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Rational Expectations and the Puzzling No-Effect of The Minimum Wage

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Abstract

Empirical literature on the employment effect of minimum wages is characterized by controversial results. We argue that expectations about future changes in the minimum wage may explain the conflicting findings. Extending a matching model, we analyze the influence of expectations. When the increase in the minimum wage is expected, agents will adjust their behavior in advance; therefore, the disemployment effect observed after the actual variation will be small and, possibly, difficult to estimate. The model is tested on Spanish data. The unexpected election of Zapatero in 2004 and the following increase in the minimum wage, provide us a clear case of unexpected change. We estimate the effect on employment and workers' flow of this policy and compare it with the effect of expected variations in the minimum wage. Results show that the increase in job separation is greater in case of the 2004-unexpected policy. Furthermore, the disemployment effect observed after the increase in the minimum wage is significant only when the change is unexpected, otherwise the estimates are not statistically different from zero.

Keywords: Minimum wage, Expectations, Employment protection

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 relied mainly on time-series variation in the minimum wage in US and aggregate data; and built a consensus around the idea that minimum wages reduce teenage employment. The latter used 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 found 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 on a particular industry.[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. The 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 employer groups and trade unions collective agreements, which have a defined duration. In the light of these features, the minimum wage policy cannot be considered as an unpredictable shock. If agents are rationale, 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 are expected to be broken, if their productivities fall below the future acceptable minimum. In a world characterized by employment protection regulation, dismissing a worker is expensive. Therefore, firms may find more convenient not to hire those marginal workers, in order to save on future costs. Then, when the minimum wage actually increases, the employment adjustment will be small, because it has been partly anticipated.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. 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. Furthermore, we allow for expectations: 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 stuatutory 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 following Portugal and Cardoso (2006),. 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.

Not all the workers are affected by the minimum wage, but only those who are low-earners.

[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.

Therefore a difference in difference approach is implemented. The empirical literature tipically identify the treated with the youth and use the adult as a control group. Young workers are more likely to be employed at low wage, but not all of them are actually low-paid.[2] 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 policy movement: unexpected changes lead to greater reduction in employment in the period following the actual change; whereas expected variations have effect on impact but ex-post coefficients are not significant. Furthermore, the increase in flows out of employment is bigger in case of unexpected policy, as predicted by the theoretical model. Temporary workers turn out to be the most affected, while separation 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 employment effect of the minimum wage

The minimum wage policy is mainly a redistributive instrument; nevertheless economic literature focuses on its employment effects.[3] 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 to support the disemployment effect of the minimum wage.

Individuals most likely to be employed at the minimum wage are the recent labor market entrants; therefore empirical studies limited their attention to young workers.

Different approaches have been used to asses the impact of the minimum wage on youth employment. The First Wave of the Minimum Wage Research used, mainly, time-series and aggregate data to estimate correlations between employment and the minimum wage. They generally found 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 criticised. The use of aggregate data may leave out many relevant variables, thus giving rise to spurious correlation.[4]

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

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

[4] 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.

The New Minimum Wage Research relied on case studies and panel data, with controversial results. In a series of papers, Card and Krueger (1994, 2000) used the 1992 increase in New Jersey's minimum wage as a natural experiment and estimated its effect on the fast-food employment. They implemented 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 replicated the analysis of Card and Krueger (1994) replacing their survey based data with administrative payroll records, and found a negative effect on New Jersey's employment relative to that in 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.

Another part of the New Minimum Wage Research exploited panel data to identify the employment effects of the minimum wage. For istance, Card (1992) studied 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 workers (i.e. teenagers who earned between the old and the new minimum wage in 1989), and controls, Card did not find a significant effect of the 1990 minimum wage increase. On the other side, Neumark and Wascher found support to the disemployment effect of the minimum wage in a series of papers (1992, 2002, 2007b). The main difference among these studies is the measure of the minimum wage: Card used the fraction of workers at or near the minimum wage, while Neumark and Wascher preferred 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 different perspectives and reach different conclusions.

In the end, the empirical literature has not been able, yet, to agree 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, then 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. Thus, monopsony could account for both positive and negative effects of the minimum wage. On the other side, it seems unreasonable to apply a monopsonistic model to low wage labor markets. Those markets are tipically characterized by a large number of relatively small employers and high worker mobility, therefore they are closer to perfect competition.

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, therefore the threat to dismiss shirking workers becomes more effective and lower resources have to be devoted to supervision and may be used to increase employment.

A matching model with endogenous search effort is also capable to reproduce different employment effect of the minimum wage. An increase in the minimum wage may provide an incentive for unemployed to exert more effort in searching for a job, given that the expected gain from being employed is higher. On the other side, the probability to get a job is lower, due to fewer vacancy posting. In case the impact on search effort is positive, the matching process becomes more efficient and may compensate for the reduction in job openings.

Clearly, the effects of the minimum wage depend on the characteristics of the labor market to which it applies.

In this paper we propose a different mechanism to account for the wide range of estimates of the employment effect of the minimum wage. 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, then the employment effects are going to be different; in particular disemployment is higher in case of an unexpected change.[5] Still, labor marker characteristics contribute to shape the employment effect of the minimum wage.

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. Then, the differences in empirical estimates are fully explained by the differences in the econometric strategy, in the dataset, or in the construction of the minimum wage index. 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 change 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 behaviour. We expect that most of the employment effect had already occurred by the 1992 and that 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 istance, the permanent income theory of consumption predicts that a tax-cut is going to have a marginal effect on consumption, if agents expect it to be temporary.

[5] 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 an equal fall in employment, regardless of expectations; because labor demand and labor supply depends only on current prices and productivities.

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, tipically once a year.[6] The frequency of adjustment is fixed by law, when the minimum wage is statutory, or by collective contracts, if the minimum wage is negotiated. Furthermore, 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, or productivity, and others.[7]

In the light of these features, the minimum wage policy cannot be considered as an unpredictable shock. Agents operating on the labor market have many information to form expectations about the timing and the magnitude of future minimum wage changes. And they have the incentive to form expectations, 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 are expected to be broken, if their productivities fall below the future acceptable minimum. In a world characterized by employment protection regulation, dismissing a worker is expensive. Therefore, firms may find more convenient not to hire those marginal workers, in order to save on future costs. 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 on the labor market with probability, respectively, $p = \frac{m(v,u)}{u}$ and $q = \frac{m(v,u)}{v}$. Call market tightness $\theta = \frac{v}{u}$. 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 draw, x, from a known probability distribution $G(x)$, 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 hitten by a shock, with frequency λ and distribution $H(x)$. Job separations occurs if the new productivity draw is lower than the productivity threshold d. Furthermore, a match may be destroyed when the minimum wage increases and, at the new wage, the

[6] 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, so that the real minimum wage changes are likely to be expected. In the following, we will abstract from changes caused only by inflation because they are marginal and not likely to significantly affect agents' behavior.

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

job is no more profitable. Then, a firing tax F is paid by the firm.[8] Note that, due to the separation cost F, the productivity threshold d is lower than the hiring standard a.

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. The model assumes that, initially, agents do not expect the minimum wage to rise. This is state 0, and it is characterized by wage w_1 and expectation parameter $\phi_0 = 0$. Then, only if the future variation in the minimum wage is expected, the subjective probability ϕ increases to $\phi_1 > \phi_0$.[9] This situation is called state 1: the wage has not moved, but expectations have been updated to the higher probability ϕ_1. In the real world, expectations may be revised due to the political announcement of a future variation in the minimum wage, or due to changes in the economic situation or in the political support such that the likeliness 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 is $w_2 > w_1$ and ϕ_2 is set at zero.

The disemployment effect is analysed 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[10]:

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

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

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 hitten by a shock and its productivity is drawn from $H(x)$, over the support $[x^l, x^u]$. 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 under the new productivity. In state 1, firms know that, with probability ϕ, the minimum wage will increase to w_2. In that case, the job is destroyed if its new value, $J_2(x)$, is lower - more negative - then the cost of firing the worker. Note that $J_i(x)$ is decreasing in the wage w and in the expectation parameter ϕ.

[8] 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 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.

[9] We could assume that the initial subjective probability ϕ_0 is positive, and lower than ϕ_1. 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 assume that $\phi_0 = 0$ 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 $\phi_1 > \phi_0$.

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

The value of a vacancy is:

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

where k is the cost of posting a vacancy. The match productivity is drawn by $G(x)$ over the support $\left[x^L, x^U\right]$. 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. Matches are formed as long as their surplus is positive. 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 $J(a) = 0$.

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 istance, imagine that the party in power changes from the right wing to the left - increase the likelyhood of a change in the wage policy.[11] 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.

[11] 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 change 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. 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.

4.2.1 Equilibrium conditions

Let's solve the problem backward. Using 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:

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

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

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

We 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, therefore less vacancies are posted and the labor market tightness θ diminishes.

In state 1, agents take into account the future variation in the value of the match. In particular, the value of a currently filled position 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, $J_1(x)$ is to the left of $J_2(x)$ and the productivity thresholds a_1 and d_1, are unambiguously smaller than a_2 and d_2. But 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 that are unprofitable under state 2 are not formed even in state 1: $a_1^B > d_2$. It can be prooved 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, i.e 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, $a_1^B > d_2$.[12] 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. In turns out that the value functions in state 0 are equal to value functions in state 2, apart from the wage, which is $w_1 < w_2$. The solution of the equilibrium conditions follows the same steps mentioned above. In the end, the two productivity threshold, a_0 and d_0 are lower then the respective values in state 1 and state 2, whereas θ is higher. The equilibrium conditions are formally derived in Appendix A.

We use the equilibrium conditions, JC, MF and JD, to compute the steady state unemployment level:

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

where $\lambda H(d_i)$ is the job destruction rate, defined as the ratio of total job destruction to employment, and $\theta_i q(\theta_i)[1 - G(a_i)]$ is the job finding rate, i.e. the ratio of total job creation to unemployment.[13] Unemployment is increasing in the job destruction threshold, d, and in the hiring standard, a, it is decreasing in the market tightness, θ. It turns out that the unemployment level is minimum in state 0, it increases in state 1, and it is even higher in state 2.

4.2.2 Job flows and unemployment dynamics

Higher minimum wage means higher labor cost to the firm. Then, matches have to be more productive in order to compensate for the greater cost. The hiring standard a is increased; so is the job destruction threshold d. Also, less vacancies will be posted, and market tightness θ decreases. Lower job creation and higher job destruction mean greater unemployment to be associated with the increase in the minimum wage.

The dynamics of unemployment are drawn in Figure 2.[14] In state 0, the unemployment is at the steady state level u_0. When an announcement, or a political or economic shock, takes place and changes expectations from ϕ_0 to ϕ_1, the unemployment level starts to rise until it reaches the

[12] See Appendix A for a formal proof.

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

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

where $\lambda H(d)(1 - u)$ is the job destruction and $\theta q(\theta)[1 - G(a)]u$ 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 $[1 - G(a)]$.

[14] Figure 2 and Figure 3 are examples of transition paths. The exact shape of the curves depends on the value of the parameters of the model.

new steady state level u_1. The transition is led by the movements in job flows. The thresholds for job destruction ,d, match formation ,a, and vacancy posting, θ, react immediately to the variation in ϕ and jump to the new equilibrium value d_1, a_1 and θ_1.

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, but also all jobs with productivity x in the range $d_0 \leq x \leq d_1$ become unprofitable and close down. Then job destruction drops to $\lambda H(d_1)$ till the next change in the parameters (Figure 3).

The job creation rate, i.e. the ratio of total job creation to employment, decreases from $\theta_0 q(\theta_0)[1 - G(a_0)] u_0/(1-u_0)$ to $\theta_1 q(\theta_1)[1 - G(a_1)] u_0/(1-u_0)$, on impact. Then, as long as unemployment increases, job creation rises until it matches the higher job destruction rate at the new steady state (Figure 3).[15]

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, it adjusts slowly and takes time to get to u_1.[16] 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

$$\Delta u_{ex-ante} = u_1 - u_0 \tag{10}$$

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

$$\Delta u_{ex-post} = u_2 - u_1 \tag{11}$$

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. Therefore, we can distinguish only two states: state 0 and state 2.

[15] The dynamics of the job finding rate, $\theta q(\theta)[1 - G(a)]$, are depicted in Figure 4. The job finding rate does not depend on u, therefore it jumps down from $\theta_0 q(\theta_0)[1 - G(a_0)]$ to $\theta_1 q(\theta_1)[1 - G(a_1)]$ without any transition.

[16] The lenght of the transition 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. Therefore, the disemployment effect of the actual increase in the minimum wage is equal to the difference among the steady state unemployment u_2 and u_1. Conclusions would be qualitatively the same if we allowed for the more general case, but it would be difficult to quantify u_1.

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.

$$\Delta u = u_2 - u_0 \tag{12}$$

4.4 Comparison

Both expected and unexpected increase in the minimum wage lead to an increase in the unemployment rate. If we consider the overall disemployent effect, i.e. the increase in unemployment occured between state 0 and state 2, there is no difference among the expected and the unexpected policy variation. The variation in unemployment is always $u_2 - u_0$. The difference is in the dynamics.

When the increase in the minimum wage is expected, the disemployment effect is splitted 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 anticipated the policy and adjusted their behavior in advance, so that the ex-post effect will be smaller.

The goal of this paper is to provide an explanation for the controversial empirical findings; therefore we focus on implications for the ex-post effect. If we compare only the ex-post effect, it is clear that unemployment augments more after an unexpected increase in the minimum wage. In particular, job destruction increases more and the job finding rate - i.e. job creation over unemployment - decreases more:

$$\frac{JD}{1-u} \quad : \quad \lambda H(d_2) - \lambda H(d_0) > \lambda H(d_2) - \lambda H(d_1) \tag{13}$$

$$\frac{JC}{u} \quad : \quad |\theta_2 q(\theta_2)[1 - G(a_2)] - \theta_0 q(\theta_0)[1 - G(a_0)]| > |\theta_2 q(\theta_2)[1 - G(a_2)] - \theta_1 q(\theta_1)[1 - G(a_1)]| \tag{14}$$

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 significant 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.[17]

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 construct 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, and they cannot be less than 70, 80 and 90% of the inter-profession minimum wage for the first, second and third year (respectively) of validity of the contract. Until 1997, the government fixed two minimum wages: one for adult workers (+18 years old) and another for workers from 16 to 18 years old. This 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 the democracy. From 1977 to today, 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 contributes to enhance 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 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

[17] 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.

Interprofessional Agreement to Fill the Gaps in Collective Bargaining.[18] 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.[19] Anybody would have been easily able to predict it.

Instead, the increase of the minimum wage in July 2004 was largerly 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 of 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.

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 it 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 the findings of 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.

The Economist called Zapatero "the unexpected prime minister", speculating that his success was related, at least partly, to the train bombs in Madrid. Before the attacks, 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. While 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 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.[20]

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

[19] Actually, this was not a new experience for Spain. Table 3 shows that, 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 of the 80s. The novelty was the concertation process; and therefore the broad agreement and knowledge of this plan.

[20] 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

The Spanish case provide us with two types of minimum wage shocks: 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.[21] 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; thanks to the higher participation of the youth, whose employment rate augmented from 34.5 to 42.2 per cent. Also unemployment followed a decreasing trend. Flows into employment greatly increased, especially for the youth; on the other side employment stability lowered and separations increased as well. Nevertheless, the tendency was positive. 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.

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.

Our dependent variables are the employment status and the flows out and into employment. Thanks to the structure of the survey, we can match 5/6 of the individuals in any two consecutive

to pre-adjust to the policy. Empirically, this is not a concern, because data are quarterly, so that it is not possible to distinguish March 2004, the election, from July 2004, the minimum wage variation.

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

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. Therefore we construct three dependent discrete variable: (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

$$\Pr(y_{it} = 1) = \Phi(W\delta) \tag{15}$$

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

Note that $\Pr(y_{it}^{e} = 1)$ is empirically equivalent to the employment probability; $\Pr(y_{it}^{out} = 1)$ and $\Pr\left(y_{it}^{in} = 1\right)$ corresponds to the job destruction rate to employment, $\lambda H(d)$, and to the job finding rate, $\theta q(\theta)[1 - G(a)]$, respectively. Our model predicts that a rise in the minimum wage have higher effect on both 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 in and out of employment following unexpected and expected variation in the minimum wage. As explained in Section 7.1, the increase in July 2004 was unexpected; and we call U_{MW} a variable equal to 6.7 in the third quarter of 2004,[22] and zero elsewhere. All the other variations occurred to the real minimum wage are considered as expected, including those related to inflation; let's call this variable E_{MW}.

Table 2 shows that during Aznar's mandate, the real minimum wage moved very little; whereas it increased significantly after 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. We assumed that the small movements arranged by the right wing had no effect on flows and constructed a new variable for expected variation in the minimum wage, Z_{MW}. This variable is set at zero except for the rise in the first quarter of 2006.

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 threatment 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:

$$\Pr(y = 1) = \Phi(\alpha_0 + \alpha_1 Y + \alpha_2 Y * U_{MW} + \alpha_3 Y * E_{MW} + T\eta + X\beta + \varepsilon) \tag{16}$$

where Y is a dummy equal to 1 when the individual is aged 16-24 and 0 if older;[23] 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; and α_3 measures the effect of the expected changes. In

[22] 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.

[23] 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.

these framework, we can quantify the difference in the impact on flows of expected and unexpected changes in the minimum wage. Let's consider a simple case with only two periods; then we can rewrite equation 16 as:

$$\Pr(y=1) = \Phi\left(\alpha_0 + \alpha_1 Y + \alpha_2 Y * U_{MW} + \alpha_3 Y * E_{MW} + \eta_1 U + \eta_2 E + X\beta + \varepsilon\right) \quad (17)$$

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 individual have probability $\alpha_0 + \alpha_1 + \alpha_2 + \eta_1 + X\beta$ of being employed (switching status) in period 2004:3; and probability $\alpha_0 + \alpha_1 + \alpha_3 + \eta_2 + X\beta$ in period 2002:1. Therefore, 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

$$(\alpha_2 + \eta_1) - (\alpha_3 + \eta_2) - (\eta_1 - \eta_2) = \alpha_2 - \alpha_3 \quad (18)$$

which is the differential in the effect of unexpected and expected changes in the minimum wage on employment (flows). Our model predicts this difference to be positive, in absolute values.[24]

The main concern in a difference in difference approach is the choice of proper treatment and control groups.[25] Unfortunately, EPA survey does not provide data about earnings, therefore we cannot precisely disentangle the low wage workers; but we have information from the Wage Structure Survey. Table 4 reports the annual average earnings of Spanish workers in 2002, computed by age, gender and educational attainament. 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 may be 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. Therefore several specification have been estimated: (i) young versus adult; (ii) young female versus adult female; (iii) young female with low education (without studies or primary education) versus adult female 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

[24] 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 model 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: α_2 for the unexpected change and α_3 for the expected change.

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

[25] Note that the estimate of equation 16 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).

change in the minimum wage may have effect only after. But there is only on impact effect on flows (see Figure 3 and 4). The dynamics is introduced in equation 16, only for the employment probability, through *pre* and *post* effect:

$$\Pr\left(y^{e}=1\right)=\Phi\left(\begin{array}{c}\alpha_0+\alpha_1 Y+\alpha_2 Y*U_{MW}+\gamma_1 Y*U_{MW-pre}+\gamma_2 Y*U_{MW-post}\\ +\alpha_3 Y*E_{MW}+\gamma_3 Y*E_{MW-pre}+\gamma_4 Y*E_{MW-post}+T\eta+X\beta+\varepsilon\end{array}\right) \quad (19)$$

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.[26] 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 the policy change. On the other side, it is difficult to set the lenght of dynamics effects; and they may capture events different from the policy under consideration. Therefore, equation 19 is estimated using different lenght of the dynamics: from 0 to 4 quarters.

In the end, we applied the above-mentioned specifications to the flows out of employment of temporary and permanent workers separately. The Spanish labor market is characterized by the coexistence 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. Intuitively, firms will rather adjust the workforce 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. See Appendix B for the full set of regressions.

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 also in the preceding quarters if the policy was expected.

We estimated both on impact and dynamics effects. Results are shown in Tables 5 and 6. The first column includes only the on impact effect of the minimum wage; the dynamics is added in column (2) and (3).[27] We control for time effects, linear trend, region, age, gender and education.

[26] In practice, $Y*U_{MW-pre}$ ($Y*U_{MW-post}$) is set at 6.7 when the flow y refers to a young individual in x quarters preceding (following) 3:04; $Y*Z_{MW-pre}$ ($Y*Z_{MW-post}$) is equal to 5.4 in x quarters preceding (following) 1:06. With regard to $Y*E_{MW-pre}$ ($Y*E_{MW-post}$), we assumed 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 have only on impact effect. This hypothesis is sensible in an environment of low inflation. Furthermore, $Y*E_{MW-pre}$ is corrected so that, before 3:04, the future the rise in the minimum wage were expected to be equal to 2 per cent minus inflation rate. Therefore the increase of 4.9 per cent in 1:05 is lowered to 2.9 when associated to quarter preceding 3:04.

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

[27] Tables 5 and 6 shows estimates for the dynamic effect of the minimum wage two quarter before and after the actual change. Results for different transition lenght are detailed in Appendix B1.

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, therefore we discuss them jointly.

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 10 per cent rise in U_{MW} is estimated to increase employment probability by 3 per cent. Only the post effect is negative. Its magnitude decreases as the lenght of the dynamics effect increases (see Appendix B1), 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 depends 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), then 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}. Here, only the 2006:1 variation is considered as expected. The on impact and pre effects are significantly negative, as predicted by the model.

The second panel restrict 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 female with low education with adult female 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 rised. Economic agents need time to weight the importance of the 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, therefore 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 related to expected and unexpected change in the minimum wage, for the affected and the control group. All specifications control for time effects, linear trend, 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. Let's consider first results for the full sample of workers, 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 10 per cent unexpected increase in the minimum wage is associated to an increase in job separation probability by 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.

The regressions in the second panel compare young female with adult female. As explained in the previous section, these groups are more appropriate to evaluate the minimum wage effects. Previous results are confirmed: U_{MW} has greater effect. The same is true in the third panel, which considers only female 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 sunstantially shrinks.

The other columns of Tables 7 and 8 contain 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 female in the third panel. Permanent workers are significantly affected by the unexpected policy and the coefficient estimated for temporary workers, albeit higher, is 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. Employment protection may prevent permanent workers to be dismissed by increasing the adjustment cost with respect to temporary workers.[28] Nevertheless, the productivity distribution do matters: temporary jobs may be, on average, less productive; then a higher share would fall under the job destruction threshold when the minimum wage increases.[29] 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. With regard to temporary workers, we find support for the higher effect of unexpected policy, while the expected variations have no significant effect.

All regressions take into account several control variables. Time and regional dummies are mostly significant and flows out of employment display a slightly upward trend, small in magnitude, 0.1 per cent, but statistically 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.

[28] 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 estimated the disemployment effect of the minimum wage to depend, negatively, on the degree of employment protection.

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

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 mostly 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 explain it: when the minimum wage increases, job destruction increases, but it can be counterbalanced by a rise in job creation.

Not surprisingly, the youth have greater probability to enter a job. Females are associated to inflows smaller by 6.6 per cent. They seem to be discriminated both in entering and exiting the labor market; but the lower participation rate and unobservable characteristics may contribute in explaining the results. Adopting and active method of search - i.e. inquiring the job centre, or private employment agencies, contacting directly employers, etc - help finding a job. Education has a positive effect: having a university degree augments the probability to enter a job by 7% (8.3% in the subsample of female). The region of residence and the period affect the outcome; and a small upward trend is found.

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 change 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.[30] The model presented in Section 2 predicts a loss in job creation, but it has to be stressed that our model abstracted 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. The substantial rise in the beginning of Zapatero mandate may be connected with the large increase in the minimum wage, and is able to account for the lack of response in job creation rates.

Depending on the sample used, we estimated a positive or null disemployment (on impact) effect of the unexpected increase in the minimum wage. The analysis of flows allows us to trace

[30] 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 contrast 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, the treated are aged 16-24 years and controls are 25-54 years old in our study. It should not be surprising that comparing teenagers with young individuals gives different results from the comparison between young and adults.

back this result to the increase in job inflows that compensated the higher job separations. 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 prevails and employment is reduced. Small expected changes in the minimum wage, as during the Aznar mandate, have no effect on employment. We find negative, albeit not always significant, on impact and dynamics effects of the rise occurred in 2006:1. The positive effect on participation is weaker after 2005 and cannot counterbalance job destruction.

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. But the interpretation of these results has to take into account potential 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.

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 contribute 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 determine the level of the minimum wage and the periodicity of its revision. Sometimes it also fix 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 minimum wage 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 the 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: young versus adult, young female versus adult female, young female with low education versus adult female with low education.

