$

Where $\gamma = \frac{1-F(y_e^*)}{1-F(y_n^*)}$ *is the percentage of inexperienced workers who remain employed when they become experienced.*

2.4 Characterizing the Solution

The solution to the model involves solving for the reservation productivity level for each type of worker. By continuity of the value functions $E_n(y)$ and $E_e(y)$, the reservation productivities are defined by the indifference point between unemployment and being employed at the reservation productivity level. That is, $U_n = E_n(y_n^*)$ and $U_e = E_e(y_e^*)$.

Since being experienced is an absorbing state, equations (2), (4), (8), and (10) along with the free entry condition can be used to solve for $w_e(y)$, U_e, $E_e(y)$, $J_e(y)$ and y_e^*. The reservation property implies that:

$$(r+\delta)U_e = w_e(y_e^*)$$

Imposing free entry, the value function for an entrepreneur matched with an experienced worker becomes:

$$J_e(y) = \frac{y-(1+\tau)w_e(y)}{r+\delta+s_e}$$

$E_e(y)$ and $w_e(y)$ are given by the following two equations:

$$E_e(y) = \frac{w_e(y)+s_e\frac{w_e(y_e^*)}{r+\delta}}{r+\delta+s_e}$$

$$(1+\theta\tau)w_e(y) = \theta y + (1-\theta)w_e(y_e^*)$$

The wage equation implies $w_e(y_e^*) = \frac{y_e^*}{1+\tau}$. Using this fact, the reservation productivity solves the following equation:

$$\frac{y_e^*}{1+\tau} = \frac{\lambda_e\theta}{(r+\delta+s_e)(1+\theta\tau)}\int_{y_e^*}^{\infty}(y-y_e^*)dF(y)$$

Now, the solution for experienced workers can be used to solve for the reservation productivity level of inexperienced workers. The reservation property implies:

$$w_n(y_n^*) = (r+\delta+p)U_n - p\max\{E_e(y_n^*), U_e\}$$

y_n^* is solved for by using the difference between being employed and unemployed when inexperienced:

$$E_n(y) - U_n = \int_{y_n^*}^{y} E_n'(y')dy'$$

Differentiating equation (3) gives an equation for $E_n'(y)$. Since employed workers quit their jobs when they become experienced unless their productivity is above y_e^*, the differentiation is done in two parts. When $y \geq y_e^*$:

$$E_n'(y) = \frac{w_n'(y) + p\frac{w_e'(y)}{r+\delta+s_e}}{r + \delta + p + s_n}$$

When $y < y_e^*$:

$$E_n'(y) = \frac{w_n'(y)}{r + \delta + p + s_n}$$

Imposing free entry, the value function for entrepreneurs matched with a inexperienced worker becomes:

$$J_n(y) = \frac{y - (1+\tau)w_n(y) + p\mathbb{I}_{y \geq y_e^*} J_e(y)}{r + \delta + s_n + p}$$

Then the wage equation is given by:

$$(1 + \theta\tau)w_n(y) = \theta y + (1 - \theta)w_n(y_n^*)$$

Note that this equation implies that $w_n(y_n^*) = \frac{y_n^*}{1+\tau}$.

Since $w_e'(y) = w_n'(y) = \frac{\theta}{1+\theta\tau}$, a closed form expression for $E_n'(y)$ is obtained. Note that for each segment $E_n'(y)$ is a constant. Hence, assuming that $y_n^* < y_e^*$, equation (1) is used to solve for y_n^*:

$$\frac{r+\delta}{(r+\delta+p)(1+\tau)}[y_n^* + \frac{p}{r+\delta}y_e^*] = \lambda_n \int_{y_n^*}^{\infty} E_n(y) - U_n dF(y)$$

$$= \frac{\lambda_n \theta}{(r+\delta+s_n+p)(1+\theta\tau)} \left[\int_{y_n^*}^{y_e^*} (y-y_n^*)dF(y) \right.$$
$$\left. + \int_{y_e^*}^{\infty} (y_e^* - y_n^*) + \left(1 + \frac{p}{r+\delta+s_e}\right)(y-y_e^*)dF(y) \right]$$

It remains to show that $y_e^* \geq y_n^*$ to verify that the above equation gives the correct solution for y_n^*. The proof is given in the following proposition:

Proposition 1 *If $\lambda_e \geq \lambda_n$ and $s_e < s_n$, the reservation productivity level of an inexperienced worker is less than a experienced worker. That is: $y_n^* < y_e^*$.*

Proof.

Proceed by contradiction. Suppose that $y_n^* \geq y_e^*$, then we have:

$$\frac{r+\delta}{r+\delta+p}[y_n^* + \frac{p}{r+\delta}y_e^*] = \frac{\lambda_n \theta}{r+\theta\delta+s_n+p} \frac{r+\delta+s_e+p}{r+\delta+s_e} \int_{y_n^*}^{\infty} (y-y_n^*)dF(y)$$

Recalling the equation that solves y_e^*, we get:

$$\begin{aligned}
y_n^* &\leq \frac{r+\delta}{r+\delta+p} y_n^* + \frac{p}{r+\delta+p} y_e^* \\
&= \frac{\lambda_n \theta}{r+\theta\delta+s_n+p} \frac{r+\delta+s_e+p}{r+\delta+s_e} \int_{y_n^*}^{\infty} (y-y_n^*) dF(y) \\
&< \frac{\lambda_e \theta}{r+\delta+s_e} \int_{y_e^*}^{\infty} (y-y_e^*) dF(y) \\
&= y_e^*
\end{aligned}$$

A contradiction. ■

The assumption that the job separation rate for experienced workers is lower than for inexperienced workers is the key factor that generates differences in employment outcomes between young and old workers. However, the differences in separation rates are filtered through the worker's search decisions to generate employment outcomes. Because their jobs are expected to last longer, experienced workers take longer on average to find new jobs. The job finding rate for each type of worker, $i \in \{e, n\}$, is given by $\lambda_i(1 - F(y_i^*))$. In the baseline calibration, $\lambda_e = \lambda_n$ implies that experienced workers have a lower job finding rate. This force reduces the differences in employment generated by the decline in the separation rate, but the rate of employment is still lower for young workers.

2.5 Model with Minimum Wages

This section introduces minimum wages to the model. Minimum wages are introduced as a binding wage floor in the model, $\bar{w}$. For a match to form, the wage paid must be equal to or exceed this minimum level. As in Flinn (2006), the minimum wage will create a side condition on the Nash-bargaining problem in the model. This changes the equilibrium concept that was previous described. In the original model, workers and firms agreed on match formation. With a wage floor, a worker may want to work at the minimum wage, $\bar{w}$, while the firm is unwilling to form a match at this wage. To get around this problem, the firm now unilaterally chooses whether to form a match when a firm and worker meet. Hence, the worker no longer makes a maximization decision. Firms solve the same problem as before.

A second difference in the model with minimum wages concerns Nash bargaining. We continue to assume Nash bargaining with the added constraint that $w_i(y) \geq \bar{w}$. This implies that $E_i(y) - U_i \geq \theta[J_i(y) + E_i(y) - V - U_i]$ for $i \in \{e, n\}$. The equation holds with equality if $w_i(y) > \bar{w}$. Under this setup, workers get share θ of the surplus when $w_i(y) > \bar{w}$, but receive a higher share when the minimum wage binds. Additionally, the wage distribution has a positive mass at the minimum wage.

Since firms unilaterally make the choice of when to accept a match, the cutoff will be when $y \geq (1+\tau)\bar{w}$ as long as the minimum wage is above the original reservation level. For the firm to be willing to hire a worker at the minimum wage, the worker must be productive enough to cover the costs of the wage and payroll taxes. The equation shows that payroll taxes have an interaction with the level of the minimum wages as discussed in Pries and Rogerson (2005). Higher payroll taxes increase the effective minimum productivity level that a worker must possess to be hired under any given minimum wage restriction. The values of the minimum wage considered in this paper are only binding for inexperienced workers. Define $\bar{y}_n$ as the productivity level where the original wage function crosses the minimum wage; that is $w_n(\bar{y}_n) = \bar{w}$. $\bar{y}_n$ is needed to define the value function for inexperienced vacancies as it denotes the productivity level where the wage begins to rise above the minimum.

Under a minimum wage, the value function for inexperienced workers becomes:

$$(r+\delta)U_n = \lambda_n \int_{(1+\tau)\bar{w}}^{\infty} [E_n(y) - U_n] \, dF(y) \tag{11}$$

Next, the value function for inexperienced vacancies with a minimum wage is given by rewriting equation (5) as:

$$k_n = \frac{q_n}{r+\delta+s_n+p} \left[\int_{(1+\tau)\bar{w}}^{\bar{y}_n} [y - (1+\tau)\bar{w}] \, dF(y) \right.$$

$$\left. + \int_{\bar{y}_n}^{y_e^*} [y - (1+\tau)w_n(y)] \, dF(y) + \int_{y_e^*}^{\infty} [y - (1+\tau)w_n(y) + pJ_e(y)] \, dF(y) \right]$$

If worker productivity is $y \in [(1+\tau)\bar{w}, \bar{y}_n]$ the wage paid to the worker is the minimum $\bar{w}$. For values above $\bar{y}_n$ the worker is paid the wage given by unconstrained Nash-bargaining. These changes mean that a minimum wage has both a direct effect on which jobs will be available for the worker and an equilibrium effect on the profitability of vacancies in the economy. The probability that any given contact with a firm will result in a job will go down. With these changes the model can be solved for employment dynamics given a specified level of the minimum wage.

