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Abstract

This paper argues that expectations are an important element that need to be included into the analysis of the effects of the minimum wage on employment. We show in a standard matching model that these effects are higher the lower is the likelihood associated to the minimum wage variation. This property also helps explaining the controversial results found in the empirical literature. When the policy is anticipated, the observed effect at the time of the actual variation is small and hard to identify. The model is tested on Spanish data, taking advantage of the unexpected change in the minimum wage following the election of Zapatero in 2004.

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1 Introduction

Minimum wages were first introduced in Australia and New Zealand in the late 19th century and are now in force in more than 90% of all countries. Despite its widespread use, the minimum wage is a debated issue. Its supporters assert that it helps prevent the excess of exploitation in the labor market and increases the living standards of the lowest paid up to some minimum acceptable standards. Detractors claim that the minimum wage may price low-skill workers out of market, harming rather than helping the poorest workers.

Economic theory does not provide a clear prediction about the employment effects of the minimum wage: in a competitive labor market a binding minimum wage reduces employment, but this is not necessary the case in a monopsonistic labor market, where the higher wage may attract more workers without dampening the labor demand.

The empirical literature is large and can be divided in two waves: the first one ending in 1982, with the review of Brown, Gilroy and Kohen (1982); and the second one, the "New Minimum Wage Research", starting in 1991 and summarized in Neumark and Wascher (2007).

The former bulk of studies relies mainly on time-series variation in the minimum wage in US and aggregate data and has built a consensus around the idea that minimum wages reduce teenage employment. The latter uses cross-section and panel-data to identify the effects of the minimum wage in several countries with controversial results. Long panel studies that incorporate both country and time variation in minimum wages tend, on the whole, to find negative and statistically significant employment effects from minimum wage increases, while the majority of the U.S. studies that find zero or positive effects of the minimum wage on low-skill employment were either short panel data studies or case studies of a state-specific change in the minimum wage.[1]

This paper proposes a mechanism capable of reconciling those conflicting findings. The key ingredient is the distinction between expected and unexpected changes in the minimum wage. Minimum wage changes can often be foreseen. This is particularly true in countries such as France and Spain, where the statutory minimum wage is set to be updated every year, or in Italy and Germany, that have no minimum wage laws but rely on collective agreements between employer groups and trade unions, renegotiated at defined dates. In the light of these features, the minimum wage policy cannot be considered as an unpredictable shock. If agents are rational, they will form expectations about minimum wage movements and adjust their current behavior to the future economic environment. They have the incentive to anticipate the policy because the profitability of an employment relationship depends also on the future wage. When the minimum wage is expected to increase, the present value of a job decreases and less vacancies will be posted. Furthermore, some employer-employee relationships may turn unprofitable at the higher wage and will be broken. In a world characterized by employment protection regulation dismissing a worker is expensive, and firms may find more convenient not to hire those marginal workers and save on future costs. When the minimum wage actually increases, the employment adjustment will be small because it has been partly anticipated. We argue that the empirical literature has not been

[1] In their review, Neumark and Wascher (2007) argue that the lack of significant employment losses found in some analysis could be due to the short time horizon cutting off part of the adjustment process.

able to find conclusive results because the minimum wage variations under analysis were expected, so that the actual employment effect was relatively small and hard to identify. Viceversa, when the policy is unexpected, it will have stronger real effects.

The model we develop is an extension of the Mortensen and Pissarides (1994) model. The labor market is characterized by search and matching frictions, heterogeneous stochastic matching, and endogenous separations. Expectations are taken into account: agents know that the minimum wage may increase in the future. In this framework, we compare expected and unexpected changes in the minimum wage. Their effects on employment are not different in the magnitude, but in the timing: the former influence the labor market outcomes both before and after the actual variation, while the latter has no anticipated effect.

The predictions of the model are tested on Spanish data. Spain provides a suitable environment in order to test the role played by expectations. The Spanish statutory minimum wage is set to be updated yearly, therefore changes in this policy should be predictable. But this is not always the case: the increase in the Spanish minimum wage following the election of José Luis Rodríguez Zapatero was largely unexpected. Thus we can estimate and compare the effect of the unexpected rise in the minimum wage, after Zapatero election, with the expected variations. Our analysis relies on individual data from the Economically Active Population Survey, 2000-2006. This longitudinal dataset is suitable to study not only the employment effect, but also the evolution of flows. The analysis of flows allows to identify the exact source for employment changing and to better appreciate the role of the minimum wage even when the net disemployment effect is negligible.[2]

Not all workers are affected by the minimum wage, but only those with lower bargaining power or lower productivity. The empirical literature typically identify the affected group with the youth, and a difference in difference approach is implemented using the adult as a control group. But not all the young workers are actually low-paid.[3] Thus we test several specifications with more restrictive treatment and control groups.

Our results show that the employment effect depends on the nature of the minimum wage variation: unexpected changes lead to a reduction in employment in the period following the actual change; whereas expected variations have effect on impact and may decrease employment ex-ante, but do not have ex-post effects. The increase in flows out of employment is greater in case of unexpected policy, as predicted by the theoretical model. Temporary workers turn out to be the most affected, while separations do not significantly increase for permanent workers.

The plan of the paper is as follows. Section 2 gives a review of the literature on the minimum wage. The role of expectations is discussed in Section 3. Section 4 presents the model, both with and without expectations, and compare the resulting disemployment effect of the minimum wage. The empirical analysis is detailed in Section 5 and Section 6. Section 7 concludes.

[2] The advantages of analyzing flows have been first recognized in Portugal and Cardoso (2006).

[3] See Cahuc and Zylberberg (2004) for a brief discussion.

2 The employment effect of the minimum wage

The minimum wage policy is mainly a redistributive instrument; nevertheless economic literature focuses on its employment effects.[4] The simple model of competitive labor market predicts that, when the minimum wage exceeds the competitive wage, a further increase in the minimum wage leads to higher unemployment. Similar conclusions are drawn from a basic matching model, where equilibrium conditions require a rise in the minimum wage to be compensated by a lower market tightness – that means lower vacancy posting and lower job creation. However there is no clear evidence in support of the disemployment effect of the minimum wage.

Individuals most likely to be employed at the minimum wage are the recent labor market entrants. Empirical studies typically limit their attention to young workers. Different econometric strategies have been used to asses the impact of the minimum wage on youth employment. The First Wave of the Minimum Wage Research uses mainly time-series and aggregate data to estimate correlations between employment and the minimum wage. They generally find a negative effect of the minimum wage on youth employment, as summarized by Brown et al. (1982):

> "time-series studies typically find that a 10 percent increase in the minimum wage reduces teenage employment by one to three percent" (p. 524).

But this approach has been widely criticized. The use of aggregate data may leave out many relevant variables, giving rise to spurious correlation.[5]

The New Minimum Wage Research relies on case studies and panel data, with controversial results. In a series of papers, Card and Krueger (1994, 2000) exploit the 1992 increase in New Jersey's minimum wage as a natural experiment and estimate its effect on the fast-food employment. They implement a difference in difference approach, including restaurant in eastern Pennsylvania as a control group. Their estimates show either no significant effect of the increase in the minimum wage on employment, either a positive effect. These results have been questioned by Neumark and Wascher (2000). They replicate the analysis of Card and Krueger (1994) replacing their survey based data with administrative payroll records, and find a negative effect on New Jersey's employment relative to Pennsylvania. But the debate is still open: Card and Krueger (2000) replied to Neumark and Wascher's criticism and confirmed their previous results, even using payroll data.

Some studies in the New Minimum Wage Research exploit panel data to identify the employment effects of the minimum wage. For instance, Card (1992) studies the April 1990 increase in the federal minimum wage over different states, taking advantage of the variation in the distribution of wages. Low-wage regions should be more affected by the minimum wage change. Regressing the change in state teen employment on the fraction of affected

[4] Notably, some exceptions are Flinn (2006) and Boadway and Cuff (2001) that also analyze the effect of the minimum wage on welfare.

[5] The shortcomings of the time-series approach are discussed in detailed in Card and Krueger (1995). They claim that minimum wage effects on employment should ideally be examined using microdata sources and a natural-experiment methodology. Furthermore, they argue that only substantial changes in the minimum wage can be sensibly used to estimate the employment effect.

workers (i.e. teenagers who earned between the old and the new minimum wage in 1989), and controls, Card does not find a significant effect of the 1990 minimum wage increase. On the other side, Neumark and Wascher support the disemployment effect of the minimum wage in a series of papers (1992, 2002, 2007b). An important difference among these studies is the measure of the minimum wage: Card considers the fraction of workers at or near the minimum wage, while Neumark and Wascher make use of the Kaitz index. The Kaitz index is a coverage-weighted minimum wage relative to the average wage and it is the most common measure of the minimum wage. Nonetheless many concerns have been raised with regard to its computation and its suitability to account for the minimum wage impact. Dolado et al. (1996) and Neumark and Wascher (2007) discuss the issue from several perspectives, but the suitability of the Kaitz index is still an open question.

In the end, the empirical literature has not been able, yet, to reach an agreement upon the effect of the minimum wage on employment, neither to establish the correct way to handle this issue.

How does economic theory explain the empirical controversial findings? Few cogent models have been proposed. One is the monopsony model, largely exploited and extended by Alan Manning(1995, 2003, 2004) in several papers. Firms are assumed to have some power in retaining workers and, therefore, some discretion over the wages they pay. If the minimum wage lies between the monopolistic wage and the competitive wage, a rise in its level may increase employment enhancing labor supply without dampening labor demand, but lowering firms' rent. Otherwise the minimum wage has a negative effect on employment. Monopsony can account for both positive and negative effects of the minimum wage, but it has been questioned the coherence of this framework with the low wage labor markets. Those markets are characterized by a large number of relatively small employers and high worker mobility; they are closer to perfect competition then to monopsony.

An alternative to monopsonistic power is a version of the efficiency wage model developed by Rebitzer and Taylor (1996). Employers have an incentive to limit employment in order to minimize the supervision cost, that is assumed to be increasing in firm's size. Higher minimum wage helps to solve the moral hazard problem: the cost of job loss to workers currently employed increases with the wage paid, so that the threat to dismiss shirking workers becomes more effective and lower resources need to be devoted to supervision and may be used to increase employment.

A matching model with endogenous search effort is also capable to produce different employment effect of the minimum wage. On one side, an increase in the minimum wage rises the value of working and may provide an incentive for unemployed to exert more effort in searching for a job. On the other side, the firm's rent diminishes and lower vacancy are posted, so that the probability to get a job decreases with opposite effect on the search effort. When the impact on search effort is positive, the matching process becomes more efficient and may compensate for the reduction in job openings.[6]

No doubt the employment effects of the minimum wage depend on the characteristics of the labor market to which it applies.

[6] See Flinn (2006) for an empirical analysis of the effect of the minimum wage on search effort.

In this paper we propose a different mechanism to account for the wide range of empirical results. Instead of focusing on the characteristics of the labor market, we look at the characteristic of the policy under analysis, the minimum wage variations. A change in the minimum wage may be expected or not by agents, with different employment effects. In particular, we show that disemployment is higher in case of an unexpected change. Still, labor marker characteristics contribute to shape the employment effect of the minimum wage.[7]

We argue that the empirical literature was not able to find conclusive results because the minimum wage variations under analysis were expected, so that the actual employment effect was relatively small and hard to identify. Marginal differences in the econometric strategy, in the dataset, or in the construction of the minimum wage index are then able to produce conflicting estimates. A clear example is the endless debate among Card and Krueger and Neumark and Wascher about the disemployment effect of the 1992 increase in New Jersey's minimum wage. That policy had been scheduled and announced in early 1990, two years before the actual change. The advance announcement allowed Card and Krueger to collect data pre and post the minimum wage variation, but it also allowed firms and workers to adjust their behavior. We expect that most of the employment effect had already occurred by the 1992 and the reaction to the actual increase in the minimum wage was little. In this case, estimates may not be robust to small variation in the data or in the econometric strategy.

3 The role of expectations

The role of expectations in shaping the behavior of economic agents is well documented and has been extensively used to understand a variety of situations in which speculation about the future is a crucial factor in determining current action. The theory of rational expectations was first proposed by John F. Muth in the early sixties and, in 1995, Robert E. Jr. Lucas won a Nobel prize for his studies on expectations and monetary policy.

It is widely recognized that the effect of a policy depends on agents' expectations. The "policy ineffectiveness proposition" by Lucas (1972) states the neutrality of economic policies that have their effects solely by inducing forecast errors. But also policies that operate by affecting incentives have to take into account agents' expectations. For instance, the permanent income theory of consumption predicts that a tax-cut is going to have only a marginal effect on consumption if agents expect it to be temporary.

Despite that, expectations have not been introduced in the analysis of the minimum wage policy. This is surprising, especially because variations in the minimum wage are often scheduled and announced in advance.

Table 1 shows that in many countries the minimum wage is revised on regular basis,

[7] Actually, in order for expectations to play a role, we need to assume some form of rigidities in the market. In a perfectly competitive market, an increase in the minimum wage always implies a fall in employment – regardless of expectations – because labor demand and labor supply depends only on current price and productivity. We consider matching frictions, so that the firm's current optimization problem depends also on future values and expectations.

typically once a year.[8] The frequency of adjustment is fixed by law, when the minimum wage is statutory, or by collective contracts, if the minimum wage is negotiated. Also the criteria guiding the minimum wage revision are often stated by law. This is the case in Belgium, Luxemburg, Netherlands, France, Portugal, Spain, Canada and other countries, where the minimum wage is updated taking into account inflation, or the level of average wages, productivity, or other indicators.[9]

In the light of these features, the minimum wage policy cannot be considered as an unpredictable shock. Agents operating in the labor market have the possibility and the incentive to form expectations about the timing and the magnitude of future minimum wage changes, because the profitability of an employment relationship depends also on the future wage. Expected variations in the minimum wage affect the current value of a job and, in turn, the job creation and job destruction decisions. Then, when the minimum wage actually increases, the employment adjustment will be small because it has been partly anticipated.

4 The model

The model is built to mimic the labor market of low wage workers. It is characterized by search and matching frictions, heterogeneous stochastic matches and endogenous separations. The wage is fixed at the minimum wage level.

Frictions are summarized by the matching function $m(v,u)$, with constant returns to scale. Unemployed workers and firms with vacancies meet with probability $p = \frac{m(v,u)}{u}$ and $q = \frac{m(v,u)}{v}$, respectively. Call market tightness the ratio between vacancies over unemployment, $\theta = \frac{v}{u}$. The higher is θ, the higher is the probability to find a job for a worker, p, and the lower is the probability to meet a worker for a firm, q.

The productivity of a match is a stochastic drawing, x, from a known probability distribution $H(x)$, at the time of the meeting. Observing x, the firm-worker pair decides whether or not to form the match and start production. Low realization of x may be rejected because of the prospect of a better job match in the future. The minimum level of productivity such that the match is formed is called hiring standard, a.