Our results show that the unexpected increase in the minimum wage lead 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 estimated null effects of the minimum wage, regardless of expectations; whereas our model predicted a fall in employment inflows. These results may be explained by supply-side factors, as labor market participation decision and search effort. Data shows that the participation rate rised 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, therefore, job inflows, balancing the increase in separations. But if we consider the effect of the unexpected increase in the minimum wage over a longer period, then the estimates support a sizeble disemployment effect. A 10 per cent unexpected increase in the minimum wage reduced young employment by 2 per cent in the following two or three quarters, 4 per cent if we restrict to female. Whereas, the expected variations had some negative effect on impact, but no significant effect ex-post.

In sum, changes in the minimum wage have differentiated effects on flows and employment. Expectations are important to interpret the findings: the lower response of job separations and of employment may be traced back to the adjustment in the behavior of economic agents before the actual change. Empirical estimates mostly focus on the effects of the minimum wage after the actual increase. But, if the increase was expected, the ex-post effect may be too small to be identified in the data. Thus, expectations can explain at least part of the controversy on the empirical disemployment effect.

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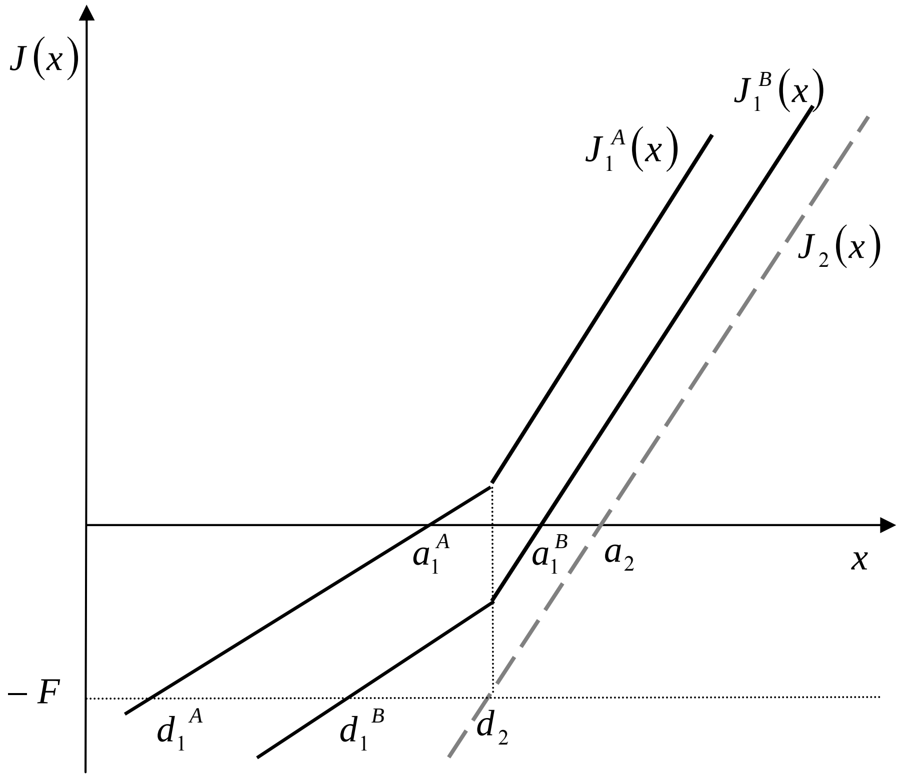
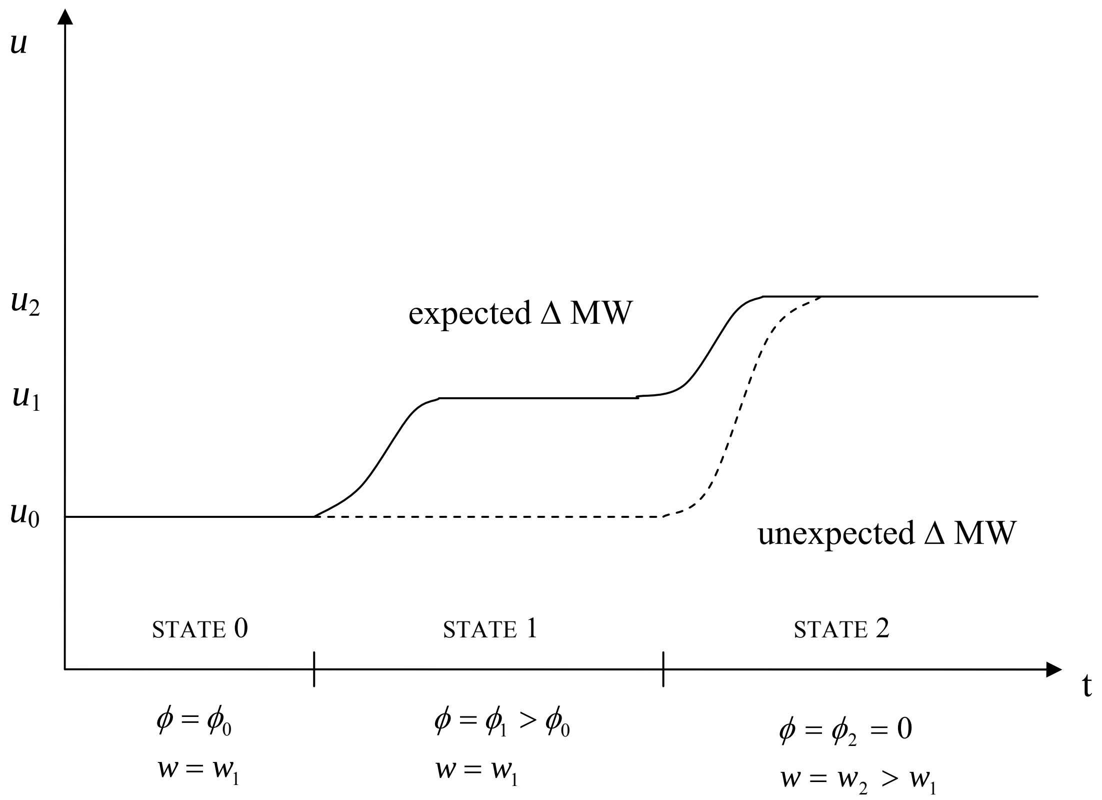
Figure 1. Job values pre and post minimum wage variation in a model with expectations.



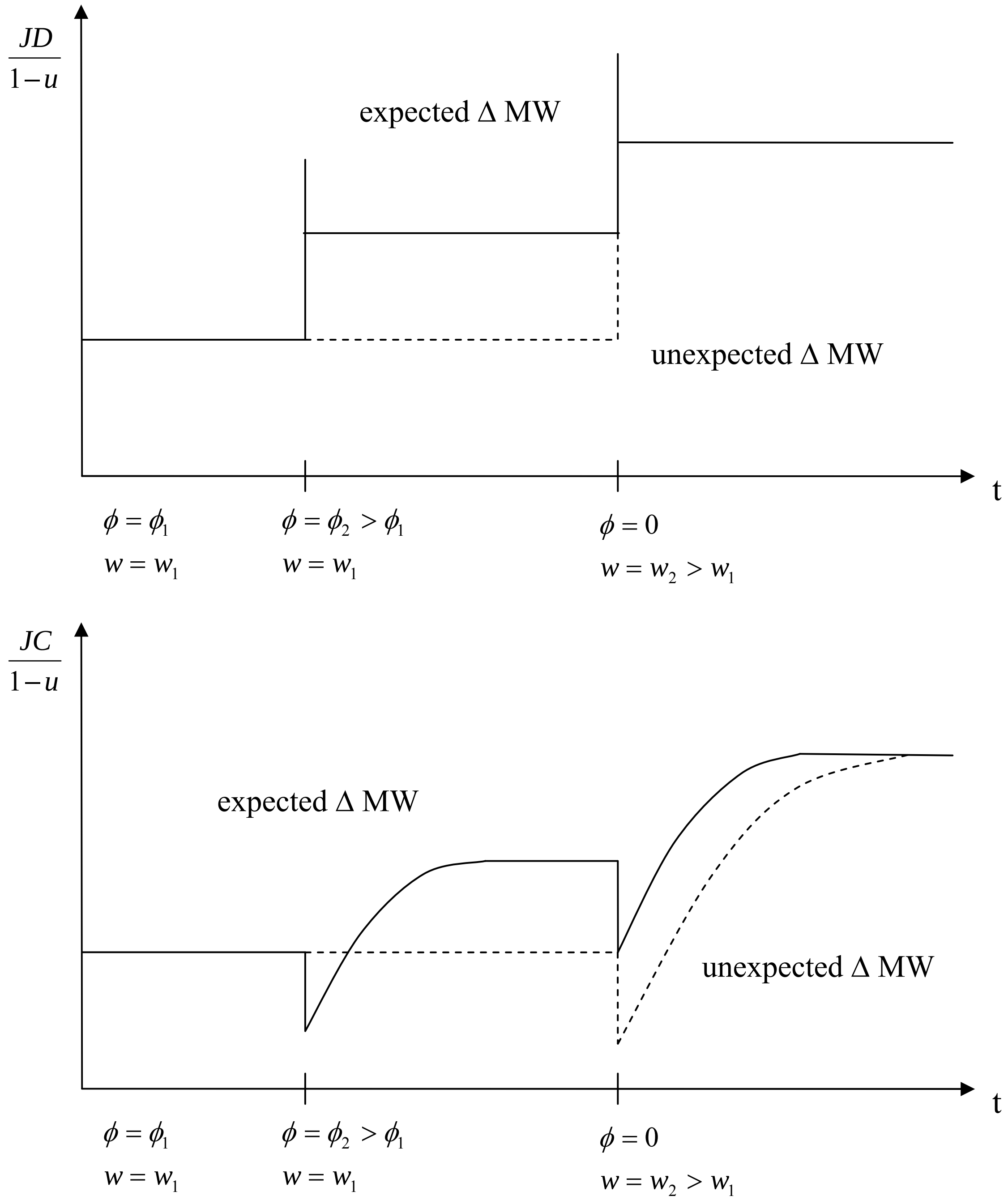
$J_1(x)$ is the value of a job with productivity x in state 1 (wage $w=w_1$; expectations $\varphi= \varphi_1$)
$J_2(x)$ is the value of a job with productivity x in state 2 (wage $w=w_2$; expectations $\varphi= \varphi_2=0$)
a is the productivity level such that $J(x)$ is null; it is called hiring standard.
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.



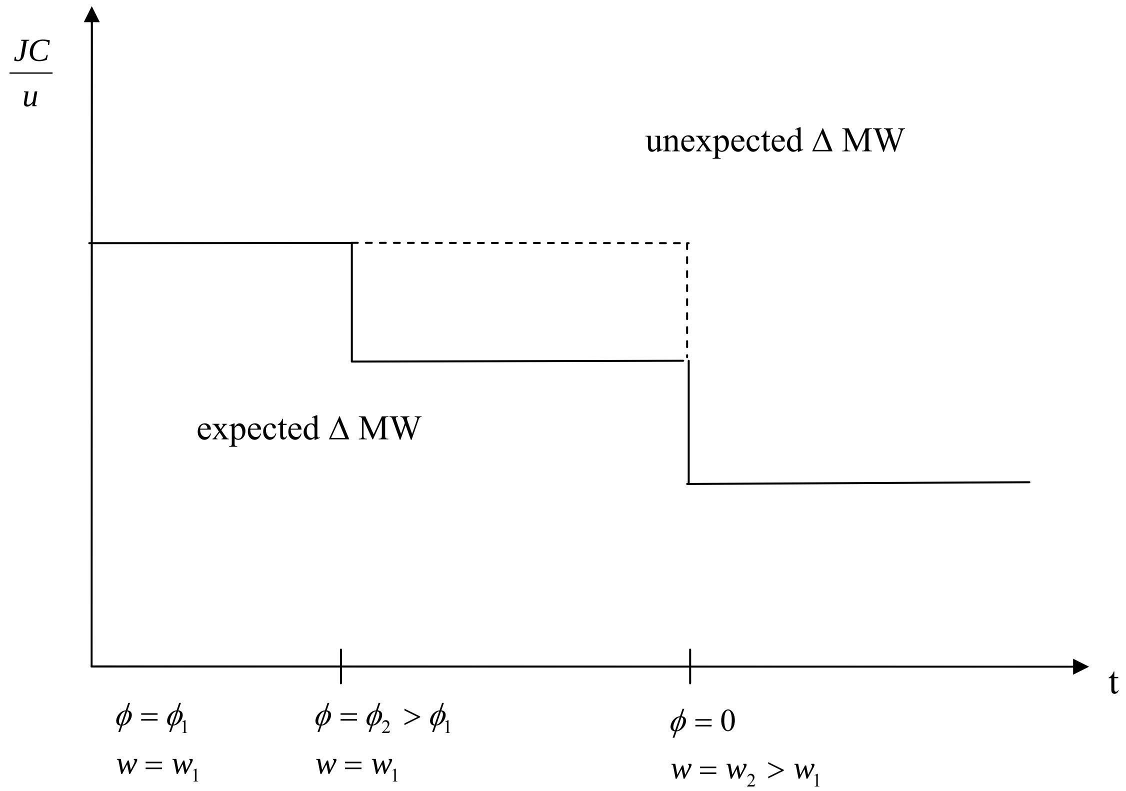
The continuous line represents the dynamic of unemployment along state 0, state 1 and state 2 in case of an expected change in the minimum wage.
The discontinuous line depict the dynamic of unemployment along state 0 and state 2 in case of an unexpected increase in the minimum wage.

Figure 3. Job creation and job destruction dynamics.



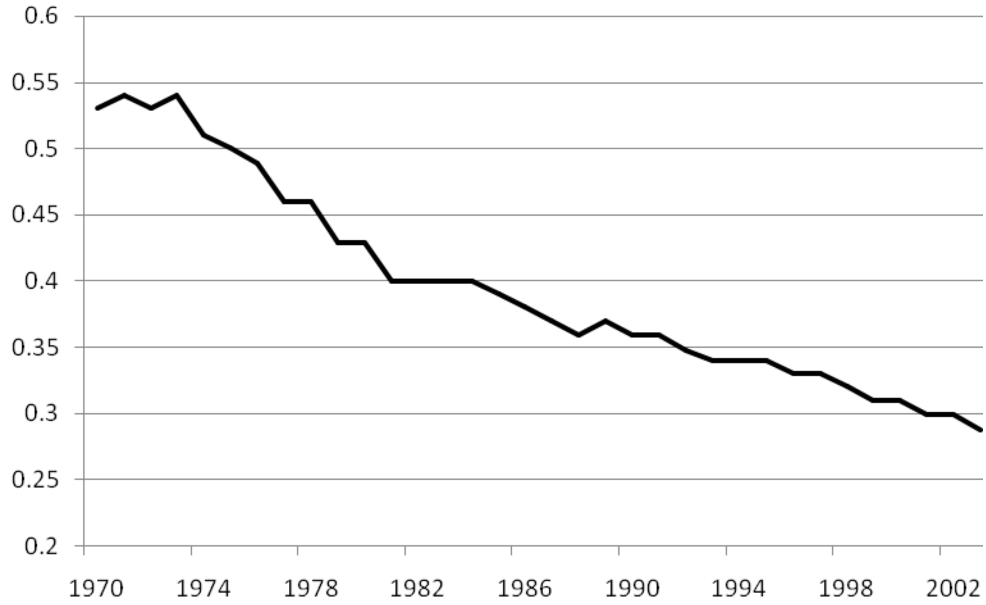
The continuous line represents the dynamic of the JD (JC) rate along state 0, state 1 and state 2 in case of an expected change in the minimum wage.
The discontinuous line depict the dynamic of the JD (JC) rate along state 0 and state 2 in case of an unexpected increase in the minimum wage.

Figure 4. Job finding rate dynamics.



The continuous line represents the dynamic 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 dynamic 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%.
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%.
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 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.

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%.
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%.
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 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.

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*ex_{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*ex_{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*ex_{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%.
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.

A The model

A.1 Equilibrium conditions in state 2:

Let's recall the firm's value function:

the job value function:

$$rJ_2(x) = x - w_2 + \lambda \int_{d_2}^{x^u} [J_2(s) - J_2(x)]\, dH(s) - \lambda H(d_2)[F + J_2(x)] \tag{20}$$

the vacancy value function:

$$rV_2 = -k + q_2 \int_{a_2}^{x^U} [J_2(s) - V_2]\, dG(s) \tag{21}$$

JOB DESTRUCTION:

The job destruction condition is

$$J_2(d_2) = -F \tag{22}$$

Subtracting **??** from 20, we get:

$$(r + \lambda)[J_2(x) - J_2(d_2)] = x - d_2 \tag{23}$$

and

$$J_2(x) = \frac{x - d_2}{r + \lambda} - F \tag{24}$$

so that we can simplify the integral in 20, and rewrite the value function as:

$$(r + \lambda) J_2(x) = x - w_2 + \frac{\lambda}{r + \lambda} \int_{d_2}^{x^u} (s - d_2)\, dH(s) - \lambda F \tag{25}$$

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

$$d_2 = w_2 - \frac{\lambda}{r + \lambda} \int_{d_2}^{x^u} (s - d_2)\, dH(s) - rF \tag{26}$$

MATCH FORMATION:

The job formation condition is

$$J_2(a_2) = 0 \tag{27}$$

Substituting condition 27 into equation 25 we get:

$$a_2 = w_2 - \frac{\lambda}{r + \lambda} \int_{d_2}^{x^u} (s - d_2)\, dH(s) + \lambda F = d_2 + (r + \lambda) F \tag{28}$$

JOB CREATION:

The free entry condition is

$$V = 0 \tag{29}$$

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

$$\int_{a_2}^{x^u} J_2(s)\, dG(s) = \frac{k}{q_2} \tag{30}$$

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

$$J_2(x) = \frac{x - a_2}{r + \lambda} \tag{31}$$

Substituting 31 into 30, we get:

$$\frac{1}{r+\lambda} \int_{a_2}^{x^u} (s - a_2)\, dG(s) = \frac{k}{q_2} \tag{32}$$

A.2 Equilibrium conditions in state 1:

Job value function:

$$rJ_1(x) =$$
$$\begin{cases} x - w_1 + \lambda \int_{d_1}^{x^u} [J_1(s) - J_1(x)]\, dH(s) - [\lambda H(d_1) + \phi_1]\,[F + J_1(x)] & \text{if } x < d_2 \\ x - w_1 + \lambda \int_{d_1}^{x^u} [J_1(s) - J_1(x)]\, dH(s) - \lambda H(d_1)\,[F + J_1(x)] + \phi_1\,[J_2(x) - J_1(x)] & \text{if } x \geq d_2 \end{cases} \tag{33}$$

$J_1(x)$ 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 proove that the third case is impossible.

After some computation, assuming $d_1 < d_2$, we can rewrite the second segment of $J_1(x)$ as:

$$\begin{aligned} (r+\lambda) J_1(x) &= x - w_1 + \phi\,[J_2(x) - J_1(x)] - \lambda F + \lambda\,[1 - H(d_2)]\,\frac{d_2 - d_1}{r+\lambda+\phi} \\ &\quad + \lambda \left[\frac{1}{r+\lambda+\phi} \int_{d_1}^{d_2} (s - d_1)\, dH(s) + \frac{1}{r+\lambda} \int_{d_2}^{x^u} (s - d_2)\, dH(s) \right] \end{aligned} \tag{34}$$

We may have two cases:

CASE A: $J_1(d_2) > 0$. Using condition 22, we have that $J_1(d_2) > 0$ is equivalent to:

$$C = (r+\lambda+\phi)[J_1(d_2) - J_2(d_2)] > (r+\lambda+\phi)F \quad (35)$$

Let's compute C using equations 34 and 25:

$$C = w_2 - w_1 + \frac{\lambda}{r+\lambda+\phi}\int_{d_1}^{d_2}(s-d_1)\,dH(s) + \frac{\lambda}{r+\lambda}\left[\int_{d_1}^{x^u}(s-d_1)\,dH(s) - \int_{d_2}^{x^u}(s-d_2)\,dH(s)\right] \quad (36)$$

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

$$C = d_1 - d_2 \quad (37)$$

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:

$$d_1 = w_1 - \lambda\left[\begin{array}{c}\frac{1}{r+\lambda+\phi}\int_{d_1}^{d_2}(s-d_1)\,dH(s)\\ +[1-H(d_2)]\frac{d_2-d_1}{r+\lambda+\phi}\end{array}\right] - \frac{\lambda}{r+\lambda}\int_{d_2}^{x^u}(s-d_2)\,dH(s) - rF \quad (38)$$

We can easily check that $d_1 < d_2$. Furthermore, substituting 26 into 38, condition 37 is verified.

MATCH FORMATION:

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

$$\begin{aligned} a_1 &= w_1 + (\lambda+\phi)F - \lambda\left[\begin{array}{c}\frac{1}{r+\lambda+\phi}\int_{d_1}^{d_2}(s-d_1)\,dH(s)\\ +[1-H(d_2)]\frac{d_2-d_1}{r+\lambda+\phi}\end{array}\right] - \frac{\lambda}{r+\lambda}\int_{d_2}^{x^u}(s-d_2)\,dH(s) \quad (39)\\ &= d_1 + (r+\lambda+\phi)F \end{aligned}$$

JOB CREATION:

Following the same steps explained in the derivation of 32, we can derive:

$$\left[\begin{array}{c}\frac{1}{r+\lambda+\phi}\int_{a_1}^{d_2}(s-a_1)\,dG(s)\\ +\frac{1}{r+\lambda}\int_{d_2}^{x^u}(s-d_2)\,dG(s) + [1-G(d_2)]\left(\frac{d_2-d_1}{r+\lambda+\phi} - F\right)\end{array}\right] = \frac{k}{q_1} \quad (40)$$

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

$$C < (r+\lambda+\phi)F \quad (41)$$

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:

$$d_1 = w_1 - \lambda\left[\begin{array}{c}\frac{1}{r+\lambda+\phi}\int_{d_1}^{d_2}(s-d_1)\,dH(s)\\ +[1-H(d_2)]\frac{d_2-d_1}{r+\lambda+\phi}\end{array}\right] - \frac{\lambda}{r+\lambda}\int_{d_2}^{x^u}(s-d_2)\,dH(s) - rF \quad (42)$$

As for case A, condition 37 has to be verified.

MATCH FORMATION:

Now the hiring standard has to belong to the second segment:

$$\begin{aligned} a_1 &= w_1 - \lambda \left[\begin{array}{c} \frac{1}{r+\lambda+\phi} \int_{d_1}^{d_2} (s-d_1)\, dH(s) \\ + [1-H(d_2)] \frac{d_2-d_1}{r+\lambda+\phi} \end{array} \right] - \frac{\lambda}{r+\lambda} \int_{d_2}^{x^u} (s-d_2)\, dH(s) + \lambda F + \phi \frac{d_2-d_1}{r+\lambda+\phi} \qquad (43) \\ &= d_1 + (r+\lambda) F + \phi \frac{d_2-d_1}{r+\lambda+\phi} \end{aligned}$$

JOB CREATION:

Following the same steps explained in the derivation of 32, we can derive:

$$\frac{1}{r+\lambda} \int_{a_1}^{x^u} (s-a_1)\, dG(s) = \frac{k}{q_1} \qquad (44)$$

A.2.1 Impossibility of the third case

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

$$(r+\lambda) J_1(x) = x - w_1 - \phi [J_1(x) - J_2(x)] + \frac{\lambda}{r+\lambda} \int_{d_1}^{x^u} (s-d_1)\, dH(s) - \lambda F \qquad (45)$$

In this case:

$$[r+\lambda+\phi][J_1(x) - J_2(x)] = w_2 - w_1 + \frac{\lambda}{r+\lambda} \left[\int_{d_1}^{x^u} (s-d_1)\, dH(s) - \int_{d_2}^{x^u} (s-d_2)\, dH(s) \right] = A \qquad (46)$$

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

$$w_2 - w_1 + \frac{\lambda}{r+\lambda} \left[\int_{d_1}^{x^u} (s-d_1)\, dH(s) - \int_{d_2}^{x^u} (s-d_2)\, dH(s) \right] = d_1 - d_2 \qquad (47)$$

JOB DESTRUCTION:

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

$$d_1 = w_1 - \frac{\lambda}{r+\lambda} \int_{d_1}^{x^u} (s-d_1)\, dH(s) - rF + \phi \frac{d_2-d_1}{r+\lambda+\phi} \qquad (48)$$

Note that $d_1 > d_2$

If we substitute (JD_1^C) and (JD_2) in condition (35), we get:

$$\begin{aligned} d_1 - d_2 &= w_2 - w_1 + \frac{\lambda}{r+\lambda}\left[\int_{d_1}^{x^u}(s-d_1) - \int_{d_2}^{x^u}(s-d_2)\right] - \phi\frac{d_2-d_1}{r+\lambda+\phi} \\ &= A - \phi\frac{d_2-d_1}{r+\lambda+\phi} \neq A \end{aligned} \tag{49}$$

We have prooved by contradiction that case C is impossible.

