Firing Costs, Efficiency Wages and Unemployment

Stefano Staffolani

Abstract. This paper uses a Shapiro–Stiglitz efficiency wage model to analyse the effects of firing costs on wages, employment, expected utility and profits. It considers that the probability of a non-shirker being fired depends on an exogenous shock which follows a two-state Markov process. It finds that higher severance payments give rise to lower wages, a lower unemployment rate, an increase in firms’ profits and a decrease in the utility of both workers and the unemployed. These conclusions derive from the finding that a greater probability of keeping one's job, because of higher firing costs, raises the value of the job and reduces the worker’s incentives to behave opportunistically; this enables firms to reduce wages. Hence, if firms pay efficiency wages, a higher degree of labour market flexibility increases unemployment.

1. Introduction

The economic literature has carefully analysed the impact of employment protection legislation (EPL) on employment levels, from both the theoretical and empirical perspectives. The persistent difference between unemployment rates in Europe and the USA, whose labour markets are usually defined as ‘rigid’ and ‘flexible’, respectively, is probably the main reason for this close attention paid by economists to EPL.

Most of the theoretical research is based on microeconomic analysis of firms’ behaviour in the presence of uncertainty, and
analyses the direct effects of firing costs on employment for a given wage (Bentolila, Bertola, 1990; Bertola, 1990; Saint Paul, 1999). The main conclusion drawn is that firing costs reduce the variability of employment in the economic cycle. However, the sign of the average employment variation is not clear: indeed, employment may be either increased or reduced by a rise in firing costs.

The empirical literature is more differentiated. The main conclusion drawn by Nickell (1998) and Nunziata and Staffolani (2001) is that none of the indicators of labour market rigidities has a significant effect on the unemployment rate, whereas when employment protection is high, labour demand adjusts less rapidly to shocks. Eventually, as Nickell and Nunziata (2000) and van Ours (2000) have shown, when unemployment protection is considered together with other measures of labour market regulation, it usually exerts a negative impact on the employment level among young people. On the other hand, Boeri et al. (2000) have found empirical evidence for a negative correlation between EPL and overall employment.

This paper presents a dynamic model in which firms set wages in order to motivate their workers, as in the Shapiro–Stiglitz efficiency wage model, in the presence of firing costs. Traditionally, models with efficiency wages take the probability of a non-shirker worker being fired as given. Once account has been taken of the existence of firing costs, this probability may no longer be considered an exogenous parameter; instead, it must be treated as one of the most important determinants of wage levels.

What relationship may we suppose to exist between firing costs and wages? Higher firing costs will reduce the probability of being fired. Depending on whether or not firing costs are also incurred for opportunistic workers, they may increase the difficulties faced by a firm in incentivizing its workers. Furthermore, if firms must pay firing costs to shirkers, workers may be less concerned about being monitored and being fired. The non-shirker condition becomes more binding, so that wages should grow where firing costs exist. On the other hand, firing costs increase the value of a job with respect to the value of unemployment, because they probably make it more difficult for the unemployed to enter employment. Workers are thus more concerned to keep their jobs, and for this reason the efficiency wage may be lower.

Firms usually pay some sort of ‘premium’ perhaps greater than the one that they are contractually obliged to provide to those workers that voluntarily resign when economic conditions are bad.
Can this premium be a way to motivate the remaining workers? Do firms which fire to a lesser extent when economic conditions require lower labour inputs have lower wage levels?

By integrating human resource management and employment protection, the purpose of this paper is to evaluate whether, in a competitive labour market with asymmetric information, firing costs can increase employment.

I built an efficiency wage model in which firms operate in two different states of the world, a good one and a bad one, choosing wages that motivate workers. The presence of firing costs (in the form of lump-sum payments made by firms to workers in the case of dismissal) reduces the endogenous probability of being fired. The goals of the model are: (a) to ascertain whether higher firing costs require higher or lower wages in order to motivate workers, (b) to analyse the subsequent effects on employment and (c) to evaluate the effects on workers’ and firms’ payoffs.

The main conclusion reached is that higher firing costs usually reduce the efficiency wage paid by the firm and that they raise the employment level. As expected, higher firing costs reduce flows between states; but probably less intuitively, they tend to reduce the utility of both workers and unemployed.

The paper is organized as follows. The second section will present the structure of the model. The third section sets out the results of numerical simulations. The final section is devoted to some concluding remarks.

2. The model

We consider a labour market composed of \( L \) identical risk-neutral workers, who are either employed or unemployed. Each firm undergoes a shock to the revenue function. Furthermore, worker monitoring is not perfect. The next two subsections will deal, respectively, with the non-shirking condition and with firms’ decision on the employment level.

2.1 The efficiency wage

With imperfect monitoring, a worker hired by a firm may or may not behave as a shirker. In the former case, s/he has probability \( q \) of being discovered and fired. In the latter case, s/he must produce an effort that induces a given loss in utility, which we will normalize.
to one. When economic conditions deteriorate, both kinds of worker can be fired, with probability $b$, and become unemployed,\textsuperscript{5} experiencing a reduction in their expected utility.

When a worker is fired, s/he receives a severance payment from the firm. We suppose that:

*Assumption 1*: Firing costs ($F$) consist of pure severance payments which, regardless of the reason for the dismissal, all workers receive when fired.