Match productivity x can be hit by a shock with frequency λ and the new productivity level is drawn from $H(x)$. Job separations occurs if the new productivity drawing is lower than the productivity threshold d. A match may also be destroyed when the minimum wage increases and, at the new wage, the job is no more profitable. In case of separation, a firing tax F is paid by the firm.[10] Note that, due to the separation cost F, the productivity threshold d is lower than the hiring standard a.

[8] The updating process concerns the nominal minimum wage. The real minimum wage varies continuously, due to inflation, and these variations may be expected or not. In the past two decades, inflation has been relatively low and stable, and we could argue that the real minimum wage changes were predictable and expected. In the model, we will abstract from changes caused only by inflation because they are marginal and not likely to significantly affect agents' behavior.

[9] Source: ILO database on the minimum wage policy.

[10] Employment protection legislation takes several forms in different countries: requirement to give a notice period to the worker before dismissal becomes effective; severance payments; possibility for the worker to contest the dismissal in front of a court; etc. Most of the literature consider only the cost incurred by the firm and paid outside of the match, which can be modeled as a tax. This is necessary in order for the

Firms know that the minimum wage may increase, and assign probability ϕ to this event. Over time expectations can be updated so that ϕ changes. We distinguish three phases. Initially, agents do not expect the minimum wage to rise, state 0, the wage is at level w_1 and the expectation parameter is $\phi_0 = 0$. In state 1 the subjective probability ϕ increases to $\phi_1 > \phi_0$,[11] the wage is still w_1 but it is expected to increase in the future with a positive probability ϕ_1. In the real world, expectations may be revised due to political announcements of a future variation in the minimum wage, or due to changes in the economic situation or in the political support such that the likelihood of an increase in the minimum wage varies. When the minimum wage actually rises, state 2, the expected event has taken place, so that the wage change to $w_2 > w_1$ and ϕ_2 is set back to zero.

The disemployment effect is analyzed in the two cases of expected and unexpected variation of the minimum wage.

4.1 Value functions

There is a continuum of identical households with total mass equal to one and a continuum of identical firms, each one holding one job. Each worker receives the minimum wage w. Given our assumptions, the value of a filled job reads:[12]

$$\begin{aligned} rJ_i(x) &= x - w_i + \lambda \textstyle\int_d^{x^u} [J_i(s) - J_i(x)]\, dH(s) + \lambda H(d)[V_i - F - J_i(x)] \\ &\quad + \phi_i \max\{V_i - F - J_i(x); J_2(x) - J_i(x)\} \qquad i = 0, 1 \end{aligned} \tag{1}$$

$$rJ_2(x) = x - w_2 + \lambda \int_d^{x^u} [J_2(s) - J_2(x)]\, dH(s) + \lambda H(d)[V_2 - F - J_2(x)] \tag{2}$$

where $w_0 = w_1$, $w_2 > w_1$, $\phi_0 = 0$, $\phi_1 > 0$.

A job produces x and costs w, with probability λ it is hit by a shock and its productivity is drawn from $H(x)$ over the support $\left[x^l, x^u\right]$. If the new productivity is below the threshold d, the job is destroyed and the firm gets a new vacancy V and pays F, otherwise the job is continued. In state 1, firms know that, with probability ϕ_1, the minimum wage will increase to w_2 and the value of a job moves to $J_2(x)$. The job is destroyed if its new value is lower then the firing cost. Note that $J_i(x)$ is decreasing in the wage w and in the expectation parameter ϕ.

The value of a vacancy is:

$$rV_i = -k + q(\theta) \int_a^{x^u} [J_i(s) - V_i]\, dH(s) \qquad i = 0, 1, 2 \tag{3}$$

employment protection legislation not to be overruled by an appropriate wage contract. In this model wages are exogenously fixed at the minimum wage level, therefore it is irrelevant whether the cost F is transferred to the worker or paid to a third part.

[11] We could assume that the initial subjective probability ϕ_0 is positive. Then we could compare the case in which expectations do not change with the case with updated expectations, from ϕ_0 to ϕ_1. Here we set $\phi_0 = 0$ because we want to compare an expected increase in the minimum wage, $\phi > 0$, with an unexpected increase in the minimum wage, $\phi = 0$. In order for these two policies to be comparable, we need to start from the same state of the world, i.e. $\phi_0 = 0$. Implications are qualitatively the same with $\phi_0 = 0$ or $\phi_0 > 0$, as long as $\phi_1 > \phi_0$.

[12] All the value functions presented in this section are at the steady state.

where k is the cost of posting a vacancy. The match productivity is drawn by $H(x)$. Conditional on meeting a worker, with probability $q(\theta)$, the match is formed and production takes place if the observed productivity is high enough, i.e. x is higher than a.

Note that, in this simple framework, we abstract from the behavior of workers. We assume that w is bigger than the workers' flow outside option, so that they are always willing to form a match and to continue it.

Firms post vacancies as long as their value is positive. Free entry ensures that, in equilibrium, the value of a vacant position is zero, i.e. $V_i = 0$. When a worker and a firm meet, they observe the match specific productivity x and decide whether or not to form the match. Given wage rigidity, it could happen that the match is profitable for the worker but not for the employer. Therefore, the match is formed only if the firm's surplus, $J - V$, is positive. The hiring standard solves $J(a) = 0$ and gives the lower bound for acceptable matches. Once the match is formed, the employment protection regulation becomes binding and the firm's outside option reduces from V to $V - F$. Therefore a job is destroyed only when its value falls below $-F$. The continuation decision is taken comparing the current productivity of the match with the threshold d. In turn, d is obtained from the condition $J(d) = -F$.

4.2 Expected increase in the minimum wage

We define an increase in the minimum wage as expected if it has been announced or if some exogenous events – for instance, the party in power changes from the right wing to the left – increase the likelihood of a change in the wage policy.[13] Recall that there are three states of the world, characterized by different wages w and expectation parameters ϕ. Expectations introduce interdependency among states. In particular, employment decisions taken in state 1 depends also on the value of matches in state 2.

In the following, we derive the equilibrium conditions and analyze the steady states and the transitions among states.

4.2.1 Equilibrium conditions

Let's solve the firm's problem backward. Substituting the value functions in state 2, namely equations 2 and 3, into the free entry condition, $V_2 = 0$, the match formation condition, $J_2(a_2) = 0$, and the job destruction condition, $J_2(d_2) = -F$, we get the equilibrium conditions:

[13]Note that, even if the minimum wage variation has been announced, this does not necessarily imply certainty about the future change. The evolution of the economic situation or of the political support may induce the government (or the unions, if the minimum wage is negotiated) to revise the annouced wage change.

An example is the 1992 increase in the New Jersey's minimum wage up to \$5.05 per hour. That variation had been scheduled in 1990, but the worsening of the New Jersey's economy rose concerns about the potential adverse impact of a higher minimum wage. The state legislature voted in March 1992 to phase in the planned increase over two years, but the vote fell just short of the margin required to override a gubernatorial veto, and the Governor allowed the \$5.05 rate to go into effect on April 1. In the end, the minimum wage increase took effect as originally planned, but expectations about it were far from certainty.

$$\frac{1}{r+\lambda}\int_{a_2}^{x^u}(s-a_2)\,dH(s)=\frac{k}{q(\theta_2)} \tag{4}$$

$$a_2=w_2-\frac{\lambda}{r+\lambda}\int_{d_2}^{x^u}(s-d_2)\,dH(s)+\lambda F \tag{5}$$

$$d_2=w_2-rF-\frac{\lambda}{r+\lambda}\int_{d_2}^{x^u}(s-d_2)\,dH(s) \tag{6}$$

Let's call these conditions JC, MF and JD, respectively. The solution to the system of three equations gives the hiring standard a, the job destruction threshold d, and market tightness θ. Note that a and d are increasing in w: a higher labor cost makes firms more choosy about forming and continuing a match. In contrast, θ is decreasing w: for any productivity level, the value of a filled job is lower, less vacancies are posted, and the labor market tightness θ diminishes.

In state 1 agents takes into account the future variation in the value of the match, and $J_1(x)$ depends on the value of a filled position in state 2. From equation 1, we have:

$$rJ_1(x)=$$
$$\begin{cases} x-w_1+\lambda\int_{d_1}^{x^u}[J_1(s)-J_1(x)]\,dH(s)-[\lambda H(d_1)+\phi_1][F+J_1(x)] & \text{if } x<d_2 \\ x-w_1+\lambda\int_{d_1}^{x^u}[J_1(s)-J_1(x)]\,dH(s)-\lambda H(d_1)[F+J_1(x)]+\phi_1[J_2(x)-J_1(x)] & \text{if } x\geq d_2 \end{cases} \tag{7}$$

Equation 7 is depicted in Figure 1 together with the value function of a job in state 2. The job value in state 1 is a piecewise function that changes slope at $x=d_2$. The first segment pertains to the low productivity matches, $x<d_2$, that won't be profitable after the minimum wage shock and will be destroyed. The second segment represents the high productivity matches, $x>d_2$, that will be continued after the policy shock.

Note that the value of a job in state 1 is always higher than the respective value in state 2 because, at least in the current period, firms pay a lower wage. Therefore the productivity thresholds a_1 and d_1 are unambiguously smaller than a_2 and d_2. The exact location of $J_1(x)$ depends on the value of the parameters of the model, in particular w_1, w_2 and F. Figure 1 shows two cases: $J_1^A(x)$ and $J_1^B(x)$. In case A the increase in the minimum wage causes the destruction of newly formed jobs, $a_1^A<d_2$. In case B the initial hiring standard fully anticipate the future rise in the reservation productivity, so that matches unprofitable in state 2 are not even formed in state 1, $a_1^B>d_2$. It can be proved that $J_1(x)$ falls in case A if the following condition is satisfied:

$$(r+\lambda+\phi)F<C \tag{8}$$

where $C=w_2-w_1+\frac{\lambda}{r+\lambda+\phi}\int_{d_1}^{d_2}(s-d_1)\,dH(s)+\frac{\lambda}{r+\lambda}\left[\int_{d_1}^{x^u}(s-d_1)\,dH(s)-\int_{d_2}^{x^u}(s-d_2)\,dH(s)\right]$.

Intuitively, when the increase in the minimum wage is high with respect to the firing cost F (case A), it is convenient to form some matches that will be destroyed after the policy shock, $a_1^A<d_2$,because the actual saving – the lower wage paid to the worker plus the value of production undertaken in state 1 – is higher than the future cost of separation. Viceversa,

when F is high with respect to the minimum wage variation, it is optimal to form only highly productive matches that will survive the policy shock, $a_1^B > d_2$.[14] Regardless of the exact value of $J_1(x)$, it is always true that the hiring standard a and the destruction threshold d are lower in state 1 than in state 2; and the market tightness θ is higher.

In state 0, agents do not expect the minimum wage to rise, i.e. they assign probability $\phi_0 = 0$ to this event. The value functions in state 0 are equal to the value functions in state 2, apart from the wage, which is $w_1 < w_2$. The solution of the equilibrium conditions gives the two productivity threshold, a_0 and d_0, that are lower then the respective values in state 1 and state 2, whereas θ_0 is higher.[15]

Knowing a, d, θ, we can compute the steady state unemployment level:

$$u_i = \frac{\lambda H(d_i)}{\lambda H(d_i) + \theta_i q(\theta_i)[1 - H(a_i)]} \qquad i = 0, 1, 2 \tag{9}$$

where $\lambda H(d_i)$ is the job destruction rate, defined as the ratio between total job destruction to employment, and $\theta_i q(\theta_i)[1 - H(a_i)]$ is the job finding rate, i.e. the ratio between total job creation to unemployment.[16] Unemployment is increasing in the job destruction threshold, d, and in the hiring standard, a, and it is decreasing in the market tightness, θ. It follows that the unemployment level is greater in state 1 than in state 0, and it is even higher in state 2.

4.2.2 Job flows and unemployment dynamics

We showed in the previous section that both the updating of expectations and the actual rise in the minimum wage have a negative effect on the job value of matches for any given productivity level. The comparison across steady state give us the following:

$$\left.\begin{array}{l} a_0 < a_1 < a_2 \\ d_0 < d_1 < d_2 \\ \theta_0 > \theta_1 > \theta_2 \end{array}\right\} u_0 < u_1 < u_2 \tag{10}$$

Moving from one state to the other the expected labor cost increases, then higher productivity will be required to form – higher hiring standard a – and to continue a match – higher job destruction threshold d – and less vacancies will be posted – higher market tightness θ. As a result, steady state unemployment increases.

[14] See Appendix A for a formal proof.

[15] The equilibrium conditions are formally derived in Appendix A.

[16] Equation 9 is obtained by setting to zero the change in unemployment:

$$\dot{u} = \lambda H(d)(1 - u) - \theta q(\theta)[1 - H(a)]u$$

where $\lambda H(d)(1-u)$ is the job destruction and $\theta q(\theta)[1 - H(a)]u$ measures the mass of job created. Recall that $q(\theta)$ is the probability of a firm to meet a worker, but not all meetings lead to a match, only those with productivity higher than a, that is $[1 - H(a)]$.

How does unemployment move from one steady state to the other? In general, the dynamics of unemployment is given by the difference between inflows, job destruction, and outflows, match formation, of workers from the pool:

$$\dot{u} = \lambda H(d)(1-u) - \theta q(\theta)[1 - H(a)]u \tag{11}$$

In steady state the two flows compensate each other and unemployment stays constant. The change in expectations and the increase in the wage act as a shock to the value functions, so that previous equilibrium parameters – a, d, θ – do not satisfy anymore equilibrium conditions JC, MF and JD. To ensure that agents are optimizing also out of the steady state, the key parameters as to vary in accordance with the shock. This in turn unbalances inflows and outflows and unemployment moves out of the steady state.

Consider the transition from state 0 to state 1. The initial values of open and filled positions are defined by equations 3 and 1 respectively, with $w = w_1$ and $\phi = 0$. Jobs are destroyed at rate $\lambda H(d_0)$ – job destruction rate – and new matches are formed at rate $\theta_0 q(\theta_0)[1 - H(a_0)]u_0/(1-u_0)$ – job creation rate. Flows are in equilibrium and unemployment is constant at level u_0. When an announcement or a political or economic shock takes place, expectations moves from $\phi_0 = 0$ to $\phi_1 > 0$ and value functions change to:

$$\begin{aligned} rV &= -k + q(\theta)\int_a^{x^u}[J(s) - V]\,dH(s) + \dot{V} & (12)\\ rJ(x) &= x - w_1 + \lambda\int_d^{x^u}[J(s) - J(x)]\,dH(s) + \lambda H(d)[V - F - J(x)] & (13)\\ &\quad +\phi_1 \max\{V - F - J(x); J_2(x) - J(x)\} + \dot{J} \end{aligned}$$

where $\dot{V}$ and $\dot{J}$ are the expected variation in the valuation of V and J over time. Optimizing conditions – $V = 0$, $J(a) = 0$, $J(d) = -F$ – applied to 12 and 13 gives the following system of equations:

$$\frac{1}{r+\lambda}\int_a^{x^u}(s-a)\,dH(s) = \frac{k}{q(\theta)} \tag{14}$$

$$a = \begin{cases} d + (r+\lambda+\phi)F & \text{if } J(d) > 0 \\ d + (r+\lambda)F + \phi\frac{d_2 - d}{r+\lambda+\phi} & \text{if } J(d) < 0 \end{cases} \tag{15}$$

$$\begin{aligned} d &= w_1 - \lambda\left[\frac{1}{r+\lambda+\phi}\int_d^{d_2}(s-d)\,dH(s) + [1 - H(d_2)]\frac{d_2 - d}{r+\lambda+\phi}\right] & (16)\\ &\quad -\frac{\lambda}{r+\lambda}\int_{d_2}^{x^u}(s-d_2)\,dH(s) - rF \end{aligned}$$

These equations do not depend on the time derivatives $\dot{V}$ and $\dot{J}$ and are identical to the equilibrium conditions for state 1 derived in Appendix A.[17] This means that the key parameters, a, d and θ, jump at the new steady state value as soon as the shock occurs and do not move any more. The only sticky variable is unemployment, u, that adjusts according to equation 11.