B Regressions

B.1 Employment probability

Notes to Tables B.1.1-B.1.6:

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 time (quarterly) effect, linear trend, region (18 dummies), age, gender, education, whether the individual attended any courses during the last month.

[1]interaction among young, a dummy equal to 1 in quarter 2004:3, and the minimum wage variation.

[2]E_{MW}: interaction among young, a dummy equal to 1 in every other quarter than 2004:3, and the minimum wage variation.

Z_{MW}: 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 x quarters.

[4]effect of the variation in the minimum wage on the following x quarters.

x is equal to 1 in model (2) and (3), 2 in model (4) and (5), 3 in model (6) and (7), and 4 in model (8) and (9).

Table B.1.1. Employment (U_{MW} vs. E_{MW}), Probit regression model.
TREATED: young, CONTROL: adult.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
young*U_{MW}[1]	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
young*E_{MW}[2]	-0.001	-0.002	-0.003	-0.000	-0.000	-0.001	-0.001	-0.001	-0.000
	(0.001)**	(0.001)***	(0.001)***	(0.001)	(0.001)	(0.001)	(0.001)*	(0.001)*	(0.001)
young*U_{MW}_pre[3]			-0.001		-0.000		-0.001		0.001
			(0.001)		(0.001)		(0.000)		(0.000)*
young*U_{MW}_post[4]		-0.003	-0.000	-0.002	-0.002	-0.001	-0.001	-0.001	0.000
		(0.001)***	(0.001)	(0.001)***	(0.001)***	(0.001)***	(0.001)	(0.000)**	(0.001)
young*E_{MW}_pre[3]			-0.005		0.000		-0.003		-0.005
			(0.001)***		(0.001)		(0.003)		(0.003)*
young*E_{MW}_post[4]		-0.002	-0.003	0.001	0.001	0.000	0.003	-0.001	0.004
		(0.001)**	(0.001)***	(0.001)**	(0.001)*	(0.001)	(0.003)	(0.001)	(0.002)
young	-0.195	-0.194	-0.190	-0.196	-0.196	-0.195	-0.193	-0.193	-0.191
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***
female	-0.321	-0.321	-0.321	-0.321	-0.321	-0.321	-0.321	-0.321	-0.321
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
medium education	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
high education	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
attending courses	-0.452	-0.452	-0.452	-0.452	-0.452	-0.452	-0.452	-0.452	-0.452
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
trend	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Pseudo-R^2	0.237	0.237	0.237	0.237	0.237	0.237	0.237	0.237	0.237
Observations	1889412	1889412	1889412	1889412	1889412	1889412	1889412	1889412	1889412

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

Table B.1.2. Employment (U_{MW} vs. Z_{MW}), Probit regression model.
TREATED: young, CONTROL: adult.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
young*U_{MW}[1]	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
young*Z_{MW}[2]	-0.002	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003
	(0.001)**	(0.001)**	(0.001)**	(0.001)**	(0.001)***	(0.001)**	(0.001)***	(0.001)**	(0.001)**
young*U_{MW}_pre[3]			-0.000		-0.001		-0.001		0.001
			(0.001)		(0.001)		(0.000)*		(0.000)
young*U_{MW}_post[4]		-0.002	-0.003	-0.002	-0.002	-0.001	-0.001	-0.001	-0.001
		(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.000)***	(0.001)***	(0.000)***	(0.001)*
young*Z_{MW}_pre[3]			-0.002		-0.002		-0.001		-0.000
			(0.001)*		(0.001)**		(0.001)		(0.001)
young*Z_{MW}_post[4]		-0.001	-0.001	0.000	-0.000	0.000	-0.000	0.000	0.000
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
young	-0.195	-0.194	-0.194	-0.194	-0.193	-0.194	-0.193	-0.194	-0.194
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
female	-0.321	-0.321	-0.321	-0.321	-0.321	-0.321	-0.321	-0.321	-0.321
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
medium education	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
high education	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
attending courses	-0.452	-0.452	-0.452	-0.452	-0.452	-0.452	-0.452	-0.452	-0.452
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
trend	0.004	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.004
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Pseudo-R^2	0.237	0.237	0.237	0.237	0.237	0.237	0.237	0.237	0.237
Observations	1889412	1889412	1889412	1889412	1889412	1889412	1889412	1889412	1889412

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

Table B.1.3. Employment (U_{MW} vs. E_{MW}), Probit regression model.
TREATED: young female, CONTROL: adult female.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
young*U_{MW}[1]	0.002	0.002	0.001	0.002	0.002	0.002	0.002	0.002	0.002
	(0.001)**	(0.001)*	(0.001)	(0.001)*	(0.001)*	(0.001)*	(0.001)*	(0.001)*	(0.001)
young*E_{MW}[2]	-0.001	-0.002	-0.004	-0.000	-0.000	-0.001	-0.002	-0.001	0.000
	(0.001)*	(0.001)**	(0.001)***	(0.001)	(0.001)	(0.001)	(0.001)**	(0.001)	(0.001)
young*U_{MW}_pre[3]			-0.001		-0.001		-0.001		0.000
			(0.001)		(0.001)		(0.001)**		(0.001)
young*U_{MW}_post[4]		-0.004	-0.001	-0.003	-0.003	-0.002	-0.002	-0.002	0.001
		(0.001)***	(0.001)	(0.001)***	(0.001)***	(0.001)***	(0.001)	(0.001)**	(0.001)
young*E_{MW}_pre[3]			-0.005		-0.000		-0.006		-0.012
			(0.001)***		(0.001)		(0.004)		(0.004)***
young*E_{MW}_post[4]		-0.002	-0.003	0.001	0.001	-0.000	0.005	-0.001	0.010
		(0.001)	(0.001)**	(0.001)	(0.001)	(0.001)	(0.004)	(0.001)	(0.004)***
young	-0.100	-0.098	-0.094	-0.099	-0.099	-0.098	-0.095	-0.097	-0.090
	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.003)***	(0.003)***	(0.003)***
medium education	0.193	0.193	0.193	0.193	0.193	0.193	0.193	0.193	0.193
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
high education	0.447	0.447	0.447	0.447	0.447	0.447	0.447	0.447	0.447
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
attending courses	-0.334	-0.334	-0.334	-0.334	-0.334	-0.334	-0.334	-0.335	-0.334
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
trend	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Pseudo-R^2	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147
Observations	952728	952728	952728	952728	952728	952728	952728	952728	952728

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

Table B.1.4. Employment (U_{MW} vs. Z_{MW}), Probit regression model.
TREATED: young female, CONTROL: adult female.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
young*U_{MW}[1]	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(0.001)**	(0.001)*	(0.001)*	(0.001)*	(0.001)	(0.001)*	(0.001)	(0.001)*	(0.001)*
young*Z_{MW}[2]	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
young*U_{MW}_pre[3]			-0.000		-0.001		-0.001		-0.000
			(0.001)		(0.001)		(0.001)**		(0.001)
young*U_{MW}_post[4]		-0.003	-0.004	-0.003	-0.004	-0.002	-0.003	-0.002	-0.002
		(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)**
young*Z_{MW}_pre[3]			-0.001		-0.001		0.000		0.001
			(0.002)		(0.001)		(0.001)		(0.001)
young*Z_{MW}_post[4]		-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
		(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
young	-0.099	-0.098	-0.098	-0.098	-0.097	-0.098	-0.096	-0.097	-0.097
	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***
medium education	0.193	0.193	0.193	0.193	0.193	0.193	0.193	0.193	0.193
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
high education	0.447	0.447	0.447	0.447	0.447	0.447	0.447	0.447	0.447
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
attending courses	-0.334	-0.334	-0.334	-0.334	-0.334	-0.334	-0.334	-0.334	-0.334
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
trend	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Pseudo-R^2	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147
Observations	952728	952728	952728	952728	952728	952728	952728	952728	952728

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

Table B.1.5. Employment (U_{MW} vs. E_{MW}), Probit regression model.
TREATED: young female with low education, CONTROL: adult female with low education.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
young*U_{MW}[1]	0.001	-0.001	-0.002	0.003	0.002	0.002	0.002	0.001	0.000
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
young*E_{MW}[2]	-0.001	-0.008	-0.011	-0.003	-0.002	-0.006	-0.006	-0.000	0.004
	(0.002)	(0.003)***	(0.003)***	(0.003)	(0.003)	(0.003)**	(0.003)**	(0.002)	(0.003)
young*U_{MW}_pre[3]			-0.002		-0.002		-0.001		-0.000
			(0.003)		(0.002)		(0.002)		(0.002)
young*U_{MW}_post[4]		-0.010	-0.004	-0.010	-0.011	-0.007	-0.007	-0.004	0.004
		(0.004)***	(0.005)	(0.003)***	(0.003)***	(0.002)***	(0.003)**	(0.002)*	(0.003)
young*E_{MW}_pre[3]			-0.011		0.002		0.001		-0.037
			(0.005)**		(0.003)		(0.013)		(0.012)***
young*E_{MW}_post[4]		-0.019	-0.022	-0.012	-0.013	-0.013	-0.014	-0.015	0.019
		(0.004)***	(0.004)***	(0.003)***	(0.003)***	(0.003)***	(0.013)	(0.003)***	(0.011)*
young	0.008	0.021	0.028	0.026	0.026	0.032	0.033	0.042	0.062
	(0.005)*	(0.005)***	(0.006)***	(0.006)***	(0.007)***	(0.007)***	(0.008)***	(0.008)***	(0.011)***
attending courses	-0.230	-0.229	-0.229	-0.230	-0.230	-0.230	-0.230	-0.230	-0.230
	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***
trend	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Pseudo-R^2	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
Observations	199349	199349	199349	199349	199349	199349	199349	199349	199349

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

Table B.1.6. Employment (U_{MW} vs. Z_{MW}), Probit regression model.
TREATED: young female with low education, CONTROL: adult female with low education.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
young*U_{MW}[1]	0.001	0.001	0.000	0.000	-0.000	-0.000	-0.001	-0.000	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
young*Z_{MW}[2]	-0.010	-0.010	-0.011	-0.011	-0.012	-0.011	-0.012	-0.012	-0.012
	(0.005)*	(0.005)**	(0.005)**	(0.005)**	(0.005)**	(0.005)**	(0.005)**	(0.005)**	(0.005)**
young*U_{MW}_pre[3]			-0.003		-0.003		-0.002		-0.002
			(0.003)		(0.002)		(0.002)		(0.002)
young*U_{MW}_post[4]		-0.007	-0.007	-0.009	-0.010	-0.010	-0.009	-0.008	-0.005
		(0.004)*	(0.004)*	(0.003)***	(0.003)***	(0.002)***	(0.002)***	(0.002)***	(0.003)*
young*Z_{MW}_pre[3]			-0.010		-0.006		-0.005		-0.006
			(0.005)*		(0.004)*		(0.003)		(0.004)
young*Z_{MW}_post[4]		-0.010	-0.011	-0.009	-0.010	-0.010	-0.010	-0.010	-0.010
		(0.005)**	(0.005)**	(0.004)***	(0.004)***	(0.004)***	(0.004)***	(0.004)***	(0.004)***
young	0.009	0.012	0.015	0.016	0.020	0.018	0.021	0.019	0.022
	(0.005)*	(0.005)**	(0.005)***	(0.005)***	(0.006)***	(0.005)***	(0.006)***	(0.005)***	(0.006)***
attending courses	-0.230	-0.230	-0.230	-0.230	-0.230	-0.230	-0.230	-0.230	-0.230
	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***
trend	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Pseudo-R^2	0.033	0.033	0.033	0.03	0.033	0.033	0.033	0.033	0.033
Observations	199349	199349	199349	199349	199349	199349	199349	199349	199349

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

B.2 Flows out of employment

Notes to Tables B.2.1-B.2.6:

The estimates are for flow out of employment, either into unemployment or out of the labor force, 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 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]E_{MW}: interaction among young, a dummy equal to 1 in every other quarter than 2004:3, and the minimum wage variation.

Z_{MW}: interaction among young, a dummy equal to 1 in quarter 2006:1 and the minimum wage variation.

Table B.2.1. Flows out of employment (U_{MW} vs. E_{MW}), Probit regression model.

Variables	(1)	(2)	(3)
young*U_{MW}[1]	0.002	0.004	0.008
	(0.000)***	(0.001)***	(0.003)**
young*E_{MW}[2]	0.000	0.000	0.004
	(0.000)	(0.000)	(0.003)
young	0.019	0.018	0.008
	(0.001)***	(0.001)***	(0.005)
female	0.020	-	-
	(0.000)***		
medium education	-0.005	-0.007	-
	(0.001)***	(0.001)***	
high education	-0.011	-0.016	-
	(0.001)***	(0.001)***	
attending courses	0.029	0.029	0.022
	(0.001)***	(0.001)***	(0.010)**
temporary	0.085	0.106	0.145
	(0.001)***	(0.001)***	(0.003)***
part-time	0.013	0.011	-0.001
	(0.001)***	(0.001)***	(0.003)
manufacturing	-0.037	-0.054	-0.086
	(0.001)***	(0.001)***	(0.003)***
service	-0.046	-0.127	-0.194
	(0.001)***	(0.004)***	(0.008)***
public sector	-0.007	-0.010	0.017
	(0.001)***	(0.001)***	(0.005)***
trend	0.001	0.001	0.002
	(0.000)***	(0.000)***	(0.000)***
Pseudo-R^2	0.161	0.156	0.162
Observations	956432	396856	48789

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

Table B.2.2. Flows out of employment (U_{MW} vs. Z_{MW}), Probit regression model.

Variables	(1)	(2)	(3)
young*U_{MW}[1]	0.002	0.004	0.008
	(0.000)***	(0.001)***	(0.003)***
young*E_{MW}[2]	0.001	0.001	0.008
	(0.000)	(0.001)	(0.005)
young	0.018	0.017	0.006
	(0.001)***	(0.001)***	(0.005)
female	0.020	-	-
	(0.000)***		
medium education	-0.005	-0.007	-
	(0.001)***	(0.001)***	
high education	-0.011	-0.016	-
	(0.001)***	(0.001)***	
attending courses	0.029	0.029	0.022
	(0.001)***	(0.001)***	(0.010)**
temporary	0.085	0.106	0.145
	(0.001)***	(0.001)***	(0.003)***
part-time	0.013	0.011	-0.001
	(0.001)***	(0.001)***	(0.003)
manufacturing	-0.037	-0.054	-0.086
	(0.001)***	(0.001)***	(0.003)***
service	-0.046	-0.127	-0.194
	(0.001)***	(0.004)***	(0.008)***
public sector	-0.007	-0.010	0.017
	(0.001)***	(0.001)***	(0.005)***
trend	0.001	0.001	0.002
	(0.000)***	(0.000)***	(0.000)***
Pseudo-R^2	0.161	0.156	0.162
Observations	956432	396856	48789

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

Table B.2.3. Flows out of employment (U_{MW} vs. E_{MW}), Probit regression model. Temporary workers.

Variables	(1)	(2)	(3)
young*U_{MW}[1]	0.008	0.009	0.011
	(0.001)***	(0.002)***	(0.007)
young*E_{MW}[2]	0.001	0.002	0.005
	(0.001)	(0.001)*	(0.005)
young	0.041	0.036	0.004
	(0.002)***	(0.003)***	(0.010)
female	0.045	-	-
	(0.001)***		
medium education	-0.013	-0.021	-
	(0.002)***	(0.003)***	
high education	-0.030	-0.045	-
	(0.002)***	(0.004)***	
attending courses	0.083	0.072	0.044
	(0.002)***	(0.003)***	(0.019)**
part-time	0.022	0.016	-0.027
	(0.002)***	(0.002)***	(0.007)***
manufacturing	-0.115	-0.145	-0.169
	(0.002)***	(0.003)***	(0.009)***
service	-0.124	-0.268	-0.315
	(0.003)***	(0.007)***	(0.012)***
public sector	0.020	0.015	0.117
	(0.002)***	(0.003)***	(0.013)***
trend	0.001	0.002	0.004
	(0.000)***	(0.000)***	(0.001)***
Pseudo-R^2	0.056	0.057	0.090
Observations	321085	143465	19384

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

Table B.2.4. Flows out of employment (U_{MW} vs. Z_{MW}), Probit regression model. Temporary workers.

Variables	(1)	(2)	(3)
young*U_{MW}[1]	0.008	0.009	0.011
	(0.001)***	(0.002)***	(0.007)*
young*Z_{MW}[2]	0.002	0.001	0.017
	(0.001)	(0.002)	(0.011)
young	0.040	0.035	0.000
	(0.002)***	(0.003)***	(0.010)
female	0.045	-	-
	(0.001)***		
medium education	-0.013	-0.021	-
	(0.002)***	(0.003)***	
high education	-0.030	-0.045	-
	(0.002)***	(0.004)***	
attending courses	0.083	0.072	0.044
	(0.002)***	(0.003)***	(0.019)**
part-time	0.022	0.016	-0.027
	(0.002)***	(0.002)***	(0.007)***
manufacturing	-0.115	-0.145	-0.170
	(0.002)***	(0.003)***	(0.009)***
service	-0.124	-0.268	-0.315
	(0.003)***	(0.007)***	(0.012)***
public sector	0.020	0.015	0.117
	(0.002)***	(0.003)***	(0.013)***
trend	0.002	0.003	0.004
	(0.000)***	(0.000)***	(0.001)***
Pseudo-R^2	0.056	0.056	0.090
Observations	321085	143465	19384

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

Table B.2.5. Flows out of employment (U_{MW} vs. E_{MW}), Probit regression model. Permanent workers.

Variables	(1)	(2)	(3)
young*U_{MW}[1]	0.000	0.001	0.008
	(0.000)	(0.001)	(0.003)**
young*E_{MW}[2]	0.000	-0.000	0.004
	(0.000)	(0.000)	(0.003)
young	0.014	0.012	0.021
	(0.001)***	(0.001)***	(0.008)***
female	0.010	-	-
	(0.000)***		
medium education	-0.002	-0.001	-
	(0.000)***	(0.001)*	
high education	-0.004	-0.004	-
	(0.001)***	(0.001)***	
attending courses	0.004	0.005	-0.001
	(0.001)***	(0.001)***	(0.009)
part-time	0.012	0.011	0.015
	(0.001)***	(0.001)***	(0.003)***
manufacturing	-0.011	-0.018	-0.033
	(0.001)***	(0.001)***	(0.004)***
service	-0.013	-0.031	-0.064
	(0.001)***	(0.004)***	(0.011)***
public sector	-0.013	-0.019	-0.026
	(0.000)***	(0.001)***	(0.003)***
trend	0.000	0.000	0.001
	(0.000)***	(0.000)	(0.000)
Pseudo-R^2	0.064	0.070	0.050
Observations	635347	253391	29405

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

Table B.2.6. Flows out of employment (U_{MW} vs. Z_{MW}), Probit regression model. Permanent workers.

Variables	(1)	(2)	(3)
young*U_{MW}[1]	0.000	0.001	0.008
	(0.000)	(0.001)	(0.003)**
young*Z_{MW}[2]	0.000	0.001	0.005
	(0.000)	(0.001)	(0.006)
young	0.014	0.012	0.020
	(0.001)***	(0.001)***	(0.008)**
female	0.010	-	-
	(0.000)***		
medium education	-0.002	-0.001	-
	(0.000)***	(0.001)*	
high education	-0.004	-0.004	-
	(0.001)***	(0.001)***	
attending courses	0.004	0.005	-0.001
	(0.001)***	(0.001)***	(0.009)
part-time	0.012	0.011	0.015
	(0.001)***	(0.001)***	(0.003)***
manufacturing	-0.011	-0.018	-0.033
	(0.001)***	(0.001)***	(0.004)***
service	-0.013	-0.031	-0.064
	(0.001)***	(0.004)***	(0.011)***
public sector	-0.013	-0.019	-0.026
	(0.000)***	(0.001)***	(0.003)***
trend	0.000	0.000	0.001
	(0.000)***	(0.000)	(0.000)
Pseudo-R^2	0.064	0.070	0.049
Observations	635347	253391	29405

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

B.3 Flows into employment

Notes to Tables B.3.1-B.3.2:

The estimates are for flow into employment, either from unemployment or out of the labor force, for female with low education 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(_pre and _post), young*E(_pre and _post), young*Z(_pre and _post) are the marginal effects of an increase by 1% of the minimum wage.

All models control for 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]E_{MW}: interaction among young, a dummy equal to 1 in every other quarter than 2004:3, and the minimum wage variation.

Z_{MW}: interaction among young, a dummy equal to 1 in quarter 2006:1 and the minimum wage variation.

Table B.3.1. Flows into employment (U_{MW} vs. E_{MW}), Probit regression model.

Variables	(1)	(2)	(3)
young*U_{MW}[1]	0.001	0.001	0.009
	(0.002)	(0.002)	(0.005)*
young*E_{MW}[2]	0.001	0.001	-0.001
	(0.001)	(0.001)	(0.004)
young	0.041	0.048	0.036
	(0.003)***	(0.003)***	(0.009)***
female	-0.066	-	-
	(0.002)***		
medium education	0.019	0.026	-
	(0.003)***	(0.003)***	
high education	0.069	0.083	-
	(0.004)***	(0.005)***	
attending courses	-0.041	-0.025	-0.001
	(0.003)***	(0.003)***	(0.012)
long-term unemployed	0.005	0.068	-0.041
	(0.004)	(0.075)	(0.046)
new hire	0.361	0.379	0.318
	(0.005)***	(0.007)***	(0.017)***
active search	0.021	0.021	0.016
	(0.002)***	(0.003)***	(0.006)***
trend	0.002	0.002	0.002
	(0.000)***	(0.000)***	(0.001)***
Pseudo-R^2	0.104	0.110	0.107
Observations	186191	112978	21081

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

Table B.3.2. Flows into employment (U_{MW} vs. Z_{MW}), Probit regression model.

Variables	(1)	(2)	(3)
young*U_{MW}^{1}	0.002	0.001	0.009
	(0.002)	(0.002)	(0.005)*
young*E_{MW}^{2}	0.004	0.005	0.012
	(0.003)*	(0.003)	(0.008)
young	0.040	0.047	0.034
	(0.003)***	(0.003)***	(0.009)***
female	-0.066	-	-
	(0.002)***		
medium education	0.019	0.026	-
	(0.003)***	(0.003)***	
high education	0.069	0.083	-
	(0.004)***	(0.005)***	
attending courses	-0.041	-0.025	-0.002
	(0.003)***	(0.003)***	(0.012)
long-term unemployed	-0.088	-0.085	-0.042
	(0.027)***	(0.016)***	(0.079)
new hire	0.361	0.379	0.318
	(0.005)***	(0.007)***	(0.017)***
active search	0.021	0.021	0.016
	(0.002)***	(0.003)***	(0.006)***
trend	0.002	0.002	0.002
	(0.000)***	(0.000)***	(0.001)***
Pseudo-R^2	0.104	0.110	0.107
Observations	186191	112978	21081

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

Screening Ex-Ante or Screening On-the-Job? The Impact of the Employment Contract

(preliminary and incomplete)

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Abstract

This paper develops a partial-equilibrium model to describe the firm's decision about the selection and screening of workers in a framework with two types of contracts: permanent and fixed-term. Two are the strategies: screening ex-ante, or recruitment process, and the monitoring practices of new hires, or screening ex-post. The optimal choice is related to the type of employment contract offered by the firm. Screening ex-ante is more likely to be the best strategy in the case of permanent workers, while it may be optimal to monitor temporary employees on-the-job, thus reducing recruitment expenses. The predictions of the model are tested using a UK employer-employee dataset. The estimates show that temporary contracts are associated with lower recruitment effort, in terms of lower cost and higher speed, but this relation depends crucially on the level of the qualification. No significant discrepancy is found in the screening strategy of high-skilled workers.

JEL Classification: D21, J30, J41, J63.

Keywords: Fixed-term contracts, Recruitment, Turnover costs

1 Introduction

During the last two decades, labor markets have experienced a deep restructuring, both in the U.S. and in European countries. A common phenomenon has been the substantial growth in the use of atypical labor contracts (Table 1). This term refers to fixed-term arrangements (employees hired on the company payroll either for a specific period of time or for a specific project), temporary-help agency employment (workers employed through a temporary help agency), on-call work and day labor (individuals who are called in on an as-needed basis), independent contractor (formally self-employed, but, *de facto,* they work as subordinate of the unique client) and, more generally, any employment relationship that can be regarded as contingent.[1]

[1] Contingent work is generally defined as an employment relationship such that there is neither an explicit nor an implicit contract for long-term employment or in which the minimum hours vary unsystematically (Polivka and Nardone, 1989).

In this paper, I will focus the analysis only on those contracts characterized by the temporariness of the employment relationship, and show that the short duration of jobs has relevant implications for the firms' screening strategy.