This hypothesis obviates the need to analyse the firms’ incentive compatibility problem. If firing costs were paid to non-shirker workers alone, firms would always have declared dismissals for shirker behaviour, even if the dismissals were for economic reasons.

The expected utility ($V$) of non-shirker and shirker risk-neutral workers employed by firm $i$ are, respectively (in this section, we simplify the notation omitting temporal indexes):

\[ rV^N_i = w_i - 1 + b_i(V^D - V^N_i + F) \tag{1} \]
\[ rV^S_i = w_i + (b_i + q)(V^D - V^S_i + F), \tag{2} \]

where $N$ denotes the non-shirker worker and $S$ the shirker; $w_i$ is the wage rate, $V^D$ is the expected utility of the unemployed. The usual non-shirking condition requires that $V^N_i = V^S_i$; this enables us to obtain the wage as a function of $V^D$:

\[ w_i = 1 + rF + rV^D + \frac{r + b_i}{q}. \tag{3} \]

For a given probability of being fired and an expected utility of being unemployed, the wage rate is increasing in firing costs.\textsuperscript{6} However, it is obvious that these two variables depend on firing costs.

Given $V^N_i = V^S_i \equiv V_i$, from equations [1] and [2] we straightforwardly find that the difference in the expected utility of a worker and that of an unemployed person is given by:

\[ V_i - V^D = F + \frac{1}{q} \tag{4} \]

and it is increasing in firing costs.

The unemployed have a probability $a$ of finding a job, and given that firms pay efficiency wages, they will obtain an increase in their
utility equal to the difference between the utility of a non-shirker worker and that of an unemployed one:

\[ r V^D = B + a(V - V^D), \]  

[5]

where \( B \) is the unemployment benefit.

Concerning the wage rate, we assume that:

Assumption 2: The wage remains the same throughout the cycle. The efficiency wage must be that paid in good states, otherwise workers will behave as shirkers in good states. The incentive compatibility constraint is slack at firms in bad states.

The constancy of the wage over the cycle is explained by the consideration that, in a more realistic set-up where productivity shocks are not constrained on two values, it may be very difficult to stipulate a contract for every state of the world. Furthermore, adopting this hypothesis enables us to ignore the possible incentive for a firm to lie about the shock level.  

Substituting equation [4] into equation [5] and the latter into equation [3], yields a first formulation of the wage-setting function:

\[ w = \left( 1 + B + \frac{r}{q} \right) + (a + r)F + \left( \frac{b + a}{q} \right). \]  

[6]

Hence, for a given flux between the states of employment and unemployment (for given \( b \) and \( a \)), the wage setting depends positively on firing costs.

Remark 1: If a firm does not consider the effects of firing costs on turnover rates, it will always increase its efficiency wages when firing costs rise.

However, it is obvious that the probability of both losing and finding a job must depend on firing costs. To analyse this probability, we consider the optimal behaviour of firms in terms of employment level.

2.2 Firm behaviour

At the beginning of each period the value of an idiosyncratic shock on total revenue, \( Z_t \), which we shall simply call the 'state of the world', is known to each firm. Two 'states of the world', labelled good and bad, exist and the probability of changing state is given by the parameter \( p \). Since transitions between good and
bad states are symmetric, both states have equal probability. Therefore, in steady state, half of firms are assumed to be in the good state and half in the bad one.

The shadow value of a job\(^{10}\) at time \(t\), \(\lambda_t\), is recursively described by the current net revenue of the job, \(Z_t R'(N_t) - w\), where \(Z_t\) is the value of the shock, \(R'(N_t)\) is the value of the marginal product with \(N_t\) workers, plus the discounted expected value of the job in the next period, \(1/(1+r)E(\lambda_{t+1})\):

\[
\lambda_t = Z_t R'(N_t) - w + \frac{1}{1+r} E(\lambda_{t+1}).
\]  

[7]

In the absence of shocks, each firm hires workers until their contribution to profit is positive, i.e. \(\lambda_t = 0\). In the presence of shocks, turnover costs change the optimal behaviour of firms.

If a firm passes from the good to the bad state, it will fire workers until the shadow value of the job is equal to the firing cost: \(\lambda_t = -F^{11}\)

\[
-F = Z_B R'(N_B) - w + \frac{1}{1+r} E(\lambda_{t+1}),
\]  

[8]

where \(B\) indicates the bad times. In the next period the firm will have probability \(1-p\) of being in the negative state (where the value of the marginal job is \(-F\)) and probability \(p\) of being in the good one (where the value of the marginal job is zero); therefore \(E(\lambda_{t+1}) = -(1-p)F\).

If a firm passes from the bad state to the good one, it will hire workers until its expected marginal revenue is nil:

\[
0 = Z_G R'(N_G) - w + \frac{1}{1+r} E(\lambda_{t+1}),
\]  

[9]

where \(Z_G\) is the value of the shock in good times. The expected value of a job in this case is: \(E(\lambda_{t+1}) = -pF\).

Substituting \(E(\lambda_{t+1})\) in both cases, we obtain the optimal level of employment in each state:

\[
Z_B R'(N_B) = w - \frac{r+p}{1+r} F
\]  

[10]

\[
Z_G R'(N_G) = w + \frac{p}{1+r} F.
\]  

[11]
From this result we can calculate the employment level in both states of the world. To do so, we must take a given total revenue function into account.