3 Calibration

The model is calibrated to match key features of employment and job separation in the United States. A period in the model corresponds to one month. The discount rate is $r = 0.003$, which is equivalent to a 4% annual interest rate. δ determines the rate at which individuals exit the labor force. Assuming that workers stay an average of 40 years, δ is set to $\frac{1}{480}$. Finally, labor market policies of minimum wages and taxes are set to the levels in the United States in the year 2000. Using data from the OECD Minimum Wage database the minimum wage is set to 36% of the median wage. For taxes, the minimum wage is interacted with the level of payroll taxes at the minimum wage level. OECD (2006) reports the payroll tax in the United States at the minimum wage where $\tau = 0.082$ in 2000. Finally, it is assumed that workers enter the model unemployed and inexperienced. To match the level of employment in the US for workers aged 15-24, half of the workers enter the workforce at age 16 and the other half enter at age 17.

The productivity distribution is assumed to be log normal ($\log y \sim N(\mu, \sigma^2)$). As a normalization, the median of the productivity distribution is set to one. This implies $\mu = 0$. The value of σ determines the dispersion of productivity and hence wages in the model. For levels of the minimum wage considered, higher values of dispersion imply that the minimum wage has a greater effect. σ is set to match the log difference in wages between the 75th and 50th percentile in the data with the same object in the model. Using the IPUMS Dataset (Ruggles et al. (2009)), the log difference in wages is computed for high school graduates aged 20-25 who work more than 20 weeks and on average more than 20 hours per week. This sample is selected to observe variation in wages that exclude differences in education and human capital accumulation not accounted for by the model. With this sample, hourly wages are constructed by dividing wage income by the number of weeks worked and average weekly hours. The log difference between the 75th and 50th percentile of wages is approximately 0.3. Using different samples had little effect on the results. σ is chosen in the model to match this target for the United States. This target yields a value of $\sigma = 0.68$.

The separation rates for experienced and inexperienced workers are calibrated to match those in the US data for individuals at age 18 and 50 respectively. Figure 2 shows separation rates in the US[5]. Separation rates decline dramatically with age. For inexperienced workers, the separation rate is set to $s_n = 0.248$, corresponding to a 16 year old in the US. For experienced workers the separation rate is set to $s_e = 0.015$ which is the level observed for individuals at age 50.

The rate at which inexperienced employed workers become experienced, p, is set so that the decline in separation rates match the US economy. The data indicate that at age 27, the average separation rate is 0.038. This implies that the share of experienced workers at age 27 should be 0.9. Using this target, the rate at which employed workers become experienced is set to $p = \frac{1}{36}$. An employed worker, on average, becomes experienced after working for three years. Higher values of p imply that workers become experienced at a faster rate and hence the employment effects of higher minimum wages have less persistence than for

[5]This data was constructed by Robert Shimer using CPS monthly microdata from 1976 to 2005. The procedure used follows Shimer (2005) to create a time-series of separation rates for each age. The reported values are the average of this time series. For additional details, please see Shimer (2005) and his webpage http://sites.google.com/site/robertshimer/research/flows.

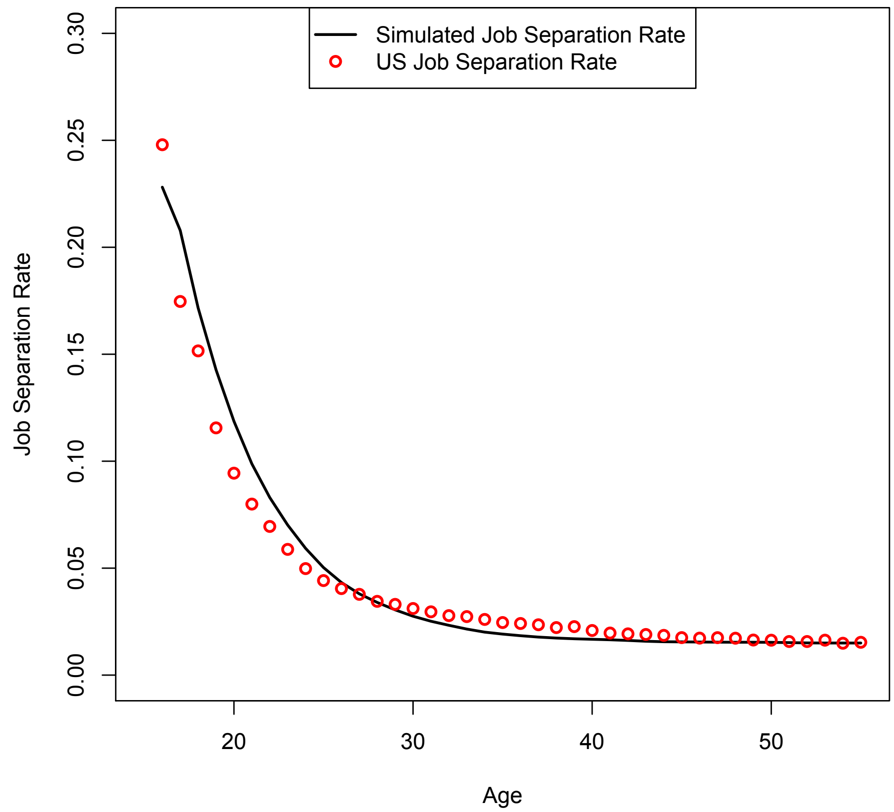


Figure 2: *Job separation rates in the United States by age and separation rates simulated from the model.*

lower values of p. Little difference exists in the magnitudes of employment effects implied by different values of p. The profile of separation rates from simulations of the model under this parameterization are plotted against the US data in Figure 2. The profile is similar to that found in the US with a sharp decline in the initial years after entering the labor force and a flat profile later in life.

Matching functions take the standard Cobb-Douglas form, $m_i(u_i, v_i) = A_i u_i^{\eta} v_i^{1-\eta}$ for

$i \in \{e, n\}$. Without loss of generality we set $A_i = 1$ for $i \in \{e, n\}$. For any choice of A_i the values of q_i and k_i can be chosen to have the same employment dynamics. η is the same in both value functions. η is set to 0.5. This value is within the range of estimates found in Petrongolo and Pissarides (2001) and is comparable with the calibration found in Pries and Rogerson (2005). The Nash bargaining parameter is $\theta = 0.5$. The choice of $\theta = \eta$ insures that the Hosios (1990) condition applies. This contrasts from Flinn (2006) who varies the Nash-bargaining parameter to generate potential efficiency gains from higher levels of minimum wages.

The remaining parameters in the model are the firm's flow costs for posting each type of vacancy, k_n and k_e. Given these costs the matching rates for both workers and firms λ_n, λ_e, q_n, and q_e are endogenously determined in the model. To pick values for k_n and k_e, the matching rates for workers are targeted to be $\lambda_n = \lambda_e = 0.9$ for the United States. There is no direct evidence to use for picking values of λ as job offer rates are not observable in the data, but the values were chosen so that they were the same across experienced and inexperienced workers and so that the level of employment would match US levels found in the data. However, setting $\lambda_n = \lambda_e$ to values between 0.5 and 1.0 had little effect on model predictions. This is because job finding rates are determined by the combination of λ and the worker's reservation values about which jobs to accept. For the set of parameters considered in the model, changing the job offer rate has little effect on employment because workers almost fully adjust which jobs they are willing to accept in response. The targeted job offer rates imply flow costs of vacancies to be $k_n = 1.66$ and $k_e = 2.76$. The higher value of k_e compared to k_n could be interpreted as finding an experienced worker entails higher costs to detect the correct skills that fit a particular job. Once k_n and k_e are set in the initial calibration, job offer rates, λ_n and λ_e, worker arrival rates, q_n and q_c, and the number of each type of vacancies, v_n and v_e all become endogenous variables that will change depending on changing policy parameters.

Parameter	Value	Target
μ	0	Normalization
σ	0.68	IPUMS Wage Variation
r	0.003	Annual Interest rate of4%
s_n	0.248	16-Year-Old Separation Rate
s_e	0.015	50-Year-Old Separation Rate
p	1/36	Curvature of Separation Rate by Age
η	0.5	Petrongolo & Pissarides (2001)
θ	0.5	Hosios (1990)
k_n	1.66	$\lambda_n = 0.9$
k_e	2.76	$\lambda_e = 0.9$

Table 1: *Calibrated values of the model parameters.*

State	Quantity
u_n	0.04
u_e	0.14
e_n	0.07
e_e	0.75

Table 2: *Steady state results for share of population in each state in the economy.*

A summary of the parameter values chosen is presented in Table 1. As an examination of the effects of these parameter choices, the steady state number of individuals in each state $\{u_n, u_e, e_n, e_e\}$ are presented in Table 2. In the model, 82% of people are employed, which is similar to the aggregate employment to population ratio of the US which is 81% in 2000.