The literature has focused on the "workers' side of the problem", analyzing, in particular, the impact of labor market reforms on the transition rates to permanent employment. On one hand, flexible contracts may provide young unexperienced workers with a "port-of-entry" into permanent employment. On the other hand, accepting a temporary contract can attach a stigma to workers, reducing their chances to get better opportunities. Both hypothesis have been tested on several national datasets.[2]

In contrast, little effort has been devoted to understanding the effect of temporary contracts on the "employers' side": the availability of various type of contracts, subject to different regulations, affects the maximization problem of the firm. Wasmer (1999) examines the relative demand of temporary workers whithin a matching model where firms can choose between a high- and a low-turnover strategy; hiring a sequence of fixed-term employees, or a permanent set of indefinite-term workers. Goux et al. (2001) estimate the structure of costs of hiring and firing workers and relate it to the employment arrangement. Using a French panel, they show that it is much less costly to adjust the number of temporary employees, than to adjust the number of permanent ones. Similar results are obtained in Abowd and Kramarz (2003), and Kramarz and Michaud (2004). All of these papers start from the assumption that hiring and separation decisions are efficient and use the information about job flows and adjustment costs in order to derive the relation between costs and labor force adjustment. Furthermore they estimate the effect of the contract type. But they do not model the choice of the contract as an outcome of the firm's maximizing problem and its interaction with the cost function. Why do firms decide to spend less in recruiting temporary workers? Are recruitment practices different, depending on the type of contract? Does it affect the resulting employment relationship?

This paper contributes to the literature in this direction. It studies the impact of atypical contracts on both the recruitment process (screening ex-ante) and the monitoring practices (screening on-the-job) of new hires. The two aspects are jointly analyzed in order to take into account the trade-off that is likely to arise between them: the employer will either choose to accurately screen applicants before hiring them or rather detect bad workers on the job, through supervision. In the former case, the initial cost of recruitment will avoid hiring - and eventually firing - unsuitable workers. In the latter, the initial saving could be compensated by higher firing costs.

A simple, two-period, partial-equilibrium model shows that the optimal strategy depends on the type of contract. Screening ex-ante is the best strategy in the case of permanent workers, while it may be optimal to monitor atypical employees on-the-job, thus reducing recruitment expenses.

The prediction of the model are tested using a cross-section dataset from the UK Data Archive: the "Survey of Employers' Recruitment Practices" (ERP) conducted in the United Kingdom in 1992.[3] It contains detailed information about the recruiting practices of over 5,000 establishments and their five more recent engagements. I construct two indicators of the investment in the screening ex-ante process: speed and cost. They are indicative of the employers' perception of the speed and cost of several available recruitment channels.

[2] Booth, Francesconi, and Frank (2000) for UK; Canziani and Petrongolo (2001) for Spain; Contini, Pacelli and Villosio (2000) for UK, Germany and Italy; Ichino, Mealli and Nannicini (2004) for Italy find that positive effects are prevailing. While the adverse effects are pointed out in Blanchard and Landier (2001), and Guell and Petrongolo (2004)

[3] The same dataset has been used by Pellizzari (2004) in order to derive implications about the employers' recruitment strategy. In the work of Pellizzari, the discriminatory variable is the job qualification, while here it is the contract type.

Empirical results are consistent with the model predictions: atypical contracts are associated with lower cost of recruitment and higher speed. The discrepancy is higher for low qualifications, while the recruitment choice seems not to be affected by the type of arrangement in the case of high-level occupation.

The rest of the paper is organized as follows. Section 2 presents a simple model in which firms optimally choose between screening ex-ante and screening on-the-job. Section 3 describes the data used fro the empirical analysis. Methodology and results are discussed in section 4. Section 5 summarizes the main findings and concludes.

2 The screening strategy

Opening a vacancy, a firm has to decide how to carry out the recruitment in order to fill the open position with a suitable worker and with the right timing. There exist several channels of recruitment: jobcentres, fee-charging agencies, notices on the press, internal notices, personal reccomendation, direct applications. They differ in costs, effectiveness and speed. For istance, applying to the Jobcentre is cheap and even effective and fast if the firm is looking for an operative, unskilled workers; while it would probably be uneffective when searching for an experienced manager. The choice of the recruitment channel is strictly related to the occupation the firm wants to fill and to the characteristics of the desired applicant. However, this choice also depends on the type of employment contract.

Searching and screening ex-ante applicants entails a cost, in terms of money spent and time devoted. Those costs are sunk: the firm recoups them during the lifetime of the employment relationship, through the surplus produced by the worker. Besides, a more accurate recruitment yields higher probability of hiring the best applicant and higher expected surplus. Therefore, the firm has to deal with a tradeoff between the ex-ante cost of screening and the ex-post expected gain from screening. The duration of the contract is likely to play a determinant role: the longer is the expected lenght of the employment relation, the smoother the amortization of the initial investment, and the more willing the employer will be to pay for recruitment. Furthermore, when long-term arrangements impose firing tax, it's even more important to closely sort out permanent workers with respect to temporary ones, in order to avoid laid off costs.

A different strategy can be implemented in order to screen workers: a firm could choose to save on recruitment, while investing more in monitoring the new hire, then valuate its performance and, eventually, dismiss the unsuitable employee. The optimality of this strategy depends on the regulation of the employment contract: when firing costs are high,[4] it is probably not convenient to substitute screening ex-ante with screening on-the-job, because, even if bad workers are detected, it could be too expensive to fire them and monitoring costs would be a net loss. Instead, it could be a good choice in the case of atypical contracts, which involve lower layoff costs. Moreover, monitoring requires time, therefore it is implementable only to those workers who are expected to stay in the position long enough. In particular, the employer may decide to fill a vacancy with a fixed-term worker and screen her throughout the flexible arrangement and eventually hire her as permanent. At the end, the confirmed employees will be only the highly productive ones.

[4] Firing costs are represented not only by dismissal taxes, but also by more subtle and psycological effects: hiring and firing regular workers frequently may prove to tarnish a firm's reputation, making it more difficult for the organization to recruit permanent employees in the future (Davis-Blake and Uzzi, 1993). Furthermore, although U.S. employers are not required to make severance payments to laid-off workers, the particular structure of the unemployment insurance tax-liability system makes dismissal of experienced workers expensive (See Abraham and Houseman, 1994). Therefore, the proposed model can be applied to both liberal and institutionalized labor markets.

Which strategy will prevail depends on the effectiveness of the two procedures - therefore, on the type of the job and on the firm specific characteristics - and on the type of contract is going to be signed. The decision process is detailed in the following simple model.

2.1 A simple model

I consider a two-period partial equilibrium model. I only model the choice of firms and assume that they face no labor supply constraint at the market wage.

Workers are heterogeneous according to their productivity θ, which is not observable. They can be either good (θ_G), with probability p, or bad (θ_B), with probability $1-p$. In both periods, they can be hired under two types of contracts: permanent P (two-period) or temporary T (one-period, renewable) and they quit fixed-term jobs with an exogenous probability $1-\alpha$.[5]

Wages w are exogenous and fixed so that all workers are willing to accept any type of job:[6]

$$w > w_R$$

where w_R is the reservation wage. In addition, I assume that firms would hire only good type workers:

$$\theta_B < w < \theta_G$$

yet, on average, it is profitable to produce:

$$p\theta_G + (1-p)\,\theta_B - w = \bar{\theta} - w > 0$$

The firm decides how much to invest in recruitment and in monitoring of new hires in order to maximize the lifetime expected profit, without discounting the future: $\delta = 1$:

$$\max_{\bar{S},S,M} E(\Pi) = E(\Pi_1) + E(\Pi_2)$$

There are three alternatives: not perform any kind of screening, $\bar{S}$; invest in recruitment, S; or perform monitoring, M. $\bar{S}$ is costless, but do not provide any information about the type of the worker. S and M produce a true signal. The former gives the information - and generate the cost - before the hiring

[5] In this simple framework, only temporary workers are allowed to quit. This assumption is without loss of generality: results wouldn't change if also permanent workers would quit with a probability $1-\alpha_p < 1-\alpha$. The higher mobility of fixed-term workers is a well known stylized fact (see, for istance, Bentolila and Bertola 1990) and it is coherent with this framework: only temporary workers can find better opportunity by quitting a job. They can reduce the risk of not being renewed and look for a permanent employment relationship.

[6] To simplify the computation, I do not take into account the positive wage differential in favour of permanent workers, as documented by the recent empirical findings. A comprehensive study by Kalleberg, Reskin and Hudson (2000, data from CPS) emphasize the heterogeneity of the impact of atypical work arrangements on hourly wages: temporary help agency employment and on-call and day labor are generally associated with wage penalties; while contract-company employees and independent contractor can present both higher or lower wages than the regular full-time counterparts. Similar results are obtained by Cipollone, Guelfi (2003, Italian data) on fixed-term and temporary help workers. Segal and Sullivan (1997, U.S.) focus on the temporary services works and confirm the penalties, even if significantly smaller, once job and worker's characteristics are taken into account. Gustafsson, Kenjoh and Wetzels show that is relatively better to be a short-term worker in Netherlands and Sweden, then in Britain or Germany.

decision; while M takes time, produces the signal in the end of the first period and it refers only to the hired applicant.[7]

In the following, I will assume that $M = S$. This assumption implies that the only difference between recruitment and monitoring is in the mechanism through which they provide the signal, while there is no a-priori convenience of one method wih respect to the other.

2.1.1 Timing

At the beginning of period 1, a vacancy arises in a firm, for a specific position. The job lasts 2 periods, but can be filled either with a permanent contract or as a temporary occupation. I am not modeling the optimal choice of the type of contract: I am assuming that the characteristics of the vacancy and of the firm uniquely identify the best arrangement, which is offered to applicants without bargaining. Then, the employer has to decide how much to invest in recruitment and in monitoring. In any case, one applicant arrives to the firm.

The employer can either spend S in screening ex-ante, or do not perform any screening, $\bar{S}$; and can decide whether to implement monitoring of the new hires, at cost M, or not. Both strategies S and M give a true signal on the type of worker, but the former produces the signal before the hiring decision, while monitoring takes time and the information is provided in the end of period 1. Then, the employer update her expected probability to face a good worker:

$$\mu = pr\left(\theta_G | signal\right)$$

ex-ante probabilities:	p		1-p	
workers' type:	θ_G		θ_B	
S or M				
signal:	G	B	G	B
ex-post probabilities:	**1**	**0**	**0**	**1**

and decide whether to hire (h) or not (nh) the applicant.

When no screening is performed, $\bar{S}$, the only piece of information available on the type of the applicant is the population proportions p and $1-p$. Therefore, the ex-post probabilities coincide with the ex-ante probabilities.

In the end, the firm chooses between 3 strategies: S, $\bar{S}$ and $\bar{S}+M$. $S+M$ is not a sensible alternative, given that after S the worker's type is known and there is no need for monitoring.[8]

In the last period, if the vacancy has been filled in period 1, no decisions are taken by the firm: the permanent worker will be still in the job, while the temporary one will be renewed as permanent with probability α. Only if screening on-the-job has been carried out, at the beginning of the second period the employer values the performance of the worker and decides whether to continue (c) the employment relationship with the same worker, or dismiss (d) her and hire another individual.

If the vacancy is still open or the temporary worker has not been renewed, recruitment effort has to be determined in the second period and the employer has to decide about hiring. Monitoring is no more a

[7] This is the simplest case, but the same results hold under more general conditions, provided that the reliability of the signal is positively correlated with the cost of screening ex-ante and ex-post.

[8] Note that the cost M is sustained only if the applicant is hired.

sensible alternative to screening ex-ante, because the signal will be received at the end of the period, when the game ends; therefore the firm would afford a cost without any advantage.[9]

2.1.2 Solution

CASE 1: Permanent contract Permanent contracts last two periods and cannot be broken. Therefore M is never convenient: even if the employer would be able to detect bad workers, she would be not allowed to fire them.[10] In the end, the choice is only between S and $\bar{S}$.

The maximizing problem of the firm is solved backward,[11] starting from the second period. If a worker has been hired previously, no decisions are taken. Otherwise, the firm compares the expected profit of the two strategies S and $\bar{S}$.

a. S : When the signal is positive, it is optimal to hire the worker; while do not hire her is the best response to a negative signal. The total expected profit depends on the strategy chosen in period 1:

- if $\bar{S}$ in period 1:
$$\begin{aligned} E_2(\Pi|S) &= [\theta_G - w - S]\Pr(S=G) + [-S]\Pr(S=B) \\ &= (\theta_G - w)\,p - S \end{aligned}$$
- if S in period 1:
$$\begin{aligned} E_2(\Pi|S) &= [\theta_G - w - 2S]\Pr(S=G) + [-2S]\Pr(S=B) \\ &= (\theta_G - w)\,p - 2S \end{aligned}$$

b. $\bar{S}$: Without screening, any applicant is hired regardless of the signal, and the profit is:

- if $\bar{S}$ in period 1: $E_2\left(\Pi|\bar{S}\right) = \bar{\theta} - w_T$
- if S in period 1: $E_2\left(\Pi|\bar{S}\right) = \bar{\theta} - w_T - S$

The optimal choice is defined in the following proposition:

Proposition 1 *At time 2, the firm chooses to invest on recruitment only if the excess of cost is lower than the expected loss - due to the possibility of hiring a bad type worker - from strategy $\bar{S}$:*

$$S \succ \bar{S} \quad \textit{if} \quad S < (1-p)(w - \theta_B)$$

The expected profit in period 2 is:

- if $\bar{S}$ in period 1: $E_2(\Pi) = \max\left\{(\theta_G - w)\,p - S; \bar{\theta} - w\right\}$
- if S in period 1: $E_2(\Pi) = \max\left\{(\theta_G - w)\,p - S; \bar{\theta} - w\right\} - S$

[9] See the Appendix and Figure 1 and 2 for a detailed presentation of the timing.
[10] Even allowing firms to fire permanent workers, I would have to take into account the dismissal costs. If firing taxes are high enough, results would not change.
[11] See the Appendix for the detailed solution.

In the first period the choice is between:

a. S : As before, it is optimal to hire only applicants associated with good signal; otherwise the hiring decision is postponed to period 2.

$$E(\Pi|S) = 2(\theta_G - w)p + (1-p)\max\left\{(\theta_G - w)p - S; \bar{\theta} - w\right\} - S$$

b. $\bar{S}$: Under the strategy $\bar{S}$, it is not always convenient to hire any applicant in the first period, but it depends on the cost of recruitment. Below a certain threshold, $p(\theta_G - w) - 2(\bar{\theta} - w)$, it is more convenient not to hire in period 1 and to sustain S in the second period.

$$E(\Pi|\bar{S}) = \max\left\{2(\bar{\theta} - w); \max\left\{(\theta_G - w)p - S; \bar{\theta} - w\right\}\right\}$$

- if $S < p(\theta_G - w) - 2(\bar{\theta} - w) : E(\Pi|\bar{S}) = (\theta_G - w)p - S$
- if $S > p(\theta_G - w) - 2(\bar{\theta} - w) : E(\Pi|\bar{S}) = 2(\bar{\theta} - w)$

After some computation, the following condition is derived:

Proposition 2 *Permanent workers will be screened only if :*

$$S \succ \bar{S} \quad if \quad S < (1-p)\left[(w - \theta_B) + p(\theta_G - \theta_B)\right]$$

In particular:

$$\begin{array}{ll} \text{if } S < (1-p)(w - \theta_B) & \rightarrow \quad S + S \succ \bar{S} + \left\{S, \bar{S}\right\} \\ \text{if } (1-p)(w - \theta_B) < S < (1-p)\left[(w - \theta_B) + p(\theta_G - \theta_B)\right] & \\ & \rightarrow \quad S + \bar{S} \succ \bar{S} + \bar{S} \\ \text{if } S > (1-p)\left[(w - \theta_B) + p(\theta_G - \theta_B)\right] & \rightarrow \quad \bar{S} + \bar{S} \succ S + \bar{S} \end{array}$$

CASE 2: Temporary contract In this case, workers can be cheaply fired. Therefore M is a sensible alternative to the recruitment strategies.

A decision is taken in period 2 only if no worker has been hired in period 1, or if the employee has been fired or quitted. The problem is similar to the game solved for the permanent contract in period 2. Hence, the condition under which S is chosen as best strategy is:

Proposition 3 *At time 2, the firm chooses to invest on recruitment only if the excess of cost is lower than the expected loss - due to the possibility of hiring a bad type worker - from strategy $\bar{S}$:*

$$S \succ \bar{S} \quad if \quad S < (1-p)(w - \theta_B)$$

The expected profit in period 2 is:

- if $\bar{S}$ in t_1 : $E_2(\Pi) = \max\left\{(\theta_G - w)p - S; \bar{\theta} - w\right\}$
- if S in t_1 : $E_2(\Pi) = \max\left\{(\theta_G - w)p - S; \bar{\theta} - w\right\} - S$

Let's consider the end of the first period.

If the firm hired in the beginning of period 1 and performed monitoring, then a signal arrives at the end of 1 and the firm will be able to disentangle the type of the worker. Given this piece of information, the employer decides whether to continue the employment relationship or not:

a. M : The firm continues the employment relationship only with those workers which showed good signal.

$$E(\Pi_2|M) = p\alpha(\theta_G - w) + (1 - p\alpha)\max\left\{(\theta_G - w)p - S; \bar{\theta} - w\right\} + \bar{\theta} - w - M$$

b. $\bar{M}$: If monitoring is not performed, no decision are taken in the end of period 1 and the firm always renews the contract, if the worker does not quit.

$$E\left(\Pi|\bar{M}\right) = (1+\alpha)\left(\bar{\theta} - w\right) + (1-\alpha)\left[\max\left\{(\theta_G - w)p - S; \bar{\theta} - w\right\}\right]$$

In the beginning of period 1, the choice is between 3 strategies: S, $\bar{S} + \bar{M}$ and $\bar{S} + M$. And the expected profits are the following:

1. S :

$$E(\Pi|S) = (1+\alpha)(\theta_G - w)p + (1 - p\alpha)\max\left\{(\theta_G - w)p - S; \bar{\theta} - w\right\} - S$$

2. $\bar{S}\&\bar{M}$:

$$\begin{aligned} E\left(\Pi|\bar{S}\&\bar{M}\right) &= \max\left\{(\theta_G - w)p - S; \bar{\theta} - w\right\} \\ &\quad + \max\left\{(1+\alpha)\left(\bar{\theta} - w\right) - \alpha\max\left\{(\theta_G - w)p - S; \bar{\theta} - w\right\}; 0\right\} \end{aligned}$$

When the cost of recruitment is lower than $\frac{(1+\alpha-\alpha p)(w-\theta_B)+p(\theta_B-\theta_G)}{\alpha}$, the optimal decision is not to hire in period 1 and to invest in recruitment in the second period. Otherwise, it is convenient to hire the applicant and, if $S > (1-p)(w-\theta_B)$, the firm chooses $\bar{S}$ in the second period, or else spends S:

- if $S < \frac{(1+\alpha-\alpha p)(w-\theta_B)+p(\theta_B-\theta_G)}{\alpha}$: $E\left(\Pi|\bar{S}\&\bar{M}\right) = (\theta_G - w)p - S$
- if $\frac{(1+\alpha-\alpha p)(w-\theta_B)+p(\theta_B-\theta_G)}{\alpha} < S < (1-p)(w-\theta_B)$:
  $E\left(\Pi|\bar{S}\&\bar{M}\right) = (1+\alpha)\left(\bar{\theta} - w\right) + (1-\alpha)\left[(\theta_G - w)p - S\right]$

- if $S > (1-p)(w-\theta_B) : E\left(\Pi|\bar{S}\&\bar{M}\right) = 2\left(\bar{\theta}-w\right)$

3. $\bar{S}\&M$:

$$\begin{aligned} E\left(\Pi|\bar{S}\&M\right) &= \max\left\{(\theta_G - w)\,p - S; \bar{\theta} - w\right\} \\ &\quad + \max\left\{\left(\bar{\theta}-w\right) + p\alpha\left(\theta_G - \bar{\theta}\right) - M; 0\right\} \end{aligned}$$

Under the strategy $\bar{S}\&M$, it is optimal to hire the applicant only if $S < \bar{\theta} - w +\ p\alpha\,(\theta_G - w)$.

- if $S < (1-p)(w-\theta_B)$:
  $E\left(\Pi|\bar{S}\&M\right) = \left(\bar{\theta}-w\right) - (2-p\alpha)\,S + p\,(\theta_G - w)\,[1+\alpha\,(1-p)]$
- if $(1-p)(w-\theta_B) < S < \bar{\theta} - w + p\alpha\,(\theta_G - w)$:
  $E\left(\Pi|\bar{S}\&\bar{M}\right) = 2\left(\bar{\theta}-w\right) + p\alpha\left(\theta_G - \bar{\theta}\right) - S$
- if $S > \bar{\theta} - w + p\alpha\,(\theta_G - w) : E\left(\Pi|\bar{S}\&\bar{M}\right) = \bar{\theta} - w$

In the end, the optimal strategy is choosen according to the following conditions:

Proposition 4 *Temporary workers will be screened only if:*

$$S \succ \bar{S}\&\left\{\bar{M}, M\right\} \quad if \quad S < (1-p)\left[(w-\theta_B) + \alpha p\,(\theta_G - \theta_B)\right]$$

In particular:

$$\begin{array}{lcl} \textit{if } S < (1-p)(w-\theta_B) & \rightarrow & S + S \succ \bar{S}\&\left\{\bar{M}; M\right\} + S \\ \textit{if } (1-p)(w-\theta_B) < S < (1-p)\left[(w-\theta_B) + p\alpha\,(\theta_G - \theta_B)\right] & & \\ & \rightarrow & S + \bar{S} \succ \bar{S}\&\left\{\bar{M}, M\right\} + \bar{S} \\ \textit{if } S < p\alpha\left(\theta_G - \bar{\theta}\right) < (1-p)\left[(w-\theta_B) + p\alpha\,(\theta_G - \theta_B)\right] & & \\ & \rightarrow & \bar{S}\&M + \bar{S} \succ \bar{S}\&\bar{M} + \bar{S} \\ \textit{if } S > (1-p)\left[(w-\theta_B) + p\alpha\,(\theta_G - \theta_B)\right] & \rightarrow & \bar{S}\&\bar{M} + \bar{S} \succ \left\{\bar{S}\&M; S\right\} + \bar{S} \end{array}$$

2.1.3 Comparison

Depending on the values of the parameters involved, the optimal recruitment strategy could be either S or $\bar{S}$ for both contracts; or it could imply different recruitment expenditure according to the lenght of the employment relationship. There is a certain set of parameters' values such that the latter equilibrium arises:

Proposition 5 *The optimal recruitment strategy is:*
- $\bar{S}$ if temporary worker
- S if permanent worker
if the following condition holds:

$$(1-p)\left[(w-\theta_B) + p\alpha\,(\theta_G - \theta_B)\right] < S < (1-p)\left[(w-\theta_B) + p\,(\theta_G - \theta_B)\right]$$

In particular, the lower is α, the wider is the set of parameters that involve the above-mentioned varied strategy. It will be optimal to invest also on recruiting atypical workers when the contract is likely to be renewed, and the expected duration of the employment relationship is long enough to amortize the cost.

The possibility of performing monitoring on temporary contracts, give rise to another varied strategy:

Proposition 6 *The optimal screening strategy is:*
- $\bar{S}\&M$ if temporary worker
- S if permanent worker
if the following conditions holds:

$$(1-p)(w-\theta_B) < S < p\alpha\left(\theta_G - \bar{\theta}\right)$$

There exists a set of parameters such that it is convenient to monitor fixed-term workers, while screening ex-ante the permanent ones. In particular, ceteris paribus, the higher is α, the wider is that interval. When the expected duration of the contract, $(1+\alpha p)$, is longer, it is more convenient to spend in monitoring the temporary hires. Whereas, if the quitting rate is high, then it is not sensible to monitor a worker who could quit next period.

3 Data

Data used in the empirical analysis comes from a detailed employer-engagement dataset about screening ex-ante: the Survey of Employers' Recruitment Practices (ERP) conducted in the United Kingdom in 1992.[12] This study was carried out by the British Social and Community Planning Research (SCPR), on behalf of the Employment Service, in order to provide an understanding of employers' use and perceptions of the various recruitment channels available to them. A selected sample of over 10,000 establishment, drawn by the Census of Employment for 1989,[13] were first contacted in Autumn 1991 via a brief preliminary telephone interview in order to categorize them into *recruiting* - establishment that either had recruited one or more employees in the previous 12 months or had unfilled vacancies at the time of the interview - versus *non-recruiting* establishment. The longer face-to-face interview took place between May and November 1992. Within each establishment, the respondents were selected to be the main person responsible for the recruitment process.

The questions regarding the establishments were grouped into three sections: a general inquiry about the type of firm and the role of the respondent; the characteristics of the workforce and information about current vacancies and recent recruits; detailed questions about the recruitment practices usually adopted by the firm.