**Assumption 3:** The relationship between total revenue and employment is of logarithmic type: $R(N_s) = \ln(N_s)$, with $s = B, G$.

The logarithmic function enables us to obtain analytical results. Furthermore, in order to simplify the model, we suppose that:

**Assumption 4:** Firing costs are proportional to wages: $F = \phi w$.

Given the two previous assumptions, we obtain from equations [10] and [11] the following labour demand function in the two states:

$$N_G(w, \phi) = \frac{C_G(\phi)}{w}, \quad [12]$$

where

$$C_G(\phi) = \frac{Z_G}{1 + \frac{p}{1 + r} \phi}$$

and:

$$N_B(w, \phi) = \frac{C_B(\phi)}{w}, \quad [13]$$

where

$$C_B(\phi) = \frac{Z_B}{1 - \frac{r + p}{1 + r} \phi}$$

In order to solve for the non-shirking wage in equation [6], each firm assigns to parameter $b$ the value it assumes in good times, whereas the probability of the unemployed being hired, $a$, is exogenous to the individual firm. In the case of a negative shock, $N_G - N_B$ workers will be fired. Hence, the probability of being
fired is simply:

\[ b(\phi) = p \left( 1 - \frac{N_B(w, \phi)}{N_G(w, \phi)} \right) = p \left( 1 - \frac{C_B(\phi)}{C_G(\phi)} \right) \equiv p(1 - c(\phi)) \quad [14] \]

where \( c(\phi) \) is the ratio between employment level in the bad states and that in the good states. The probability of being fired does not depend on wages. Given that \( C_G(\phi) \) is decreasing in firing costs and \( C_B(\phi) \) is increasing, \( dc/d\phi > 0 \); we find, as expected, that the probability of being fired is decreasing in severance pay.

Considering that firing costs are proportional to wages \((F = \phi w, \text{ assumption 4})\) we can solve equation [6]:

\[ w = \frac{qH + p(1 - c(\phi)) + a}{q[1 - \phi(r + a)]}, \quad [15] \]

where \( H \equiv B + 1 + r/q \). Let us analyse this result. The derivative of \( w \) with respect to \( \phi \) has an indeterminate sign.\(^{14}\) Hence, wages in individual firms may both increase or decrease relative to firing costs. With respect to equation [3], where severance pay always raised wages, we find that:

**Remark 2**: A firm that considers the effects of severance payment on its own turnover rates may reduce its efficiency wages when redundancy payments increase.

In order to evaluate the effects of parameter \( a \) of equation [15], the next section considers the overall economic system.

### 2.3 The macroeconomic equilibrium

In steady state, the number of unemployed workers who enter jobs equals the number of fired workers.\(^ {15}\) The flows between the state of employment and unemployment concern \((p/2)(N_G - N_B)\) individuals. The number of unemployed workers is given by the whole labour force minus total employment, \( L - (N_G + N_B)/2 \). Therefore, in equilibrium:

\[ a(\phi, N_G) = \frac{p(N_G - N_B)}{2L - (N_G + N_B)} = \frac{p(1 - c(\phi))}{2 \frac{L}{N_G} - (1 + c(\phi))} \quad [16] \]
The relationship between the probability of being hired and firing costs is unambiguously negative. In fact, \( a \) is decreasing in \( c(\phi) \) and increasing in \( N_G \). Given that \( N_G \) decreases and \( c(\phi) \) increases with \( \phi \), we find, as expected, that the probability of finding a job for an unemployed worker is decreasing in firing costs. Therefore, as is well known in the economic literature (see Bertola, 1990), firing costs always reduce the turnover rate.

Given the positive relationship between \( w \) and \( a \) shown by equation [15], we may conclude that:

**Remark 3:** The effect of firing costs on efficiency wages is always lower when the economy as a whole is considered, rather than the single firm, because higher severance payments, by reducing the probability of finding a job when unemployed, gives jobs more 'appeal' and reduces the level of wages chosen by individual firms.

In fact, when a firm decides to maintain more workers during downturns, it reduces the probability that the unemployed will find jobs (\( a \)); as a consequence, other firms may reduce their efficiency wages because of a positive externality between firms.

Substituting equation [16] into equation [15] yields the equilibrium wage-setting function, i.e. the relationship between the efficiency wage and employment in good states:

\[
\begin{align*}
    w(\phi, N_G) &= \frac{qH + b(\phi) + a(\phi, N_G)}{q[1 - \phi(r + a(\phi, N_G))]}, \\
    &\text{[17]} \\
\end{align*}
\]

that is, a positive relationship between the wage and the employment level in good states. Given assumption 2, it follows that the wage does not depend on employment level in bad states.

Combining the labour demand function in good states (equation [12]) with the wage-setting function (equation [17]) we obtain the equilibrium wage (\( w^*(\phi) \)), the employment level in good states (\( N_G^*(\phi) \)) and in bad states (\( N_B^*(\phi) \)).

Figure 1 shows the wage-setting function and the labour demand function in the space \( N_G, w \) for two different values of firing costs (\( \phi = 0; \phi = 1 \)). It presents a case in which the wage-setting function diminishes when firing costs increase. In this case, wages must decrease, whereas the effects on employment in good states are ambiguous.16

We are interested mainly in the relationship between the equilibrium variables and firing costs. Consider that a sufficient
condition for a decrease in the equilibrium wage with respect to firing costs is that the wage-setting function shifts downwards when firing costs increase. In fact, if we could demonstrate that the wage decreases in firing costs for a given $N_G$, and given the negative relationship between $N_G$ and firing costs (see equation [12]), it would follow that an increase in firing costs undoubtedly reduces the equilibrium wage.