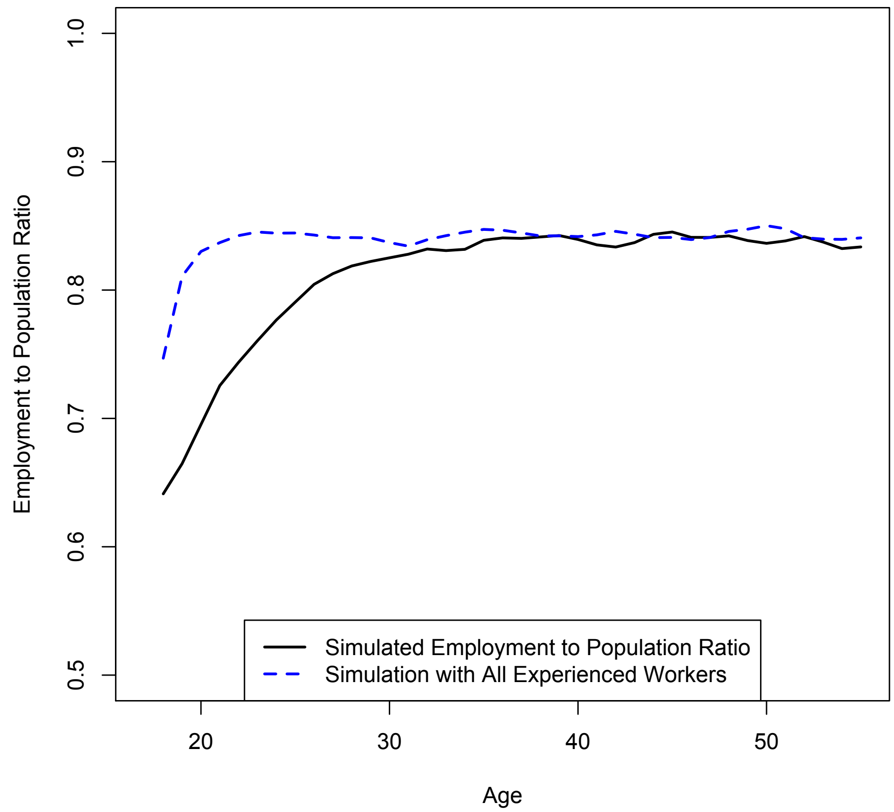


Figure 3: *Average employment rates by age from simulated model.*

Also, the table shows that in the stationary distribution of employment outcomes 11% of workers are inexperienced while 89% are experienced. The employment to population ratio of inexperienced workers is 62% while it goes up to 84% for experienced workers.

Figure 3 plots the average employment to population ratio by age simulated from the calibrated model and compares it to the employment to population ratio by age for the same model where all workers start off experienced. In the model, employment is low for young workers both because they start off without jobs and because they are inexperienced. The figure show that a model without the experience channel can explain some of the low youth employment, but the convergence to steady state levels of employment occurs extremely quickly. Including the additional decline in separation rates as workers gain experience provides a mechanism where the model can generate persistently low employment observed for young workers.

4 Model predictions

The calibrated model with minimum wage is consistent with many observed patterns of employment by age. This section describes the predictions of the model for job finding rates and effects of the minimum wage on employment. The model provides a theoretical explanation for a variety of empirical findings in the literature.

4.1 Job Finding Rates

One prominent source of heterogeneity is that job finding rates decline with age in the United States. The model is able to generate an endogenous decline in job finding rates as workers become experienced. In the model, the observed job finding rate for a worker is given by the combination of their matching rate λ and the probability that they accept a job from a new match. For a worker of type $i \in \{e, n\}$, this probability is given by: $\lambda_i(1 - F(y_i^*))$. Therefore, the fact that $y_n^* < y_e^*$ predicts a decline in job finding rates with age. Figure 4 plots the average job finding rate by age in the United States and the job finding rate by age simulated from the model. The figure shows that the magnitude of the decline is similar in the model and the US, but the model is unable to generate the higher level of job finding rates found in the US. Part of the reason for this is that the model is calibrated to match the employment to population ratio in the US while the job finding rates are computed from the base of unemployed workers. Computing a job finding rate for everyone not currently employed would lower the finding rate from the data[6].

A second implication of the model is that higher levels of the minimum wage drive down job finding rates for inexperienced workers. Figure 5 plots the job finding rate by age for the US simulation and the simulation for France with a minimum wage of 0.6 of the median wage and payroll taxes set to 23%. The figure shows that high levels of the minimum wage significantly flatten the profile of job finding rates over time. Cohen et al. (1997) compare job finding rates between the United States and France and find that French job finding rates are much lower than those in the US. The higher levels of minimum wages in France can partially explain these observed differences.

4.2 Employment Effects of Minimum Wages

The empirical literature on minimum wages and employment dynamics has looked at direct employment effects and implications for the wage distribution and future earnings of individuals who face high minimum wages. The model is consistent with empirical findings that minimum wages disproportionately harm young workers employment outcomes.

[6] As a rough adjustment, the job finding rate computed from the data could be multiplied by the percentage of the population that is unemployed and divided by one minus the employment to population ratio. In 2000, the unemployment rate in the US was 3.9% and the employment to population ratio for workers aged 15-64 was 78.9%. This implies that the job finding rate would be multiplied by 0.18 which moves the lines closer together. Of course, this calculation ignores large differences in labor force participation by age.

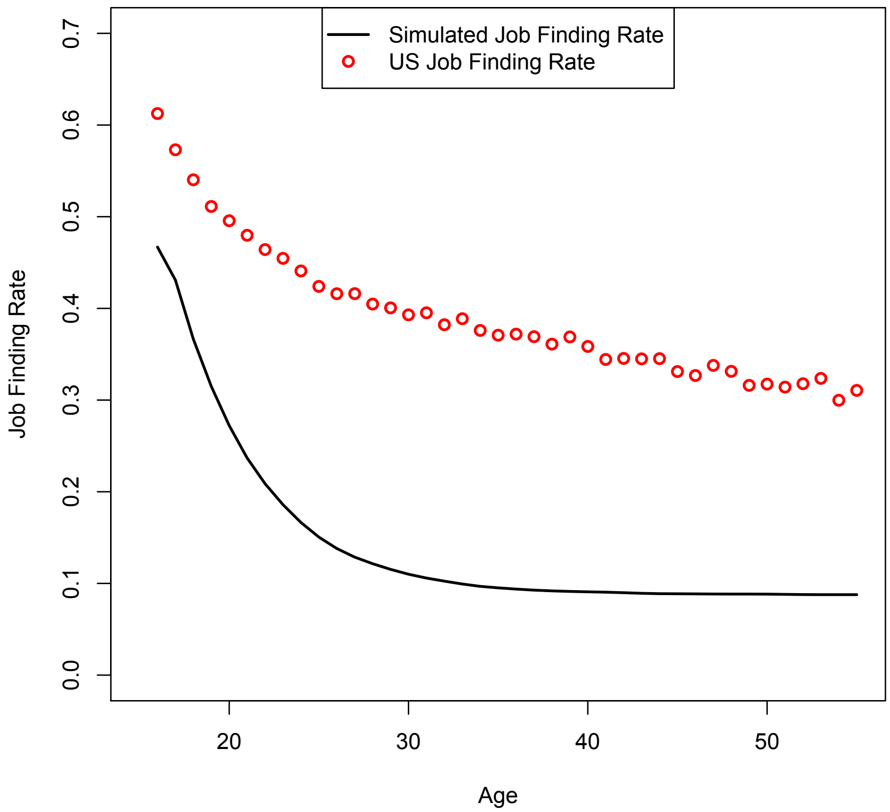


Figure 4: *Average job finding rates in the United States by age and finding rates simulated from the model.*

Figure 6 shows the employment effects of minimum wages simulated from the model. It shows the average employment to population ratio by age for six different values of the minimum wage. Minimum wages are calibrated as a percentage of the median wage. The figure shows that the effects of minimum wages are non-linear. As minimum wages rise, the employment declines among young workers become more dramatic. The solid line depicts the average employment rate in the model with minimum wages at 20% of the median. As

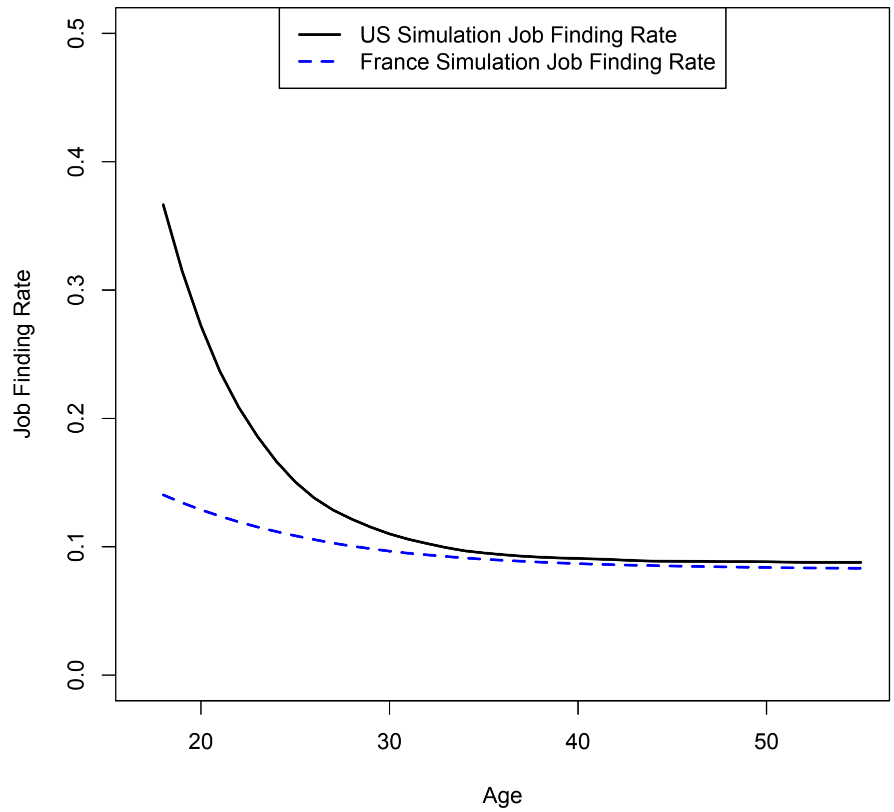


Figure 5: *Simulated average job finding rates in the United States and France by age.*

the level of the minimum wage rises, the effects of increasing the minimum wage become larger. Moreover, Figure 6 shows that the effects of a minimum wage are initially large and die out over time as workers gain experience. Higher levels of the minimum wage generate greater persistence in employment as it takes workers longer to gain experience.