[17] It is easily showed that the optimizing conditions force the time derivatives $\dot{V}$ and $\dot{J}$ to be equal to zero. See Pissarides (2000) for a discussion of the out of the steady state dynamics. Formal derivations are available upon request.

The dynamics of flows and unemployment are depicted in Figures 2 to 4. On impact, the job destruction rate rises from $\lambda H(d_0)$ to $\{\lambda H(d_1) + [H(d_1) - H(d_0)]\}$. The variation follows the increase in the job destruction threshold, d, and the separations of all matches with productivity x in the range $d_0 \leq x \leq d_1$. Then job destruction drops to $\lambda H(d_1)$ till the next shock. The job creation rate decreases from $\theta_0 q(\theta_0)[1 - H(a_0)]u_0/(1-u_0)$ to $\theta_1 q(\theta_1)[1 - H(a_1)]u_0/(1-u_0)$, because of the higher a and the lower θ. Then, as long as unemployment increases, job creation rises until it matches the higher job destruction rate at the new steady state.[18]

On impact unemployment also jumps, following the rise in the job destruction flows, but does not reach the new steady state level in one step. As long as the job destruction rate is higher than the job creation rate, the unemployment level increases and it adjusts slowly to the new steady state level u_1.[19] This is a well known property of the matching model (see Pissarides (2000)): frictions imply that unemployment is a predetermined variable and follows a stable and backward looking process governed by the difference between the job creation and the job destruction flows.

Once the minimum wage actually increases a second transition path starts, from u_1 to u_2. The hiring standard and the job destruction thresholds jump to the new steady state values a_2 and d_2, and market tightness falls to θ_2. Job flows follow the same transition path discussed before and unemployment gradually rises.

The disemployment effect of the minimum wage is distributed over time: a first increase occurs between the announcement and the actual change

$$\Delta u_{ex-ante} = u_1 - u_0 \tag{17}$$

a second increase takes place following the actual variation in the minimum wage

$$\Delta u_{ex-post} = u_2 - u_1 \tag{18}$$

4.3 Unexpected increase in the minimum wage

A minimum wage variation is unexpected if agents never assign a nonzero probability to the event. When the minimum wage actually increases, this is a shock to the economy that switch directly from state 0 to state 2.

[18] The dynamics of the job finding rate – i.e. the ratio between the number of newly formed match and unemployment, $\theta q(\theta)[1 - H(a)]$ – are depicted in Figure 4. The job finding rate does not depend on u, therefore it jumps down from $\theta_0 q(\theta_0)[1 - H(a_0)]$ to $\theta_1 q(\theta_1)[1 - H(a_1)]$ without any transition.

[19] The lenght of transitions depends on the primitive parameters of the model, in particular it depends on the efficiency of the matching function. It may happen that at the time the minimum wage is actually increased the transition has not finished yet, so that the steady state 1 is never reached. In order to simplify the comparisons among states we assume that the steady state 1 is reached before the minimum wage variation occurs. Conclusions would be qualitatively the same if we allowed for a more general case but it would be difficult to quantify the unemployment level at the time of the minimum wage change and the following disemployment effect.

Value functions and equilibrium conditions have been discussed in the previous sections. In this case we do not observe state 1 – the state with positive expectations about a change in the minimum wage – but we can use the results showed for state 0 and state 2. As in the model with expectations, when the minimum wage increases the job destruction threshold d and the hiring standard a increase, while market tightness θ decreases. Therefore steady state unemployment increases.

The unemployment dynamics are represented by the dotted line in Figure 2. There is only one transition, from state 0 to state 1. After the increase in the minimum wage, the unemployment moves from u_0 to u_2. The transition path of job flows and unemployment has been detailed in the previous section.

Note that, when the increase in the minimum wage is unexpected, the disemployment effect takes place only after the actual variation.

$$\Delta u = u_2 - u_0 \tag{19}$$

4.4 Comparison

Both expected and unexpected increase in the minimum wage lead to a rise in the unemployment rate. as regards the overall disemployment effect, i.e. the increase in unemployment occurred between state 0 and state 2, there is no difference among the expected and the unexpected policy variation. The difference is in the dynamics.

When the rise in the minimum wage is expected, the disemployment effect is split between the ex-ante effect – before the actual change – and the ex-post effect – after the actual change. Instead, when the increase in the minimum wage is unexpected, the disemployment effect is concentrated ex-post.

This distinction is not irrelevant when it comes to the empirical estimation of the minimum wage impact. Empirical studies analyzed the ex-post effect. But we just showed that when the minimum wage variation is expected the ex-post effect is only a part of the total effect. Firms anticipate the policy and adjust their behavior in advance so that the ex-post impact of the minimum wage will be smaller. Unemployment increases less – from u_1 to u_2 – and the jump in job destruction and in the job finding rate – i.e. job creation over unemployment – is lower:

$$\frac{JD}{1-u} \quad : \quad \lambda H\left(d_2\right) - \lambda H\left(d_1\right) < \lambda H\left(d_2\right) - \lambda H\left(d_0\right) \tag{20}$$

$$\frac{JC}{u} \quad : \quad \theta_1 q\left(\theta_1\right)\left[1 - H\left(a_1\right)\right] - \theta_2 q\left(\theta_2\right)\left[1 - H\left(a_2\right)\right] < \begin{array}{l} \theta_0 q\left(\theta_0\right)\left[1 - H\left(a_0\right)\right] \\ -\theta_2 q\left(\theta_2\right)\left[1 - H\left(a_2\right)\right] \end{array} \tag{21}$$

The goal of this paper is to provide an explanation for the controversial empirical findings, therefore we focus on the ex-post effect. Note that expectations do not neutralize the disemployment effect of the minimum wage, but they reduce its magnitude. This may help understanding the difficulties in supporting the disemployment effect with robust empirical evidence. In order to obtain a null or even positive employment effect we would need to include labor participation or search effort decisions, but this goes beyond our purposes.[20]

5 Empirical analysis

The model presented in Section 4 predicts that a certain increase in the minimum wage leads to a higher (ex-post) disemployment effect when it is unexpected than when it is expected. Testing the model requires the discrimination among expected and unexpected minimum wage changes. In general it is not possible to observe individual expectations about policy changes, but the recent story of Spain provide a useful identification strategy.

5.1 Institutional framework

The Spanish law provides the minimum wage to be adjusted every half a year, taking into account the cost of living, the level of wages and incomes in the country, the evolution of productivity, and the economic situation. But in practice the government sets the interoccupational minimum wage only one a year by Royal Decree, following a period of consultation with the most representative trade unions and employers' associations. The new amount becomes mandatory from the first of each following January.

The minimum wage legislation applies to workers from all occupations, trades and economic sectors. Subminimum wages are specified for trainees – subminima cannot be less than 70, 80 and 90% of the inter-profession minimum wage for the first, second and third year of validity of the contract. Until 1997 the government fixed two minimum wages: one for adult workers (+18 years old) and another for workers aged between 16 and 18. The difference was eliminated in 1998.

This particular setting suggests that minimum wage changes can be foreseen. Furthermore, Spain enjoyed a considerable political stability after the death of Franco and the birth of democracy. From 1977 to now, Spain had four prime ministers only: Adolfo Suárez, centre-right coalition, Felipe González, PSOE, José María Aznar, People's Party, and José Luis Rodríguez Zapatero, Socialist Party. Political stability may have facilitated the formation of clear expectations.

The prediction of minimum wage changes was trivial during the second Aznar's mandate. José María Aznar López served as the President of the Government of Spain from 1996 to 2004. In 1997 the government promoted a process of dialogue with trade unions and

[20] In this model we abstract from workers' decision about optimal search effort. When the minimum wage increases, the value of being employed increases and could induce workers to exert more effort in searching for a job with positive effect on employment. On the other hand, higher minimum wage means also lower vacancy posting that is detrimental to the search effort. The net effect is ambiguous and there is no consensus on the empirical evidence.

Neumark and Wascher (1995) found a positive and significant effect of the minimum wage on young workers' search effort and used this evidence to explain the weak disemployment effect found in some studies. On the other side, Flinn (2006) did not find significant support for the minimum wage to rise the contact rates.

employers' organizations for the preparation of labor market reforms. The concertation led to three agreements: Interprofessional Agreement on Collective Bargaining, Interprofessional Agreement on Employment Stability, and Interprofessional Agreement to Fill the Gaps in Collective Bargaining.[21] As regards the wage setting, unions accepted wage moderation in exchange for a limitation in the use of temporary contracts. In the following period the minimum wage rose by two per cent each year, according to the inflation target. Taking into account the real inflation, this meant a slight but persistent decrease in the real minimum wage.[22]

Instead the increase in the minimum wage in July 2004 was largely unexpected, in the timing and in the magnitude.

On 14th March of 2004, three days after the terrorist attack, the Spanish socialist party won the election and José Luis Rodríguez Zapatero became the new premier. An important point in the socialist agenda was the increase in the minimum wage up to 600 euros by the end of the mandate. Soon after the election Zapatero announced a rise in the minimum wage by 6.6%, mandatory from the beginning of July.

The Economist called Zapatero "the unexpected prime minister", speculating that his success was related, at least partly, to the train bombs in Madrid. On the 11th March of 2004 three trains exploded in Atocha Station in Madrid. The explosions killed 191 people and 1,500 were wounded. It has been the largest peacetime attacks in Spanish history.

Spain was involved in Iraq war as an U.S. ally and has been threatened reprisals by Bin Laden in the October of 2003. Nevertheless, the conservative government pointed in the direction of ETA – the Basque separatist group that seeks the independence of the Basque country – as the author of the attack. This claim was not taken back despite many hints in the direction of Al-Qaeda. By the afternoon of the 13th of March it was already quite clear that the attack was executed by an Islamic terrorist group. Blaming ETA against the facts turned out to be a serious mistake for the right wing. The government was accused of manipulating information about the real authorship of the attacks to avoid the consequences of public anger at a bombing motivated by its foreign policy. Zapatero himself repeatedly accused the Popular Party of lying about those who were responsible for the attacks and promised to withdraw Spanish troops from Iraq, in case he was elected.

Before the bombing opinion polls had pointed to a win for the People's Party (PP), but in a few days the election result was reversed. In a recent paper Montalvo(2006) identifies the effect of the terrorist attacks on the election result comparing the voting behavior of the presential voters with respect to the absentee voters, i.e. the citizens abroad. The first group voted on the 14th of March, knowing about the terrorist attacks. The latter group was allowed to start voting from the 2nd of March, so that they could have voted before the bombing. A difference in difference estimator is constructed using data on voting results of Congressional elections from 1993 to 2004. The estimate shows that the terrorist attack reduced the support for the PP by approximately 5 percentage point. Therefore, the election of the socialist party was as unexpected as the event, the bombing, that contributed to its

[21] See Molina Romo (2003, 2004) for an analysis of the concertation process in Spain in the 90s.

[22] The lowering of the real minimum wage was not a new experience for Spain. Table 3 shows that also before the Aznar government, despite the high increase in the nominal minimum wage, the real one was most of the time decreasing or roughly stable, due to the great inflation in the 80s. The novelty was the concertation process and therefore the broad agreement and widespread knowledge of this plan.

realization. It follows that the July-2004 rise in the minimum wage was also unexpected, as opposed to the widely expected variation previously carried out by the conservatory party.[23]

The Spanish case provide us with two types of minimum wage changes: expected, pre-bombing, and unexpected, July-2004. Now we can test the prediction of the model concerning the influence of expectations on the disemployment effect.

5.2 Data

Data used in the empirical investigation comes from the Economically Active Population Survey (EPA) 2000-2006.[24] EPA is a rotating quarterly survey carried out by the Spanish National Statistical Institution. Its main goal is to reveal the characteristics of the population living in the Spanish national territory.

The planned sample size consists of about 64,000 households with approximately 150,000 individuals aged sixteen or more. The survey's rotation scheme implies that every new rotation group stays in the survey for six consecutive quarters, so that we can follow the employment story of individuals for one year and a half. The questionnaire is submitted to a single household respondent who answers for all the persons living in the household. The household respondent may change between successive interviews. This allows low attrition rate but increases the measurement error, especially in retrospective questions.

The questionnaire is composed of several sections asking about educational attainment and working status of each individual in the household. The reference period for most questions is the week before the interview. The first quarter of each year also includes retrospective questions about the working status of the individual one year earlier. There are no information about earnings.

Table 3, lower panel, shows that labor market participation is relatively low in Spain: over the 2000-2006 period only around 50 per cent of the Spanish labor force was employed, and 7 per cent was unemployed. Yet, participation rate was increasing, from 0.53 in 2000 to 0.64 in 2006, driven from the higher participation of the youth whose employment rate augmented from 34.5 to 42.2 per cent. Unemployment followed a decreasing trend and flows into employment greatly increased, especially for the youth. On the other side employment stability lowered and separations increased as well. Note that the share of temporary workers is considerably high in Spain: almost 70 per cent of the youth and 30 per cent of the adults are employed under temporary contracts.

[23] At the time of the election, the July-2004 rise in the minimum wage became expected. We assume that the time passed between the election and the actual rise in the minimum wage, two months, is not long enough to allow agents to pre-adjust to the policy. Empirically, this is not a matter of concern because data are quarterly, and it is not possible to distinguish March 2004, the election, from July 2004, the minimum wage variation.

[24] INE, Enquesta de Población Activa, Anonimizado de Flujos, 2000-2006.

5.3 Econometric issues

Two sets of equations are estimated. At first we analyze the effect of the minimum wage variation on the probability of being employed. Then, following Portugal and Cardoso (2006), we concentrate on flows in and out of employment, and we relate them to the change in the minimum wage. Analyzing the dynamics of flows, instead of the evolution of the employment or the unemployment stock, allows us to identify the exact source for employment changing and to better appreciate the role of the minimum wage even when the net disemployment effect is small.