A further set of questions was asked to the 5,635 recruiting establishment. Five of the more recent engagements[14] were selected in order to cover the largest variety of occupational groups, as defined by the

[12] Hales, J., Employers' Recruitment Practices : The 1992 Survey [computer file]. Colchester, Essex: UK Data Archive [distributor], March 1999. SN: 3694.

[13] The 1989 Census covered all existing establishments with 25 or more employees and was supplemented by a random sample of smaller establishment. The sample is not random but designed to ensure that the number of establishments selected in each size category and region was sufficient to allow meaningful analysis. For this reason, small firms and firms outside London and the South East were oversampled. However, weights are provided to recover population proportions.

[14] An engagement was defined as *"Recruiting an employee, where a new contract of employment is involved"*. This includes internal transfers and promotions.

Standard Occupational Classification (SOC). This led to a sample of 22,707 engagements, for each of whom detailed information - about the characteristics of the job, those of the newly hired worker, the recruitment methods activated, whether the recruit was still employed ad how satisfied the employer was with her - were collected. Those data allow to identify the factors affecting the screening ex-ante procedures and their relation with the type of contract. Therefore, they are used in order to verify the predictions of the model about recruitment strategy, while no information are available about the monitoring process.

Descriptive statistics of the full sample and of the subsample used in the regressions are shown in Table 2. It is worth noting that atypical contracts (temporary, causal, fixed term and self-employed) account for about one third of the total number of engagements.

The dependent variable is constructed from the answers to questions E39 and E40 of the questionnarie:

> E39: `Using the scale on this card [from 1 (=not at all important) to 7 (=very important)], how important a factor in your use of the recruitment method(s) was the speed with which you expected it/they would provide a suitable recruit on this occasion?`
>
> E40: `Looking at the scale again, how important a factor in your use of recruitment method(s) was keeping down the cost of announcing/advertising the vacancy on this occasion?`

They refer to the second most recent engagement and have been asked to all recruiting establishments.

Each answer has been associated with the channel(s) used first in that particular case and indexes of speed (code in E39) and cost ($-$ code in E40) are computed as the average, over firm, of the respective valuation codes. For instance, the cost-index of the channel `"jobcentre"` is equal to the mean of the valuations assigned to E40 by all the establishments which used jobcentre as one of the first channels to recruit the second engagement. In order to allow heterogeneity in the valuation of the same recruitment channel depending on the type of occupation - as motivated in section 2 - the averages have been computed within the engagements for similar jobs.[15] Results are shown in figure 4 and 5. It is clear that the valuation of each recruitment channel is not general but relative to the job position it has to fill. For istance, reccomendation is the most expensive and fastest channel when looking for highly skilled workers, but the same channel is associated to low indexes, in absolute value, for low skilled employees.

Then, indicators of the speed/cost efficiency of the recruitment practices are constructed as the mean of the previous index over the channels used first for each single engagement. This means that, if firm f used first channels `"press"` and `"word of mouth"` to fill the vacancy i, then the indicator of the speed, y_{fi}, is given by the average of speed(press) and speed(word of mouth).

In the end, I have two indexes of recruitment effort for each engagement: `speed` and `cost`.

[15] Indexes have been computed according to two different grouping schemes.

Scheme A: skilled (professional associate & technical; professional; management and administration); unskilled (routine unskilled, operatives and assembly, sales, protective and personal service, craft and skilled service, clerical and secretarial)

Scheme B: skilled (professional associate & technical; professional; management and administration); low skilled (sales, protective and personal service, craft and skilled service, clerical and secretarial); unskilled (routine unskilled, operatives and assembly).

The regressions results reported in Tables 3 to 8 refer to the grouping scheme B. Results for scheme A are qualitatively and quantitatively very similar.

4 Empirical Analysis

This section tests the main predictions of the preceding analysis by empirically studying the link between the type of contracts and the screening effort. The data limitation imply that only the theoretical implications about screening ex-ante could be properly analyzed.

The model suggests that, ceteris paribus, the recruitment channels involved in hiring an atypical worker should be:

a. cheaper: due to the shorter amortization period

b. faster: time spent in recruiting is also an investment that the firm wants to minimize when the contract is temporary. Furthermore, flexible contracts are often implemented in order to fill an unexpected personnel absence or to adjust labor to fluctuations in demand which cannot be precisely forecasted long ahead, therefore a temporary need could be also urgent to be filled.

4.1 Econometric specification

The relation between screening effort and the type of contract is estimated in a linear framework (OLS) for each of the two indicators:

$$y_{ijf} = screening\_effort = \alpha + \beta_0 W_{ijf} + \beta_1 F_{if} + \beta_2 J_{jf} + \gamma C_{ijf} + \varepsilon_{ijf}$$

$$C_{ijf} = contract\_type = \begin{cases} 0 & \text{typical} \\ 1 & \text{atypical} \end{cases}$$

where W_{ijf} is the matrix of the characteristics of the worker in engagement i, job j, firm f; F_{if} are the firm's specificities - which do not vary across jobs in the same establishment - and job's variables are collected in J_{jf}; namely:[16]

- worker characteristics: gender, age, ethnic group, disability, previous employment status;
- firm characteristics: industry classification code, region, labor force, level of activity, trend of activity, quality of the workforce;
- job characteristics: occupation classification code, initial pay, supervision task, standard recruitment procedure.

I assumed that the choice of the contract precedes the decision over the recruitment procedure, that is C is predetermined. This is true only if I can control for all the relevant regressors which enter both the contract and the screening equations. Infact, even if C comes first, it is determined by almost the same variables that do enter the screening-effort equation. An endogeneity bias comes from the existence of unobservable characteristics of firms and jobs which are grouped in the error term $\varepsilon_{ijf} = e_{ijf} + \eta_j + \eta_f$ and cause inconsistency.

[16] Most of those information have been collected for all the sample, but missing values are not unusual. At the end, the subsample on which I estimate the equation is smaller: 3,467 weighted observation with respect to the initial 20,339. Nevertheless, I can still assume that results are representative of the population, given that the composition of the subsample is very closed to the initial one (Table 2).

Given the availability of several engagements for each firm, I can correct for the endogeneity bias by estimating a fixed effect (FE) model, which net out both unobservables:

- first step: cancel the firm fixed-effect by taking the average over j

$$\begin{aligned}\bar{y}_{if} &= \alpha + \beta_0 \bar{W}_{if} + \beta_1 F_{if} + \beta_2 \bar{J}_f + \gamma \bar{C}_{if} + \beta_3 R_f + \bar{e}_{if} + \bar{\eta} + \eta_f \\ \tilde{y}_{ijf} &= y_{ijf} - \bar{y}_{if} = \beta_0 \tilde{W}_{ijf} + \beta_2 \tilde{J}_{jf} + \gamma \tilde{C}_{ijf} + \tilde{e}_{ijf} + \tilde{\eta}_j\end{aligned}$$

- second step: cancel the job fixed-effect by taking the average over f

$$\begin{aligned}\bar{\tilde{y}}_{ij} &= \beta_0 \overline{\tilde{W}}_{ij} + \beta_2 \bar{\tilde{J}}_j + \gamma \bar{\tilde{C}}_{ij} + \bar{\tilde{e}}_{ij} + \tilde{\eta}_j \\ \tilde{\tilde{y}}_{ijf} &= \tilde{y}_{ijf} - \bar{\tilde{y}}_{ij} = \beta_0 \widetilde{\tilde{W}}_{ijf} + \beta_2 \tilde{\tilde{J}}_{jf} + \gamma \tilde{\tilde{C}}_{ijf} + \tilde{\tilde{e}}_{ijf}\end{aligned}$$

An equivalent strategy consist in estimating a simple linear regression model with dummy variables for each job and for each firm.

Furthermore, adding interacted terms to the econometric specifications allows for differentiated effects of contracts depending on occupational level and industry. Those characteristics reflect the varied magnitudes of the model parameter α, and the productivity differential $\theta_G - \theta_B$.[17]

Limitations:

All the results presented in this paper are derived by using the dataset on the recruiting establishments. Therefore, a potential issue is the selection bias. If firms selfselect themselves into one on the two groups, *recruiting* and *non-recruiting*, according to a selection rule s such that:

$$E\left(\varepsilon_{ijf} | W_{ijf}, F_{if}, J_{jf}, C_{ijf}, s_f\right) \neq 0$$

then the estimated coefficients would be inconsistent.

In particular, the selection rule can be written as:

$$s_f = \begin{cases} 1 & \text{if } s_f^* > 0 \quad \text{recruiting establisment} \\ 0 & \text{if } s_f^* < 0 \quad \text{non-recruiting establisment} \end{cases}$$

$$\begin{aligned} s_f^* &= S_f \delta + e_{jf} \\ y_{ijf} &= y_{ijf}^* \times I\left(s_f^* > 0\right) = \begin{cases} y_{ijf}^* & \text{if } s_f = 1 \\ - & \text{if } s_f = 0 \end{cases}\end{aligned}$$

s_f^* represents the FOC from maximizing profits on workforce

S_f comprises economic variables likely to affect firm f hiring decision and can include the same regressors as the main equation, y_{ijf}.

Then:

$$\begin{aligned} E\left(y_{ijf} | W_{ijf}, F_{if}, J_{jf}, C_{ijf}, s_f = 1\right) &= \alpha + \beta_0 W_{ijf} + \beta_1 F_{if} + \beta_2 J_{jf} + \gamma C_{ijf} + E\left(\varepsilon_{ijf} | e_{jf}\right) \\ &= \alpha + \beta_0 W_{ijf} + \beta_1 F_{if} + \beta_2 J_{jf} + \gamma C_{ijf} + \lambda\left(S_f \delta\right)\end{aligned}$$

[17] Tables 3 to 5 show results only for the regressions without interacted terms, with contract-occupation interacted terms, and with contract-industry interacted terms. The same set of regressions have been estimated using contract-occupation-industry interacted terms. Results are qualitatively similar but, for brevity, they are not included in the tables.

Therefore, there is no selection bias only if ε_{ijf} is not correlated with e_{jf}. While the bias arises when both the selection equation and the main equation include correlated unobservable variables as regressors. This is likely to be true in this case: the choice of whether to hire new workers, s_f, and how to recruit them, y_{ijf}, depend probably on roughly the same set of variables, observable and unobservable.

By using firm and job fixed effects, the selection rule component, $\lambda(S_f\delta)$, is canceled out and consistency is ensured.

$$E\left(y_{ijf} - FE_f - FE_j | W_{ijf}, F_{if}, J_{jf}, C_{ijf}, s_f = 1\right) = \alpha + \beta_0 \widetilde{\widetilde{W}}_{ijf} + \beta_2 \widetilde{\widetilde{J}}_{jf} + \gamma \widetilde{\widetilde{C}}_{ijf}$$

Results are representative only of the recruiting firms, while the dataset does not provide any information to control for differentiated effect of C depending on the hiring decision s_f.

4.1.1 Results

The recruitment effort equations have been estimated through OLS and FE procedures. Tables 3 and 4 show the estimated coefficient of `contract` in the cost and speed regression, respectively. The estimates for the control variables are included in Tables 5 to 8. The columns (1), (2) and (3) in Tables 5 and 7 correspond to the OLS regressions in Tables 3 and 4, respectively. The columuns(1), (2) and (3) in Tables 6 and 8 correspond to the FE regressions in Tables 3 and 4. The columns (1'), (2') and (3') differ from the (1), (2) and (3) by the inclusion of a further regressor: `urgency`. `Urgency` is a dummy variable equal to 1 when the job position was urgent to be filled[18]. Unfortunately, this information is available only for 2 engagements each firm; therefore the sample size is halves and the results could be misleading, due to the low degree of freedom.

Recruitment cost - Table 3:

Table 3 shows the estimated coefficient of `contract` in the cost-regression. As expected, it is negative and significant both in OLS and FE regressions[19]: overall, firms tend to spend less for screening atypical workers, as claimed in section 2.

Occupation interacted terms are mainly negative and significant, apart from high level occupations, that are associated with not significant coefficients. This is coherent with the model prediction: skilled jobs are characterized by higher variation in productivity related to different personal characteristics of the employee, therefore the loss related to a bad match is bigger and it becomes convenient to invest in screening ex-ante both temporary and permanent applicants.[20]

Coefficients of the industry interacted terms are mainly negative, but `"Energy and water supply"` and `"Other services"` presents a positive coefficient in the FE regression. A thorough analysis of the use of short term contracts in these industry would be needed to explain the result, but this goes beyond the scope of this study.

[18] Urgency corresponds to the question D36: Suppose that for some reason he/she could not have started work till a month later. Would this delay have mattered to you or not?

[19] Note that the coefficient of contract in the FE regression is lower, in absolute terms, than the corresponding coefficient in OLS regression. The difference reflects the endogeneity bias.

[20] Proposition 4 states that it is optimal to invest in recruiting temporary workers when:

$$S < (1-p)\left[(w-\theta_B) + p\alpha\left(\theta_G - \theta_B\right)\right]$$

It is evident that an increase in $(\theta_G - \theta_B)$ relaxes the constraint on the screening ex-ante cost.

The control variables (Table 5 and 6) present reasonable estimates: expensive recruitment channels are needed in order to hire individuals currently working, but lower cost is associated to the re-employement or promotion of former employees. The investment in recruitment increases hand in hand with the qualifications and with the wage: the recruitment expeditures are positively related to the future productivity of those employees, which is in line with the simple model.

Adding `urgency` helps to explain part of the remaining variation in the valuation of the cost of recruitment, but the sample is considerably smaller. The coefficient of `contract` remains negative only when associated with the occupation soc1, `"Routine, unskilled"`, and some of the industry. In FE-Urgency (2') (Table 6), `"Protective and personal service"`, `"Professional associate and technical occupations"` and `"Professional jobs"` interacted terms have positive coefficients. One possible conjecture is that skilled position are filled with temporary arrangements mainly when a specific need arises, requiring a thorough screening; but the results could also be due to small sample bias, given the low number of high skilled engagements.

Recruitment speed - Table 4:

The OLS (1) regression gives a highly significant positive coefficient on `contract`: atypical contracts involve faster recruitment channels.

The specifications with interacted terms confirms the differentiated effect of contract type: time saving on atypical is more important for low qualifications, while it is not the case for skilled job. The coefficients pertaining to high level occupations present negative coefficients, which can be explained by the same conjectures proposed in the previous section.

Table 7 and 8 shows that recruitment involving only standard procedures imply lower speed; more time is devoted to the screening of applicants for qualified positions, especially professional and technical occupation and managers.

Controlling for `urgency` does have any relevant impact on the results, except for the contract coefficient in FE (1'), which turns negative, but the interacted terms are similar to Table 4. As expected, urgent vacancy are filled through faster channels.

5 Conclusion

This paper provides empirical evidence of the lower recruiting effort exerted by employers when hiring temporary workers, in line with the recent literature on the structure of adjustment costs. Results show that firms spend less in hiring temporary workers, with respect to permanent ones. This is especially true for the low-level occupations, while the relation is not significant or even reversed when estimated on the highly-skilled jobs.

Those findings point out that the screening procedure implemented by a firm is not simply a minimizing cost problem, but involve other assessments, in particular the valuation of the impact of screening on the worker's quality. Therefore, when the productivity gap between good and bad workers is high, as it is the case for managers and administrators, then it will be optimal to invest in the recruitment of both temporary and permanent workers.

As the model explains, recruitment is only one of the strategies that a firm can implement in order to control for the new hire's suitability. An alternative is the monitoring procedure, which need to be further tested when specific data are available.

Even if there is evidence of lower investment in recruiting atypical workers, it cannot be inferred those workers are, in general, of lower quality. A wider analysis is needed, taking into account monitoring, but also training[21] - that is the firm investment in the employees' specific human capital, with positive effect on the productivity - and macroeconomic shocks - which imply higher missmatching with regard to permanent workers.[22]

However, results provided in this paper raise some concerns about the current and prospective productivity of labor. Nagypal (2004) and Abowd et al. (2002) provide some evidence that productivity depends more on the unmeasured personal characteristics of the employees, than on the human capital accumulation. Therefore, it is more efficient to learn the quality of the match through screening and monitoring process, than to invest on training. Besides, there is evidence that workers on short-term contract are less involved in training (Arulampalam and Booth (1998)), are more likely to suffer work accidents (Guadalupe (2003)) and are involved in less skilled positions (Felstead et al. (2001) and Felstead and Gallie (2004)). Further analysis is needed in order to assess the impact of temporary contracts on the overall productivity.

[21] See for istance the models developed by Bac (2000) and Felli and Harris (2004); and the empirical evidence in Arulampalam and Booth (1998) and Rix et al. (1999).

[22] The positive effect of temporary contracts in reducing missmatch is found in Alonso-Borrego et al (2004), Blanchard and Landier (2002) and Veracierto (2003).

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6 Appendix: solution of the model

6.1 Permanent Contract:

6.1.1 Timing:

Consider the case of a firm dealing with a vacancy for a permanent worker. Monitoring is no more a suitable alternative, because permanent contracts are characterized by the unbreakability of the employment relationship. The contracts last two years and cannot be terminated before. Therefore, even if screening on-the-job would allow firms to disentangle between good and bad workers, it would not be possible to dismiss the bad ones and the cost of monitoring would not produce any gain. The firm can choose only between strategies S, screening ex-ante, and $\bar{S}$, no screening. If no applicant is hired in period 1, the decision is postponed to period 2.

The timing of the game is detailed in Picture 1.

6.1.2 Solution:

PERIOD 2:

If the firm did not hire in period 1, then it has to decide about recruitment strategy and about hiring in the beginning of period 2.

The final payoffs depend also on the strategy adopted in the initial period, therefore there are two different games, or knots, in period 2: the choice between S and $\bar{S}$ when S has been implemented in period 1; and the same choice when the first period strategy has been $\bar{S}$.

1. **Upper knot (following S)**

   (a) S :

$$S: \begin{array}{ll} \text{G} \left\langle \begin{array}{ll} \text{h} & E_2(\Pi|G) = \theta_G - w - 2S > -2S \\ \text{nh} & E_2(\Pi|G) = -2S \end{array} \right. \\ \text{B} \left\langle \begin{array}{ll} \text{h} & E_2(\Pi|B) = \theta_B - w - 2S < -2S \\ \text{nh} & E_2(\Pi|B) = -2S \end{array} \right. \end{array}$$

   When the signal is positive, it is optimal to hire the worker, while do not hire her is the best response to a negative signal. The expected profit is:

$$\begin{aligned} E_2(\Pi|S) = & \ [\theta_G - w - 2S] \Pr(S = G) + [-2S] \Pr(S = B) \\ & = [\theta_G - w - 2S] p + [-2S](1-p) \\ & = (\theta_G - w) p - 2S \end{aligned}$$

   (b) $\bar{S}$:

$$\bar{S}: \left\langle \begin{array}{ll} \text{h} & E_2(\Pi) = p\theta_G + (1-p)\theta_B - w - S > -S \\ \text{nh} & E_2(\Pi) = -S \end{array} \right.$$

   Without screening, any applicant is hired regardless of the signal.

$$E_2(\Pi|\bar{S}) = \bar{\theta} - w - S$$

2. **Lower knot (following $\bar{S}$)**

(a) S :

$$S : \begin{array}{ll} \text{G} & \left\langle \begin{array}{ll} \text{h} & E_2 (\Pi|G) = \theta_G - w - S > -S \\ \text{nh} & E_2 (\Pi|G) = -S \end{array} \right. \\ \text{B} & \left\langle \begin{array}{ll} \text{h} & E_2 (\Pi|B) = \theta_B - w - S < -S \\ \text{nh} & E_2 (\Pi|B) = -S \end{array} \right. \end{array}$$

When the signal is positive, it is optimal to hire the worker, while do not hire her is the best response to a negative signal.

$$\begin{aligned} E_2 (\Pi|S) = & \ [\theta_G - w - S] \Pr (S = G) + [-S] \Pr (S = B) \\ & = [\theta_G - w - S] p + [-S] (1 - p) = (\theta_G - w) p - S \end{aligned}$$

(b) $\bar{S}$:

$$\bar{S} : \left\langle \begin{array}{ll} \text{h} & E_2 (\Pi) = \bar{\theta} - w > 0 \\ \text{nh} & E_2 (\Pi) = 0 \end{array} \right.$$

Without screening, any applicant is hired regardless of the signal.

$$E_2 \left(\Pi|\bar{S}\right) = \bar{\theta} - w$$

In both knots, the optimal choice is defined in the following proposition:

Proposition 7 *At time 2, the firm chooses to invest on recruitment only if the excess of cost is lower than the expected loss - due to the possibility of hiring a bad type worker - from strategy $\bar{S}$:*

$$S \succ \bar{S} \quad \text{if} \quad S < (1 - p) (w - \theta_B)$$

The expected profit in period 2 is

- if $\bar{S}$ in t_1 : $E_2 (\Pi) = \max \left\{(\theta_G - w) p - S; \bar{\theta} - w\right\}$
- if S in t_1 : $E_2 (\Pi) = \max \left\{(\theta_G - w) p - S; \bar{\theta} - w\right\} - S$

PERIOD 1:

1. **Assume that** $S < (1 - p) (w - \theta_B)$. In this case, S will be chosen as best strategy in period 2. In period 1, the choice is between:

(a) S :

$$S : \begin{array}{ll} \text{G} & \left\langle \begin{array}{ll} \text{h} & E (\Pi|G) = 2 (\theta_G - w) - S > \\ \text{nh} & E (\Pi|G) = (\theta_G - w) p - 2S \end{array} \right. \\ \text{B} & \left\langle \begin{array}{ll} \text{h} & E (\Pi|B) = 2 (\theta_B - w) - S < \\ \text{nh} & E (\Pi|B) = (\theta_G - w) p - 2S \end{array} \right. \end{array}$$

Following strategy S, it is optimal to hire applicants who showed signal G, while not to take on individuals with bad signals. In the end, the expected profit from strategy S is:

$$\begin{aligned} E(\Pi|S) &= [2(\theta_G - w) - S]\Pr(S = G) + [(\theta_G - w)p - 2S]\Pr(S = B) \\ &= 2(\theta_G - w)p + (1-p)[(\theta_G - w)p - S] - S \end{aligned}$$

(b) $\bar{S}$:

$$\bar{S}: \quad \left\langle \begin{array}{ll} \text{h} & E(\Pi) = 2\left(\bar{\theta} - w\right) \\ \text{nh} & E(\Pi) = (\theta_G - w)p - S \end{array} \right.$$

In this case, the solution is not univocal, but it depends on the value of the parameters involved in the value functions.

$$E\left(\Pi|\bar{S}\right) = \max\left\{2\left(\bar{\theta} - w\right); (\theta_G - w)p - S\right\}$$

- if $S < p(\theta_G - w) - 2\left(\bar{\theta} - w\right) : E\left(\Pi|\bar{S}\right) = (\theta_G - w)p - S$
- if $S > p(\theta_G - w) - 2\left(\bar{\theta} - w\right) : E\left(\Pi|\bar{S}\right) = 2\left(\bar{\theta} - w\right)$

Under the strategy $\bar{S}$, it is not always convenient to hire the applicant in the first period, but it depends on the cost of recruitment. When $S < (\theta_G - w)p - 2\left(\bar{\theta} - w\right)$, it is optimal not to hire in period 1 and to implement S in the second period.