Figure 7 shows how the results of the model vary for different values of τ. The figure shows that higher values of payroll taxes do not have large employment effects on their own. However, it is important to control for the interaction between payroll taxes and minimum

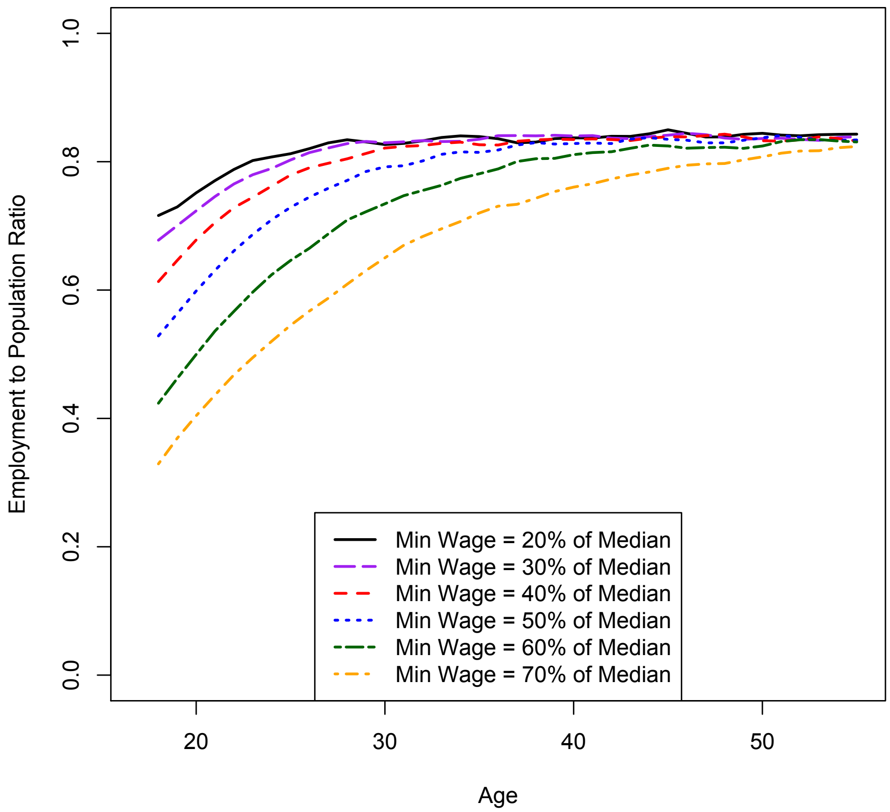


Figure 6: *Average employment by age in model by minimum wage level.*

wages as higher payroll taxes directly influence the costs paid by a firm that hires a worker at the minimum wage.

Results from the model are consistent with the empirical literature that examines the employment effects of minimum wage regulations. Card and Krueger (1994) stimulated interest in research on minimum wage by arguing that a minimum wage increase in Pennsylvania had no adverse impact on employment. Since then, a large body of empirical research has sought to evaluate the effects of the minimum wage on employment outcomes. For a recent

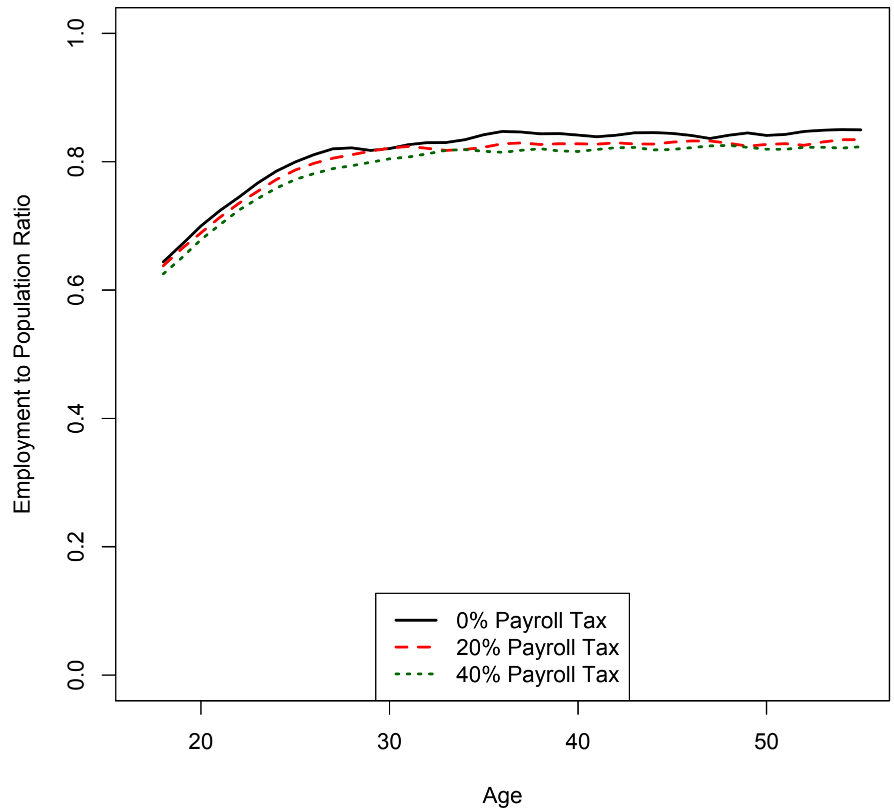


Figure 7: *Average employment by age in model for various levels of payroll taxes.*

survey of the literature see Neumark and Wascher (2007). While there is no consensus on the overall effect of minimum wages, most studies conclude that minimum wages have slightly negative employment effects, though often the effects are not statistically significant. While not a comprehensive review, this section uses the model to help reconcile the major results from this literature.

First, the model helps explain the failure of some papers to find significant effects of minimum wage on employment such as Card and Krueger's (1994) failure to find any negative effects of the minimum wage on employment in the United States. Since minimum wages are relatively low in the United States and minimum wages have a non-linear effect on employment, it is unsurprising that small changes in the minimum wage might have insignificant effects on employment.

Even without a general consensus on the effect of minimum wages on overall employment, there is a large literature that finds that minimum wages adversely effect employment of youths. Despite not finding general evidence that minimum wages hurt employment Dolado et al. (1996) find that minimum wages effect young workers. Using longitudinal data Abowd et al. (1997) find that young men employed at the minimum wage in both France and the United States have large decreases in their probability of employment after an increase in the minimum wage. Differences in total size of employment effects could be a function of the portion of the population paid at the minimum wage, which is higher in France. Looking over 17 OECD countries Neumark and Wascher (2004) find that in general minimum wages cause decreased employment among young workers. The declines are less severe in countries that have special provisions whereby youths are hired at wages below the minimum. Moreover, Wessels (2005) finds that minimum wages significantly decrease teenage labor force participation.

Empirical studies have also focused on France where minimum wages are especially high. Bazen and Skourias (1997) find a negative effect of minimum wages on youth employment in France despite finding no significant effects for other groups. Fougere et al. (2000) study the effects of various youth employment policies in France. They find that subsidies that reduce the labor costs of hiring young workers have strong positive effects on increasing employment. The model is broadly consistent with these empirical findings. It reveals a mechanism where youth employment outcomes are hurt by increases in the minimum wage while other segments of the population suffer no adverse employment effect.

4.3 Long-Run Effects

Neumark and Nizalova (2004) document that exposure to high minimum wages at young ages has long-run effects for employment outcomes. They show that exposure to high minimum wages implies that workers both work and earn less even into their late 20's. Moreover, Keane and Wolpin (1997) show that human capital accumulation while on the job is important to understanding worker's labor market decisions and outcomes. Missing skill accumulation early in life has long run implications for wage growth if the agent is unable to make up for the lack of skill accumulation while waiting for employment.

The model can account for differences in wage outcomes as experienced workers have a higher reservation productivity level and earn much higher wages than inexperienced workers. Workers who are exposed to high minimum wages early in life will have a much lower probability of becoming employed and experienced. Figure 8 presents the percentage of people who are experienced by age from the model calibrated with US and French policy parameters. It shows that under a higher minimum wage a worker is less likely to be experienced and that these effects can persist for many years. The lower rate of experience will show up as lower rates of employment and wages later in life.