Exploiting the structure of the survey we can match 5/6 of the individuals in any two consecutive quarters and check whether they changed status or not. We only distinguish between employment and non-employment. The reason is that we are primarily interested in the effect of the minimum wage on the youth, for whom unemployment and nonparticipation in the labor force are typically not distinct states. Our dependent variables are the employment status and the flows out of and into employment, namely: (i) y_{it}^{e} is equal to 1 if individual i is employed in quarter t, 0 otherwise; (ii) y_{it}^{out} is equal to 1 if individual i is employed in quarter t and non-employed in quarter $t+1$, and it is set at 0 if she is employed both at t and $t+1$; (iii) y_{it}^{in} is equal to 1 if individual i is non-employed in quarter t and employed in quarter $t+1$, and it is set at 0 if she is non-employed both at t and $t+1$. We use the same econometric framework to model the probability of being employed and of switching status, the probit model:

$$\Pr\left(y_{it}=1\right)=\Phi\left(W\delta\right) \tag{22}$$

where $\Phi\left(\cdot\right)$ is the cumulative distribution of a standard normal.

Note that $\Pr\left(y_{it}^{e}=1\right)$ is empirically equivalent to the employment probability; $\Pr\left(y_{it}^{out}=1\right)$ and $\Pr\left(y_{it}^{in}=1\right)$ corresponds to the job destruction rate to employment, $\lambda H\left(d\right)$, and to the job finding rate, $\theta q\left(\theta\right)\left[1-H\left(a\right)\right]$, respectively. Our model predicts that a rise in the minimum wage have higher effect on employment (decrease), job destruction (increase) and job creation (decrease) when it is unexpected than when expected.

The key variable is the variation – quarter to quarter – in the real minimum wage. The influence of expectations on the disemployment effect is identified comparing the change in flows and employment probability following unexpected and expected variation in the minimum wage. As explained in Section 7.1, the increase in July 2004 was unexpected. It is identified by the variable U_{MW} which is equal to 6.7 in the third quarter of 2004,[25] and zero elsewhere. All the other variations occurred to the real minimum wage are considered as expected, including those related to inflation, E_{MW}.

Table 2 shows that during Aznar's mandate, the real minimum wage moved very little, whereas it increased significantly when Zapatero came into power. We may expect the marginal effect of an increase in the minimum wage to be different in the two periods. Therefore an alternative specification have also been estimated, comparing the effects of U_{MW} with a new variable, Z_{MW}, that takes value zero except for the minimum wage rise in

[25] Zapatero increase the nominal minimum wage by 6.6 per cent. From quarter 2:04 and 3:04 inflation declined by 0.1, therefore the variation in the real minimum wage between 2:04 and 3:04 is 6.7.

the first quarter of 2006. This means we are assuming that the small movements arranged by the right wing or due uniquely to inflation had no impact on employment nor flows.

Changes in the minimum wage do not affect all workers, but only those who are low-earners. Following most of the literature we identify the treatment group with the young because they are more likely to be affected by the minimum wage policy. The control group is composed by the adult. A difference in difference approach is applied to estimate the following regression:

$$\Pr(y = 1) = \Phi(\alpha_0 + \alpha_1 Y + \alpha_2 Y * U_{MW} + \alpha_3 Y * E_{MW} + T\eta + X\beta + \varepsilon) \tag{23}$$

where Y is a dummy equal to 1 when the individual is aged 16-24 and 0 if older;[26] T is a set of time dummies, one for each quarter; and X is the set of covariates, including gender, education, and the region of residence. The coefficient α_2 captures the effect of the unexpected (2004:3) increase in the minimum wage on the treated group, α_3 measures the effect of the expected changes. The difference between the two coefficients gives a measure of the difference in the impact of expected and unexpected changes in the minimum wage. Let's illustrate the result in a simple case with only two periods. Equation 23 reads:

$$\Pr(y = 1) = \Phi(\alpha_0 + \alpha_1 Y + \alpha_2 Y * U_{MW} + \alpha_3 Y * E_{MW} + \eta_1 U + \eta_2 E + X\beta + \varepsilon) \tag{24}$$

where U and E are two time dummies that take value 1, respectively, at the quarter 2004:3 – unexpected change in the minimum wage – and 2002:1 – expected change. Young individuals have probability $\alpha_0+\alpha_1+\alpha_2+\eta_1+X\beta$ of being employed (or switching status) in period 2004:3, and probability $\alpha_0+\alpha_1+\alpha_3+\eta_2+X\beta$ in period 2002:1. The difference in the impact of unexpected and expected changes in the minimum wage is $(\alpha_2 + \eta_1) - (\alpha_3 + \eta_2)$, for the youth. Similarly we can compute the differential for the adult as $(\alpha_0 + \eta_1 + X\beta) - (\alpha_0 + \eta_2 + X\beta) = \eta_1 - \eta_2$. Subtracting one differential from the other, we get

$$(\alpha_2 + \eta_1) - (\alpha_3 + \eta_2) - (\eta_1 - \eta_2) = \alpha_2 - \alpha_3 \tag{25}$$

which is the differential in the effect of unexpected and expected changes in the minimum wage on employment (or flows), net time trend. Our model predicts this difference to be positive in absolute values.[27]

[26] We consider only workers aged up to 54 years. Older workers are not included in order to minimize the contamination of results generated by early retirement decisions.

[27] Strictly speaking, the proposed approach is not a difference in difference. The first stage difference is not among pre-treatment probability and post-treatment probability, but between two different treatment. We could consider this specification as a difference in difference in difference. The initial difference, omitted in the text, is the usual first stage:

$$(\alpha_0 + \alpha_1 + \alpha_2 + \eta_1 + X\beta) - (\alpha_0 + \alpha_1 + X\beta) = \alpha_2 + \eta_1$$

which is the impact of the unexpected change in the minimum wage for the youth, and:

$$(\alpha_0 + \eta_1 + X\beta) - (\alpha_0 + X\beta) = \eta_1$$

which is the relative impact on the adult. Similarly, the impact of the expected change in the minimum wage would be $\alpha_3 + \eta_2$ for the young, and η_2 for the adult.

The second stage would be the difference among the impact on the young and on the adult for the two different treatment: $\alpha_2 + \eta_1 - \eta_1 = \alpha_2$ for the unexpected change and $\alpha_3 + \eta_2 - \eta_2 = \alpha_3$ for the expected change.

In the end, the third difference turns out to be $\alpha_2 - \alpha_3$.

The main concern in a difference in difference approach is the choice of proper treatment and control groups.[28] Unfortunately EPA survey does not provide data about earnings, therefore we cannot precisely disentangle the low wage workers, instead we exploited the information from the Wage Structure Survey. Table 4 reports the annual average earnings of Spanish workers in 2002 computed by age, gender, and educational attainments. Young workers receive significantly lower wages, 9,686.12 euros whereas the overall average is 19,802.45 euros. This supports the traditional comparison between young and adult individuals. But the 2002 annual minimum wage was set at 6,190.80 euros and among the youth there are also high or medium wage earners who are not affected by the minimum wage change. Female workers always get lower wages than males, especially if they are young and low educated (without studies or primary education). Therefore several specification have been estimated: (i) the young versus the adults; (ii) young females versus adult females; (iii) young females with low education versus adult females with low education.

The model has also implication for the timing of the treatment effect: an expected change in the minimum wage affects employment both before and after the actual variation, but an unexpected change in the minimum wage may have effect only after. While there is only on impact effect on flows (see Figure 3 and 4). The dynamics is introduced in equation 23 for the employment probability including *pre* and *post* effect:

$$\Pr\left(y^e=1\right)=\Phi\left(\begin{array}{c}\alpha_0+\alpha_1 Y+\alpha_2 Y*U_{MW}+\gamma_1 Y*U_{MW-pre}+\gamma_2 Y*U_{MW-post}\\ +\alpha_3 Y*E_{MW}+\gamma_3 Y*E_{MW-pre}+\gamma_4 Y*E_{MW-post}+T\eta+X\beta+\varepsilon\end{array}\right) \tag{26}$$

where $Y*U_{MW-pre}$ ($Y*E_{MW-pre}$) accounts for the impact of the unexpected (expected) change in the minimum wage in the period preceding the actual change, and $Y*U_{MW-post}$ ($Y*E_{MW-post}$) accounts for the impact in the following period.[29] The recent empirical literature (see Neumark and Wascher (2007)) stresses the importance of including lagged effects of the minimum wage because it may take time to adjust to policy changes, we also include anticipated effects. The question is in the setting of the length of dynamic effects. It a short length is chosen, it may miss part of the story, if too long it may capture events different from the policy under consideration. Therefore equation 26 is estimated using different lengths, from 0 to 4 quarters.

The employment outflows regressions are replicated also focusing on temporary or permanent workers separately. The Spanish labor market is characterized by the coexistence

[28]Note that the estimate of equation 23 does not suffer from inconsistency of standard errors because the treatment, i.e. the minimum wage variation, is not serially correlated. See Bertrand, Duflo, and Mullainathan (2004).

[29]In practice $Y*U_{MW-pre}$ ($Y*U_{MW-post}$) is set at 6.7 when the status y refers to a young individual in x quarters preceding (following) July 2004; $Y*Z_{MW-pre}$ ($Y*Z_{MW-post}$) is equal to 5.4 in x quarters preceding (following) January 2006. With regard to $Y*E_{MW-pre}$ ($Y*E_{MW-post}$), we assume that only the variation in the real minimum wage associated to the yearly updating can have pre and post effect, whereas those due to inflation may only have on impact effect. This hypothesis is sensible in an environment of low inflation. Furthermore we assume that, before July 2004, the expectede increase in the real minimum wage was constant at 2 per cent minus the inflation rate. Therefore the increase of 4.9 per cent in January 2005 is lowered to 2.4 when associated to quarters preceding July 2004.

The estimated coefficient associated to the *pre* (*post*) effects account for the average effect of the minimum wage variation within the *pre* (*post*) period.

of two types of employment contracts: fixed-term and open-ended contracts. The former are associated with low employment protection, whereas the latter are strongly protected by high separation costs and just-cause standard. An increase in the cost of labor is likely to affect the two groups of workers in a different way. Firms will rather adjust the work-force dismissing temporary workers, instead of paying firing costs to terminate a permanent contract.

6 Empirical results

Main results are reported in Tables 5 to 9. Estimates for the full set of regressions are not included here but available upon request.

6.1 Employment probability

Consider first employment probability. Our model predicts a decrease in employment at the time of the minimum wage increase. Furthermore transitions are expected in the following period and, if the policy is expected, in the preceding quarters .

Marginal effects of a one percent increase in the minimum wage on the average individual are shown in Tables 5 and 6. The first column includes only the on impact effect of the minimum wage, the dynamics are added in column (2) and (3).[30] We control for time effects, region, age, gender and education. As anticipated in the previous Section, two specifications are implemented – using E_{MW} or Z_{MW} as expected-minimum-wage variable – for different treatment and control groups. Note that the common variables are robust across specifications.

The upper panel compares young versus adult individuals. Surprisingly the on impact effect of the unexpected change in the minimum wage is significantly positive: a 1 per cent rise in U_{MW} is estimated to increase employment probability by 0.3 per cent. Only the *post* effect is negative. Its magnitude decreases as the length of the dynamics increase[31], suggesting that transitions are relatively short. The *pre* effect is statistically null. This confirms the unexpected nature of U_{MW}. The estimates associated to the expected change in the minimum wage depend on the specification. When we consider all the expected variations occurred before and after Zapatero election, E_{MW}, both the on impact and *pre* effects are null. Let's recall that the minimum wage was increased very mildly during the Aznar's mandate. If employment reacts only to substantial variation in the minimum wage, as argued by Card and Krueger (1995), this non linearity is not accounted in the econometric model and may bias the result. Furthermore the wage moderation policy carried on by Aznar dates back to the agreements in 1997 and its effect may have been fully anticipated by 2000. Therefore we focus on the second specifications, U_{MW} versus Z_{MW}. In this case, only the January 2006 variation is considered as expected. The on impact and *pre* effects are significantly negative, as predicted by the model.

[30] Tables 5 and 6 shows estimates for the dynamic effect of the minimum wage two quarters before and after the actual change. Results for different transition lenghts are detailed in Appendix B1, available upon request.

[31] These results are not reported here, but available upon request.

The second panel restricts the sample to females. Results are similar in magnitude, but only the *post* effect of U_{MW} is statistically significant. In the lower panel, we compare young females with low education with adult females with low education. The coefficients associated to the expected variation Z_{MW} are negative and significant both on impact and in the dynamics – but the *pre* effect is only marginally significant – in line with model predictions. The unexpected change reduces employment only ex-post.

How do we explain the positive or not significant effect of the unexpected increase in the minimum wage? Part of the story may lie on the surprise: Zapatero was unexpectedly elected in March 2004 and after 3 moths the minimum wage was substantially raised. Economic agents need time to weight the importance of a shock and to react, so that the negative effect is found only ex-post. But other forces may play a role: the change of power from the right wing to the left and the subsequent rise in the minimum wage could have increased the workers' confidence in the labor market, enhancing participation and active job search. This is confirmed by the jump in participation rates, especially of young people.

6.2 Flows out of employment

Regressions in Tables 7 and 8 compare the flows out of employment following expected and unexpected changes in the minimum wage, for the treatment and the control group. All specifications control for time effects, region, age, gender, education, contract type, working day, sector, occupation, whether the individual was employed in the public sector and whether she attended any courses during the last month. Estimates of the marginal effects for the full sample of workers are reported in column (All).

The upper panel shows results for young versus adult persons. In both specifications the estimated on impact effect of the unexpected increase in the minimum wage is significantly positive and higher than the corresponding effect of the expected change, which is not statistically different from zero. A 1 per cent unexpected increase in the minimum wage is associated to an increase in job separation probability by 0.2 per cent, while the effect is null after an expected minimum wage rise. These results are consistent with model predictions: expectations reduce the effect of the minimum wage at the time of the actual variation.

Regressions in the second panel compare young females with adult females. Previous results are confirmed: U_{MW} has greater effect than E_{MW} and Z_{MW}. The same is true in the third panel, which considers only females with low education. Note that the effect of the minimum wage, both expected and unexpected, increases as we restrict the sample. This support the idea that we better identified the treatment group in the lower panels. On the other side, the size of the sample substantially shrinks.

The other columns of Tables 7 and 8 report estimates associated to temporary and permanent workers. The second column considers flows from temporary jobs to non-employment. An increase in U_{MW} implies a significant rise in the job separation probability. Coefficients associated to expected changes in the minimum wage are smaller and not significant. Permanent workers, third column, are not affected by the minimum wage, all the coefficients are statistically null. Results are somewhat different if we consider the subsample of low educated females in the third panel. Permanent workers are significantly affected by the unexpected policy, but the coefficient associated to temporary workers is higher, albeit only marginally significant. Still, the effect of E_{MW} and Z_{MW} is lower and not significant.

Note that the difference in the coefficients of U_{MW} between the two types of worker cannot be entirely traced back to the role of firing costs. On one side, employment protection may prevent permanent workers to be dismissed by increasing the adjustment cost with respect to temporary workers.[32] On the other side, the productivity distribution do matters: temporary jobs may be, on average, less productive and a higher share fall under the job destruction threshold when the minimum wage increases.[33] Anyway, we are interested in the difference between the impact of expected and unexpected change in the minimum wage within the same group of workers. As regards temporary workers, we find support for the higher effect of unexpected policy with respect to expected variations.