The derivative of wages with respect to firing costs gives:

$$
\text{sign} \left( \frac{dw}{d\phi} \right) = \text{sign} \left[ \frac{db}{d\phi} + \frac{da}{d\phi} + qw(\phi, N_G) \right. \\
+ \left. \left( r + a(\phi, N_G) + \phi \frac{da}{d\phi} \right) \right], \quad \text{[18]}
$$

where the first two addends are negative and the third is positive.

It is difficult to evaluate the sign of the relationship between wages and firing costs in the general case. We can gain some idea about the conditions that make $dw/d\phi < 0$; particularly, both $b(\phi)$ and $a(\phi, N_G)$ are concave functions of $\phi$; hence, a higher $\phi$ increases the term with a negative sign ($db/d\phi, da/d\phi$) and, by decreasing the unemployed workers’ probability of finding jobs, $a(\phi, N_G)$, it may reduce the positive one.
It is easier to evaluate the relationship between the equilibrium wage and firing costs. Appendix A shows that:

**Remark 4:** If the ratio between firing costs and the wage lies in the non-empty interval \([\phi, \phi_{\text{max}}]\), an increase in firing costs gives rise to a reduction in the wage.

This result tell us that the negative relationship between wages and employment protection should be downward sloping to the right of a realistic value of \(\phi\). Analyses of the derivative evaluated at \(\phi = 0\) do not yield any firm conclusion, however. In fact, for \(\phi = 0\), we may obtain both a positive and a negative relation between the wage and firing costs, depending on a complicated expression concerning all the parameters of the model.

Once we know the relation between firing costs and wages, the manner in which firing costs affect employment can be analysed straightforwardly. In fact, we know from equation [12] that

\[
\frac{dN_G}{d\phi} = \frac{\frac{dC_G}{d\phi} w - \frac{dw}{d\phi} C_G}{w^2}
\]

and that

\[
\frac{dN_B}{d\phi} = \frac{\frac{dC_B}{d\phi} w - \frac{dw}{d\phi} C_B}{w^2}.
\]

Given that \(dC_G/d\phi < 0\) and that \(dC_B/d\phi > 0\), we may state that:

**Remark 5:** If wages are decreasing in firing costs, employment in bad states certainly grows; if wages are increasing in firing costs, employment in good states certainly decreases.

Obviously, if the wage is decreasing in firing costs, it is impossible to say anything about employment in good states, and if it is decreasing, about employment in bad states. Hence, average employment during an economic cycle cannot be determined analytically.

To obtain further information on these relations and to analyse the behaviour of other variables which are not analytically determinable (firms’ profits, the unemployment rate, the utility of workers and the unemployed) we now perform numerical simulations of the model.
3. Results of the numerical simulations

We first obtain an analytical formulation for the wage rate. After substituting equation [12] into equation [16] to yield:

\[ a(w, \phi) = \frac{p(1 - c(\phi))}{2 \frac{wL}{C_G(\phi)} - (1 + c(\phi))}, \]  

substituting this equation into equation [17] and solving with respect to \( w \), we obtain a second-order equation in \( w \): \( A_0(\phi)w^2 + A_1(\phi)w + A_2(\phi) = 0 \), where:

\[ A_0(\phi) = 2Lp(1 - r\phi)q > 0 \]
\[ A_1(\phi) = -q[(2p - b(\phi))(1 - r\phi) + \phi pb(\phi)]C_G(\phi) - 2pL(b(\phi) + qH) < 0 \]
\[ A_2(\phi) = C_G(\phi)[Hq(2p - b(\phi)) + b(\phi)p - (b(\phi))^2] > 0 \]

Considering the higher root (because it is possible to demonstrate that the lower one gives the impossible solution \( w^* < H \); see equation [6]), we obtain the following equation defining the wage:

\[ w^*(\phi) = \frac{-A_1(\phi) + \sqrt{[A_1(\phi)]^2 - 4A_0(\phi)A_2(\phi)}}{2A_0(\phi)}. \]  

This equation, evaluated for different values of the parameters, is always concave but we cannot say whether, for realistic values of \( \phi \), it is increasing or decreasing.

Once the wage is known, we may calculate:

- employment in good and bad states, \( N^*_G(\phi) \) and \( N^*_B(\phi) \), from equations [12] and [13];
- the turnover rates, \( b^*(\phi) \) from equation [14] and \( a^*(\phi) \) from equation [16];
- the average unemployment rate,

\[ u^* = \frac{L - \frac{N^*_G(\phi) + N^*_B(\phi)}{2}}{L}; \]
— the utilities of workers and the unemployed and firms’ average profits.\(^\text{18}\)

Numerical simulations were obtained as follows:

(1) the parameters of the model (except \(\phi\)) were chosen randomly by extracting them from uniform distributions, as explained in Table 1, for 50,000 simulations;\(^\text{19}\)

(2) given the other parameters extracted in each simulation, parameter \(\phi\) was drawn randomly from a uniform distribution whose minimum value was 0 and whose maximum value was the endogenous level of firing costs that, given the other parameters, equates employment in bad and good states (see equation [21]);

(3) the variables \(w^*, N_G^*, N_B^*, u^*, V^D, V^*, \pi^*\) were calculated;

(4) the random parameter \(\phi\) was augmented by 0.005 and, given the other parameters, the variables indicated at the previous point were recalculated;

(5) all simulations yielding impossible results were filtered and eliminated:

\[
\frac{N_G^* + N_B^*}{2} > L, \quad N_G^* < 1, \quad N_B^* < 1, \quad u^* < 0, \quad a^* < 0, \quad a^* > 1, \quad b^* < 0, \quad b^* > 1;
\]

(6) all the remaining 47,709 simulations were processed.