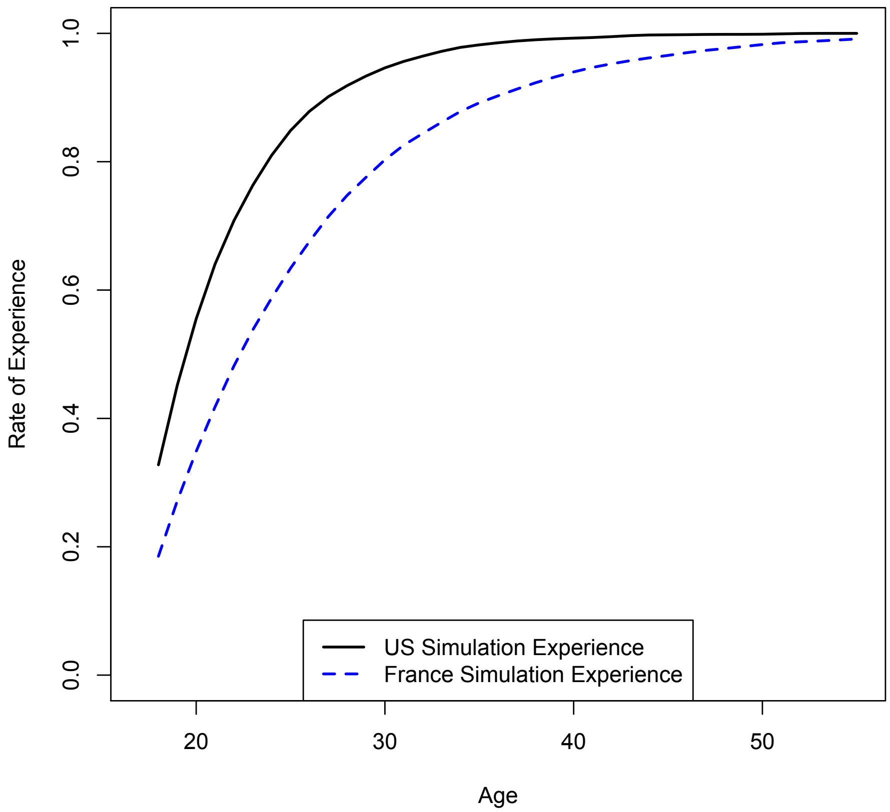


Figure 8: *Percent of population with experience by age for the model simulated with US and French parameters.*

5 European Employment

A large literature examines the difference in labor market outcomes between the United States and Europe. Prescott (2004) documented that hours worked has declined dramatically in Europe relative to the US since the 1970s. Rogerson (2008) decomposes this decline showing that both hours worked and the employment to population ratio decline since the mid 1950s. These papers attribute the weaker labor market outcomes to taxes and a weakness in the market services sector in Europe respectively.

This section examines the extent to which minimum wages can explain the cross sectional pattern in employment found in European countries, the United States, and Canada in 2000. Minimum wages have been declining in real terms in the United States while they have been increasing in many European countries since the 1970s. This pattern is consistent with the time series pattern of employment.

5.1 Employment Differences

Using male labor force statistics, the employment to population ratio for each country is decomposed into age groups revealing that the decline is concentrated in the young (15-24) and old (55-64) groups. An examination of average outcomes in Canada, France, Portugal, Spain, and the United States is included. Germany and Italy are excluded, as they do not have nationally legislated minimum wages. Belgium and the United Kingdom have special lower minimum wages for young workers that lower the effects of high minimum wage policies. These special provisions for youth are documented in Funk and Lesch (2006). For comparability, these countries are excluded although minimum wages turn out to still have significant employment effects in the United Kingdom and Belgium, especially in later years.

The labor data used in this paper are obtained from the OECD Corporate Data Environment Labor Market Statistics Database. Using the Labor Force Statistics (LFS) by Sex and Age, series of employment to population ratios are constructed for each age group. The data are broken down into five different age groups: 15-24, 25-34, 35-44, 45-54, and 55-64. This paper focuses on the large observed differences among the 15-24 year age group while abstracting from differences among 55-64 year olds that are likely explained by differences in retirement and unemployment insurance policies.

Country	15-24	25-34	35-44	45-54	55-64
Canada	56.2	80.2	81.3	77.7	48.1
France	23.2	76.3	80.1	78.3	34.3
Portugal	42.0	83.9	84.0	76.8	50.8
Spain	36.3	70.2	70.8	62.8	37.0
US	59.7	81.5	82.2	80.5	57.8

Table 3: *Average employment to population ratio by age band in 2000.*

Decomposing the employment to population ratio into age bands reveals that the differences in employment outcomes are concentrated in the 15-24 year age group. Table 3 shows the average employment to population ratios by age group of five countries in 2000 that were plotted in Figure 1. The table shows that all countries except Spain have remarkably consistent employment to population ratios for male workers aged 25-54 with employment to population ratios around 80%. The largest difference among age groups is found in the youngest (aged 15-24) workers. The age pattern documented is consistent with that shown in Rogerson (2006) for Belgium, France, Germany, and Italy in 2000. This pattern implies that young workers being out of employment is a primary cause for differences in European employment relative to the US.

To explain the relative decline in European employment, it is important to understand the differences in employment for young workers. While a large literature has tried to understand the total decline in hours worked, few have examined differences by age. This section explores how much of the differences in employment for young workers can be explained by differences in minimum wages across countries.

5.2 Minimum Wages

Minimum wages vary dramatically across countries. However, there is no standard measure for comparing minimum wage levels. To calibrate the model, the ratio of the minimum wage to the median is used. This measure controls for differences in wage levels to account for how binding the minimum wage levels are in each country. Countries that have high productivity and pay high wages can sustain higher absolute levels of the minimum before the minimum wage policy will cut into the distribution of accepted jobs. To understand how minimum wages vary across countries that are considered, three different measures of minimum wages are presented in Table 4: the hourly minimum wage, the ratio of the minimum to the median wage, and the percentage of workers who earn the minimum. The percentage of full-time employees who are paid the minimum wage provides evidence of how binding the minimum wage is across countries. Data on minimum wages come from three sources. First, OECD (2006) present info on the hourly minimum wage in 2000. Second, the OECD Minimum Wage Database has data on the level of the minimum wage with respect to the median wage. The US, Spain, and Canada have low minimum wages relative to the median and low percentages of the workers earn the minimum while Portugal and France have higher minimum wage ratios. Portugal is interesting because it has the lowest hourly minimum wage

Country	Hourly Min Wage	Ratio of Min to Median	% Earning Minimum
Canada	$6.77	0.41	NA
France	$8.80	0.60	14.0
Portugal	$3.22	0.47	4.0
Spain	$4.28	0.37	0.8
US	$6.08	0.36	1.5

Table 4: *Hourly minimum wages in 2000 in US dollars at 2006 prices, ratio of the minimum wage to the median wage in 2000, and percent of full-time employees earning the minimum wage in 2002.*

but the ratio to the median is fairly high. Finally, in a EuroStat Statistics in Focus handout, Paternoster (2004) presents the percentage of the population that is paid the minimum wage in 2002 in all countries under consideration except Canada. Spain and the US have very few workers who earn the minimum wage, in Portugal 4% earn the minimum, but in France 14% earn the minimum.

5.3 Quantitative Results

This section quantitatively assesses the impact of changing minimum wage and payroll tax levels to those found in each country. This policy experiment gives a quantitative answer to how US employment patterns would change by adopting minimum wage and payroll tax policies of each country holding all other labor market policies fixed. By simulating employment outcomes for each set of policy variables, the model can be used to calculate how much of observed differences in youth employment outcomes are explained by differences in minimum wages.

For a given ratio of the minimum wage to the median wage in each country, the model is used to compute job finding rates for inexperienced and experienced workers and the probability that a worker quits when she becomes experienced. These three numbers along with the calibrated separation rates for inexperienced and experienced workers are used to simulate the model in continuous time. From the continuous time simulation, the worker's employment status and experience are recorded at the end of each model period. This corresponds to monthly employment data. Employment outcomes for each worker are recorded for 40 years of data. For each specification, the model simulated for 10,000 individual outcomes so that the average employment and experience rates can be computed for each month from the time that a worker enters the labor force. These data are then aggregated into yearly data by age to be comparable with OECD statistics.

To match the data, averages for 10-year age bands are computed from the simulated data. Figure 9 shows the simulated results for the US plotted against the data. It shows that the model does a good job of matching the US level of youth employment and the transition into prime aged employment levels. The model has no feature to account for declines in employment levels in later life, so the predicted employment is slightly higher than observed for workers aged 45-54.

Country	15-24	25-34	35-44	45-54
Canada	55.1	75.3	81.9	83.3
France	40.4	70.9	79.6	82.5
Portugal	52.3	77.5	81.0	83.1
Spain	57.3	76.8	82.3	83.2
US	58.8	77.3	82.7	83.4