Proof. It is easy to compute that

$$\max\left\{2\left(\bar{\theta} - w\right); (\theta_G - w)p - S\right\} = 2\left(\bar{\theta} - w\right) \text{ if } S > p(\theta_G - w) - 2\left(\bar{\theta} - w\right)$$

I need to check that this condition is coherent with the initial assumption: $S < (1-p)(w - \theta_B)$. It is always true that:

$$(1-p)(w - \theta_B) > p(\theta_G - w) - 2\left(\bar{\theta} - w\right)$$

Therefore there will be an interval

$$S \in \left[p(\theta_G - w) - 2\left(\bar{\theta} - w\right), (1-p)(w - \theta_B)\right]$$

in which it is optimal to hire the worker, with an expected gain of $2\left(\bar{\theta} - w\right)$. While, if $S < p(\theta_G - w) - 2\left(\bar{\theta} - w\right)$, it will more proficient not to hire the worker and to earn $(\theta_G - w)p - S$. ■

In the end, the best strategy associated to a permanent-contract-vacancy is:

Proposition 8 *Under the assumption $S < (1-p)(w - \theta_B)$, permanent workers are always screened ex-ante:*

$$S + S \succ \bar{S} + S \quad if \quad S < (1-p)(w - \theta_B)$$

Proof. $S + S \succ \bar{S} + S$ if

$$2(\theta_G - w)p + (1-p)[(\theta_G - w)p - S] - S > \max\left\{2\left(\bar{\theta} - w\right); (\theta_G - w)p - S\right\}$$

If $(\theta_G - w)p - 2\left(\bar{\theta} - w\right) < S < (1-p)(w - \theta_B)$, then:

- strategy $\bar{S}+S$: $E(\Pi)=\max\left\{2\left(\bar{\theta}-w\right);(\theta_G-w)\,p-S\right\}=2\left(\bar{\theta}-w\right)$

- strategy $S+S$: $E(\Pi)=2(\theta_G-w)\,p+(1-p)\left[(\theta_G-w)\,p-S\right]-S$

$$E(\Pi|S+S)-E\left(\Pi|\bar{S}+S\right)=(1-p)\left[p(\theta_G-w)-S+2(w-\theta_B)\right]-S$$

Under the hypothesis $S<(1-p)(w-\theta_B)$:

$$\begin{aligned}
& \inf\{(1-p)\left[p(\theta_G-w)-S+2(w-\theta_B)\right]-S\}= \\
= \;& (1-p)\left[p(\theta_G-w)-(1-p)(w-\theta_B)+2(w-\theta_B)\right]-(1-p)(w-\theta_B) \\
= \;& (1-p)\,p(\theta_G-w)+(1-p)\,p(w-\theta_B)>0 \\
\rightarrow \;& E(\Pi|S+S)-E\left(\Pi|\bar{S}+\bar{S}\right)>0
\end{aligned}$$

Therefore, strategy $S+S\succ\bar{S}+S$

If $S<(\theta_G-w)\,p-2\left(\bar{\theta}-w\right)$, then

- strategy $\bar{S}+S$: $E(\Pi)=\max\left\{2\left(\bar{\theta}-w\right);(\theta_G-w)\,p-S\right\}=(\theta_G-w)\,p-S$

- strategy $S+S$: $E(\Pi)=2(\theta_G-w)\,p+(1-p)\left[(\theta_G-w)\,p-S\right]-S$

$$E(\Pi|S+S)-E\left(\Pi|\bar{S}+S\right)=(\theta_G-w)\,p+(1-p)\left[(\theta_G-w)\,p-S\right]$$

Under the condition $S<(\theta_G-w)\,p-2\left(\bar{\theta}-w\right)$:

$$\begin{aligned}
& \inf\{(\theta_G-w)\,p+(1-p)\left[(\theta_G-w)\,p-S\right]\}= \\
= \;& (\theta_G-w)\,p+(1-p)\left[(\theta_G-w)\,p-(\theta_G-w)\,p+2\left(\bar{\theta}-w\right)\right] \\
= \;& (\theta_G-w)\,p+(1-p)\,2\left(\bar{\theta}-w\right)>0
\end{aligned}$$

Therefore, strategy $S+S\succ\bar{S}+S$. Note that hypothesis $S<(1-p)(w-\theta_B)$ implies that $S\succ\bar{S}$ in period 2; then it is also true that:

$$\begin{aligned}
S+S &\succ S+\bar{S} \\
\bar{S}+S &\succ \bar{S}+\bar{S}
\end{aligned}$$

■

2. **Assume** $S>(1-p)(w-\theta_B)$. In this case, $\bar{S}$ will be chosen as best strategy in period 2. In period 1, the choice is between:

   (a) S :

$$S:\quad \begin{array}{ll} \text{G} & \left\langle \begin{array}{ll} \text{h} & E(\Pi|G)=2(\theta_G-w)-S> \\ \text{nh} & E(\Pi|G)=\bar{\theta}-w-S \end{array}\right. \\ \text{B} & \left\langle \begin{array}{ll} \text{h} & E(\Pi|B)=2(\theta_B-w)-S< \\ \text{nh} & E(\Pi|B)=\bar{\theta}-w-S \end{array}\right. \end{array}$$

Following strategy S, it is optimal to hire applicants who showed signal G, while not to take on individuals with bad signals. In the end, the expected profit from strategy S is:

$$\begin{aligned} E(\Pi|S) &= [2(\theta_G - w) - S]\Pr(S = G) + [\bar{\theta} - w - S]\Pr(S = B) \\ &= 2(\theta_G - w)p + (1-p)(\bar{\theta} - w) - S \end{aligned}$$

(b) $\bar{S}$:

$$\bar{S}: \quad \left\langle \begin{array}{ll} \text{h} & E(\Pi) = 2(\bar{\theta} - w) > \\ \text{nh} & E(\Pi) = \bar{\theta} - w \end{array} \right.$$

It is always optimal to hire the applicant.

$$E(\Pi|\bar{S}) = 2(\bar{\theta} - w)$$

In this case, the best strategy associated to a permanent-contract-vacancy is:

Proposition 9 *Under the assumption $S > (1-p)(w - \theta_B)$, permanent workers will be screened ex-ante in period 1 only if :*

$$S + \bar{S} \succ \bar{S} + \bar{S} \quad if \quad S < (1-p)[(w - \theta_B) + p(\theta_G - \theta_B)]$$

Proof. $S + \bar{S} \succ \bar{S} + \bar{S}$ means that

$$2(\theta_G - w)p + (1-p)(\bar{\theta} - w) - S > 2(\bar{\theta} - w)$$

This condition is equivalent to $S < (1-p)[(w - \theta_B) + p(\theta_G - \theta_B)]$.
Note that hypothesis $S > (1-p)(w - \theta_B)$ implies that $\bar{S} \succ S$ in period 2; therefore it is also true that:

$$\begin{aligned} S + \bar{S} &\succ S + S \\ \bar{S} + \bar{S} &\succ \bar{S} + S \end{aligned}$$

■

The solution of the game is summarized in Picture 3 and in the following proposition.

Proposition 10 *Permanent workers will be screened, at least in period 1, only if :*

$$S \succ \bar{S} \quad if \quad S < (1-p)[(w - \theta_B) + p(\theta_G - \theta_B)]$$

In particular:

$$\begin{array}{ll} if\ S < (1-p)(w - \theta_B) & \rightarrow \quad S + S \succ \bar{S} + \{S, \bar{S}\} \\ if\ (1-p)(w - \theta_B) < S < (1-p)[(w - \theta_B) + p(\theta_G - \theta_B)] & \\ & \rightarrow \quad S + \bar{S} \succ \bar{S} + \{S, \bar{S}\} \\ if\ S > (1-p)[(w - \theta_B) + p(\theta_G - \theta_B)] & \rightarrow \quad \bar{S} + \bar{S} \succ S + \{S, \bar{S}\} \end{array}$$

6.2 Temporary Contract:

6.2.1 Timing:

Consider the case of a firm dealing with a vacancy for a temporary worker. Now monitoring is a sensible alternative, given that temporary contracts last only one year, then they can be either renewed or terminated at no cost. The firm can choose between three strategies: S, screening ex-ante, and $\bar{S}\&\bar{M}$, no screening ex-ante nor monitoring, and $\bar{S}\&M$, no screening ex-ante followed by monitoring. While the strategy $S\&M$ is never convenient: if S is performed at the beginning of period 1, then the resulting signal will reveal the type of the applicant and there won't be any need for monitoring the worker.

If the applicant is hired and monitoring is performed, the signal is received at the end of period 1. Then, the firm decides whether to continue the relationship with the worker or not. Given the insecurity of the job, the worker has incentive to quit and to look for a better position. Employees quit the job with probability $1-\alpha$

A decision is taken in period 2 only if no worker has been hired in period 1, or if the employee has been fired or quitted.

See Picture 2 for the detailed timing of the game.

6.2.2 Solution:

PERIOD 2:

The problem is similar to the game solved for the permanent contract in period 2, except that there are four more knots. It is easy to verify that the condition under which S is chosen as best strategy is:

Proposition 11 *At time 2, the firm chooses to invest on recruitment only if the excess of cost is lower than the expected loss - due to the possibility of hiring a bad type worker - from strategy $\bar{S}$:*

$$S \succ \bar{S} \quad \text{if} \quad S < (1-p)(w-\theta_B)$$

PERIOD 1 - END:

If the firm hired in the beginning of period 1 and performed monitoring, then a signal arrives at the end of period 1 and the firm will be able to disentangle the type of the worker. Given this piece of information, the employer decides whether to continue the employment relationship or not

1. **Assume** $S < (1-p)(w-\theta_B)$. Therefore, S will be chosen as best strategy in period 2.

   (a) M : If monitoring is performed in period 1, then the firm has to choose whether to continue or not the relationship.

$$M: \begin{array}{ll} G & \left\langle \begin{array}{ll} \text{c} & E(\Pi|G) = \alpha\left[2(\theta_G-w)\right] + (1-\alpha)\left[\theta_G - w + p(\theta_G-w) - S\right] - M > \\ \text{d} & E(\Pi|G) = (1+p)(\theta_G-w) - M - S \end{array}\right. \\ B & \left\langle \begin{array}{ll} \text{c} & E(\Pi|B) = \alpha\left[2(\theta_B-w)\right] + (1-\alpha)\left[\theta_B - w + p(\theta_G-w) - S\right] - M < \\ \text{d} & E(\Pi|B) = \theta_B - w - M - S + p(\theta_G-w) \end{array}\right. \end{array}$$

The firm continues the employment relationship only with those workers which showed good signal.

$$E\left(\Pi|M\right)=p\alpha\left(\theta_G-w\right)+\left(1-p\alpha\right)\left[\left(\theta_G-w\right)p-S\right]+\bar{\theta}-w-M$$

(b) $\bar{M}$: If monitoring is not performed, no decision is taken in the end of period 1 and the firm always renew the contract if the worker does not quit.

$$E\left(\Pi|\bar{M}\right)=\left(1+\alpha\right)\left(\bar{\theta}-w\right)+\left(1-\alpha\right)\left[\left(\theta_G-w\right)p-S\right]$$

2. **Assume** $S>\left(1-p\right)\left(w-\theta_B\right)$. In this case $\bar{S}$ is chosen in period 2.

(a) M :

$$M:\begin{array}{cl} \text{G} & \left\langle\begin{array}{ll}\text{c} & E\left(\Pi|G\right)=\alpha\left[2\left(\theta_G-w\right)\right]+\left(1-\alpha\right)\left[\theta_G-w+\bar{\theta}-w\right]-M>\\ \text{d} & E\left(\Pi|G\right)=\theta_G-w-M+\bar{\theta}-w\end{array}\right.\\ \text{B} & \left\langle\begin{array}{ll}\text{c} & E\left(\Pi|B\right)=\alpha\left[2\left(\theta_B-w\right)\right]+\left(1-\alpha\right)\left[\theta_B-w+\bar{\theta}-w\right]-M<\\ \text{d} & E\left(\Pi|B\right)=\theta_B-w-M+\bar{\theta}-w\end{array}\right.\end{array}$$

The firm continues the employment relationship only with those workers which showed good signal.

$$E\left(\Pi|M\right)=p\alpha\left(1-p\right)\left(\theta_G-\theta_B\right)+2\left(\bar{\theta}-w\right)-M$$

(b) $\bar{M}$:

$$E\left(\Pi|\bar{M}\right)=2\left(\bar{\theta}-w\right)$$

If monitoring is not performed, no decision is taken in the end of period 1 and the firm always renew the contract if the worker does not quit.

PERIOD 1 - BEGINNING:

In the beginning of period 1, the choice is between 3 strategies: S, $\bar{S}\&\bar{M}$ and $\bar{S}\&M$.

1. **Assume** $S<\left(1-p\right)\left(w-\theta_B\right)$. Investing S in screening ex-ante is the optimal strategy in period 2.

(a) S : If S is chosen in period 1 and no monitoring is performed, the firm will hire only the workers with a good signal. If those workers do not quit, they will be renewed as permanent, otherwise the firm will invest in S in the second period. The expected profit is the following:

$$S:\begin{array}{cl} \text{G} & \left\langle\begin{array}{ll}\text{h} & E\left(\Pi|G\right)=\left(1+\alpha\right)\left(\theta_G-w\right)+\left(1-\alpha\right)\left[\left(\theta_G-w\right)p-S\right]-S>\\ \text{nh} & E\left(\Pi|G\right)=\left(\theta_G-w\right)p-2S\end{array}\right.\\ \text{B} & \left\langle\begin{array}{ll}\text{h} & E\left(\Pi|B\right)=\left(1+\alpha\right)\left(\theta_B-w\right)+\left(1-\alpha\right)\left[\left(\theta_G-w\right)p-S\right]-S<\\ \text{nh} & E\left(\Pi|B\right)=\left(\theta_G-w\right)p-2S\end{array}\right.\end{array}$$

$$E\left(\Pi|S\right)=\left(1+\alpha\right)\left(\theta_G-w\right)p+\left(1-p\alpha\right)\left[\left(\theta_G-w\right)p-S\right]-S$$

(b) $\bar{S}\&\bar{M}$: If the firm do not invest in screening ex-ante, neither in monitoring, then the expected profit is:

$$\bar{S}\&\bar{M}: \quad \left\langle \begin{array}{ll} \text{h} & E(\Pi) = (1+\alpha)\left(\bar{\theta} - w\right) + (1-\alpha)\left[(\theta_G - w)p - S\right] \\ \text{nh} & E(\Pi) = (\theta_G - w)p - S \end{array} \right.$$

$$E\left(\Pi|\bar{S}\&\bar{M}\right) = (\theta_G - w)p - S + \max\left\{(1+\alpha)\left(\bar{\theta} - w\right) + -\alpha\left[(\theta_G - w)p - S\right]; 0\right\}$$

When the cost of recruitment is lower than $\frac{(1+\alpha-\alpha p)(w-\theta_B)+p(\theta_B-\theta_G)}{\alpha}$, the optimal decision is not to hire in period 1 and to invest in recruitment in the second period. Otherwise, it is convenient to hire the applicant.

$$\begin{array}{lll} \text{if } S < \frac{(1+\alpha-\alpha p)(w-\theta_B)+p(\theta_B-\theta_G)}{\alpha} & \rightarrow & E\left(\Pi|\bar{S}\&\bar{M}\right) = (\theta_G - w)p - S \\ \text{if } \frac{(1+\alpha-\alpha p)(w-\theta_B)+p(\theta_B-\theta_G)}{\alpha} < S < (1-p)(w-\theta_B) & \rightarrow & E\left(\Pi|\bar{S}\&\bar{M}\right) = (1+\alpha)\left(\bar{\theta} - w\right) + \\ & & +(1-\alpha)\left[(\theta_G - w)p - S\right] \end{array}$$

(c) $\bar{S}\&M$: If the firm invest in monitoring in the first period and renew the worker only if she showed a good signal, then the expected profit is:

$$\bar{S}\&M: \quad \left\langle \begin{array}{ll} \text{h} & E(\Pi) = \left(\bar{\theta} - w\right) + p\alpha(\theta_G - w) \\ & \qquad + (1-p\alpha)\left[(\theta_G - w)p - S\right] - M > \\ \text{nh} & E(\Pi) = (\theta_G - w)p - S \end{array} \right.$$

$$E\left(\Pi|\bar{S}\&M\right) = (\theta_G - w)p - S + \max\left\{\left(\bar{\theta} - w\right) + p\alpha(\theta_G - w) - p\alpha\left[(\theta_G - w)p - S\right] - M; 0\right\}$$

The employer hire the applicant only if the cost of monitoring is under a certain threshold:

$$M < \left(\bar{\theta} - w\right) + (1-p)p\alpha(\theta_G - w) + p\alpha S$$

In this simple game, screening ex-ante and screening on-the-job both give a true signal. Therefore it is reasonable to assume that they cost the same: $M = S$. Furthermore, this assumption allow to study the choice between recruitment and monitoring in a framework in which the only difference between the two strategies is in the mechanism through which they provide the signal, but there is no a-priori convenience of one method wih respect to the other. Then, the condition under which it is optimal to hire the applicant becomes:

$$M = S < \frac{\left(\bar{\theta} - w\right) + (1-p)p\alpha(\theta_G - w)}{1 - p\alpha}$$

Under the hypothesis $S < (1-p)(w-\theta_B)$, this condition is always met. The expected profit from strategy $\bar{S} + M$ is:

$$E\left(\Pi|\bar{S}\&M\right) = \left(\bar{\theta} - w\right) - (2 - p\alpha)S + p(\theta_G - w)\left[1 + \alpha(1-p)\right]$$

In the end, the optimal strategy is:

Proposition 12 *Under the assumption $S < (1-p)(w-\theta_B)$, temporary workers are always screened ex-ante:*

$$S+S \succ \bar{S}\&\left\{\bar{M};M\right\}+S \quad if \quad S<(1-p)(w-\theta_B)$$

Proof. The result comes from the comparison of the expected profits associated with the two strategies $S+S \succ \bar{S}+S$:

If $S < \frac{(1+\alpha-\alpha p)(w-\theta_B)+p(\theta_B-\theta_G)}{\alpha}$, then:

- strategy $\bar{S}\&\bar{M}+S$: $E(\Pi)=(\theta_G-w)p-S$
- strategy $S+S$: $E(\Pi)=(1+\alpha)(\theta_G-w)p+(1-p\alpha)[(\theta_G-w)p-S]-S$

$$E(\Pi|S+S)-E\left(\Pi|\bar{S}\&\bar{M}+S\right)=\alpha(\theta_G-w)p+(1-p\alpha)[(\theta_G-w)p-S]$$

Under the hypothesis $S<(1-p)(w-\theta_B)$, $(\theta_G-w)p-S>\bar{\theta}-w>0$. Therefore:

$$E(\Pi|S+S)-E\left(\Pi|\bar{S}\&\bar{M}+S\right)>0$$

If $S > \frac{(1+\alpha-\alpha p)(w-\theta_B)+p(\theta_B-\theta_G)}{\alpha}$, then:

- strategy $\bar{S}\&\bar{M}+S$: $E(\Pi)=(1+\alpha)\left(\bar{\theta}-w\right)+(1-\alpha)[(\theta_G-w)p-S]$
- strategy $S+S$: $E(\Pi)=(1+\alpha)(\theta_G-w)p+(1-p\alpha)[(\theta_G-w)p-S]-S$

$$E(\Pi|S+S)-E\left(\Pi|\bar{S}\&\bar{M}+S\right)=2\alpha(\theta_G-w)p+(1-p\alpha)[(\theta_G-w)p-S]-\alpha S-(1+\alpha)\left(\bar{\theta}-w\right)$$

Rearranging:

$$E(\Pi|S+S)-E\left(\Pi|\bar{S}\&\bar{M}+S\right)=\left\{\begin{array}{c}\alpha(1-p)[(\theta_G-w)p-S+(w-\theta_B)]\\+\left[(\theta_G-w)p-S-\left(\bar{\theta}-w\right)\right]\end{array}\right\}>0$$

Therefore, strategy $S+S\succ\bar{S}\&\bar{M}+S$.

Let's compare $S+S$ with $\bar{S}\&M+S$:

- strategy $\bar{S}\&M+S$: $E(\Pi)=\left(\bar{\theta}-w\right)-(2-p\alpha)S+p(\theta_G-w)[1+\alpha(1-p)]$
- strategy $S+S$: $E(\Pi)=(1+\alpha)(\theta_G-w)p+(1-p\alpha)[(\theta_G-w)p-S]-S$

$$E(\Pi|S+S)-E\left(\Pi|\bar{S}\&M+S\right)=(\theta_G-w)p-\left(\bar{\theta}-w\right)>0$$

Therefore, $S+S\succ\bar{S}\&M+S$.

In the end:

$$S+S\succ\bar{S}\&\left\{\bar{M};M\right\}+S$$

Note that hypothesis $S < (1-p)(w-\theta_B)$ implies that $S \succ \bar{S}$ in period 2; then it is also true that:

$$\bar{S}\&\{\bar{M};M\} + S \succ \bar{S}\&\{\bar{M};M\} + \bar{S}$$

■

Note that, in the interval $S < (1-p)(w-\theta_B)$, the optimal strategy for both type of contracts is S. Which means that, when it is optimal to invest in recruitment in the second period, it has to be optimal in the first period as well. It is never convenient to postpone the cost of screening ex-ante.

2. **Assume** $S > (1-p)(w-\theta_B)$. This means that the firm will choose $\bar{S}$ in period 2.

   (a) S : Under the strategy S, the firm will hire the applicant only in case of good signal.

$$S: \begin{array}{ll} \text{G} & \left\langle \begin{array}{ll} \text{h} & E(\Pi|G) = (1+\alpha)(\theta_G - w) + (1-\alpha)(\bar{\theta} - w) - S > \\ \text{nh} & E(\Pi|G) = \bar{\theta} - w - S \end{array} \right. \\ \text{B} & \left\langle \begin{array}{ll} \text{h} & E(\Pi|B) = (1+\alpha)(\theta_B - w) + (1-\alpha)(\bar{\theta} - w) - S < \\ \text{nh} & E(\Pi|B) = \bar{\theta} - w - S \end{array} \right. \end{array}$$

$$E(\Pi|S) = (1+\alpha)(\theta_G - w)p + (1-p\alpha)(\bar{\theta} - w) - S$$

   (b) $\bar{S}\&\bar{M}$:

$$\bar{S}\&\bar{M}: \quad \left\langle \begin{array}{ll} \text{h} & E(\Pi) = 2(\bar{\theta} - w) > \\ \text{nh} & E(\Pi) = \bar{\theta} - w \end{array} \right.$$

   It is always optimal to hire the applicant, obtaining the following expected profit:

$$E(\Pi|\bar{S}\&\bar{M}) = 2(\bar{\theta} - w)$$

   (c) $\bar{S}\&M$:

$$\bar{S}\&M: \quad \left\langle \begin{array}{ll} \text{h} & E(\Pi) = (\bar{\theta} - w) + p\alpha(\theta_G - w) + (1-p\alpha)(\bar{\theta} - w) - M > \\ \text{nh} & E(\Pi) = \bar{\theta} - w \end{array} \right.$$

$$E(\Pi|\bar{S}\&M) = \bar{\theta} - w + \max\{(\bar{\theta} - w) + p\alpha(\theta_G - \bar{\theta}) - M; 0\}$$

   The employer hire the applicant only if the cost of monitoring is under a certain threshold:[23]

$$M < (\bar{\theta} - w) + p\alpha(\theta_G - \bar{\theta}) = (\bar{\theta} - w) + (1-p)p\alpha(\theta_G - \theta_B)$$

   The expected profit from strategy $\bar{S}\&M$ is:

$$E(\Pi|\bar{S}\&M) = \bar{\theta} - w + \max\{(\bar{\theta} - w) + p\alpha(\theta_G - \bar{\theta}) - M; 0\}$$

[23] Given that I assumed $M = S$, I've to check that the condition $M < \bar{\theta} - w + p\alpha(\theta_G - \bar{\theta})$ is coherent with $S > (1-p)(w-\theta_B)$. The necessary condition is:

$$(1-p)(w-\theta_B) < \bar{\theta} - w + p\alpha(\theta_G - \bar{\theta})$$

and it is always satisfied.

- if $M < \left(\bar{\theta} - w\right) + (1-p)\,p\alpha\,(\theta_G - \theta_B) : E\left(\Pi|\bar{S}\&M\right) = 2\left(\bar{\theta} - w\right) + p\alpha\left(\theta_G - \bar{\theta}\right) - M$
- if $M > \left(\bar{\theta} - w\right) + (1-p)\,p\alpha\,(\theta_G - \theta_B) : E\left(\Pi|\bar{S}\&M\right) = \bar{\theta} - w$

In the end, the optimal strategy is:

Proposition 13 *Under the assumption $S > (1-p)(w - \theta_B)$, temporary workers will be screened ex-ante only if :*

$$S + \bar{S} \succ \bar{S}\&\left\{\bar{M}, M\right\} + \bar{S} \quad if \quad S < (1-p)\left[(w - \theta_B) + \alpha p\,(\theta_G - \theta_B)\right]$$

Proof. Let's compare the expected profits associated to strategies $S + \bar{S}$ and $\bar{S}\&\bar{M} + \bar{S}$:

- strategy $\bar{S}\&\bar{M} + \bar{S}$: $E(\Pi) = 2\left(\bar{\theta} - w\right)$
- strategy $S + \bar{S}$: $E(\Pi) = (1+\alpha)(\theta_G - w)\,p + (1 - p\alpha)\left(\bar{\theta} - w\right) - S$

$$E\left(\Pi|S + \bar{S}\right) - E\left(\Pi|\bar{S}\&\bar{M} + \bar{S}\right) = (1-p)\left[(w - \theta_B) + \alpha p\,(\theta_G - \theta_B)\right] - S$$

Therefore:

$$S + \bar{S} \succ \bar{S}\&\bar{M} + \bar{S} \quad if \quad S < (1-p)\left[(w - \theta_B) + \alpha p\,(\theta_G - \theta_B)\right]$$

Now, under the hypothesis $S < (1-p)\left[(w - \theta_B) + \alpha p\,(\theta_G - \theta_B)\right]$:

- strategy $\bar{S}\&M + \bar{S}$: $E(\Pi) = \bar{\theta} - w + \max\left\{\left(\bar{\theta} - w\right) + p\alpha\left(\theta_G - \bar{\theta}\right) - M; 0\right\}$
- strategy $S + \bar{S}$: $E(\Pi) = (1+\alpha)(\theta_G - w)\,p + (1 - p\alpha)\left(\bar{\theta} - w\right) - S$

If $M = S < \left(\bar{\theta} - w\right) + (1-p)\,p\alpha\,(\theta_G - \theta_B)$ then

$$E\left(\Pi|\bar{S}\&M + \bar{S}\right) = 2\left(\bar{\theta} - w\right) + p\alpha\left(\theta_G - \bar{\theta}\right) - M$$

$$E\left(\Pi|S + \bar{S}\right) - E\left(\Pi|\bar{S}\&M + \bar{S}\right) = (1-p)(w - \theta_B) > 0$$

Therefore, screening ex-ante is preferred to screening on the job: $S + \bar{S} \succ \bar{S}\&M + \bar{S}$.