The main results of the simulation exercise are given in Table 2, which shows the percentage of cases in which variables increased with respect to a small increase in firing costs, as explained in

Table 1. Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Valid cases: 47,709</th>
<th>Min</th>
<th>Max</th>
<th>Avg.</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour force ((L))</td>
<td></td>
<td>15.00</td>
<td>25.00</td>
<td>20.00</td>
<td>2.88</td>
</tr>
<tr>
<td>Interest rate ((r))</td>
<td></td>
<td>0.01</td>
<td>0.05</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>Unemployment benefit ((B))</td>
<td></td>
<td>0.70</td>
<td>1.30</td>
<td>1.00</td>
<td>0.17</td>
</tr>
<tr>
<td>Probability of being fired for shirking ((q))</td>
<td></td>
<td>0.10</td>
<td>0.90</td>
<td>0.50</td>
<td>0.23</td>
</tr>
<tr>
<td>Ratio between shocks in bad and good times ((Z))</td>
<td></td>
<td>0.50</td>
<td>1.00</td>
<td>0.80</td>
<td>0.12</td>
</tr>
<tr>
<td>Probability of change of state ((p))</td>
<td></td>
<td>0.01</td>
<td>0.60</td>
<td>0.30</td>
<td>0.17</td>
</tr>
<tr>
<td>Firing costs ((\phi))</td>
<td></td>
<td>0.00</td>
<td>11.69</td>
<td>0.32</td>
<td>0.57</td>
</tr>
</tbody>
</table>

The wage rate decreases 97 times out of 100, pointing to the conclusion that firing costs depress wages and, in a large number of cases (88 out of 100), also depress workers’ expected utility. This finding suggests that, at least when workers are risk neutral, an increase in the ‘value’ of the job caused by a rise in firing costs enables firms to reduce monitoring problems. This conclusion is confirmed by the fact that, in 93 percent of cases, firms’ profits increase. Another important finding is that employment in good states grows in 55 percent of cases. Furthermore, given that employment in bad states always increases, unemployment decreases in 94 percent of cases. Hence, employment protection legislation is not always detrimental to unemployment.

The reduction in turnover rates, both on entry to and exit from employment, gives rise to the result that the expected utility of unemployed workers usually decreases (in 98 percent of simulations) when firing costs increase.

Further important information may be obtained if we analyse the results outlined above for different values of some of the parameters. Table 3 shows the percentages of simulations in which the variables (by row) increase with respect to an infinitesimal increase in firing costs, for different classes of:

— firing costs;
— probability of being subject to a shock;
— magnitude of the shock.

The first part of Table 3 refers to firing costs. It shows, by columns, the value of firing costs relative to their maximum value, in classes. This maximum acceptable firing cost value is the one that equates employment in good and bad states and obviously depends on the parameters of the model drawn in each of the

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Avg. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage level ($w$)</td>
<td>39,639</td>
<td>2.86</td>
</tr>
<tr>
<td>Unemployment rate ($u$)</td>
<td>46,327</td>
<td>5.76</td>
</tr>
<tr>
<td>Workers’ utility ($V$)</td>
<td>41,250</td>
<td>12.15</td>
</tr>
<tr>
<td>Unemployed workers’ utility ($V_D$)</td>
<td>43,343</td>
<td>1.59</td>
</tr>
<tr>
<td>Firms’ profits ($\pi$)</td>
<td>40,133</td>
<td>92.82</td>
</tr>
</tbody>
</table>

Table 2. Percentages of cases in which the variables (by row) increase with respect to an infinitesimal increase in firing costs
It is given by (see equations [12] and [13]):
\[
\phi_{\text{max}} = \frac{(1 - Z)(1 + r)}{p(1 + Z) + r}.
\] [21]

Hence, the first part of Table 3 displays the value of \(\phi/\phi_{\text{max}}\). A higher initial level of firing costs reduces the frequency of a positive sign for the wage rate and the unemployment rate and increases the frequency of a positive sign for firms’ profits. The utility of workers and the unemployed increases with a higher frequency if firing costs are low.

These results confirm remark 4, which stated that when firing costs are ‘sufficiently’ high the relationship between firing costs and the wage is negative.
The second part of Table 3 shows the percentages of the overall simulations in which the variables grew with respect to an increase in firing costs for different levels of the ‘turbulence’ of the economic system, $p$. The greater the turbulence, the higher the probability that firing costs will reduce wages and unemployment, and the higher the probability that firms’ profits will rise. It seems, therefore, that when shocks are frequent, firing costs are less likely to be detrimental to employment. At the same time, a greater ‘turbulence’ is more likely to reduce the expected utility of workers and of the unemployed and to raise firms’ profits.