Table 5: *Average employment to population ratio simulated from the model.*

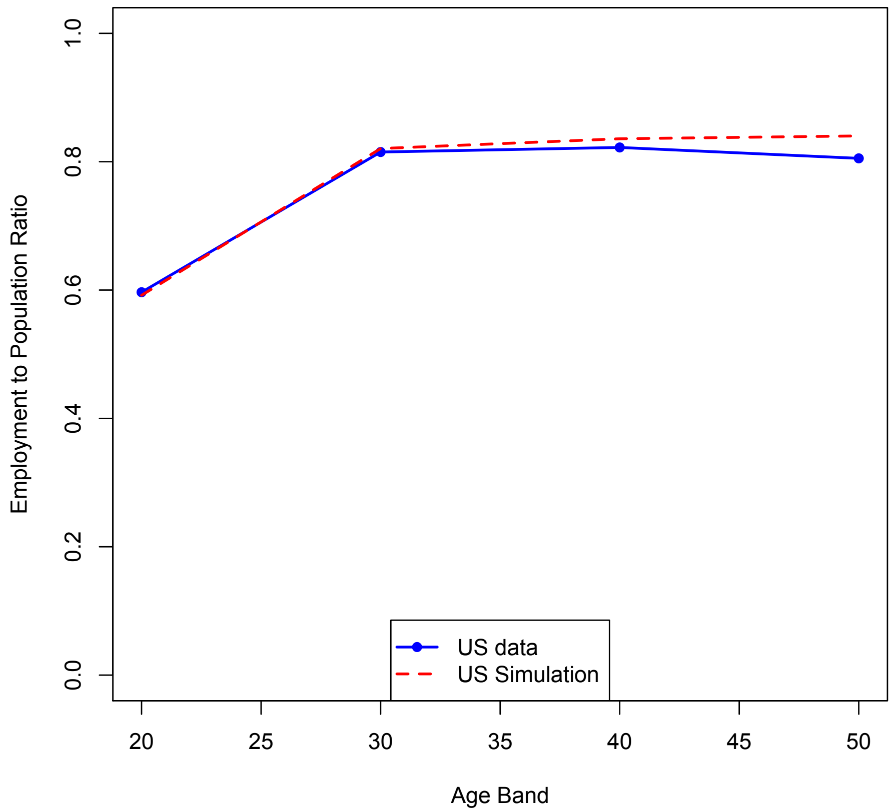


Figure 9: *Simulated results for the US compared to the data.*

Table 5 reports the employment to population ratios for each age band from the model with minimum wages and payroll taxes set to the level of each country. The qualitative features of the model are similar to those found in the data. Patterns in the data for countries are similar to the data in that there are not large differences for prime aged employment while differences in minimum wages and taxes manifest themselves in lower levels of employment for young workers.

To get a better sense of how much the model is able to explain, the data from each country

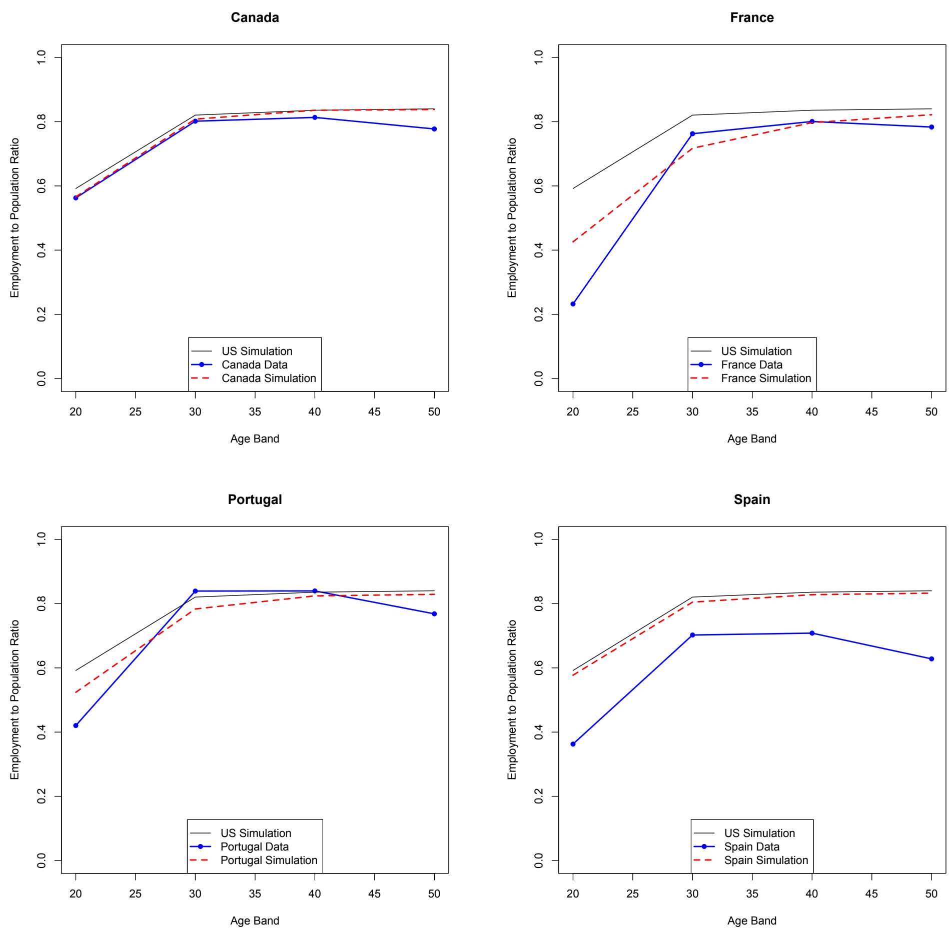


Figure 10: *Simulated effects of differences in minimum wages plotted against data from each country.*

are plotted against baseline model predictions of the US and the model predictions for the levels of minimum wages and payroll taxes found in that country in Figure 10. For Canada, France, and Portugal the model can account for a significant portion of the difference in youth employment outcomes from the US. For Canada, neither the labor market policies nor the employment outcomes differ much from the US. In this case, the model slightly over predicts the observed differences. This is not that surprising as there is not much variation to be accounted for. France and Portugal both have significantly lower levels of youth employment than the United States. In both cases, varying minimum wages and payroll taxes allows the model to generate about half of the employment differences for young workers. The exercise shows that minimum wages are a significant factor in explaining employment outcomes in countries with high levels of minimum wages. The predicted outcomes for prime aged workers are similar to those viewed in the data.

Spain is an interesting outlier to both the patterns in the data and outcomes of the model. First, prime aged workers in Spain work at a much lower rate than those in all of the other countries. By decomposing employment to population ratio by sex, prime aged males work at a similar rate to those in the US while female employment is much lower. Given this shift down due to lower female participation, the age employment profile is nearly the same shape as found in the US. Moreover, Spain is a good example of a country with low levels of minimum wages and payroll taxes. Since minimum wages are not that binding the model predicts that other factors would dominate employment outcomes.

To get a better sense of how well the model is able to predict the data, Figure 11 plots the simulated model results for each age band against the data. If the model and data fit perfectly, each point should lie on the 45-degree line. The figure shows that for most of the countries the model fits well. The points that are farthest from the 45 degree line are the 15-24 year old points for France and Portugal, where the model over-predicts the employment rates (it only can account for about half of the observed decline in employment for young workers in these countries compared to the US). Also, the model over-predicts employment

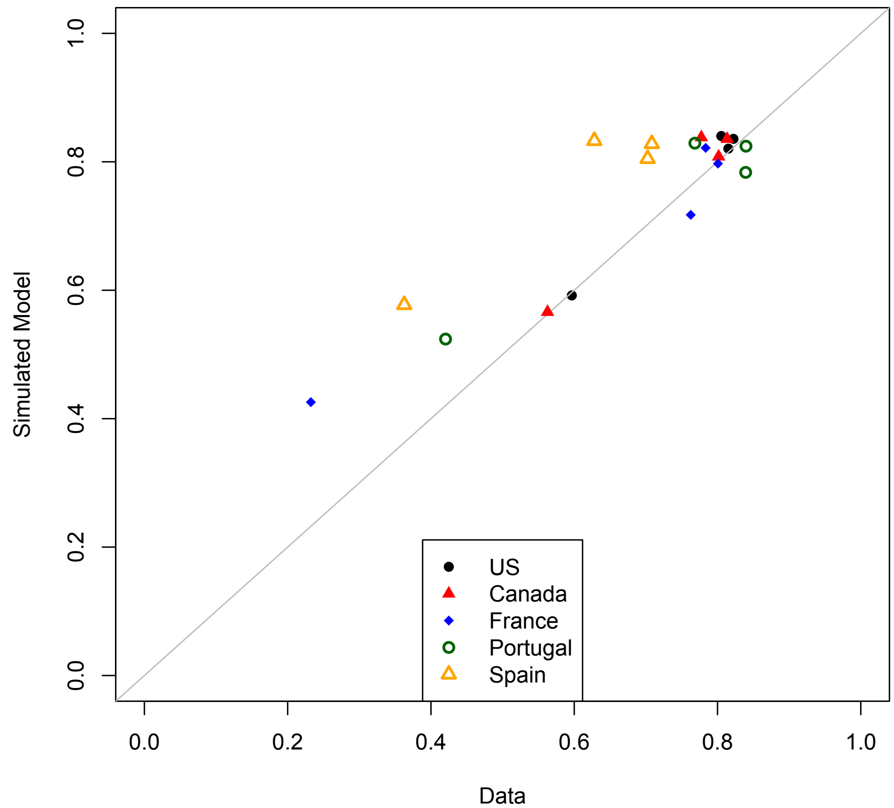


Figure 11: *Simulated model result for each age band plotted against the data.*

for all ages in Spain due to differences in employment among females across countries. For the remainder of the points, the model and data are very close.

Despite not including many factors that could influence employment differences across countries, the model shows that minimum wages can play a significant role in explaining differences in youth employment between the United States and European countries that have high minimum wage regulations. These results are also obtained in a framework that holds job separation rates fixed for experienced and inexperienced workers in the model.

A second potential weakness with the simulation strategy is dealing with educational differences across countries. If higher minimum wages decreased employment and increased educational attainment it could change the interpretation of the results. The model attempts to explain patterns of employment, but doesn't include educational choices. Neumark and Wascher (2003) empirically evaluate the effect of minimum wage on school enrollments and find that increases in the minimum wage decreases enrollment. Higher minimum wages decrease both the number of young people in school and the number who work.