If $M = S > \left(\bar{\theta} - w\right) + (1-p)\,p\alpha\,(\theta_G - \theta_B)$ then $E\left(\Pi|\bar{S}\&M + \bar{S}\right) = \bar{\theta} - w$.
In this case, $E\left(\Pi|\bar{S}\&\bar{M} + \bar{S}\right) > E\left(\Pi|\bar{S}\&M + \bar{S}\right)$, then:

$$S + \bar{S} \succ \bar{S}\&\bar{M} + \bar{S} \succ \bar{S}\&M + \bar{S}$$

In the end, under the hypothesis $S < (1-p)\left[(w - \theta_B) + \alpha p\,(\theta_G - \theta_B)\right]$, the following disequality holds:[24]

$$S + \bar{S} \succ \bar{S}\&M + \bar{S}$$

[24] Note that the following disequalities has to hold:

$$\begin{aligned} S &< (1-p)\left[(w - \theta_B) + \alpha p\,(\theta_G - \theta_B)\right] \\ S &> (1-p)(w - \theta_B) \end{aligned}$$

This is true only if $(1-p)\left[(w - \theta_B) + \alpha p\,(\theta_G - \theta_B)\right] > (1-p)(w - \theta_B)$ and it is always satisfied.

While, if $S > (1-p)\left[(w-\theta_B) + \alpha p\left(\theta_G - \theta_B\right)\right]$, then:

$$\begin{aligned}\bar{S}\&\bar{M} + \bar{S} &\succ S + \bar{S} \succ \bar{S}\&M + \bar{S} \;\; if \;\; S < \left(\bar{\theta} - w\right) + (1-p)\, p\alpha\left(\theta_G - \theta_B\right) \\ \bar{S}\&\bar{M} + \bar{S} &\succ \bar{S}\&M + \bar{S} \succ S + \bar{S} \;\; if \;\; S > \left(\bar{\theta} - w\right) + (1-p)\, p\alpha\left(\theta_G - \theta_B\right)\end{aligned}$$

■

The solution of the game is showed in Picture 4 and is summarized in the following proposition and is summarized in the following proposition:

Proposition 14 *Temporary workers will be screened ex ante, at least in the first period, only if:*

$$S \succ \left\{\bar{S} + M; \bar{S}\right\} \quad if \quad S < (1-p)\left[w - \theta_B + p\alpha\left(\theta_G - \theta_B\right)\right]$$

In particular:

$$\begin{array}{ll} if\ S < (1-p)(w-\theta_B) & \rightarrow \quad S + S \succ \bar{S}\&\left\{\bar{M}; M\right\} + S \\ if\ (1-p)(w-\theta_B) < S < (1-p)\left[(w-\theta_B) + p\alpha\left(\theta_G - \theta_B\right)\right] & \\ & \rightarrow \quad S + \bar{S} \succ \bar{S}\&\left\{\bar{M}, M\right\} + \bar{S} \\ if\ S < p\alpha\left(\theta_G - \bar{\theta}\right) < (1-p)\left[(w-\theta_B) + p\alpha\left(\theta_G - \theta_B\right)\right] & \\ & \rightarrow \quad \bar{S}\&M + \bar{S} \succ \bar{S}\&\bar{M} + \bar{S} \\ if\ S > (1-p)\left[(w-\theta_B) + p\alpha\left(\theta_G - \theta_B\right)\right] & \rightarrow \quad \bar{S}\&\bar{M} + \bar{S} \succ \left\{\bar{S}\&M; S\right\} + \bar{S} \end{array}$$

6.2.3 Comparison

Depending on the values of the parameters involved, the optimal recruitment strategy could be either S or $\bar{S}$ for both contracts; or it could imply different recruitment expenditure according to the lenght of the employment relationship. There is a certain set of parameters' values such that the latter equilibrium arises:

Proposition 15 *The optimal recruitment strategy is:*
- $\bar{S}$ if temporary worker
- S if permanent worker
if the following condition holds:

$$(1-p)\left[(w-\theta_B) + p\alpha\left(\theta_G - \theta_B\right)\right] < S < (1-p)\left[(w-\theta_B) + p\left(\theta_G - \theta_B\right)\right]$$

In particular, the lower is α, the wider is the set of parameters which involve the above-mentioned varied strategy. It will be optimal to invest also on recruiting atypical workers when the contract is likely to be renewed, and the expected duration of the employment relationship is long enough to amortize the cost.

The possibility of performing monitoring on temporary contracts, give rise to another varied strategy:

Proposition 16 *The optimal screening strategy is:*

- $\bar{S}\&M$ *if temporary worker*
- S *if permanent worker*

if the following conditions holds:

$$(1-p)(w-\theta_B) < S < p\alpha\left(\theta_G - \bar{\theta}\right)$$

There exists a set of parameters such that it is convenient to monitor fixed-term workers, while screening ex-ante the permanent ones. In particular, ceteris paribus, the higher is α, the wider is that interval: when the expected duration of the contract, $(1+\alpha p)$, is longer, it is more convenient to spend in monitoring the temporary hires. Whereas, if the quitting rate is high, then it is not sensible to monitor a worker which could not be renewable next period.

Figure 1: Permanent contract vacancy - Timing

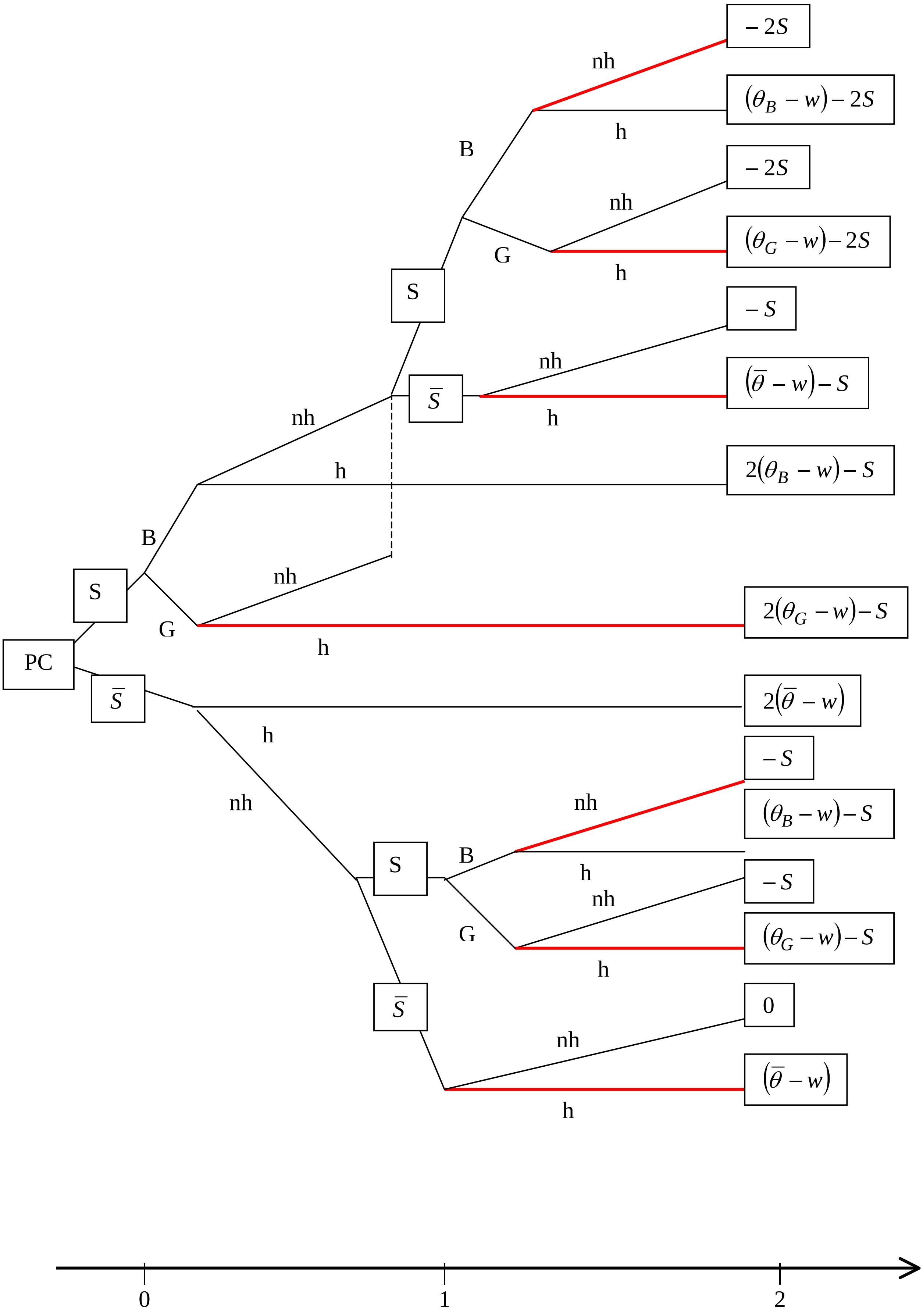

Figure 2: Temporary contract vacacancy – Timing

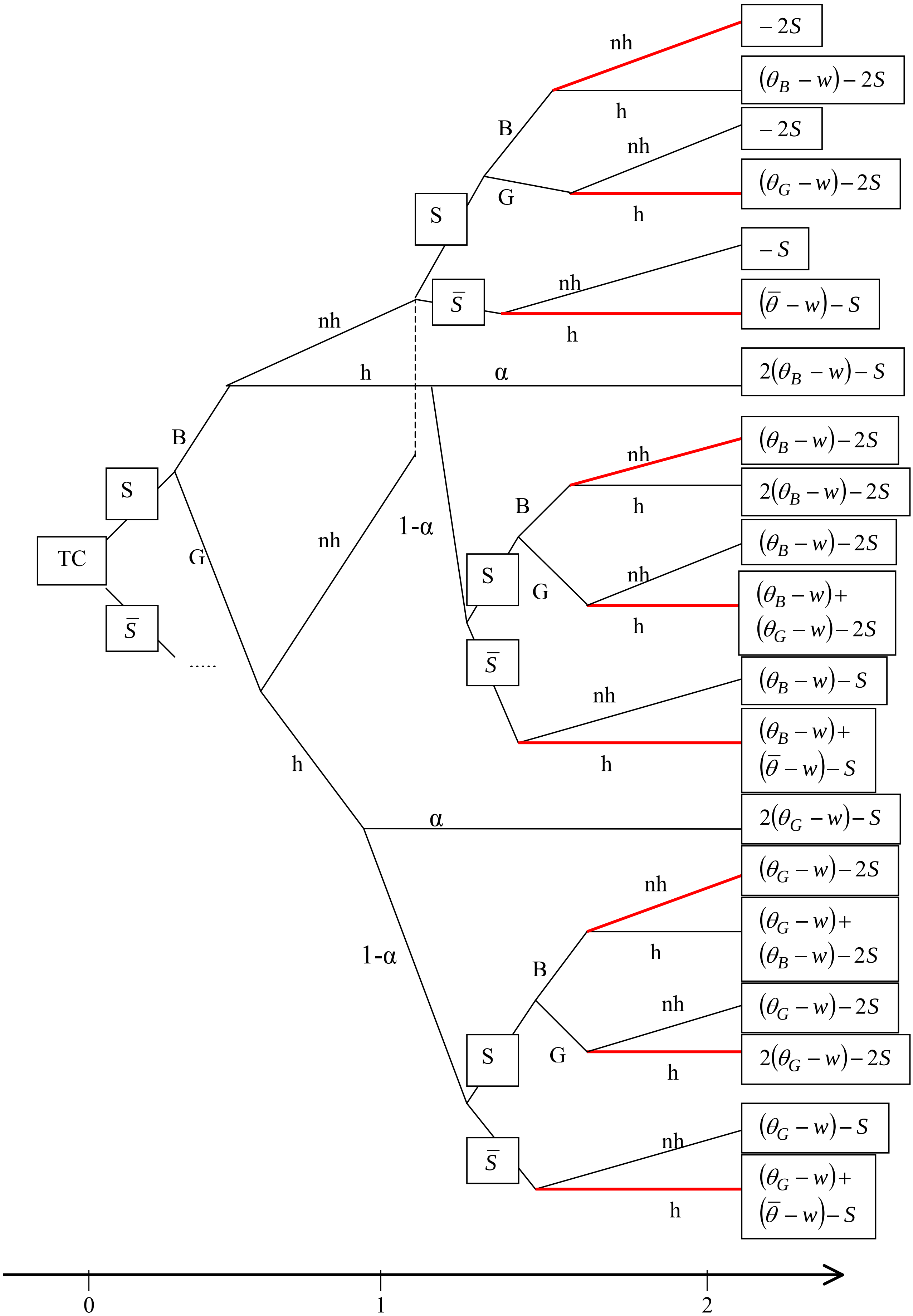

Figure 2: Temporary contract vacancy – Timing (continue)