All regressions take into account several control variables. Time and regional dummies are mostly significant. Young workers are more likely to separate, their probability to exit employment is 1 to 2 per cent higher than adults. Being female increases this probability by another 2 per cent. The characteristics of the employment relationship also matters: part time workers are associated to higher mobility – except if we restrict our attention to the subsample of female with low education – and, not surprisingly, temporary contracts entail greater separation rates. On the other side, education faintly reduces job exit. Both positive and negative effects are somewhat stronger for temporary workers, and weaker for permanent ones.

6.3 Flows into employment

According to the model, higher labor cost should lead to lower flows into employment, but estimates in Table 9 are largely not significant and positive for both expected and unexpected changes in the minimum wage. The increase in the minimum wage had either no effects on employment inflows, either a positive effect. In Section 6.1, we found a positive or not significant employment effect of the minimum wage, on impact. Now we are able to characterize it: when the minimum wage augments job destruction increases but it is counterbalanced by the rise in job creation.

Not surprisingly, the young have greater probability to enter a job. Females are associated to inflows smaller by 6.6 per cent. They appear to be discriminated both in entering and exiting the labor market, but the lower participation rate and unobservable characteristics may contribute in explaining these results. Adopting and active method of search – such as inquiring the job centre, or private employment agencies, contacting directly employers, etc. – helps finding a job. Education has a positive effect. In particular, having a university degree augments the probability to enter a job by 7% (8.3% in the subsample of females). The region of residence and the period affect the outcome.

[32] The counterbalancing effect of EPL on the disemployment impact of the minimum wage is claimed also by Neumark and Wascher (2004). Using a panel of several countries, they estimate the disemployment effect of the minimum wage to depend, negatively, on the degree of employment protection.

[33] When finding an occupation is easier in the market of temporary jobs, lower skill workers are likely to self-select themselves into this market, whereas permanent jobs will be filled by higher skill workers.

6.4 Discussing the results

We claim the disemployment effect of the minimum wage to be different depending on whether it was expected or not. Our results partly confirm this idea: the rise in job separations is estimated to be stronger in case of an unexpected changes in the minimum wage, with respect to expected variations. The difference is statistically significant and not negligible: a 10 percent increase in the minimum wage is associated to an augment in the job-exit probability by 2% (4% if only females are taken into account) if unexpected versus not significant effect if expected. On the other side, job creation rates do not appear to be affected by changes in the minimum wage.[34] The model presented in Section 2 predicts a loss in job creation, but it has to be stressed that our model abstracts from the workers' behavior. A matching model including the workers' decision about the optimal search effort would be able to reproduce these results. The rise in the minimum wage may induce agents to exert more effort in looking for a better paid job, thus increasing the efficiency of the match process and counterbalancing the lower vacancy posting. The evolution of the participation rate goes in this direction: the youth's participation rate was, on average, 47.5 per cent in 2000-2003, it jumped to 49.2 in 2004, and 52.1 in 2005. Higher participation has the same effect on flows than greater search effort and may account for the lack of response in job creation rates.

Depending on the sample used, we estimate a positive or null disemployment on-impact effect of the unexpected increase in the minimum wage. The analysis of flows allows us to trace back this result to the increase in job inflows compensating the higher job separations. Empirical evidence suggests that young individuals reacted to Zapatero election and the rise in the minimum wage by participating more and more effectively in the labor market. But over a longer period the negative effect prevailed and employment was reduced, resulting in a negative ex-post effect. On the other side, small expected changes in the minimum wage, as during the Aznar mandate, had no significant effect on employment. The substantial expected increase occurred in January 2006 is estimated to have negative, albeit not always significant, on impact and dynamic effects.

The effect of the minimum wage is found to be different depending on the employment relationship: temporary workers are highly affected, especially by unexpected variations. On the contrary there is no evidence of increased job separations for permanent workers. This may be due to the protection guaranteed by firing costs – whenever a labor force adjustment is needed, a firm will rather cheaply dismiss temporary workers – or to differences among the two types of workers – if temporary ones are, on average, less productive, a higher share will be affected by the minimum wage.

[34] These findings are at odds with Portugal and Cardoso (2006). Their results point out a negative effect of the minimum wage on hirings, and a decrease in job separations for young workers explained by higher job attachment. Instead, we find no effect on hirings and an increase in separations. Nevertheless, the discrepacy is not crucial because of the different focus of their analysis. Portugal and Cardoso study the impact of the increase in the sub-minimum wage for workers aged 17-19 years, in Portugal, and compare those individuals with a control group composed by persons aged 20-35 years. Whereas in our study the treated are aged 16-24 years and controls are 25-54 years old. It should not be surprising that comparing teenagers with young individuals gives different results from the comparison between the young and the adults.

7 Conclusion

Empirical literature on minimum wages is characterized by controversial results. It is far from clear whether a policy that increase the minimum wage has a negative effect on employment or not. Nor economic theory provides a clear prediction.

This paper contributes to the debate by proposing a mechanism capable of reconciling conflicting findings. The key ingredient is the distinction between expected and unexpected changes in the minimum wage. The role of expectations in shaping the behavior of economic agents has been extensively studied in a variety of subject, but not in the analysis of the minimum wage effect. In many countries law determines the level of the minimum wage and the periodicity of its revision. Sometimes it also fixes criteria to be used to update the minimum wage, such as the dynamics of prices and productivity. In light of these features, it is important to understand how expectations about the future change in the minimum wage affect the employment impact of this policy.

The model proposed include expectations and shows that, when the change in the minimum wage is expected, the disemployment effect is going to be smaller than in the case of an unexpected change of the same magnitude. The reason is that the effect of the higher future labor cost has been partly anticipated by agents. This does not mean that expected changes are less detrimental to the labor market, but that it is more difficult to empirically measure their effect because they also impact on the current agents' behavior. Thus, in order to test whether minimum wage affect or not unemployment, it would be safer to limit the analysis to the unexpected minimum wage changes.

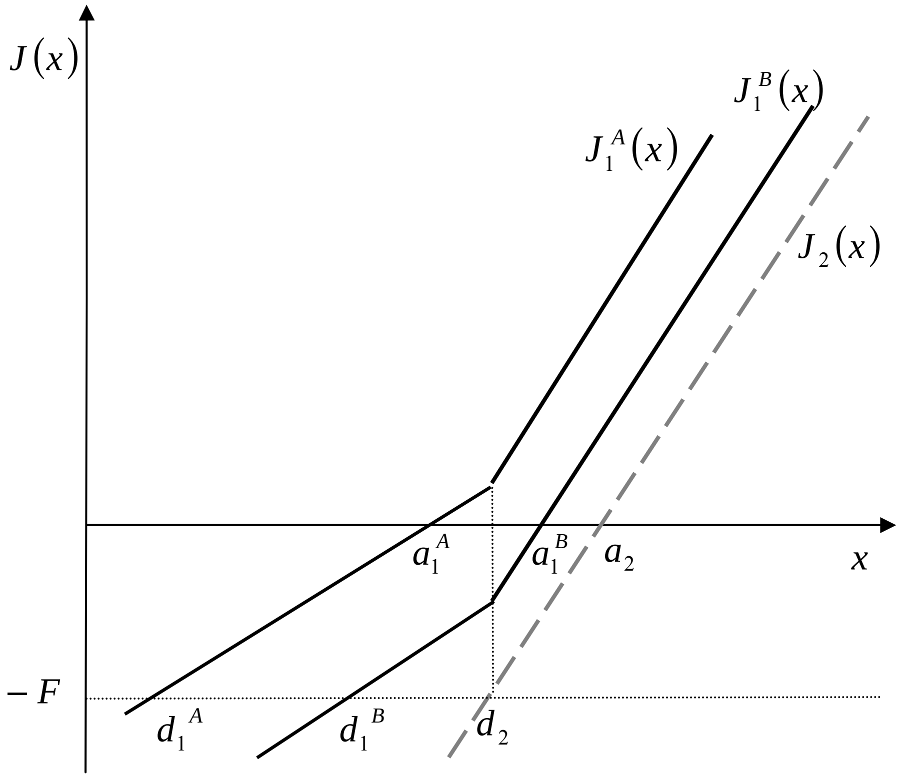
A clear case of unexpected variation in the minimum wage is the increase operated in Spain, in July 2004, by the newly-elected socialist party. We use this natural experiment to test the validity of our model. In particular we compare the estimated effect of that rise in the minimum wage on employment and on workers' flow with the effect of expected changes. In order to net out confounding factors, we implement a difference in difference approach along several specifications: the young versus the adults, young females versus adult females, young females with low education versus adult females with low education.

Our results show that the unexpected increase in the minimum wage leads to a stronger rise in job separation than expected variations. The impact is greater if we restrict the analysis to temporary workers, while permanent workers do not seem to be affected by the minimum wage policy. With regard to job creation, we estimate null effects of the minimum wage regardless of expectations, whereas our model predicts a fall in employment inflows. These findings may be explained by supply-side factors, as labor market participation decision and search effort. Data show that the participation rate raised in 2004 and 2005, when the minimum wage was substantially increased.

The net employment effect depends on the magnitude of flows. On impact, the surprise of Zapatero election highly enhanced participation and, in turn, job inflows, balancing the increase in separations. When we consider the effect of the unexpected policy over a longer period, the estimates support a sizable disemployment effect. A 10 per cent unexpected increase in the minimum wage reduces young employment by 2 per cent in the following two or three quarters, by 4 per cent if we restrict to females. On the contrary, the expected variations have some negative on-impact effect on employment, but no significant effect ex-post.

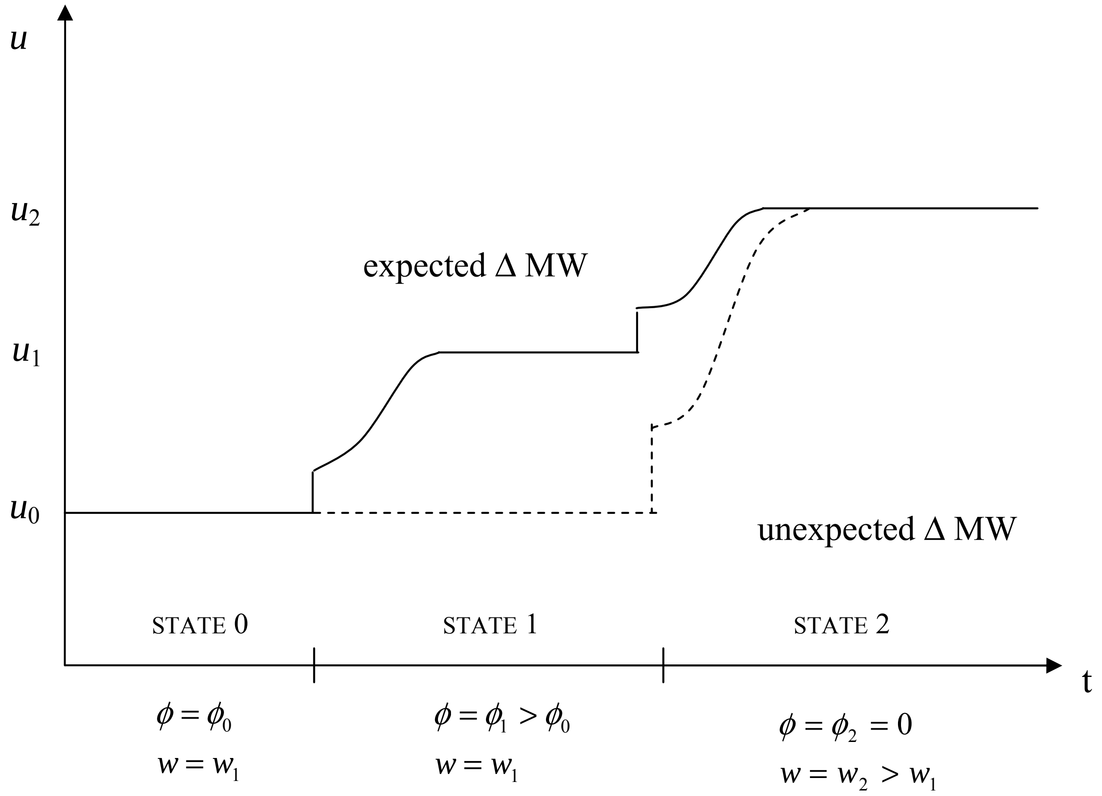
In sum, employment stock and flows are found to react in a different way to minimum wage changes depending on expectations. A low ex-post response of job separations and employment may be traced back to the adjustment in the behavior of economic agents occurred before the actual change. It follows that the ex-post effect may be too small to be identified in the data. Therefore expectations can explain, at least party, the empirical controversy on the disemployment effect of the minimum wage.

Figure 1. Job values pre and post minimum wage variation in a model with expectations.