Finally, in the third part of Table 3, we analyse the effects of the magnitude of shocks. The greater this magnitude, the higher the frequency of increases in the unemployment rate, wages, the utility of workers and the unemployed, and the lower the frequency of increases in firm profits.

The two other parameters of the model are the probability of being monitored for shirking ($q$) and the interest rate ($r$). The effects of different levels of these parameters on the relationship between the firing rate and the model variables are presented in Table 4. It seems that a higher interest rate and a higher probability of being monitored are more likely to produce a positive relationship between wages and firing costs. Hence, higher

<table>
<thead>
<tr>
<th>Interest rate, in classes</th>
<th>$&lt; 0.02$</th>
<th>$0.02–0.03$</th>
<th>$0.03–0.04$</th>
<th>$&gt; 0.04$</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage level ($w$) (%)</td>
<td>1.3</td>
<td>2.0</td>
<td>3.4</td>
<td>4.8</td>
<td>2.9</td>
</tr>
<tr>
<td>Unemployment rate ($u$) (%)</td>
<td>4.9</td>
<td>5.6</td>
<td>5.7</td>
<td>6.8</td>
<td>5.8</td>
</tr>
<tr>
<td>Workers’ utility ($V$) (%)</td>
<td>6.6</td>
<td>12.3</td>
<td>13.8</td>
<td>15.4</td>
<td>12.2</td>
</tr>
<tr>
<td>Unemployed workers’ utility ($V_D$) (%)</td>
<td>2.1</td>
<td>2.1</td>
<td>1.3</td>
<td>0.9</td>
<td>1.6</td>
</tr>
<tr>
<td>Firms’ profits ($\pi$) (%)</td>
<td>95.5</td>
<td>93.8</td>
<td>92.4</td>
<td>89.7</td>
<td>92.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Probability of being monitored, in classes</th>
<th>$&lt; 0.3$</th>
<th>$0.3–0.5$</th>
<th>$0.5–0.7$</th>
<th>$&gt; 0.7$</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage level ($w$) (%)</td>
<td>1.2</td>
<td>2.3</td>
<td>3.5</td>
<td>4.7</td>
<td>2.9</td>
</tr>
<tr>
<td>Unemployment rate ($u$) (%)</td>
<td>1.7</td>
<td>4.7</td>
<td>7.1</td>
<td>9.5</td>
<td>5.8</td>
</tr>
<tr>
<td>Workers’ utility ($V$) (%)</td>
<td>5.8</td>
<td>10.7</td>
<td>14.2</td>
<td>18.3</td>
<td>12.2</td>
</tr>
<tr>
<td>Unemployed workers’ utility ($V_D$) (%)</td>
<td>0.1</td>
<td>0.7</td>
<td>2.1</td>
<td>3.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Firms’ profits ($\pi$) (%)</td>
<td>97.2</td>
<td>94.3</td>
<td>91.4</td>
<td>87.8</td>
<td>92.8</td>
</tr>
</tbody>
</table>

firing costs should be preferred by those firms unable to monitor their workers effectively. It should be stressed that in the numerical simulations where both the parameters $q$ and $r$ are set at a very low level ($q < 0.15, r < 0.015$), an unambiguous result is obtained: the wage rate, the unemployment rate, the utility of workers and the unemployed always decrease, whereas firm profits always increase.

It therefore seems that, in the case of an increase in firing costs, firms prefer an economy with high turbulence characterized by shocks of small magnitude, whereas workers prefer an economy where shocks are rare but strong. This conclusion is consistent with the analytical results presented in Appendix A. Furthermore, firms that experience greater monitoring problems are more likely to accept an increase in firing costs.

An important finding to be emphasized is that in none of the simulations did the expected utility of workers, that of unemployed workers, and firms’ profits all grow with respect to firing costs, nor did all of them decrease. It was therefore found that firing costs always redistribute wealth among firms, workers and the unemployed.

The relationships revealed by the model are illustrated by Figures B1–B5 in Appendix B, which plot the relevant variables22 with respect to firing costs (Figure B1), the probability of changing state (Figure B2), the probability of being fired for shirking (Figure B3), the shock level in bad states (Figure B4), and unemployment benefit (Figure B5).

The relation between firing costs ($\phi$) and the model’s variables (Figure B1) are those to be expected from the analysis presented in Table 2. Higher firing costs lead to lower wages, unemployment, turnover rates, and they reduce the utility of both workers and unemployed. Firms’ profits tend to increase.

If $p$ is below a given threshold, greater ‘turbulence’ in the economic system (Figure B2) produces an increase in wage rates, unemployment, the utility of workers and of the unemployed, and a reduction in profits. For higher $p$, all these results are reversed.

More effective worker supervision ($q$) implies lower wages and a lower unemployment rate; it reduces the utility of both workers and the unemployed (Figure B3).

A higher level of shocks in bad states increases employment and profits, but reduces both wages and workers’ expected utility.

An increase in unemployment benefit ($B$) raises, as expected, wages and unemployment; it increases the expected utility of workers and the unemployed, and it reduces firms’ profits (Figure B5).

4. Concluding remarks

The existence of monitoring problems within firms has been the basis for the formal model developed in this paper.

Analysis of the relationship between firing costs and efficiency wages is a complicated undertaking because it requires consideration of both the direct effects of firing costs on wages and the indirect ones arising from changes in turnover rates between employment and unemployment. Hence, most of the conclusions now outlined are based on numerical simulations of the model.

