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Abstract

This paper provides evidence for the size of firing costs for eight countries. In contrast to the existing literature, we use the optimality conditions obtained in a search and matching model to find a reduced form equation for firing costs. We find that our estimates are slightly larger compared with other studies. Finally, we offer three explanations for the observed cross-country patterns.

Keywords: Employment protection, Firing costs, Optimality conditions.

JEL codes: C22, J41, J63.

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1 Introduction

The effects of firing costs on welfare (e.g. Hopenhayn and Rogerson (1993) or Alvarez and Veracierto (1998)) and business cycle dynamics (e.g. Veracierto (2008) or Lechthaler et al. (2010)) have been studied in great detail. However, there is a fundamental challenge in calibrating and, therefore, applying dynamic models with firing costs: how large are they?

Garibaldi and Violante (2005) show that layoff costs have two components, (i) transfers from firm to worker and (ii) a tax that is paid outside the firm-worker pair. While there is evidence on the size of severance payments (i) for a number of countries, firing costs (i+ii) additionally contain administrative and procedural costs and, therefore, are hard to estimate.

For severance payments, Cozzi et al. (2010) show that there is sizable variation across countries. For example, in Italy severance payments equal 20 monthly wages, while they equal 1.2 monthly wages in the United Kingdom. For firing costs, the literature uses different approaches. Abowd and Kramarz (2003) use establishment data for French firms and a statistical model to estimate hiring and firing costs. They find that firing costs are a increasing and concave function in the number of layoffs with a large fixed component. Further, Dolfin (2006) uses firm-level data for the United States from the 1982 Employment Opportunity Pilot Project. She finds that the costs of firing documentation have significant effects on turnover, vacancies, hours, and number of workers.

Often, one relies on the estimates of Bentolila and Bertola (1990). Besides the fact that the paper is 23 years old, the authors use an ad hoc equation for expected dismissal costs. They find that the value of firing costs in the UK is 25 percent of annual wages, while it is 75 percent of annual wages in Germany (on an annual basis).[1]

This paper uses a different approach to find a value for firing costs in search and matching models. We follow the contribution by Burnside et al. (1993): they use the model's optimality conditions to derive a reduced form equation describing the evolution of effort over the cycle. To determine the value of firing costs we use the optimality condition for job creation from a standard search and matching model with firing costs. At this point it should be noted that we use highly aggregated data to obtain a value for the firing costs and, therefore, disregard the fact that firing cost vary across workers, shown by Dolado et al. (2005, 2007). Hence, we interpret the result as an economy-wide average value of firing costs.

Finally, using data for eight countries, we provide a cross-country analysis of firing costs and present three explanations for the observed patterns.

2 Reduced Form Equation

We assume that the good market is perfectly competitive, while the labor market is imperfect due to the assumption of search and matching frictions. Trade in the labor market is uncoordinated, costly, and time-consuming. Search takes place on a discrete and closed market. Workers can be

[1] A different approach is to make firing costs proportional to productivity. However, this is just a transformation from an estimate for the share of firing costs from wages to the share from productivity.

either employed or unemployed, such that there is no out of labor force option. Similarly, each firm has one job that is either filled, or vacant. If the job is filled, it is subject to the time-varying probability of being exogenously destroyed, $\rho_t > 0$. Firms create jobs at the rate $M(U_t, V_t)$ at the non-state-contingent cost of $c > 0$ units of output per vacancy, where $M(\cdot)$ is the homogeneous-of-degree-one-matching-function,

$$M(U_t, V_t) = mU_t^{\mu} V_t^{1-\mu}, \tag{1}$$

where $m > 0$ gives the match efficiency, $\mu > 0$ is the elasticity of the matching function with respect to unemployment and V_t is the vacancy rate.