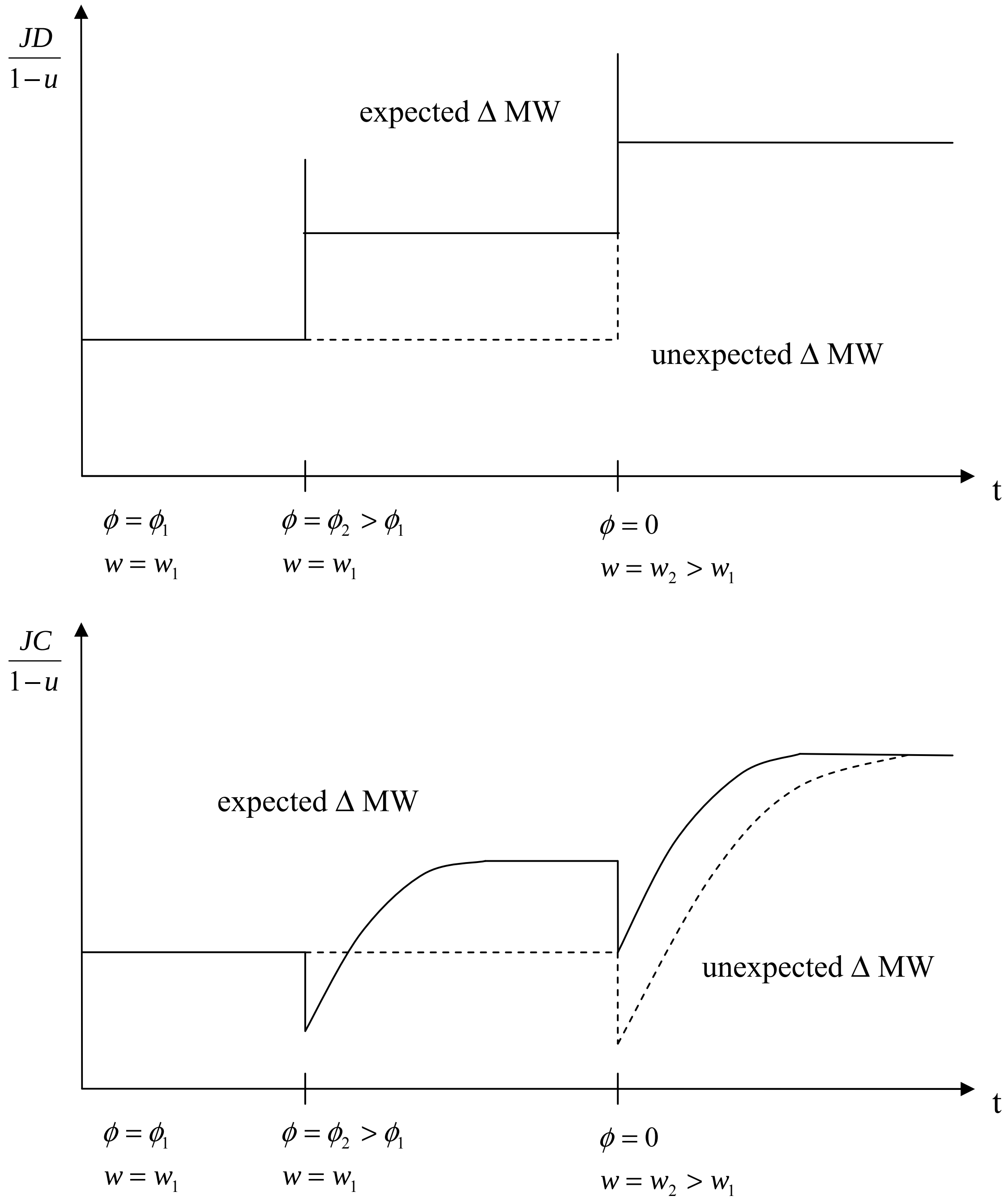
$J_1(x)$ is the value of a job with productivity x in state 1 (wage w=w_1; expectations φ= φ_1)
$J_2(x)$ is the value of a job with productivity x in state 2 (wage w=w_2; expectations φ= φ_2=0)
a is the productivity level such that $J(x)$ is null; it is called hiring standard.
d is the productivity level such that $J(x)$ is equal to $-F$, the firing cost; it is called job destruction threshold.
The position of $J_1(x)$ depends on the value of the primitive parameters. Here, two cases are depicted: A and B. When firing costs are low with respect to the minimum wage variation, case A, the hiring standard a_1 is lower than the job destruction threshold in state 2, d_2. Otherwise, case B, the hiring standard a_1 is higher than d_2.

Figure 2. Unemployment dynamics.



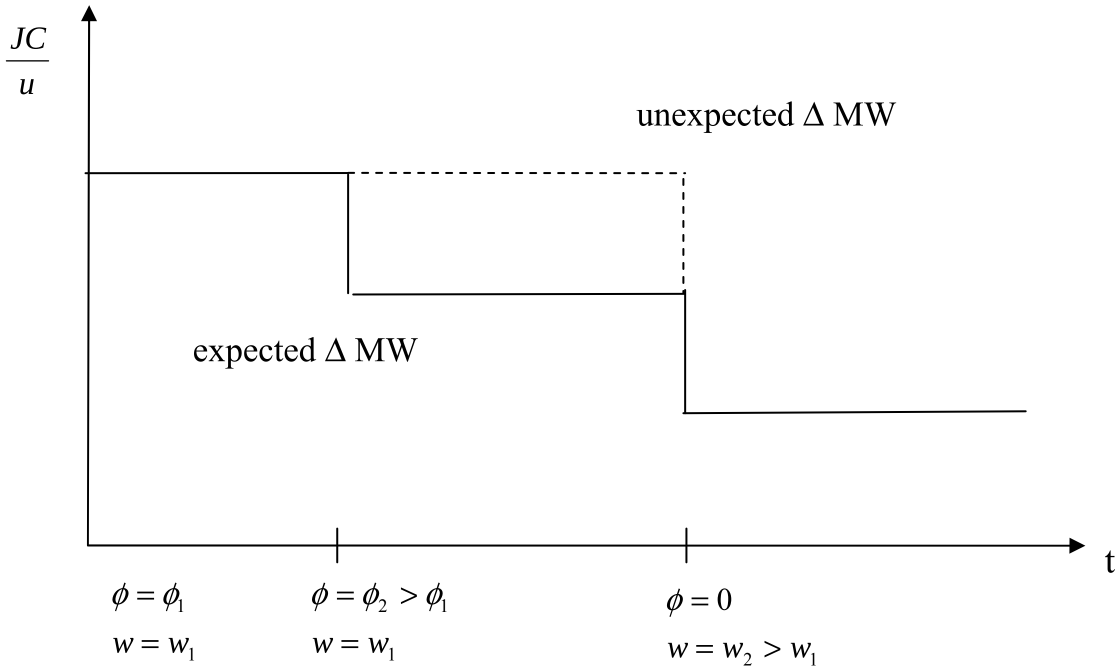
The continuous line represents the dynamics of unemployment along state 0, state 1 and state 2 in case of an expected change in the minimum wage.
The discontinuous line depict the dynamics of unemployment along state 0 and state 2 in case of an unexpected increase in the minimum wage.

Figure 3. Job creation and job destruction dynamics.



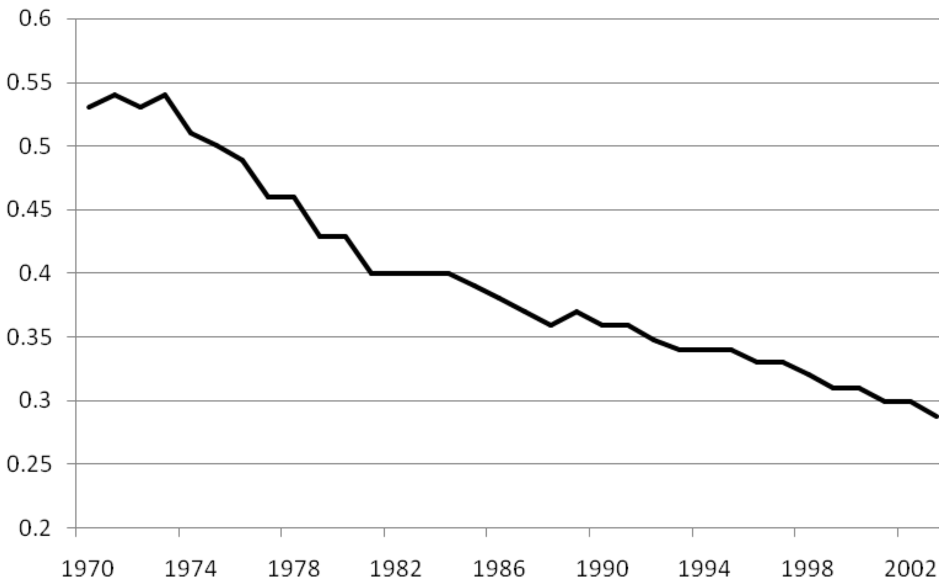
The continuous line represents the dynamics of the JD (JC) rate along state 0, state 1 and state 2 in case of an expected change in the minimum wage.
The discontinuous line depict the dynamics of the JD (JC) rate along state 0 and state 2 in case of an unexpected increase in the minimum wage.

Figure 4. Job finding rate dynamics.



The continuous line represents the dynamics of the job finding rate along state 0, state 1 and state 2 in case of an expected change in the minimum wage.
The discontinuous line depict the dynamics of the job finding rate along state 0 and state 2 in case of an unexpected increase in the minimum wage.

Figure 5. Minimum relative to median wages of full-time workers in Spain.



Source: OECD.

Table 1. The minimum wage policy in OECD countries.

Country	Method for setting	Adjustment provision
Australia	Statute	Yearly
Belgium	Negotiated	Yearly
Canada	Statute	Not defined
France	Statute	At least yearly
Germany	Negotiated	Usually every 12 months
Greece	Negotiated	Twice a year
Italy	Negotiated	Every two years
Japan	Statute	When necessary
Luxemburg	Statute	Twice a year
Netherlands	Statute	Twice a year
New Zealand	Statute	Yearly
Portugal	Statute	Yearly
Spain	Statute	Yearly
Sweden	Negotiated	Usually every 3 years
United Kingdom	Wage Councils	Yearly
US	Statute	Not defined

Source: ILO database on the minimum wage policy.

Table 2. Evolution of the minimum wage in Spain

Date of coming into effect	Minimum wage	Variation over previous MW	CPI [1]	Variation real MW
6-1-1980	136.85	10.2	15.56	-5.36
6-1-1981	153.98	12.5	14.54	-2.04
1-1-1982	170.93	11.0	14.41	-3.41
1-1-1983	193.29	13.1	12.17	0.93
1-1-1984	208.79	8.0	11.28	-3.28
1-1-1985	223.40	7.0	8.81	-1.81
1-1-1986	241.25	8.0	8.79	-0.79
1-1-1987	253.33	5.0	6.10	-1.1
1-1-1988	264.69	4.5	4.41	0.09
1-1-1989	280.55	6.0	6.22	-0.22
1-1-1990	300.57	7.1	6.99	0.11
1-1-1991	320.04	6.5	6.18	0.32
1-1-1992	338.25	5.7	6.55	-0.85
1-1-1993	351.77	4.0	4.23	-0.23
1-1-1994	364.03	3.5	5.00	-1.5
1-1-1995	376.83	3.5	4.77	-1.27
1-1-1996	390.18	3.5	3.65	-0.15
1-1-1997	400.45	2.6	2.54	0.06
1-1-1998	408.93	2.1	1.85	0.25
1-1-1999	416.32	1.8	1.87	-0.07
1-1-2000	424.80	2.0	2.92	-0.92
1-1-2001	433.45	2.0	3.79	-1.79
1-1-2002	442.20	2.0	2.50	-0.5
1-1-2003	451.20	2.0	3.75	-1.75
1-1-2004	460.50	2.0	2.19	-0.19
7-1-2004	490.80	6.6	2.20	4.4
1-1-2005	513.00	4.5	1.04	3.46
1-1-2006	540.90	5.4	4.01	1.39
1-1-2007	570.60	5.5	2.42	3.08

Source: Minimum wage: Ministerio Trabajo y Asuntos Sociales (BOE); CPI: OECD (MEI).
[1] Values in CPI column shows the percentage change of the CPI between two changes in the minimum wage, so that CPI=6.10 in 1/1/1987 is the variation of the price level between 1/1/1986 and 1/1/1987; and CPI=2.20 in 7/1/2004 is the variation of the price level between 1/1/2004 and 7/1/2004.

Table 3. Composition of the dataset, percentage.

	2000-2006	2000	2004	2006
Age:				
young (16-24)	13.99	15.82	13.15	12.68
adult (25-54)	53.94	52.52	54.25	55.29
old (at least 55)	32.06	31.67	32.60	32.03
Gender:				
male	48.68	48.55	48.55	49.00
female	51.32	51.45	51.45	51.00
Education:				
primary or lower	37.96	42.89	36.95	32.90
secondary or professional	41.99	39.23	42.61	44.76
university or higher	20.05	17.88	20.44	22.34
Status:				
employed	50.37	45.68	49.43	58.15
Contract type: [1]				
temporary	32.00	32.08	30.64	34.03
permanent	68.00	67.92	69.36	65.97
Sector: [1]				
primary	5.23	6.02	4.99	4.49
manufacturing	30.70	31.56	30.38	29.58
services	63.91	62.42	64.63	65.48
Occupation: [1]				
armed forces	0.52	0.54	0.52	0.45
legislators, senior officials and managers	7.53	7.90	7.64	7.28
professionals	12.47	11.80	13.22	12.28
technicians and associate professionals	10.74	9.75	10.94	11.45
clerk	9.48	9.92	9.28	9.28
service workers and shop and market sales workers	14.35	13.66	14.24	15.39
skilled agricultural and fishery workers	3.30	4.07	3.22	2.58
craft and related trade workers	17.22	17.43	16.99	16.70
plant and machine operators and assemblers	9.95	10.71	9.96	9.26
elementary occupations	14.31	14.20	14.00	14.89
Public	15.93	16.23	16.67	14.71

Private	83.92	83.77	83.33	84.84
unemployed	6.98	7.66	7.24	5.79
long term unemployed [2]	31.59	33.67	31.28	29.22
out of labor force	42.65	46.66	43.33	36.06

	Young		Adult	
	2000	2006	2000	2006
Education:				
primary or lower	9.88	10.53	28.83	15.58
secondary or professional	74.75	76.09	45.61	52.93
university or higher	15.37	13.39	25.56	31.48
Status:				
employed	34.52	42.20	70.77	75.44
Contract type: [1]				
temporary	68.44	66.08	27.62	31.55
permanent	31.56	33.92	72.38	68.45
unemployed	12.77	9.97	10.31	6.57
out of labor force	52.71	47.83	18.92	17.99
Flows: [3]				
employment-employment	88.62	84.03	96.05	94.90
employment-non employment	11.38	15.96	3.95	5.10
unemployment-unemployment	62.30	35.25	69.27	41.15
unemployment-employment	26.12	42.00	20.62	35.93
unemployment-out of labor force	11.58	22.75	10.11	22.92
nonemployment-nonemployment	91.72	84.59	91.68	84.90
nonemployment-permanent job	0.75	1.40	1.47	2.78
nonemployment-temporary job	7.54	14.01	6.85	12.32

Source: Computation based on INE, Enquesta de Población Activa, Anonimizado de Flujos, 2000-2006. Values are computed as (weighted) percentages over the number of individuals who answered the relative questions.

[1] Percentages computed over the employed persons.

[2] Percentages computed over the unemployed persons.

[3] Percentages refers to the share of employed (unemployed) individuals who got employed (unemployed) in the following quarter, excluding individuals who exit the survey.

Table 4. Annual average earnings per worker.