The paper has shown that the relationship between firing costs and wages is, in most cases, negative. Higher firing costs reduce the wage that ensures that the non-shirking condition holds. This wage reduction has positive effects on employment in bad states of the world and uncertain effects on employment in good ones. The unemployment rate tends to be reduced by firing costs. Obviously, the higher the firing costs, the lower the turnover rates.

The paper has also evaluated the effect of turnover costs on the expected utility of employed and unemployed workers, and on firms’ profits. The result obtained was that, contrary to what might have been expected, the utility of workers and of the unemployed tends to be reduced by an increase in firing costs, whereas firms’ profits increase. This conclusion can be explained if one considers that strong employment protection leads to great value being placed on jobs; firms are able to pay lower incentive-compatible wages, so that workers’ utility may diminish. Consequently, it cannot be taken for granted that employment protection increases workers’ utility.

The conclusions just outlined are based on the hypothesis that wage determination depends on the imperfect monitoring of workers’ actions. Analyses which consider the role of trade unions in bargaining and the effects of asymmetries between insiders and outsiders in economies where firms are hit by exogenous shocks and subject to severance payments would be the natural development of the analysis presented in this paper.

Appendix A

Equation [16] can be written as a function of $w$, substituting the labour demand function (equation [12]) into $N_G$. Hence, we write
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equation [17] as follows:

$$G(w, \phi) = w - \frac{qH + b(\phi) + a(w, \phi)}{q[1 - \phi(r + a(w, \phi))]} ,$$  \[A1\]

where \(a(w, \phi)\) is defined in equation [19]. We differentiate \(G(w, \phi)\) with respect to the wage and firing costs. We obtain:

$$\frac{\partial G}{\partial w} = 1 - \frac{1 + \phi(Hq + b(\phi) - r) \partial a}{q[1 - \phi(r + a(w, \phi))]^2 \partial w} .$$

From equation [16] we know that \(a(\phi, N_G)\) is increasing in \(N_G\) and hence that \(\partial a/\partial w < 0\). Consequently, given the definition of \(H\) (see equation [15]), \(Hq + b(\phi) - r > 0\). The previous equation is certainly positive. The derivative with respect to \(\phi\) gives:

$$\frac{\partial G}{\partial \phi} = \left[1 - \phi(r + a(w, \phi))\right]$$

$$\times \left[ - \frac{db}{d\phi} - \frac{\partial a}{\partial \phi} - qw \left( r + a(w, \phi) + \phi \frac{\partial a}{\partial \phi} \right) \right].$$  \[A2\]

Let us analyse this equation. The first factor \(\left[1 - \phi(r + a(w, \phi))\right]\) is positive, otherwise wages would be negative. The two derivatives of the second factor are both negative. Consequently, a sufficient non-necessary condition for obtaining a positive sign for the above derivative, and thus have \(dw/d\phi < 0\), is that:

$$\left[r + a(w, \phi) + \phi \frac{\partial a}{\partial \phi} \right] < 0.$$  \[A3\]

We may go further. From equation [19], we can differentiate \(a(w, \phi)\) with respect to \(\phi\), obtaining:

$$\frac{\partial a}{\partial \phi} = \frac{a(\phi)}{p(1 - c(\phi))} \left( a(\phi) - p \frac{dc}{d\phi} + \frac{a(\phi)^2}{p(1 - c(\phi))} \right) \left( \frac{dC_G}{d\phi} \right) .$$  \[A4\]
Given that the right-hand second addend in the previous equation is negative \( dC_G/d\phi < 0 \), if we consider only the first addend we have a less stringent sufficient condition in equation [A3]. We consequently do not consider the second addend of equation [A4] and substitute the first addend in equation [A3]; after some manipulation, we find that a sufficient non-necessary condition for a negative relationship between wages and firing costs to arise is:

\[
\frac{dc}{d\phi} > \frac{1 + r}{\phi} \left( \frac{a(\phi)}{a(\phi) - 1} \right)
\]

The left-hand side of the previous equation is certainly positive. The right-hand side is certainly negative if \( a(w, \phi) < p \). Given that \( a(w, \phi) \) is decreasing in \( \phi \), there exists a level of \( \phi \) which ensures that the wage rate is decreasing in \( \phi \). Unfortunately, nothing else can be said about this value of \( \phi \) (we can solve the previous equation in \( \phi \), but doing so yields a very tedious condition). However, we can analyse the case in which firing costs tend to the maximum acceptable value, the one that maintains the employment level in the economic cycle constant, as explained in equation [21]. In this case, the exit rate from unemployment \( (a(\phi)) \) tends to zero and the ratio between employment in bad states and in good states \( (c(\phi)) \) tends to unity. We can therefore state:

\[
\frac{dw}{d\phi} < 0 \quad \text{for} \quad \phi < \phi_{\text{max}}.
\]

There always exists a sufficiently high value of firing costs, lower than the perfect rigidity value, which reduces wages when firing costs increase.