Minimum wages decreasing the level of youth employment does not rule out other explanations for lower levels of European employment. Understanding these differences requires explanations that can explain the age pattern of employment differences found in the data. Minimum wages are a promising candidate to explain differences in youth employment. It should also be noted that this paper examines only differences in employment to population ratios where Prescott (2004) documents that average annual hours of work per person in employment is also much lower in Europe. Evidence on hours worked is not available by age, which makes it difficult to evaluate the total effects of the model. Complimentary explanations for lower levels of European employment include tax policies and structural change offered by Prescott (2004) and Rogerson (2008). Ljungqvist and Sargent's (1998) explanation that lost human capital when unemployed along with high levels of unemployment insurance cause longer unemployment durations in Europe is a plausible candidate to explain the lower rates of employment among older workers who have acquired large stocks of human capital, but will be unable to account for differences in youth employment.

6 Conclusion

Much of the macro labor literature has focused on representative agent models that abstract from differences in labor market decisions over an individual's life cycle. This paper extends standard search models to feature a worker's experience in the labor market. Experience gives workers a lower rate of job separations. This model allows differences in employment outcomes to be considered by age, since older workers are more likely to be experienced.

Examining the model with minimum wages provides a theoretical foundation for empirical findings on the effects of minimum wages and an ability to evaluate the effects of minimum wages on youth employment outcomes across countries. The model is consistent with many of the empirical findings on the effects of minimum wages. Minimum wages decrease youth employment while having a small effect on prime aged employment outcomes. Also, the model predicts minimum wages to have non-linear effects on employment, which helps explain why empirical studies have found very small effects of minimum wages in the US but greater effects in other countries.

The relative decline in European youth employment is a significant feature in the discrepancy of labor market outcomes between Europe and the United States. Understanding why Europeans work less than Americans must include an explanation of the large differences in the age patterns of work across countries. The model matches the decline of European employment relative to the United States in that there is little difference in employment outcomes for prime aged workers.

The findings in this paper should be viewed as complimentary to other explanations for the decline in European employment. This paper documents that minimum wages have a significant effect on youth employment outcomes. Other policies that have been studied such as differences in taxes and technology certainly play a role in accounting for overall differences in hours worked across countries. To completely understand differences in employment it is important to understand how these institutions interact to influence employment outcomes.

References

Abowd, John M., Francis Kramarz, Thomas Lemieux, and David N. Margolis, "Minimum Wages and youth Employment in France and the United States," 1997. NBER Working Paper 6111.

Bazen, Stephen and Nicolas Skourias, "Is there a negative effect of minimum wages on youth employment in France?," *European Economic Review*, April 1997, *41* (3-5), 723–732.

Card, David and Alan B Krueger, "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania," *American Economic Review*, September 1994, *84* (4), 772–93.

Cohen, Daniel, Arnaud Lefranc, and Gilles Saint-Paul, "French unemployment: a transatlantic perspective," *Economic Policy*, October 1997, *12* (25), 265–292.

Dolado, Juan, Francis Kramarz, Stephen Machin, Alan Manning, David Margolis, Coen Teulings, Gilles Saint-Paul, and Michael Keen, "The Economic Impact of Minimum Wages in Europe," *Economic Policy*, October 1996, *11* (23), 317–372.

Flinn, Christopher J., "Minimum Wage Effects on Labor Market Outcomes under Search, Matching, and Endogenous Contact Rates," *Econometrica*, 07 2006, *74* (4), 1013–1062.

Fougere, Denis, Francis Kramarz, and Thierry Magnac, "Youth employment policies in France," *European Economic Review*, May 2000, *44* (4-6), 928–942.

Funk, Lothar and Hagen Lesch, "Minimum Wage Regulations in Selected European Countries," *Intereconomics: Review of European Economic Policy*, March 2006, *41* (2), 78–92.

Gorry, Aspen, "Experience and Worker Flows," January 2010. Unpublished, UC, Santa Cruz.

Hosios, Arthur J, "On the Efficiency of Matching and Related Models of Search and Unemployment," *Review of Economic Studies*, April 1990, *57* (2), 279–98.

Jovanovic, Boyan, "Job Matching and the Theory of Turnover," *Journal of Political Economy*, October 1979, *87* (5), 972–90.

Keane, Michael P and Kenneth I Wolpin, "The Career Decisions of Young Men," *Journal of Political Economy*, June 1997, *105* (3), 473–522.

Ljungqvist, Lars and Thomas Sargent, "The European Unemployment Dilemma," *Journal of Political Economy*, June 1998, *106* (3), 514–550.

Mortensen, Dale T, "Wages, Separations, and Job Tenure: On-the-Job Specific Training or Matching?," *Journal of Labor Economics*, October 1988, *6* (4), 445–71.

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

Neal, Derek, "The Complexity of Job Mobility among Young Men," *Journal of Labor Economics*, April 1999, *17* (2), 237–61.

Neumark, David and Olena Nizalova, "Minimum Wage Effects in the Longer Run," NBER Working Papers 10656, National Bureau of Economic Research, Inc July 2004.

_ **and William Wascher**, "Minimum wages and skill acquisition: another look at schooling effects," *Economics of Education Review*, February 2003, *22* (1), 1–10.

_ **and** _ , "Minimum Wages, Labor Market Institutions, and Youth Employment: A Cross-National Analysis," *Industrial & Labor Relations Review*, 2004, *57* (2), 223–248.

_ **and** _ , "Minimum Wages and Employment," IZA Discussion Papers 2570, Institute for the Study of Labor (IZA) January 2007.

OECD, "Special Feature: The Tax Treatment of Minimum Wages," Technical Report, OECD Taxing Wages 2005/2006 2006.

Paternoster, Anne, "Minimum Wages: EU Member States, Candidate Countries and the US 2004," EuroStat, Statistics in Focus October 2004.

Petrongolo, Barbara and Christopher A. Pissarides, "Looking into the Black Box: A Survey of the Matching Function," *Journal of Economic Literature*, June 2001, *39* (2), 390–431.

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

Prescott, Edward C., "Why do Americans work so much more than Europeans?," *Federal Reserve Bank of Minneapolis Quarterly Review*, 2004, (Jul), 2–13.

Pries, Michael and Richard Rogerson, "Hiring Policies, Labor Market Institutions, and Labor Market Flows," *Journal of Political Economy*, August 2005, *113* (4), 811–839.

Rocheteau, Guillaume and Murat Tasci, "Positive and normative effects of a minimum wage," Working Paper 0801, Federal Reserve Bank of Cleveland 2008.

Rogerson, Richard, "Understanding Differences in Hours Worked," *Review of Economic Dynamics*, July 2006, *9* (3), 365–409.

_ , "Structural Transformation and the Deterioration of European Labor Market Outcomes," *Journal of Political Economy*, 04 2008, *116* (2), 235–259.

_ **and Johanna Wallenius**, "Micro and Macro Elasticities in a Life Cycle Model with Taxes," *Journal of Economic Theory*, 11 2009, *144* (6), 2277–2292.

Ruggles, Steven, Matthew Sobek, Trent Alexander, Catherine A. Fitch, Ronald Goeken, Patricia Kelly Hall, Miriam King, and Chad Ronnander, *Integrated Public Use Microdata Series: Version 4.0 [Machine-readable database]*, Minneapolis, MN: Minnesota Population Center [producer and distributor], 2009.

Shimer, Robert, "Reassessing the Ins and Outs of Unemployment," 2005. Manuscript, University of Chicago, June 21.

Wessels, Walter J., "Does the Minimum Wage Drive Teenagers Out of the Labor Force?," *Journal of Labor Research*, January 2005, *26* (1), 169–176.

Appendix

A Employment Time Series

This section connects the initial plot of cross country employment in 2000 to the time series evidence on employment to population ratios by age for Canada, France, Portugal, Spain, and the United States. The OECD Corporate Data Environment Labor Market Statistics Database is used to construct employment to population ratios by ten year age band. Unfortunately, when breaking down the employment data by age, only limited time series evidence is available for many countries. Moreover, average hours worked are not available by age group. Prescott (2004) and Rogerson (2006) emphasize that employment differences across countries occurs both in differences in average employment to population ratios and average annual hours worked per employed worker. However, it is likely that the younger and older workers who show most of the decline in employment are also more likely to be part time workers than those in prime ages.

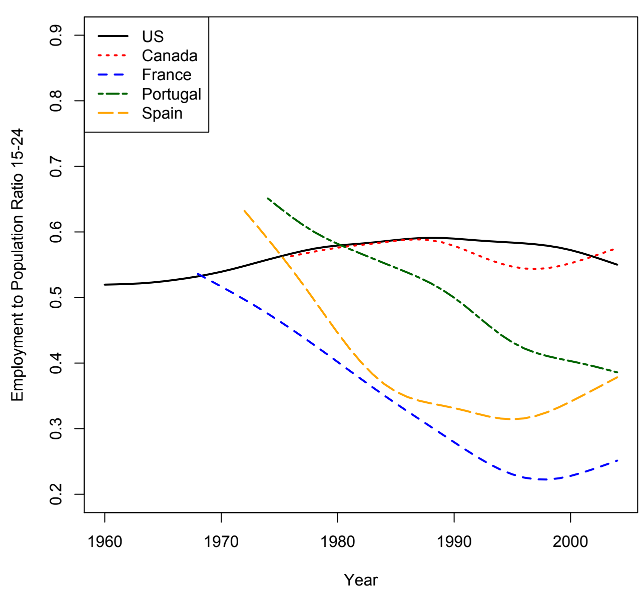


Figure 12: *Employment to population ratio for 15-24 year olds over time.*

Figure 12 show the employment to population ratio for young workers plotted from 1960-2004. The graph plots the HP Filtered trend of employment to population ratio with smoothing parameter set to 100 for the total (male and female) population. Over this time, youth employment in the United States is fairly stable. The graph shows a slight increase until 1990 with a slight decline in employment after. This contrasts with the sharp decline in employment for over time in France, Portugal and Spain. Canada' pattern of youth employment is similar to the United States. The striking decline in European employment motivates a large literature to explain the differences between the United States and Europe. The differences in employment for the young group shown in the introduction of the paper are the outcome of these longer time trends.