The vacancy-to-unemployment ratio

$$\theta_t = \frac{V_t}{U_t}, \tag{2}$$

reflects labor market tightness. Then, the vacancy filling probability is $q(\theta_t) = M(U_t, V_t)/V_t = m(U_t/V_t)^{\mu}$. Combining entry and exit definitions yields the evolution of employment which states that employment today will be driven by the number of non-separated workers from the last period and the non-destroyed matches from the last period. Along this line, the evolution of aggregate unemployment can be written as $U_t = 1 - N_t$.

We assume the existence of a representative firm that solves its profit maximization problem

$$\max_{\{N_t, V_t\}} \mathbb{E}_t \sum_{t=0}^{\infty} \beta^t \lambda_t \left[Y_t - W_t N_t - cV_t - \rho_t N_t \Gamma_t\right], \tag{3}$$

subject to the evolution of employment

$$N_t = (1 - \rho_t)(N_{t-1} + M_{t-1}), \tag{4}$$

and the production function

$$Y_t = Z_t N_t. \tag{5}$$

Here, Z_t is a Hicks-neutral aggregate technology shock.

The second term in parenthesis gives total wage costs. The third term reflects total vacancy posting costs and firing costs $\Gamma_t \geq 0$, for all separated workers.

Finally, the FONCs are

$$\begin{aligned} \partial N_t : \tau_t &= \frac{Y_t}{N_t} - W_t + (1 - \rho_t)\mathbb{E}_t\left[\beta_{t+1}\tau_{t+1}\right] - \rho_t \Gamma_t, && (6) \\ \partial V_t : c &= (1 - \rho_t) q(\theta_t) \mathbb{E}_t\left[\beta_{t+1}\tau_{t+1}\right], && (7) \end{aligned}$$

where $\beta_{t+1} = \beta\frac{\lambda_{t+1}}{\lambda_t}$ is the stochastic discount factor and τ_t is the multiplier on the evolution of employment. Assuming a logarithmic utility function in consumption the marginal utility of consumption, λ_t, is

$$\lambda_t = \frac{1}{C_t}. \tag{8}$$

Using the FONCs gives the optimality condition for job creation

$$\frac{c}{q(\theta_t)} = \mathbb{E}_t\left\{(1 - \rho_t)\beta_{t+1}\left[\frac{Y_{t+1}}{N_{t+1}} - W_{t+1} + \frac{c}{q(\theta_{t+1})} - \rho_t \Gamma_t\right]\right\}. \tag{9}$$

The left-hand side of this equation gives the (time-varying) hiring costs which equal the benefits of creating a new job. The latter depends on the marginal product of labor depleted by the wage and increased by saved hiring costs in the next period in case of non-separation.

Solving this equation for Γ_t gives

$$\Gamma_t = \mathbb{E}_t \left\{ \frac{1}{\rho_t} \left[\frac{Y_{t+1}}{N_{t+1}} - W_{t+1} + \frac{c}{q(\theta_{t+1})} - \frac{c}{(1-\rho_t)\beta_{t+1} q(\theta_t)} \right] \right\}. \tag{10}$$

In principal, we can use this equation to back out the value of firing costs. However, often one assumes that firing costs are proportional to the wage and we therefore assume

$$\Gamma_t = \gamma_t W_t. \tag{11}$$

Then, (10) reads as

$$\begin{aligned} \gamma_t &= \mathbb{E}_t \left\{ \frac{1}{\rho_t W_t} \left[\frac{Y_{t+1}}{N_{t+1}} - W_{t+1} + \frac{c}{q(\theta_{t+1})} - \frac{c}{(1-\rho_t)\beta_{t+1} q(\theta_t)} \right] \right\}, \qquad (12) \\ &= \mathbb{E}_t \left\{ \frac{1}{\rho_t W_t} \left[\frac{Y_{t+1}}{N_{t+1}} - W_{t+1} + \frac{c}{m\left(\frac{U_{t+1}}{V_{t+1}}\right)^{\mu}} - \frac{c}{(1-\rho_t)\beta \frac{C_t}{C_{t+1}} m \left(\frac{U_t}{V_t}\right)^{\mu}} \right] \right\}. \qquad (13) \end{aligned}$$

3 Data

In order to compute firing costs using equation (13) we need the following time series: output, employment, unemployment, wages, vacancies, and consumption.