	Both sexes	Males	Females
All ages:			
All studies	19,802.45	22,169.16	15,767.56
Without studies	12,903.30	14,834.33	8,472.45
Primary education	15,640.44	17,645.14	10,826.92
Secondary education I	15,679.54	17,591.76	11,700.95
Secondary education II	21,634.00	25,324.39	16,483.21
Intermediate vocational training	17,961.83	21,273.29	14,376.30
Advanced level vocational training	20,990.63	23,521.88	16,133.26
University diploma or equivalent	25,760.28	30,757.84	21,151.78
University graduates, advanced engineers and doctors	32,997.45	38,691.15	25,629.76
16-20:			
All studies	9,686.12	10,544.80	7,969.87
Without studies	9,278.73	10,512.64	5,541.15
Primary education	10,298.77	11,239.23	7,764.66
Secondary education I	9,628.97	10,328.17	8,241.05
Secondary education II	8,033.05	8,578.59	7,568.66
Intermediate vocational training	9,466.13	10,479.07	7,967.70
Advanced level vocational training	9,972.65	10,514.21	8,220.05
University diploma or equivalent	.	.	.
University graduates, advanced engineers and doctors	.	.	.
20-29:			
All studies	14,362.39	15,514.60	12,807.39
Without studies	10,829.08	11,885.03	7,867.49
Primary education	12,514.78	13,699.42	9,831.87
Secondary education I	12,719.82	13,926.53	10,632.19
Secondary education II	13,567.01	15,380.88	11,917.10
Intermediate vocational training	13,593.23	15,542.71	11,469.79
Advanced level vocational training	15,035.08	16,564.92	12,814.17
University diploma or equivalent	17,745.12	19,991.45	16,145.80
University graduates, advanced engineers and doctors	19,954.96	21,779.35	18,431.84
30-39:			
All studies	19,617.60	21,403.46	16,691.07
Without studies	12,521.57	14,279.82	8,213.71
Primary education	14,220.82	15,856.50	10,191.84
Secondary education I	15,093.27	16,763.60	11,486.21
Secondary education II	20,289.74	22,938.64	16,842.99
Intermediate vocational training	17,458.46	20,358.07	14,219.56

Advanced level vocational training	20,911.57	22,946.39	17,150.76
University diploma or equivalent	25,120.61	28,897.29	21,407.02
University graduates, advanced engineers and doctors	31,319.03	35,695.59	26,236.48
40-49:			
All studies	22,995.37	25,856.57	17,962.67
Without studies	13,574.95	15,989.38	8,849.69
Primary education	16,376.78	18,755.03	11,558.79
Secondary education I	17,873.95	20,207.01	13,032.38
Secondary education II	27,445.69	30,790.41	21,373.92
Intermediate vocational training	21,611.09	26,449.83	16,750.49
Advanced level vocational training	26,196.57	28,724.20	20,256.25
University diploma or equivalent	31,161.56	37,751.95	25,280.99
University graduates, advanced engineers and doctors	42,183.66	47,529.07	33,117.10

Source: INE, Wage structure survey, 2002.

Table 5. Employment (U_{MW} vs. E_{MW}), Probit regression model.

	(1)	(2)	(3)
TREATED: Young - CONTROL: Adult			
young*U_{MW}[1]	0.003	0.003	0.003
	(0.001)***	(0.001)***	(0.001)***
young*E_{MW}[2]	-0.001	-0.000	-0.000
	(0.001)**	(0.001)	(0.001)
young*U_{MW}_pre[3]			-0.000
			(0.001)
young*U_{MW}_post[4]		-0.002	-0.002
		(0.001)***	(0.001)***
young*E_{MW}_pre[3]			0.000
			(0.001)
young*E_{MW}_post[4]		0.001	0.001
		(0.001)**	(0.001)*
Pseudo-R^2	0.237	0.237	0.237
Observations	1889412	1889412	1889412
TREATED: Young female - CONTROL: Adult female			
young*U_{MW}[1]	0.002	0.002	0.002
	(0.001)**	(0.001)*	(0.001)*
young*E_{MW}[2]	-0.001	-0.000	-0.000
	(0.001)*	(0.001)	(0.001)
young*U_{MW}_pre[3]			-0.001
			(0.001)
young*U_{MW}_post[4]		-0.003	-0.003
		(0.001)***	(0.001)***
young*E_{MW}_pre[3]			-0.000
			(0.001)
young*E_{MW}_post[4]		0.001	0.001
		(0.001)	(0.001)
Pseudo-R2	0.147	0.147	0.147
Observations	952728	952728	952728
TREATED: Young female low education *CONTROL: Adult female low education*			
young*U_{MW}[1]	0.001	0.003	0.002
	(0.003)	(0.003)	(0.003)
young*E_{MW}[2]	-0.001	-0.003	-0.002
	(0.002)	(0.003)	(0.003)
young*U_{MW}_pre[3]			-0.002
			(0.002)
young*U_{MW}_post[4]		-0.010	-0.011
		(0.003)***	(0.003)***

young*E_{MW}_pre[3]			0.002
			(0.003)
young*E_{MW}_post[4]		-0.012	-0.013
		(0.003)***	(0.003)***
Pseudo-R2	0.033	0.033	0.033
Observations	199349	199349	199349

Standard errors are reported in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Reading:
The estimates are for employment probability, for individuals aged 16-54. The table reports marginal effects computed at the sample means of continuous variables (and at value zero of the variables involving the minimum wage variation); and discrete change of dummy variable from 0 to 1. The values associated to young*U_{MW} (_pre and _post), young*E_{MW} (_pre and _post), young*Z_{MW} (_pre and _post) are the marginal effects of an increase by 1% of the minimum wage.
All models control for age (dummy equal to 1 if age 16-24, 0 if age 24-54), gender, education, whether the individual attended any courses during the last month, time (quarterly) effect, linear trend, region of residence (18 dummies).

[1]interaction among young, a dummy equal to 1 in quarter 2004:3, and the minimum wage variation.
[2]interaction among young, a dummy equal to 1 in every other quarter than 2004:3, and the minimum wage variation.
[3]effect of the variation in the minimum wage on the former 2 quarters.
[4]effect of the variation in the minimum wage on the following 2 quarters.

Table 6. Employment (U_{MW} vs. Z_{MW}), Probit regression model.

	(1)	(2)	(3)
TREATED: Young - CONTROL: Adult			
young*U_{MW}[1]	0.003	0.003	0.003
	(0.001)***	(0.001)***	(0.001)***
young*Z_{MW}[2]	-0.002	-0.003	-0.003
	(0.001)**	(0.001)**	(0.001)***
young*U_{MW}_pre[3]			-0.001
			(0.001)
young*U_{MW}_post[4]		-0.002	-0.002
		(0.001)***	(0.001)***
young*Z_{MW}_pre[3]			-0.002
			(0.001)**
young*Z_{MW}_post[4]		0.000	-0.000
		(0.001)	(0.001)
Pseudo-R^2	0.237	0.237	0.237
Observations	1889412	1889412	1889412

TREATED: Young female - CONTROL: Adult female			
young*U_{MW}[1]	0.002	0.002	0.002
	(0.001)**	(0.001)*	(0.001)
young*Z_{MW}[2]	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)
young*U_{MW}_pre[3]			-0.001
			(0.001)
young*U_{MW}_post[4]		-0.003	-0.004
		(0.001)***	(0.001)***
young*Z_{MW}_pre[3]			-0.001
			(0.001)
young*Z_{MW}_post[4]		-0.001	-0.001
		(0.001)	(0.001)
Pseudo-R2	0.147	0.147	0.147
Observations	952728	952728	952728
TREATED: Young female low education			
CONTROL: Adult female low education			
young*U_{MW}[1]	0.001	0.000	-0.000
	(0.003)	(0.003)	(0.003)
young*Z_{MW}[2]	-0.010	-0.011	-0.012
	(0.005)*	(0.005)**	(0.005)**
young*U_{MW}_pre[3]			-0.003
			(0.002)
young*U_{MW}_post[4]		-0.009	-0.010
		(0.003)***	(0.003)***
young*Z_{MW}_pre[3]			-0.006
			(0.004)*
young*Z_{MW}_post[4]		-0.009	-0.010
		(0.004)***	(0.004)***
Pseudo-R2	0.033	0.033	0.033
Observations	199349	199349	199349

Standard errors are reported in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Reading: see Table 5

Table 7. Flows out of employment (U_{MW} vs. E_{MW}), Probit regression model.

	All	Temporary	Permanent
TREATED: Young - CONTROL: Adult			
young*U_{MW}[1]	0.002	0.008	0.000
	(0.000)***	(0.001)***	(0.000)
young*E_{MW}[2]	0.000	0.001	0.000
	(0.000)	(0.001)	(0.000)
young	0.019	0.041	0.014
	(0.001)***	(0.002)***	(0.001)***
female	0.020	0.045	0.010
	(0.000)***	(0.001)***	(0.000)***
temporary	0.085	-	-
	(0.001)***		
part-time	0.013	0.022	0.012
	(0.001)***	(0.002)***	(0.001)***
Pseudo-R^2	0.161	0.056	0.064
Observations	956432	321085	635347
TREATED: Young female - CONTROL: Adult female			
young*U_{MW}[1]	0.004	0.009	0.001
	(0.001)***	(0.002)***	(0.001)
young*E_{MW}[2]	0.000	0.002	-0.000
	(0.000)	(0.001)*	(0.000)
young	0.018	0.036	0.012
	(0.001)***	(0.003)***	(0.001)***
temporary	0.106	-	-
	(0.001)***		
part-time	0.011	0.016	0.011
	(0.001)***	(0.002)***	(0.001)***
Pseudo-R2	0.156	0.057	0.070
Observations	396856	143465	253391
TREATED: Young female low education			
CONTROL: Adult female low education			
young*U_{MW}[1]	0.008	0.011	0.008
	(0.003)**	(0.007)	(0.003)**
young*E_{MW}[2]	0.004	0.005	0.004
	(0.003)	(0.005)	(0.003)
young	0.008	0.004	0.021
	(0.005)	(0.010)	(0.008)***
temporary	0.145	-	-
	(0.003)***		
part-time	-0.001	-0.027	0.015
	(0.003)	(0.007)***	(0.003)***

Pseudo-R2	0.162	0.090	0.050
Observations	48789	19384	29405

Standard errors are reported in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Reading:
The estimates are for employment probability, for individuals aged 16-54. The table reports marginal effects computed at the sample means of continuous variables (and at value zero of the variables involving the minimum wage variation); and discrete change of dummy variable from 0 to 1. The values associated to young*U_{MW} (_pre and _post), young*E_{MW} (_pre and _post), young*Z_{MW} (_pre and _post) are the marginal effects of an increase by 1% of the minimum wage.
All models control for age (dummy equal to 1 if age 16-24, 0 if age 24-54), gender, education, contract type, working day lenght, time (quarterly) effect, linear trend, region (18 dummies), sector (3 dummies), occupation (10 dummies), whether the individual was employed in the public sector and whether she attended any courses during the last month. All the independent variables refer to the initial situation, before the exit from the employment pool.

[1]interaction among young, a dummy equal to 1 in quarter 2004:3, and the minimum wage variation.
[2]interaction among young, a dummy equal to 1 in every other quarter than 2004:3, and the minimum wage variation.
[3]effect of the variation in the minimum wage on the former 2 quarters.
[4]effect of the variation in the minimum wage on the following 2 quarters.

Table 8. Flows out of employment (U_{MW} vs. Z_{MW}), Probit regression model.

	All	Temporary	Permanent
TREATED: Young - CONTROL: Adult			
young*U_{MW}[1]	0.002	0.008	0.000
	(0.000)***	(0.001)***	(0.000)
young*Z_{MW}[2]	0.001	0.002	0.000
	(0.000)	(0.001)	(0.000)
young	0.018	0.040	0.014
	(0.001)***	(0.002)***	(0.001)***
female	0.020	0.045	0.010
	(0.000)***	(0.001)***	(0.000)***
temporary	0.085	-	-
	(0.001)***		
part-time	0.013	0.022	0.012
	(0.001)***	(0.002)***	(0.001)***
Pseudo-R^2	0.161	0.056	0.064
Observations	956432	321085	635347

TREATED: Young female - CONTROL: Adult female			
young*U_{MW}[1]	0.004	0.009	0.001
	(0.001)***	(0.002)***	(0.001)
young*Z_{MW}[2]	0.001	0.001	0.001
	(0.001)	(0.002)	(0.001)
young	0.017	0.035	0.012
	(0.001)***	(0.003)***	(0.001)***
temporary	0.106	-	-
	(0.001)***		
part-time	0.011	0.016	0.011
	(0.001)***	(0.002)***	(0.001)***
Pseudo-R2	0.156	0.056	0.070
Observations	396856	143465	253391
TREATED: Young female low education CONTROL: Adult female low education			
young*U_{MW}[1]	0.008	0.011	0.008
	(0.003)***	(0.007)*	(0.003)**
young*Z_{MW}[2]	0.008	0.017	0.005
	(0.005)	(0.011)	(0.006)
young	0.006	0.000	0.020
	(0.005)	(0.010)	(0.008)**
temporary	0.145	-	-
	(0.003)***		
part-time	-0.001	-0.027	0.015
	(0.003)	(0.007)***	(0.003)***
Pseudo-R2	0.162	0.090	0.049
Observations	48789	19384	29405

Standard errors are reported in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Reading: see Table 7.

Table 9. Flows into employment, Probit regression model.

	U_{MW} vs. E_{MW}	U_{MW} vs. Z_{MW}
TREATED: Young - CONTROL: Adult		
young*U_{MW}[1]	0.001	0.002
	(0.002)	(0.002)
young*E_{MW}[2]	0.001	0.004
	(0.001)	(0.003)*
young	0.041	0.040
	(0.003)***	(0.003)***
female	-0.066	-0.066
	(0.002)***	(0.002)***
active search	0.021	0.021
	(0.002)***	(0.002)***
Pseudo-R^2	0.104	0.104
Observations	186191	186191
TREATED: Young female - CONTROL: Adult female		
young*U_{MW}[1]	0.001	0.001
	(0.002)	(0.002)
young*E_{MW}[2]	0.001	0.005
	(0.001)	(0.003)
young	0.048	0.047
	(0.003)***	(0.003)***
active search	0.021	0.021
	(0.003)***	(0.003)***
Pseudo-R2	0.110	0.110
Observations	112978	112978
TREATED: Young female low education		
CONTROL: Adult female low education		
young*U_{MW}[1]	0.009	0.009
	(0.005)*	(0.005)*
young*E_{MW}[2]	-0.001	0.012
	(0.004)	(0.008)
young	0.036	0.034
	(0.009)***	(0.009)***
active search	0.016	0.016
	(0.006)***	(0.006)***
Pseudo-R2	0.107	0.107
Observations	21081	21081

Standard errors are reported in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Reading:
The estimates are for employment probability, for individuals aged 16-54. The table reports marginal effects computed at the sample means of continuous variables (and at value zero of the variables involving the minimum wage variation); and discrete change of dummy variable from 0 to 1. The values associated to young*U_{MW} (_pre and _post), young*E_{MW} (_pre and _post), young*Z_{MW} (_pre and _post) are the marginal effects of an increase by 1% of the minimum wage.
All models control for age (dummy equal to 1 if age 16-24, 0 if age 24-54), gender, education, contract type, working day lenght, time (quarterly) effect, linear trend, region (18 dummies), whether the individual is looking for the first job or last sector (3 dummies) and occupation (10 dummies) where she was employed, whether she was in the public sector, attended any courses during the last month, adopted active methods to search for a job, whether she was waiting to start a new job. All the independent variables refer to the initial situation, before the exit from the nonemployment pool.

[1]interaction among young, a dummy equal to 1 in quarter 2004:3, and the minimum wage variation.
[2] ex_{MW} stays for E_{MW} in columns (1) and (2); for Z_{MW} in columns (3) and (4).
young*E_{MW} is the interaction among young, a dummy equal to 1 in every other quarter than 2004:3, and the minimum wage variation.
young*Z_{MW} is the interaction among young, a dummy equal to 1 in quarter 2006:1, and the minimum wage variation.
[3]effect of the variation in the minimum wage on the former 2 quarters.
[4]effect of the variation in the minimum wage on the following 2 quarters.

References

Bertrand, M., E. Duflo, and S. Mullainathan (2004, February). How Much Should We Trust Differences-in-Differences Estimates? *The Quarterly Journal of Economics*, 249–275.