**Appendix B**

Each of the following figures plots the wage rate \( w \), employment in bad and good states \( (N_B \text{ and } N_G) \), the unemployment rate \( (u) \), the turnover rates \( (a \text{ and } b) \), the expected utility for workers
Figure B.1. Variables with respect to firing costs ($F$)

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CEIS Press; Cesare Cecchino Brodolini and Blackwell Publishers Ltd 2002.
Figure B2. Variables with respect to the probability of changing state ($\rho$)
Figure B3. Variables with respect to the probability of being fired for shirking ($q$)

- $w_i(i)$
- $N_G(i)$
- $N_B(i)$
- $u_i(i)$
- $a_i(i)$
- $b_i(i)$
- $V_{N_i}(i)$
- $V_{D_i}(i)$
Figure B4. Variables with respect to the shock level in bad states ($Z_B$)
Figure B5. Variables with respect to unemployment benefits (B)

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and the unemployed \((V_N\text{ and } V_D)\), and the expected profits \((\pi)\),
with respect to one of the parameters of the model. The other parameters are set at the following levels: \(r = 0.03; q = 0.49; B = 1; L = 20; Z_G = 55; Z_B = 33; p = 0.47; \phi = 0.42.\)

Notes

1 A notable exception is Fella (2000) who considers a model similar to that proposed here. The main difference is that Fella assumes that firms change wages in the two states of the world, whereas in this paper firms maintain a fixed wage. Moreover, and contrary to the model presented here, Fella supposes that shirkers do not receive severance payments, and that the firing costs for firms may differ from the severance payments received by fired non-shirker workers. Finally, he assumes that the unemployed do not receive unemployment benefit.

2 Consider a job in which the worker knows that s/he will be fired at the end of the current period. The current ‘value’ of the job is nil, so that the worker will not make the effort required by the firm. The lower the probability of being fired, the higher the ‘value’ of the job and the lower the efficiency wage.

3 As in Fella (2000).

4 This conclusion is obtained by considering risk-neutral workers. With risk-averse workers, the negative relationship between wage rate and firing cost is even closer.

5 For the moment we shall treat this probability as a parameter; as will become clear below, it depends on the employment level in the two states of the world.

6 The reverse result would have been obtained had we supposed that firing costs were paid only to workers fired for reasons other than shirking. With an expected utility function of the shirker given by \(rV_D^s = w_i + b_i(V_D - V_D^s + F) + q(V_D - V_D^s),\) the wage rate would have been decreasing in \(F\). We thus obtain a situation in which a decrease in employment protection is more likely to have a positive effect on employment. On the other hand, adopting the hypothesis that all fired workers cost the same to a firm means that we are not obliged to consider the incentive compatibility constraint that a firm should have respected if firing costs were not paid for shirker workers.

7 For a different approach, see Fella (2000).

8 We consider the symmetrical equilibrium where all firms pay the same wage, as stated in assumption 2. Hence, we eliminate the index \(i\).

9 This result is partially different from that obtained by Fella (2000, equation 16) (where severance payments reduce wages). This difference depends on the payment of firing costs to fired shirker workers (see note 6), which was excluded in Fella’s model.

10 For further insight into models with adjustment costs using two-stage Markov chains see, Bagliano and Bertola (2001, Ch. 3).

11 If \(\lambda_i < -F\), the firm could increase profits by firing workers at the margin; in fact, a job for which \(\lambda_i < -F\) yields an expected negative profit higher than the cost of firing.

12 Other forms, specifically the quadratic and the Cobb–Douglas production functions, were considered in numerical simulations. The results did not differ from those presented here.
Hence, in our notation, $b \equiv b_G$.

In fact, it can be straightforwardly demonstrated that $\text{sign}(dw/\phi) = \text{sign}(p(\phi - p) + rwq)$. Consider the case of a very small $p$. In this case, $p(\phi - p) < rwq$. Consider a very small $r$. The value of $\phi - p$ is always positive, so that $p(\phi - p) > rwq$.

Consider that firing is only undertaken by firms passing from good to bad states and that we set the number of firms to one.

However, an increase in firing costs associated with a reduction in the wage level increases employment in bad states.

Unfortunately, this result cannot be obtained analytically; all the simulations yield a concave relationship between wage and firing costs.

From equations [1–5] we obtain:

$$V^* = \frac{(r + \alpha^*)(b^* + \phi w^* - 1) + h^*B}{r(r + \alpha^* + b^*)}$$

$$V^*D = \frac{1}{q} + \phi w^*,$$

whereas the definition of expected firm profits in good and in bad states gives:

$$\pi^g(\phi) = \frac{1}{r} \left[ Z_g \ln(N^g_B) + Z_B \ln(N^g_B) - w^*(N^g_B - N^g_B) \right]$$

$$\pi^b(\phi) = \frac{1}{2(1 + r)} \phi w^*(N^g_B - N^g_B).$$

The parameters were chosen in such a way that the unemployment rate was usually between 0 and 0.5. Thus, once the labour force had been fixed, we obtained a range of plausible values for the shocks $Z_B$ and $Z_G$.

The number of simulations effectively analysed was less than the number of valid simulations because we did not consider the simulations in which the variables remained unchanged (8 decimals).

For ‘sufficiently’ high $p$, there is no ambiguity to the sign of the relationship between wages and firing costs, which is always negative.

Respectively, the wage rate ($w$), employment in bad and good states ($N^b_B$ and $N^g_B$), the unemployment rate ($\pi$), turnover rates ($\alpha$ and $\beta$), the expected utility of workers and the unemployed ($V^g$ and $V^b$), and expected profits ($\pi$).

References