Time series for the United States are taken from the Bureau of Labor Statistics and the Bureau of Economic Analysis. For the seven European countries (Austria, Czech Republic, Finland, Hungary, Poland, Portugal, and UK) time series are taken from Eurostat and the OECD.[2] We use seasonally adjusted, quarterly data from 2001:Q1 to 2012:Q2.[3] Time series for output, consumption, and wages are detrended using the GDP deflator.

Finally, we also use a time series for the separation rate but, due to data limitation, only for the United States. For the remaining seven countries we take the individual separation rates from the estimates by Hobijn and Sahin (2009). The only exception is Austria, for which no estimate is presented in Hobijn and Sahin (2009). We assume a value of four percent which is an intermediate value across all estimates.

Before we present the estimation results, we need to calibrate the following parameters: the match efficiency m, vacancy posting costs c, the discount factor β, and the elasticity of the matching function μ. The discount factor is set to 0.99 as common in the literature. Match efficiency is set to a value of 0.7 which is a value usually obtained in search and matching models. We assume that the elasticity of the matching function is 0.4 as usual in the literature. Finally, vacancy posting costs are taken from the steady state and are equal to 0.06.

[2] The dataset as well as the estimation codes are available upon request.

[3] The limiting factor here is data for vacancies.

Finally, in order to put our results into perspective, we use data on the strictness of employment protection legislation (overall and for temporary employment), spending and participation in active labor market programs, and union density all obtained from the OECD database.

4 Results

Figures 1 and 2 present the estimated values of firing costs as a share of quarterly wages (within each quarter) over the 2001:Q1 to 2012:Q2 period. For simplicity, we disregard the expectation operator in the estimation. Further, table 1 shows the average firing cost value over the sample period.

Table 1: Average firing costs.

Country	mean(γ_t)
USA	0.3
UK	0.31
Austria	0.38
Czech Republic	0.78
Finland	0.37
Hungary	0.61
Poland	0.72
Portugal	0.55

For the United States we obtain a value of 0.3 over the entire sample. The graph shows that firing costs increase at the beginning of our sample, remained almost constant at a value of roughly 0.3 and in 2009 increased to a value of 0.32. Here, one might interpret this increase with the financial crisis triggering a large recession increasing the cost of firing a worker.

The estimated series for the UK shares the initial upward trend that we observed for the United States. This trend continues until the end of 2006 when a slight downward trend until 2009 kicks in. About one year later compared the US a positive upward shift is visible. On average we find a value of 0.31 for the UK.

For Austria, the time series for firing costs shows a slight upward trend up to the end of 2007. This upward trend is followed by a significant drop of firing costs from 0.4 to 0.35. At the end of our sample we find that firing costs tend to increase. Overall, we find an average value of 0.38 for firing costs in Austria.

In contrast to the upward trends we observed before, Finland shows a slight downward trend from the beginning of our sample. This downward trend becomes even steeper from the first quarter of 2007 on, decreasing from 0.42 to 0.32. This negative trend continues until the beginning of 2009, when firing costs stabilize around a value of 0.35. In summation, the mean value of firing costs for Finland is 0.37.

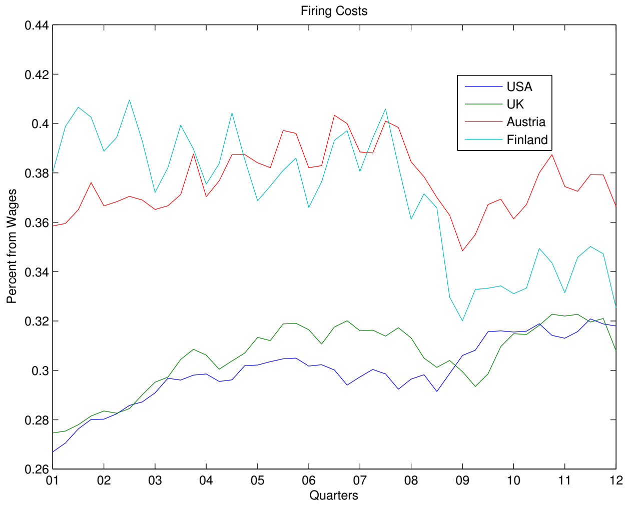

Figure 1: Firing costs over the cycle.