Boadway, R. and K. Cuff (2001). A Minimum Wage Can Be Welfare-Improving and Employment-Enhancing. *European Economic Review 45*, 553–576.

Brown, C., C. Gilroy, and A. Kohen (1982). The Effect of the Minimyn Wage on Employment and Unemployment. *Journal of Economic Literature 20*, 487–528.

Cahuc, P. and A. Zylberberg (2004). *Labor Economics*. Cambridge, Massachusetts: The MIT Press.

Card, D. (1992, October). Using Regional Variation in Wages to Measure the Effects of the Federal Minimum Wage. *Industrial and Labor Relations Review 46*(1), 22–37.

Card, D. and A. B. Krueger (1994, December). Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania. *American Economic Review 84*(5), 772–793.

Card, D. and A. B. Krueger (1995). *Mith and Measurement: The New Economics of the Minimum Wage*. Princeton, NJ: Princeton University Press.

Card, D. and A. B. Krueger (2000, December). MinimumWages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania: Reply. *American Economic Review 90*(5), 1397–1420.

Dolado, J., F. Kramarz, S. Machin, A. Manning, D. Margolis, and C. Teulings (1996, October). The Economic Impact of Minimum Wages in Europe. *Economic Policy 23*(3-5), 318–372.

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

Lucas, R. E. J. (1972). Expectations and the Neutrality of Money. *Journal of Economic Theory 4*(2), 103–124.

Manning, A. (1995). How Do We Know That Real Wages are Too High? *Quarterly Journal of Economics*.

Manning, A. (2003). The Real Thin Theory: Monopsony in Modern Labour Markets. *Labour Economics 10*, 105–131.

Manning, A. (2004). Monopsony and the Efficiency of Labour Market Interventions. *Labour Economics 11*, 145–163.

Molina Romo, Ó. (2003). The Politics of Wage Bargaining Reform in Italy and Spain 1991-2001. *EUI Working Paper SPS* (14), 1–45.

Molina Romo, Ó. (2004). Still the Century of Political Exchange? Policy Adjustment and Political Exchange in Southern Europe. *EUI Working Paper SPS* (14), 1–53.

Montalvo, J. G. (2006). Voting After the Bombing: Can Terrorist Attacks Change the Outcome of Democratic Elections? *Universitat Pompeu Fabra Working Paper* (1000).

Mortensen, D. T. and C. A. Pissarides (1994, July). Job Creation and Job Destruction in the Theory of Unemployment. *The Review of Economic Studies. 61*(3), 397–415.

Neumark, D. and W. Wascher (1992, October). Employment Effects of Minimum and Subnminimum Wages: Panel Data on State Minimum Wage Laws. *Industrial and Labor Relations Review 46*(1), 55–81.

Neumark, D. and W. Wascher (1995). Minimum-Wage Effects on School and Work Transitions of Teenagers. *The American Economic Review 85*(2), 244–249.

Neumark, D. and W. Wascher (2000, December). Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania: Comment. *The American Economic Review 90*(5), 1362–1396.

Neumark, D. and W. Wascher (2007a, January). Minimum Wages and Employment. *IZA Discussion Paper* (2570).

Neumark, D. and W. Wascher (2007b, February). Minimum Wages, the Earned Income Tax Credit, and Employment: Evidence from the Post-Welfare Reform Era. *NBER Working Paper* (12915), 1–37.

Neumark, D. and W. L. Wascher (2002, Winter). State-Level Estimates of Minimum Wage Effects: New Evidence and Interpretations from Disequilibrium Models. *Journal of Human Resources 37*(1), 35–62.

Pissarides, C. A. (2000). *Equilibrium Uneployment Theory.* Cambridge, Massachusetts: The MIT Press.

Portugal, P. and A. R. Cardoso (2006). Disentangling the Minimum Wage Puzzle: An Analysis of Worker Accessions and Separations. *Journal of the European Economic Association 4*(5), 988–1013.

Rebitzer, J. B. and L. J. Taylor (1996). The Consequences of Minimum Wage Laws: Some New Theoretical Ideas. *Journal of Public Economics 56*, 245–256.

A The model

A.1 Equilibrium conditions in state 2:

Let's recall the firm's value function:
the job value function:

$$rJ_2(x) = x - w_2 + \lambda \int_{d_2}^{x^u} [J_2(s) - J_2(x)]\, dH(s) - \lambda H(d_2)[F + J_2(x)] \tag{27}$$

the vacancy value function:

$$rV_2 = -k + q_2 \int_{a_2}^{x^u} [J_2(s) - V_2]\, dH(s) \tag{28}$$

JOB DESTRUCTION:
The job destruction condition is

$$J_2(d_2) = -F \tag{29}$$

Subtracting 29 from 27, we get:

$$(r + \lambda)[J_2(x) - J_2(d_2)] = x - d_2 \tag{30}$$

and

$$J_2(x) = \frac{x - d_2}{r + \lambda} - F \tag{31}$$

so that we can simplify the integral in 27, and rewrite the value function as:

$$(r + \lambda) J_2(x) = x - w_2 + \frac{\lambda}{r + \lambda} \int_{d_2}^{x^u} (s - d_2)\, dH(s) - \lambda F \tag{32}$$

Valuating the value function in d_2, we get the job destruction equation:

$$d_2 = w_2 - \frac{\lambda}{r + \lambda} \int_{d_2}^{x^u} (s - d_2)\, dH(s) - rF \tag{33}$$

MATCH FORMATION:
The job formation condition is

$$J_2(a_2) = 0 \tag{34}$$

Substituting condition 34 into equation 32 we get:

$$a_2 = w_2 - \frac{\lambda}{r + \lambda} \int_{d_2}^{x^u} (s - d_2)\, dH(s) + \lambda F = d_2 + (r + \lambda) F \tag{35}$$

JOB CREATION:
The free entry condition is

$$V = 0 \tag{36}$$

Substituting the free entry condition into the value function of a vacancy, we get:

$$\int_{a_2}^{x^u} J_2(s)\,dH(s) = \frac{k}{q_2} \tag{37}$$

Furthermore, using the match formation condition and the linearity property of the job value function, we can write:

$$J_2(x) = \frac{x - a_2}{r + \lambda} \tag{38}$$

Substituting 38 into 37, we get:

$$\frac{1}{r+\lambda}\int_{a_2}^{x^u} (s - a_2)\,dH(s) = \frac{k}{q_2} \tag{39}$$

A.2 Equilibrium conditions in state 1:

Job value function:

$$rJ_1(x) =$$

$$\begin{cases} x - w_1 + \lambda \int_{d_1}^{x^u} [J_1(s) - J_1(x)]\,dH(s) - [\lambda H(d_1) + \phi_1][F + J_1(x)] & \text{if } x < d_2 \\ x - w_1 + \lambda \int_{d_1}^{x^u} [J_1(s) - J_1(x)]\,dH(s) - \lambda H(d_1)[F + J_1(x)] + \phi_1 [J_2(x) - J_1(x)] & \text{if } x \geq d_2 \end{cases} \tag{40}$$

$J_1(x)$ is composed by two linear segments with slope $\frac{1}{r+\lambda+\phi}$, if $x < d_2$, and $\frac{1}{r+\lambda}$, elsewhere. Note that the distance between $J_2(x)$ and the second segment of $J_1(x)$ is equal to $\frac{d_2-d_1}{r+\lambda+\phi}$. Therefore 3 cases are possible:

A. $d_1 < d_2$ and $J_1(d_2) > 0$, i.e. the second segment $J_1(x)$ lies above $J_2(x)$ and the horizontal axis;

B. $d_1 < d_2$ and $-F < J_1(d_2) < 0$, i.e. the second segment $J_1(x)$ lies above $J_2(x)$ and intersects the horizontal axis;

C. $d_1 > d_2$, i.e. the second segment $J_1(x)$ lies below $J_2(x)$.

We can prove that the third case is impossible.

Let's analyze the first two cases. After some computation, assuming $d_1 < d_2$, we can rewrite the second segment of $J_1(x)$ as:

$$\begin{aligned} (r+\lambda)J_1(x) &= x - w_1 + \phi[J_2(x) - J_1(x)] - \lambda F + \lambda[1 - H(d_2)]\frac{d_2 - d_1}{r+\lambda+\phi} \\ &\quad + \lambda\left[\frac{1}{r+\lambda+\phi}\int_{d_1}^{d_2}(s-d_1)\,dH(s) + \frac{1}{r+\lambda}\int_{d_2}^{x^u}(s-d_2)\,dH(s)\right] \end{aligned} \tag{41}$$

CASE A:

$J_1(d_2) > 0$. Using condition 29, we have that $J_1(d_2) > 0$ is equivalent to:

$$C = (r + \lambda + \phi)[J_1(d_2) - J_2(d_2)] > (r + \lambda + \phi) F \tag{42}$$

Let's compute C using equations 41 and 32:

$$C = w_2 - w_1 + \frac{\lambda}{r + \lambda + \phi} \int_{d_1}^{d_2} (s - d_1) \, dH(s) + \frac{\lambda}{r + \lambda} \left[\int_{d_1}^{x^u} (s - d_1) \, dH(s) - \int_{d_2}^{x^u} (s - d_2) \, dH(s) \right] \tag{43}$$

We know that the second segment of $J_1(x)$ is parallel to $J_2(x)$ at distance $\frac{d_2 - d_1}{r + \lambda + \phi}$, therefore it has also to be true that

$$C = d_1 - d_2 \tag{44}$$

JOB DESTRUCTION:

When $J_1(d_2) > 0$, the job destruction threshold has to belong to the first segment. Therefore, imposing the job destruction condition, we have:

$$d_1 = w_1 - \lambda \left[\begin{array}{c} \frac{1}{r+\lambda+\phi} \int_{d_1}^{d_2} (s - d_1) \, dH(s) \\ + [1 - H(d_2)] \frac{d_2 - d_1}{r+\lambda+\phi} \end{array} \right] - \frac{\lambda}{r + \lambda} \int_{d_2}^{x^u} (s - d_2) \, dH(s) - rF \tag{45}$$

We can easily check that $d_1 < d_2$. Furthermore, substituting 33 into 45 condition 44 is verified.

MATCH FORMATION:

Also the hiring standard has to belong to the first segment:

$$\begin{aligned} a_1 &= w_1 + (\lambda + \phi) F - \lambda \left[\begin{array}{c} \frac{1}{r+\lambda+\phi} \int_{d_1}^{d_2} (s - d_1) \, dH(s) \\ + [1 - H(d_2)] \frac{d_2 - d_1}{r+\lambda+\phi} \end{array} \right] - \frac{\lambda}{r + \lambda} \int_{d_2}^{x^u} (s - d_2) \, dH(s) \\ &= d_1 + (r + \lambda + \phi) F \end{aligned} \tag{46}$$

JOB CREATION:

Following the same steps explained in the derivation of 39, we can derive:

$$\left[\begin{array}{c} \frac{1}{r+\lambda+\phi} \int_{a_1}^{d_2} (s - a_1) \, dH(s) \\ + \frac{1}{r+\lambda} \int_{d_2}^{x^u} (s - d_2) \, dH(s) + [1 - H(d_2)] \left(\frac{d_2 - d_1}{r+\lambda+\phi} - F \right) \end{array} \right] = \frac{k}{q_1} \tag{47}$$

CASE B:

$-F < J_1(d_2) < 0$ which is equivalent to:

$$C < (r + \lambda + \phi) F \tag{48}$$

JOB DESTRUCTION:

When $-F < J_1(d_2) < 0$ the job destruction threshold has to belong to the first segment. Therefore we can use the result from case A:

$$d_1 = w_1 - \lambda \left[\begin{array}{c} \frac{1}{r+\lambda+\phi} \int_{d_1}^{d_2} (s - d_1) \, dH(s) \\ + [1 - H(d_2)] \frac{d_2 - d_1}{r+\lambda+\phi} \end{array} \right] - \frac{\lambda}{r + \lambda} \int_{d_2}^{x^u} (s - d_2) \, dH(s) - rF \tag{49}$$

As for case A, condition 44 is verified.
MATCH FORMATION:
Now the hiring standard has to belong to the second segment:

$$\begin{aligned} a_1 &= w_1 - \lambda \left[\begin{array}{c} \frac{1}{r+\lambda+\phi} \int_{d_1}^{d_2} (s-d_1)\, dH(s) \\ + [1-H(d_2)] \frac{d_2-d_1}{r+\lambda+\phi} \end{array} \right] - \frac{\lambda}{r+\lambda} \int_{d_2}^{x^u} (s-d_2)\, dH(s) + \lambda F + \phi \frac{d_2-d_1}{r+\lambda+\phi} \\ &= d_1 + (r+\lambda) F + \phi \frac{d_2-d_1}{r+\lambda+\phi} \end{aligned} \tag{50}$$

JOB CREATION:
Following the same steps explained in the derivation of 39, we can derive:

$$\frac{1}{r+\lambda} \int_{a_1}^{x^u} (s-a_1)\, dH(s) = \frac{k}{q_1} \tag{51}$$

A.3 Impossibility of case C

Suppose that $d_1 > d_2$. Then, we can rewrite the second segment of $J_1(x)$ as:

$$(r+\lambda) J_1(x) = x - w_1 - \phi [J_1(x) - J_2(x)] + \frac{\lambda}{r+\lambda} \int_{d_1}^{x^u} (s-d_1)\, dH(s) - \lambda F \tag{52}$$

In this case:

$$[r+\lambda+\phi] [J_1(x) - J_2(x)] = w_2 - w_1 + \frac{\lambda}{r+\lambda} \left[\int_{d_1}^{x^u} (s-d_1)\, dH(s) - \int_{d_2}^{x^u} (s-d_2)\, dH(s) \right] = A \tag{53}$$

It has also to be true that $[r+\lambda+\phi] [J_1(x) - J_2(x)] = d_1 - d_2$, that is:

$$w_2 - w_1 + \frac{\lambda}{r+\lambda} \left[\int_{d_1}^{x^u} (s-d_1)\, dH(s) - \int_{d_2}^{x^u} (s-d_2)\, dH(s) \right] = d_1 - d_2 \tag{54}$$

JOB DESTRUCTION:
When $J_1(d_2) < 0$, the job destruction threshold has to belong to the first segment. Therefore:

$$d_1 = w_1 - \frac{\lambda}{r+\lambda} \int_{d_1}^{x^u} (s-d_1)\, dH(s) - rF + \phi \frac{d_2-d_1}{r+\lambda+\phi} \tag{55}$$

Note that $d_1 > d_2$
If we substitute (JD_1^C) and (JD_2) in condition (35), we get:

$$\begin{aligned} d_1 - d_2 &= w_2 - w_1 + \frac{\lambda}{r+\lambda} \left[\int_{d_1}^{x^u} (s-d_1) - \int_{d_2}^{x^u} (s-d_2) \right] - \phi \frac{d_2-d_1}{r+\lambda+\phi} \\ &= A - \phi \frac{d_2-d_1}{r+\lambda+\phi} \neq A \end{aligned} \tag{56}$$

We have proved by contradiction that case C is impossible.