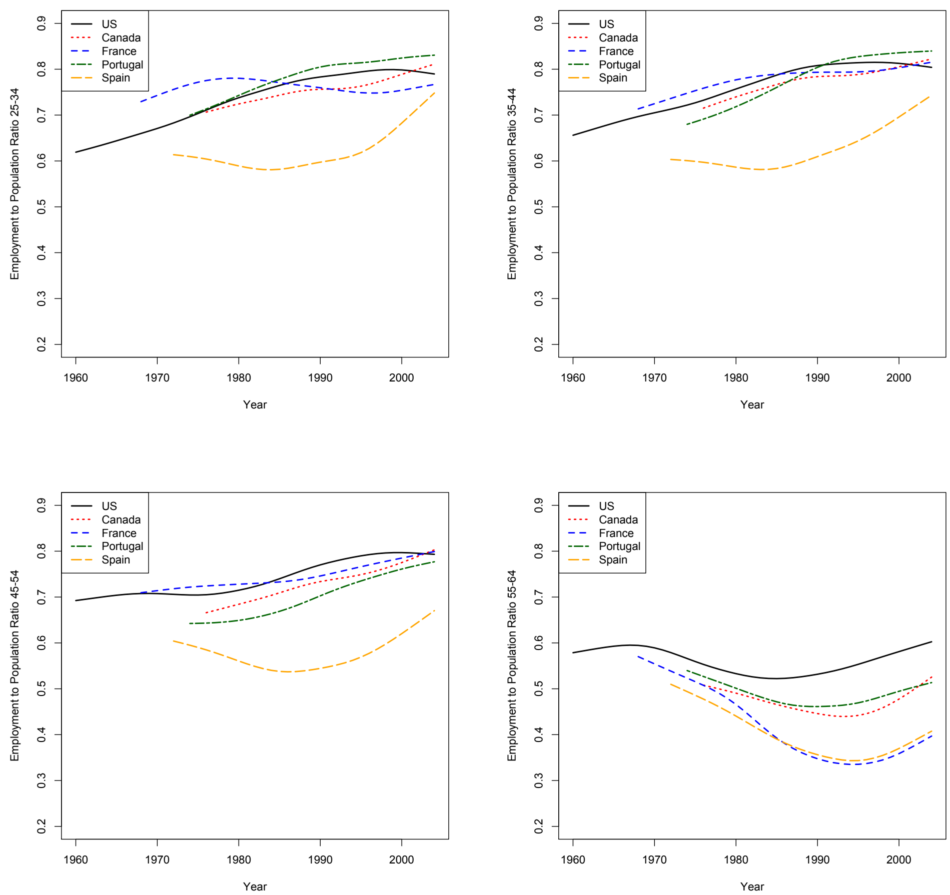


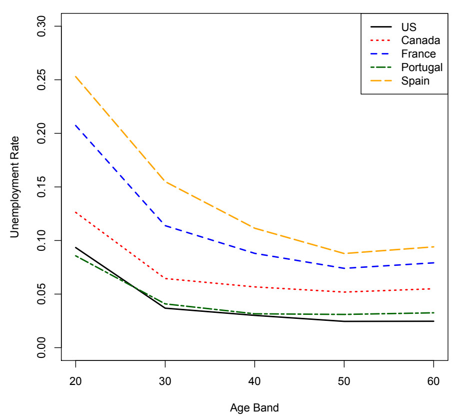
Figure 13: *Employment to population ratio over time for different age groups.*

Figure 13 shows the time series of the HP trend employment to population ratios for the four other age groups. The results are also consistent with the introduction. For the 25-34, 35-44, and 45-54 year old groups, the employment patterns in all countries except Spain are remarkably similar. Restricting the data to only males would bring the results from Spain more in line with the rest of the countries. Moreover, the upward trend in employment over the period for these prime aged groups is due to increased employment among females during the period. The bottom right panel shows the time series for workers aged 55-64. Again this figure shows declines in employment for all a countries starting around 1970. While the US employment remains fairly stable and recovers in the 1990s, France and Spain sustain much larger declines while Canada and Portugal are in between the two extremes.

It is interesting to compare the timing of the decline of 55-64 year old workers with the 15-24 age group. Rogerson (2006) emphasizes that looking at employment generates declines in Europe starting in the 1960s while looking at unemployment data points to European divergence starting in the 1970s. While the time series is not long enough to present a clear picture, breaking down the data by age indicate that declines in youth employment were much more severe in the 1970s while the declines among the older group were concentrated in the 1980s. Part of the explanation to reconcile these results could be that older workers who do not work are more likely to show up as unemployed while younger workers may drop out of the labor force. This would allow employment to decline starting earlier as youth employment declines while the spike in unemployment happens later when older workers employment drops.

B Unemployment vs. Labor Force Participation

This paper uses employment to population ratios to evaluate cross-country labor market outcomes. Another standard measure is to look at unemployment rates. Looking at unemployment rates gives a slightly different picture, but the main findings are still apparent.



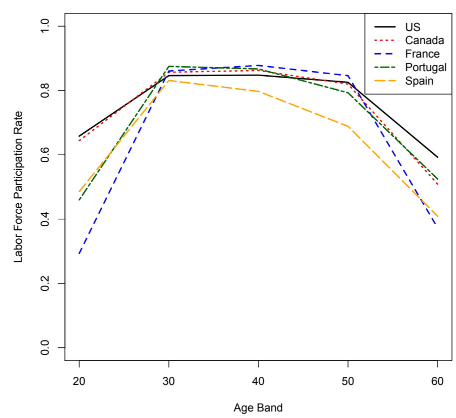


Figure 14: *Unemployment rate and labor force participation rate by age in 200o.*

Figure 14 plots both the unemployment rate and labor force participation rate by age group for the year 2000. Both the unemployment and labor force margin are active. The unemployment graph shows that unemployment is higher for young workers and the cross country differences are larger. The difference is that there are still noticeable differences in the unemployment rate across countries for prime aged workers. The cross country differences grow slightly for 55-64 year old workers. The plot of labor force participation closely resembles that for the employment to population ratio. There are significant cross country differences for 15-24 and 55-64 year old workers while prime aged workers participate at similar levels for all countries besides Spain.

Using employment to population ratios gives a more complete analysis of the effect of labor market policies on individual work behavior as some policies can also incentivize workers to remain in the labor market. The employment to population ratio captures both the unemployment and labor force participation margins of workers out of employment.

C Minimum Wage Time Series

There is mixed evidence on how changing minimum wages over time is able to account for changes in youth employment. Dolado et al. (1996) suggests that minimum wages are unlikely to account for large changes in employment over time in Europe as they have not increased dramatically in most countries and because many countries have separate minimum wages for young workers. For a detailed description of these policies see Funk and Lesch (2006). The results in this paper challenge those findings by showing that high levels of the minimum wage can explain large portions of employment differences for young workers across countries.

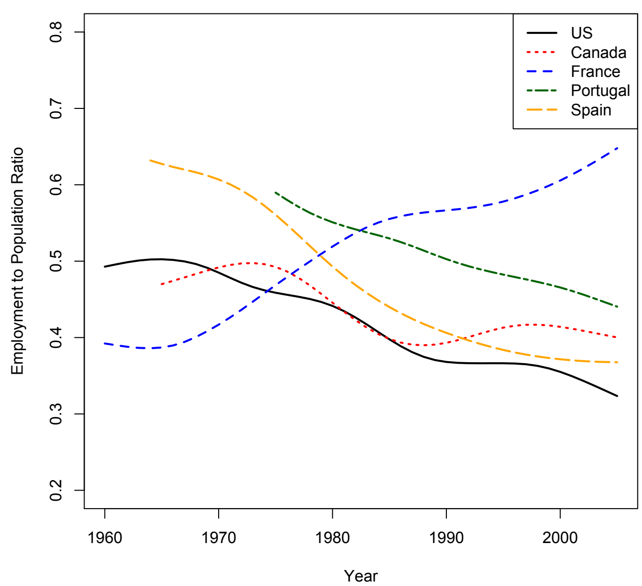


Figure 15: *Ratio of minimum wage to minimum wage in each country over time.*

To evaluate the time series evidence, Figure 15 plots the ratio of the minimum wage to the median wage over time. The data is the HP trend with a smoothing parameter of 100. This ratio is a plausible measure of how binding a given level of minimum wages are in each country. The two potential issues to evaluate are the level of plot and the time trend. The levels show that European countries have had consistently higher minimum wages than the United States over this period with the exception of France who started with a lower level. The time trends point to declining importance of minimum wages in all countries besides France. France is the one exception where minimum wages rise consistently since 1960 from a level of about 40% of the median wage to about 60% of the median. The graph shows that while the minimum wage might not be the driving force for trends in employment for all countries it has the potential to explain a large portion of the difference in youth employment between France and the United States between 1960 and 2000. This is important as France has the worst youth employment outcomes of any of the countries considered in this study.