Turning to the countries in Figure 2, we find that firing costs in Hungary reveal a slight downward trend from 0.65 to 0.57 at the end of our sample period. On average, firing costs equal 0.61. A similar pattern is obtained for the Czech republic. Starting from a level of roughly 0.8 firing costs decrease over the entire sample to reach a value of almost 0.73 at the end of our sample. The mean value of firing costs for the Czech republic is equal to 0.78. Very small deviations in firing costs are obtained for Portugal. Here, firing costs show little variation and stay close to the mean value of 0.55 over the entire sample. Only towards the end of the sample we observe a strong upward trend.

Finally, the estimated time series for Poland shows much more variation as the other time series. We observe a sharp upward trend at the beginning of the sample period that continues until 2005. Then, for roughly three years firing costs stay put at a level of 0.77, before they decrease and stabilize around a level of about 0.7. On average, firing costs in Poland equal 0.72.

5 Robustness

In this section we want to provide a robustness check for the United States. Since we have a time series for the separation rate for the United States, we want to compare our firing cost time series computed using a fix separation rate of 3.18 percent and the observed time series. Figure 3 presents the time series for the US firing costs. The figure shows that our interpretation as an upper bound seems reasonable. The two time series share the same trends over the entire time span. We observe an upward trend at the beginning of the sample until the mid-2003's. Then, from 2004 to 2007 we find little variation in the value until 2008, when a upward shift becomes visible. As pointed out, the time series with the fixed separation rate is significantly above the time series with the observed time series. Until 2009 the difference is stable at roughly six percentage points. After the level shift of 2009 the variable time series is above the fix time series, while the difference is much

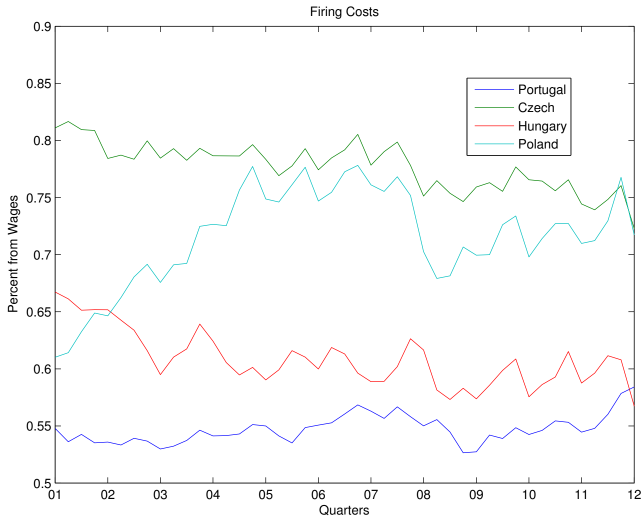

Figure 2: Firing costs over the cycle.

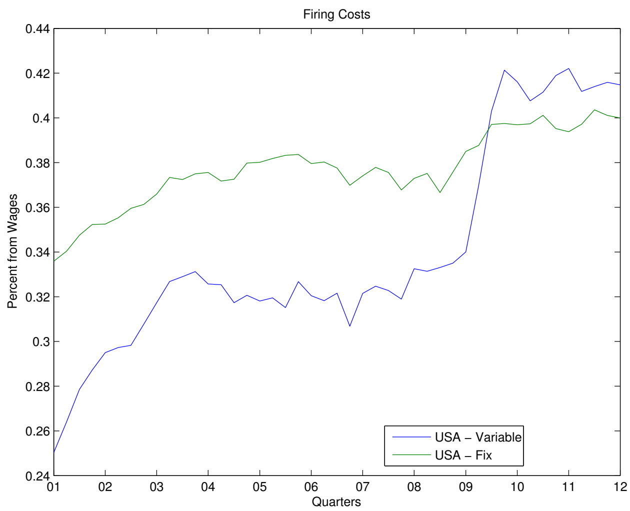

Figure 3: Robustness check for the United States.

smaller at a value of about two percentage points.

6 Explaining the Results

After describing our results, we want to test and discuss several explanations for the observed patterns. Of course, this regression suffers from the limited number of observations such that we should be careful in interpreting the results.

First, let us begin with discussing the relation between firing costs and potential explanatory variables. Employment protection legislation (EPL, for short). One would expect that countries with a c.p. stricter EPL would feature a high value of firing costs. Furthermore, spending and participation in active labor market programs (ALMP, for short) varies significantly across countries. As those ALMP programs affect the incentives and the skill level of (unemployed) workers, there might be a relation between the cost of firing a worker and ALMP. Finally, a higher union density might increase the costs of firing a worker.

Table 2: Firing Cost Regression. Significance levels: *: 10 % level, **: 5 % level, ***: 1 % level. Mixed is cubi for EPL and union density and quadratic for ALMP.

Parameter	Linear	Quadratic	Cubic	Mixed
Constant	0.35***	0.36***	0.36***	0.39***
EPL	0.06**	0.02**	0.01**	0.01**
ALMP	-0.05	-0.03	-0.02*	-0.05*
Union Density	-0.0002	0	0	0
LLN	11.36	10.98	10.93	10.9

Table 2 summarizes our OLS estimation results. We show four different specifications: a linear model, two models with a quadratic and a cubic non-linearity and a mixed model with a cubic effect of EPL and union density and a quadratic relation for ALMP.

The resulting coefficient for EPL is positive and is significant at the five percent level. Its value varies between 0.06 as an upper bound and 0.01 as a lower bound. Second, the regression coefficient of firing costs on spending as percentage of GDP we find a coefficient varying between -0.05 and -0.02. The coefficient is significant at the 5 percent level, once we allow for a cubic relationship and insignificant in the linear and quadratic scenarios. Finally, the coefficient on union density is insignificant in all considered cases.

We can draw the conclusion that in our limited sample (i) non-linear effects exist and (ii) that EPL and active labor market programs do have a significant impact on firing costs.

7 Final Remarks

This study is concerned with providing cross-country evidence for the value of firing costs in order to calibrate state-of-the-art search and matching models with labor turnover costs. In contrast to existing studies, we use the approach pursued by Burnside et al. (1993) and use optimality conditions to find a reduce form equation for the share of firing costs from wages.

Using time series for eight different countries, we estimate the value of firing costs across our sample period from 2001 to 2012. We find that firing costs vary significantly across countries. The lowest values are obtained for the UK (31 percent of quarterly wages) and the United States (3 percent of quarterly wages). On the other side of the spectrum, Poland (0.72) and the Czech republic (0.78) show the largest values of firing costs. If we compare our results with the existing values used in the literature, we find that for most countries they are larger compared with the existing literature. However, for the United States the value of roughly one third of quarterly wages seems to be in line with the usual values found in the literature. Further, we offer three explanations for the observed differences across countries. In summation, strictness of employment protection and active labor market programs seem to have a non-linear, significant effect on firing costs.

At the end, we would like to stress several limiting factors that should be considered in the interpretation of our results and could be considered in future work. First, the size of search frictions might also vary significantly across countries which would bias our results. Second, we assumed that the values of deep parameters are identical across countries. More evidence on those parameters would also increase the accuracy of our results. Finally, one might think of introducing hours and time-varying hiring costs (parameter c).

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