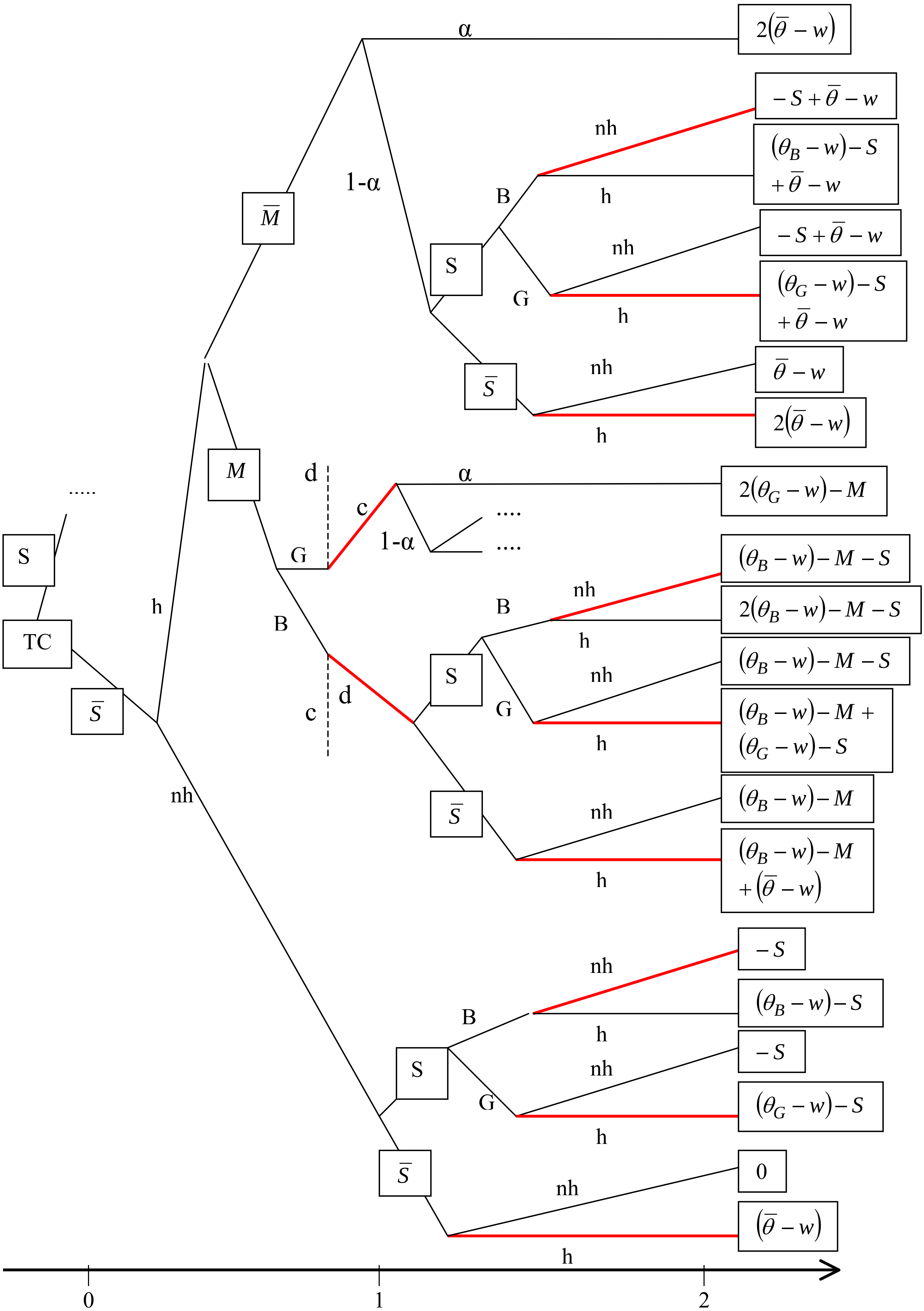

Figure 3: Permanent contract vacancy – Solution

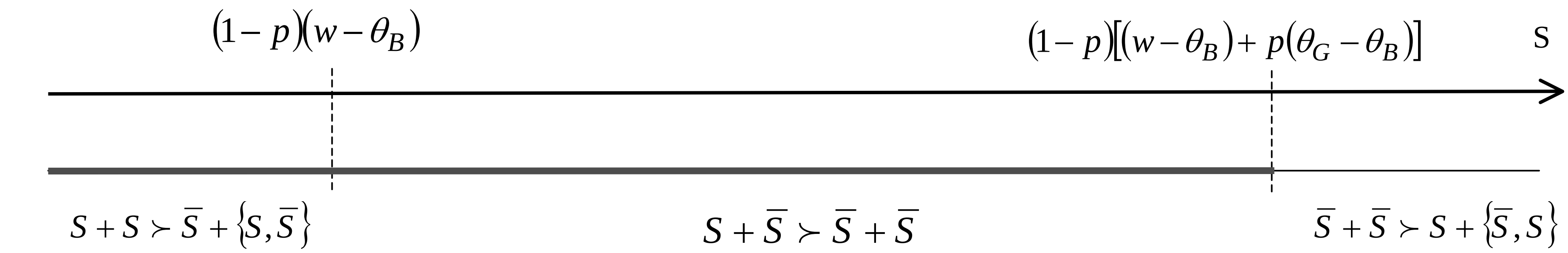

Figure 4: Temporary contract vacancy – Solution & Comparison

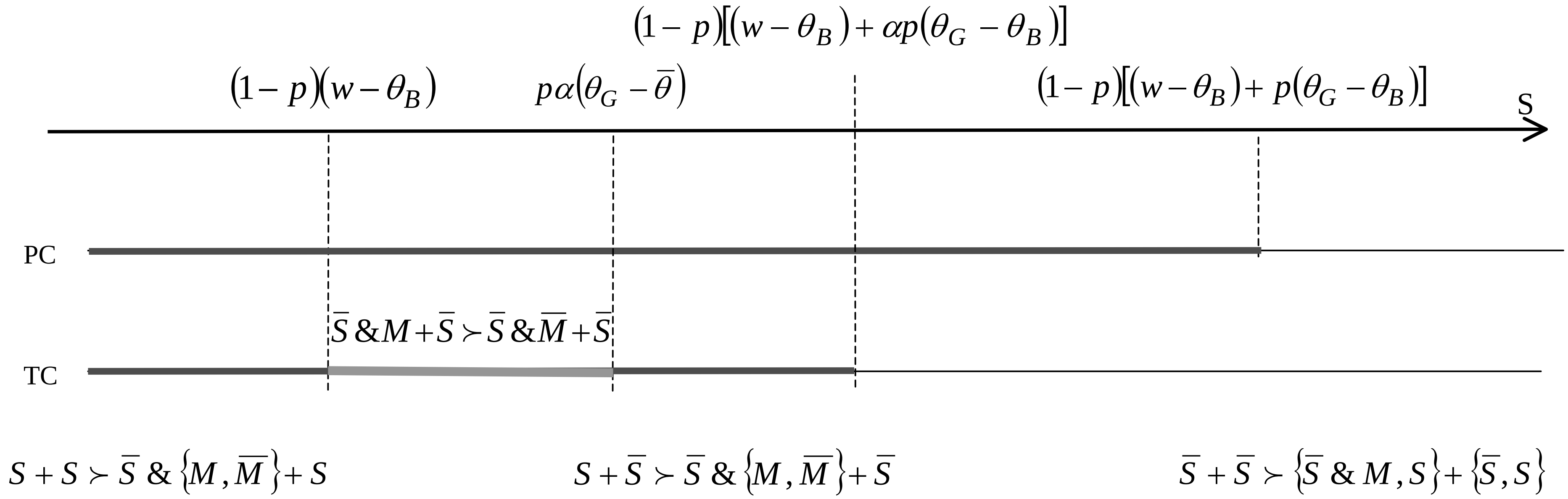

Figure 4: Recruitment channels valuation by job qualification: speed

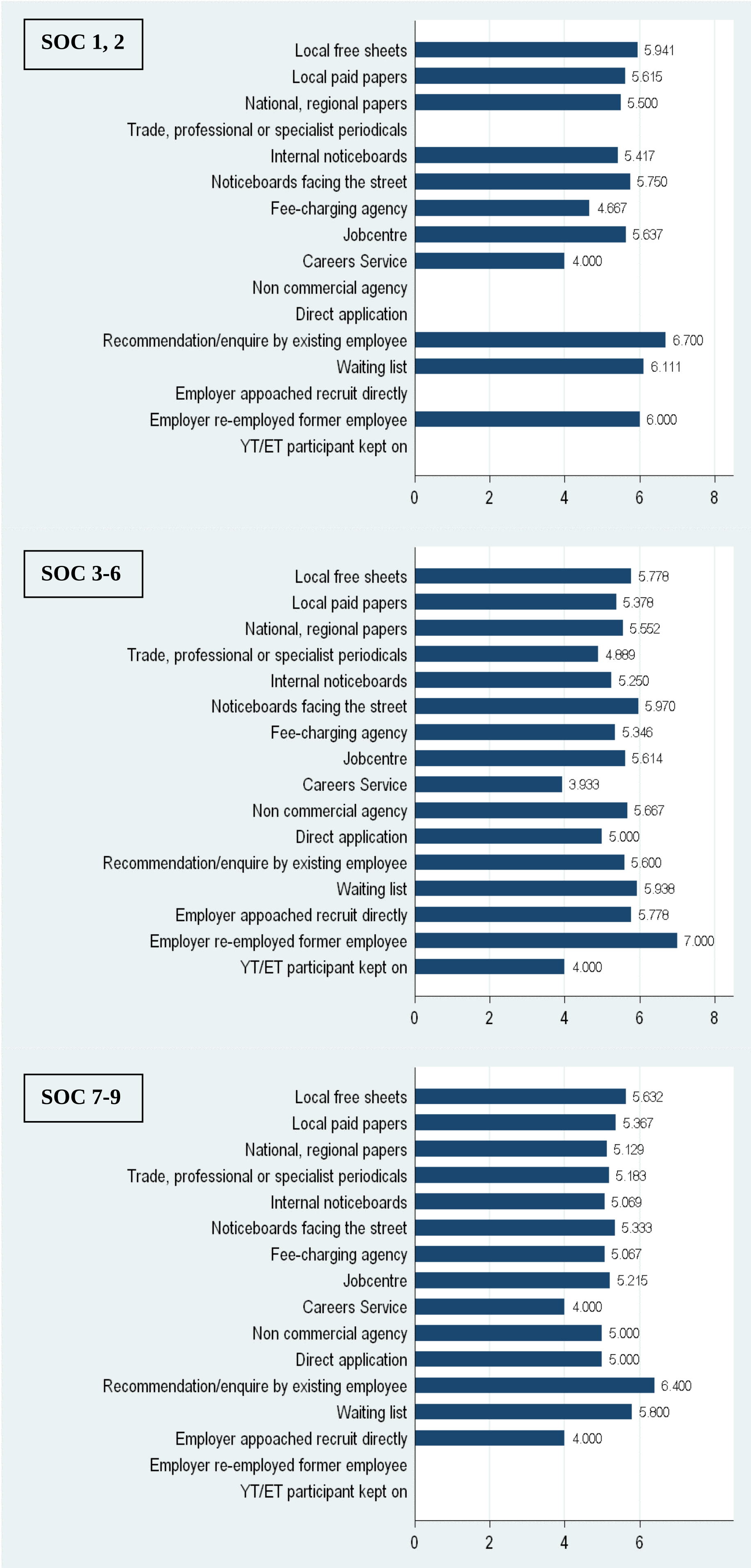

Figure 5: Recruitment channels valuation by job qualification: cost

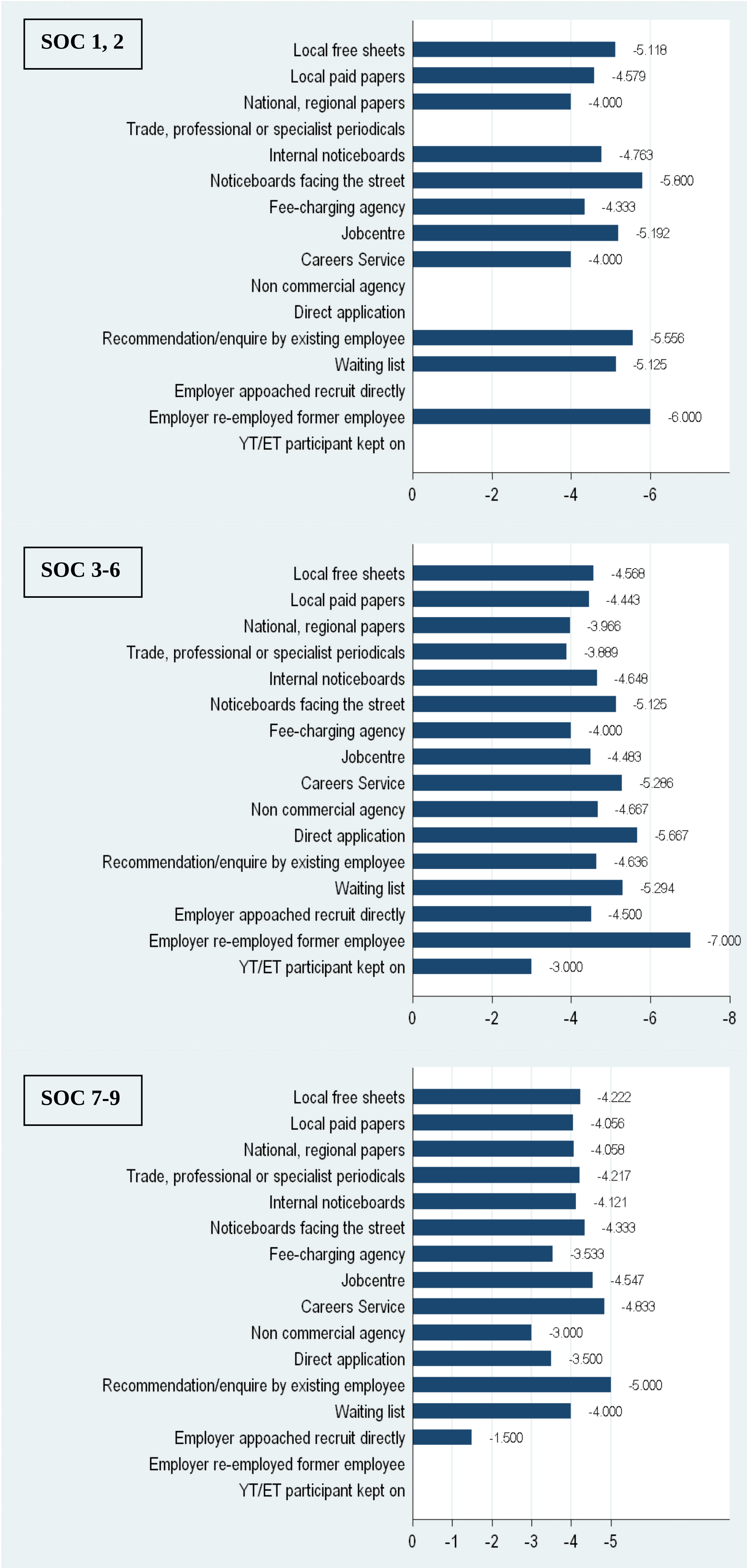

Table 1: Dynamic of the share of temporary employment

	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
EU-15*	9.0	10.2	10.4	10.9	10.6	11.0	11.5	11.8	12.2	12.8	13.2	13.4
Belgium	6.9	5.3	5.1	4.9	5.1	5.1	5.3	5.9	6.3	7.8	10.3	9.0
Denmark	12.3	10.8	11.9	11.0	10.7	12.0	12.1	11.2	11.1	10.1	10.2	10.2
Germany*	10.0	10.5	10.1	10.5	10.3	10.3	10.4	11.1	11.7	12.3	13.1	12.7
Greece	21.1	16.5	14.7	10.2	10.4	10.3	10.2	11.0	10.9	13.0	13.0(2)	13.1
Spain	15.6	29.8	32.2	33.5	32.2	33.7	35.0	33.6	33.6	32.9	32.7	32.1
France	4.7	10.5	10.2	10.5	10.9	11.0	12.3	12.6	13.1	13.9	14.0	15.0
Ireland	7.3	8.5	8.3	8.7	9.4	9.5	10.2	9.2	9.4	9.4(1)	9.4(1)	4.6
Italy	4.8	5.2	5.4	7.5	6.0	7.3	7.2	7.5	8.2	8.6	9.8	10.1
Luxembourg	4.7	3.4	3.3	2.9	3.0	2.9	..	2.6	2.1	2.9	3.4	3.4
Netherlands	7.5	7.6	7.7	9.7	10.0	10.9	10.9	12.0	11.4	12.7	12.0	14.0
Austria	..	..	..	..	..	..	6.0	8.0	7.8	7.8	7.5	7.9
Portugal	14.4	18.3	16.4	11.0	9.8	9.4	10.0	10.6	12.2	17.3	18.6	20.4
Finland	10.5	11.5	12.0	13.1	12.7	12.9	16.5	17.3	17.1	17.7	18.2	17.7
Sweden	11.9	10.0	9.8	10.5	11.5	11.5	12.5	11.8	12.1	12.9	13.9	14.7
UK	7.0	5.2	5.3	5.5	5.9	6.5	7.0	7.1	7.4	7.1	6.8	6.7
US**	..	0.9	0.9	1.0	1.2	1.5	1.6	1.7	1.8	1.9	1.9	1.9

Source: European Countries: European Commission. Employment in Europe (1985-1996) and Labour Force Survey (1997-2000).
US: American Staffing Association and Bureau of Labor Statistics.
* Since 1991, data on Germany and EU-15 include the new German Länder
** Data on US regard only temporary help agency employment
(1) Ireland reports the 1997 value for 1998 and 1999.
(2) Greece reports the 1998 value for 1999.

Table 2: Descriptive statistics (weighted values)

Contract type:	Full sample	Sample
Temporary	22.74	22.20
Casual	1.90	0.40
Fixed-term	10.02	4.81
Permanent	62.78	70.05
Provisional	2.09	2.52
Self-employed	0.06	-
Don't know/Not answered	0.41	-
Sample size (engagements)	*20,339*	*3,416*
Establishments' characteristics:		
SIC:		
1. Energy and water supply	0.42	0.56
2. Metals, minerals, etc.	1.73	1.82
3. Metal goods, engineering, etc.	5.61	6.43
4. Other manufacturing	5.94	7.32
5. Construction	3.08	2.09
6. Distribution, catering, etc.	32.66	35.77
7. Transport and communication	4.64	4.09
8. Banking, insurance, etc.	16.99	23.71
9. Other services	28.92	18.78
Sample size (establishment)	*6,271*	*1,291*
Size:		
3 - 10	40.44	38.30
11 - 24	21.37	18.80
25 - 49	15.73	13.83
50 - 99	9.31	12.00
100 - 199	6.40	7.68
200 - 499	4.47	6.72
500 - 999	1.12	1.68
1000 - 1999	0.62	0.64
2000 or more	0.54	0.35
Sample size (establishment)	*6,284*	*1,291*
Region:		
London/SE	30.74	32.60
South West	9.08	8.21
West Mids	9.14	11.32
E Mids/East	11.37	12.12
York/Humber	8.85	9.18
North West	12.15	11.47
North	4.31	3.10
Wales	5.11	3.72
Scotland	9.24	8.27

Sample size (establishment)	*6,284*	*1,291*
Job's characteristics:		
SOC:		
Routine, unskilled	15.59	10.52
Operatives & assembly	18.80	28.62
Sales	6.11	12,45
Protective and Personal service	6.78	6.07
Craft & Skilled Service	6.34	6.39
Clerical & Secretarial	18.77	16.98
Professional assoc & technical	10.49	6.35
Professional	13.44	9.07
Management & administration	3.69	3.54
Sample size	*20,339*	*3,416*
Supervision:		
Yes	84.09	88.34
No	15.91	11.66
Sample size	20,208	3.416
Workers' characteristics:		
Gender:		
Male	45.77	53.03
Female	54.23	46.97
Sample size	*20,292*	*3,416*
Age:		
16-18	5.55	6.48
19-24	26.93	31.90
25-34	39.73	38.40
35-44	19.03	17.67
45-54	7.01	4.87
55 or over	1.74	0.67
Sample size	*19,705*	*3,416*
Employment status:		
Sub-contract/agency employee working at this establishment	2.80	1.99
Employee at a different establishment of this organization	4.72	3.94
Working for another employer	36.41	46.95
Unemployed	31.93	23.05
In full time education	11.00	19.90
Not in the labour market	5.56	2.75
Other	2.25	1.43
Don't know / Not stated	5.33	-
Sample size	*20,339*	*3,416*

Table 3: Regression - channel cost

	OLS			FE		
	(1)	(2)	(3)	(4)	(5)	(6)
Contract	-0.132 (7.94)***			-0.026 (2.52)**		
conxsoc1		-0.093 (1.78)*			0.124 (5.23)***	
conxsoc2		-0.182 (7.46)***			-0.283 (8.86)***	
conxsoc3		-0.070 (1.52)			-0.241 (5.44)***	
conxsoc4		0.172 (2.81)***			0.074 (2.72)***	
conxsoc5		-0.941 (12.47)***			-0.299 (5.45)***	
conxsoc6		-0.067 (1.98)**			-0.022 (1.15)	
conxsoc7		-0.017 (0.21)			-0.025 (1.24)	
conxsoc8		0.110 (1.08)			0.021 (1.15)	
conxsoc9		-0.008 (0.04)			-0.109 (1.96)**	
conxsic1			0.040 (0.42)			0.416 (4.19)***
conxsic2			0.231 (3.73)***			0.086 (1.12)
conxsic3			-0.299 (9.24)***			-0.407 (11.83)***
conxsic4			-0.256 (7.54)***			-0.285 (4.33)***
conxsic5			-0.111 (0.51)			-0.007 (0.04)
conxsic6			-0.245 (6.70)***			-0.182 (4.57)***
conxsic7			0.007 (0.11)			-0.269 (2.50)**
conxsic8			0.021 (0.64)			0.016 (0.46)
conxsic9			0.061 (0.94)			0.024 (2.05)**
Controls:						
Workers' character.	yes	yes	yes	yes	yes	yes
Firms' character.	yes	yes	yes	no	no	no
Jobs' character.	yes	yes	yes	yes	yes	yes
Obs	3053	3053	3053	6994	6994	6994
Adjusted R-squared	0.60	0.62	0.62	0.86	0.87	0.87

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Regression - channel speed

	OLS			FE		
	(1)	(2)	(3)	(4)	(5)	(6)
Contract	0.163 (11.07)***			0.011 (1.49)		
conxsoc1		0.254 (5.35)***			-0.003 (0.19)	
conxsoc2		0.137 (6.21)***			0.116 (4.83)***	
conxsoc3		0.206 (4.97)***			0.095 (2.85)***	
conxsoc4		-0.007 (0.12)			0.019 (0.91)	
conxsoc5		0.314 (4.59)***			0.139 (3.37)***	
conxsoc6		0.217 (7.10)***			0.064 (4.52)***	
conxsoc7		0.058 (0.76)			-0.043 (2.79)***	
conxsoc8		0.067 (0.72)			-0.040 (2.96)***	
conxsoc9		-0.459 (2.49)**			-0.048 (1.15)	
conxsic1			0.282 (3.30)***			1.037 (14.16)***
conxsic2			-0.334 (6.08)***			0.137 (2.42)**
conxsic3			0.127 (4.41)***			0.082 (3.24)***
conxsic4			0.286 (9.45)***			0.267 (5.49)***
conxsic5			0.039 (0.20)			0.159 (1.04)
conxsic6			0.207 (6.36)***			0.070 (2.39)**
conxsic7			0.138 (2.37)**			0.133 (1.68)*
conxsic8			0.213 (7.30)***			0.045 (1.78)*
conxsic9			-0.036 (0.63)			-0.031 (3.59)***
Controls:						
Workers' character.	yes	yes	yes	yes	yes	yes
Firms' character.	yes	yes	yes	no	no	no
Jobs' character.	yes	yes	yes	yes	yes	yes
Obs	3053	3053	3053	6994	6994	6994
Adjusted R-squared	0.49	0.50	0.51	0.85	0.85	0.86

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5: OLS Regression - channel cost

	Main			Urgency		
	(1)	(2)	(3)	(1')	(2')	(3')
Contract	-0.132			0.017		
	(7.94)***			(0.55)		
conxsoc1		-0.093			-0.206	
		(1.78)*			(2.52)**	
conxsoc2		-0.182			-0.128	
		(7.46)***			(2.56)**	
conxsoc3		-0.070			0.404	
		(1.52)			(4.55)***	
conxsoc4		0.172			0.358	
		(2.81)***			(3.65)***	
conxsoc5		-0.941			-0.021	
		(12.47)***			(0.10)	
conxsoc6		-0.067			0.017	
		(1.98)**			(0.29)	
conxsoc7		-0.017			-0.049	
		(0.21)			(0.43)	
conxsoc8		0.110			0.028	
		(1.08)			(0.25)	
conxsoc9		-0.008			0.122	
		(0.04)			(0.19)	
conxsic1			0.040			0.182
			(0.42)			(0.94)
conxsic2			0.231			-0.042
			(3.73)***			(0.37)
conxsic3			-0.299			-0.151
			(9.24)***			(2.47)**
conxsic4			-0.256			-0.297
			(7.54)***			(4.73)***
conxsic5			-0.111			-0.378
			(0.51)			(0.81)
conxsic6			-0.245			0.001
			(6.70)***			(0.02)
conxsic7			0.007			0.082
			(0.11)			(0.76)
conxsic8			0.021			0.189
			(0.64)			(3.68)***
conxsic9			0.061			0.121
			(0.94)			(1.53)
Workers' character.:						
female	0.008	0.016	0.002	0.000	0.002	0.012
	(0.57)	(1.10)	(0.11)	(0.00)	(0.10)	(0.50)
Age:[1]						
19-24	0.035	0.036	0.026	0.140	0.130	0.137
	(1.35)	(1.44)	(1.01)	(3.48)***	(3.23)***	(3.45)***
25-34	0.136	0.145	0.140	0.249	0.233	0.239
	(5.11)***	(5.58)***	(5.36)***	(5.78)***	(5.44)***	(5.57)***
35-44	0.141	0.147	0.126	0.225	0.226	0.224
	(4.97)***	(5.29)***	(4.53)***	(4.84)***	(4.92)***	(4.84)***
45-54	0.023	0.093	0.035	0.300	0.264	0.296
	(0.65)	(2.63)***	(0.99)	(5.16)***	(4.54)***	(5.14)***
55 and over	0.155	0.181	0.203	0.235	0.288	0.319
	(2.15)**	(2.57)**	(2.85)***	(1.24)	(1.54)	(1.69)*
white	-0.063	-0.048	-0.055	0.079	0.069	0.067
	(2.72)***	(2.12)**	(2.44)**	(1.92)*	(1.68)*	(1.65)*
disability	0.117	0.109	0.114	0.300	0.302	0.213

	(1.97)**	(1.88)*	(1.96)**	(2.58)***	(2.62)***	(1.84)*
worker	0.065	0.054	0.058	0.008	0.021	-0.003
	(4.57)***	(3.90)***	(4.14)***	(0.33)	(0.84)	(0.13)
former employee	-0.090	-0.084	-0.093	-0.035	-0.051	-0.085
	(3.14)***	(3.00)***	(3.30)***	(0.80)	(1.17)	(1.93)*
Firms' character.:						
sic2	0.141	0.160	0.045	0.176	0.164	0.159
(metals/minerals)	(2.69)***	(3.11)***	(0.76)	(2.36)**	(2.22)**	(1.98)**
sic3	0.037	0.054	0.122	0.272	0.276	0.297
(metal goods/engineer.)	(0.81)	(1.19)	(2.40)**	(4.08)***	(4.20)***	(4.27)***
sic4	0.003	0.006	0.065	0.225	0.236	0.315
(other manufacturing)	(0.07)	(0.13)	(1.25)	(3.28)***	(3.48)***	(4.22)***
sic5	-0.017	-0.008	0.004	0.243	0.229	0.302
(construction)	(0.17)	(0.08)	(0.04)	(1.20)	(1.15)	(1.36)
sic6	-0.192	-0.168	-0.119	0.038	0.062	0.050
(distrib./catering)	(4.08)***	(3.63)***	(2.27)**	(0.55)	(0.92)	(0.69)
sic7	0.071	-0.004	0.013	0.200	0.191	0.124
(transport/commun.)	(1.30)	(0.07)	(0.19)	(2.39)**	(2.26)**	(1.13)
sic8	0.020	0.029	0.030	0.224	0.208	0.193
(banking/insurance)	(0.46)	(0.66)	(0.61)	(3.40)***	(3.20)***	(2.76)***
sic9	-0.035	-0.028	0.005	0.132	0.114	0.128
(other services)	(0.73)	(0.59)	(0.09)	(1.89)*	(1.65)*	(1.75)*
N° employees in UK:[2]						
100-200	-0.065	-0.087	-0.070	-0.093	-0.100	-0.111
	(1.27)	(1.75)*	(1.41)	(1.09)	(1.17)	(1.30)
200-500	-0.066	-0.085	-0.074	-0.081	-0.086	-0.082
	(1.52)	(2.01)**	(1.75)*	(1.16)	(1.25)	(1.19)
500-1000	-0.061	-0.065	-0.070	-0.071	-0.070	-0.068
	(1.45)	(1.56)	(1.67)*	(0.97)	(0.97)	(0.94)
1000-2000	-0.047	-0.048	-0.006	-0.128	-0.110	-0.078
	(1.07)	(1.12)	(0.15)	(1.75)*	(1.52)	(1.07)
2000-5000	-0.122	-0.129	-0.128	-0.060	-0.051	-0.037
	(2.86)***	(3.10)***	(3.05)***	(0.80)	(0.69)	(0.50)
5000-10000	-0.019	-0.016	-0.013	0.005	0.021	-0.010
	(0.44)	(0.37)	(0.32)	(0.07)	(0.29)	(0.14)
10000-50000	-0.064	-0.090	-0.071	-0.165	-0.165	-0.149
	(1.55)	(2.22)**	(1.73)*	(2.37)**	(2.40)**	(2.18)**
50000-100000	0.072	0.045	0.072	0.156	0.146	0.143
	(1.57)	(1.00)	(1.60)	(2.01)**	(1.90)*	(1.86)*
≥100000	0.055	0.040	0.012	-0.062	-0.209	-0.103
	(1.21)	(0.90)	(0.28)	(0.76)	(2.47)**	(1.28)
N° employees in the establishment	-0.000	-0.000	-0.000	0.000	0.000	0.000
	(1.57)	(1.98)**	(2.41)**	(2.26)**	(1.89)*	(1.70)*
(N° employees)^2	0.000	0.000	0.000	-0.000	-0.000	-0.000
	(0.37)	(1.16)	(1.72)*	(3.19)***	(2.76)***	(2.30)**
Production intensity:[3]						
at full capacity	-0.055	-0.058	-0.062	0.007	-0.019	0.000
	(1.05)	(1.13)	(1.21)	(0.11)	(0.29)	(0.00)
somewhat below f.c.	-0.088	-0.085	-0.084	0.022	0.004	0.030
	(1.63)	(1.60)	(1.58)	(0.31)	(0.06)	(0.42)
considerably below f.c.	0.058	0.062	0.026	0.231	0.204	0.210
	(0.84)	(0.93)	(0.38)	(2.08)**	(1.86)*	(1.90)*
Production trend:[4]						
expanding slowly	-0.019	-0.019	-0.016	-0.038	-0.042	-0.024
	(1.05)	(1.05)	(0.86)	(1.23)	(1.34)	(0.77)
stable	-0.135	-0.120	-0.112	-0.129	-0.111	-0.116
	(7.95)***	(7.22)***	(6.68)***	(4.40)***	(3.83)***	(3.96)***
contracting slowly	-0.082	-0.094	-0.061	-0.089	-0.075	-0.089

	(3.72)***	(4.30)***	(2.79)***	(2.21)**	(1.87)*	(2.25)**
contracting fast	-0.081	-0.075	-0.104	-0.286	-0.265	-0.263
	(1.80)*	(1.69)*	(2.33)**	(3.43)***	(3.20)***	(3.20)***
changeble	0.252	0.224	0.266	0.292	0.273	0.310
	(7.25)***	(6.36)***	(7.70)***	(5.09)***	(4.68)***	(5.45)***
workforce is:[5]						
1	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
2	-0.036	-0.043	-0.125	-0.012	0.123	0.093
	(0.38)	(0.47)	(1.33)	(0.03)	(0.36)	(0.27)
3= satisfactory	-0.215	-0.226	-0.270	-0.084	0.004	-0.080
	(2.38)**	(2.55)**	(3.04)***	(0.25)	(0.01)	(0.24)
4	-0.056	-0.070	-0.137	-0.082	0.036	-0.091
	(0.63)	(0.80)	(1.56)	(0.24)	(0.11)	(0.27)
5	-0.084	-0.084	-0.132	-0.031	0.072	-0.023
	(0.97)	(0.99)	(1.55)	(0.09)	(0.22)	(0.07)
6	-0.115	-0.156	-0.165	-0.101	-0.015	-0.079
	(1.33)	(1.83)*	(1.93)*	(0.30)	(0.04)	(0.24)
7= major strenght	-0.088	-0.107	-0.140	-0.075	0.044	-0.057
	(1.01)	(1.27)	(1.65)	(0.22)	(0.13)	(0.17)
Region:[6]						
South West	-0.056	-0.014	-0.075	0.079	0.094	0.075
	(1.95)*	(0.50)	(2.66)***	(1.67)*	(2.01)**	(1.61)
West Mids	0.063	0.047	0.063	0.130	0.156	0.137
	(2.66)***	(2.00)**	(2.69)***	(3.05)***	(3.64)***	(3.21)***
E Mids/East	0.111	0.100	0.099	0.134	0.155	0.109
	(5.49)***	(4.94)***	(4.95)***	(3.73)***	(4.12)***	(3.02)***
York/Humber	0.126	0.124	0.121	0.116	0.153	0.136
	(4.43)***	(4.44)***	(4.32)***	(2.28)**	(3.01)***	(2.69)***
North West	0.020	0.013	0.025	0.054	0.086	0.056
	(0.79)	(0.51)	(1.03)	(1.41)	(2.22)**	(1.46)
North	0.163	0.127	0.171	0.089	0.126	0.108
	(5.70)***	(4.41)***	(6.07)***	(1.82)*	(2.59)***	(2.24)**
Wales	0.074	0.076	0.072	0.075	0.086	0.043
	(1.52)	(1.60)	(1.50)	(0.74)	(0.87)	(0.44)
Scotland	0.154	0.152	0.163	0.122	0.140	0.115
	(5.30)***	(5.30)***	(5.71)***	(2.58)***	(2.97)***	(2.45)**
Job characteristics:						
Standard recruitment procedures	0.004	0.004	0.009	0.068	0.070	0.061
	(0.16)	(0.17)	(0.34)	(1.65)*	(1.73)*	(1.49)
SOC:[7]						
soc2	-0.016	0.024	-0.002	-0.089	-0.082	-0.028
(operatives/assembly)	(0.58)	(0.71)	(0.07)	(1.80)*	(1.28)	(0.55)
soc3	0.289	0.295	0.267	0.266	0.151	0.230
(sales)	(9.22)***	(8.58)***	(8.57)***	(5.44)***	(2.67)***	(4.72)***
soc4	0.305	0.236	0.265	0.191	-0.054	0.154
(protect./personal service)	(8.62)***	(5.75)***	(7.50)***	(3.04)***	(0.68)	(2.42)**
soc5	0.155	0.269	0.124	0.209	0.128	0.169
(craft/skilled service)	(4.24)***	(6.73)***	(3.41)***	(3.54)***	(1.95)*	(2.83)***
soc6	0.361	0.352	0.338	0.310	0.242	0.278
(clerical/secretarial)	(12.40)***	(10.69)***	(11.57)***	(6.53)***	(4.27)***	(5.86)***
soc7	0.812	0.814	0.803	0.797	0.747	0.776
(assoc. profess./technical)	(23.33)***	(21.81)***	(23.36)***	(14.91)***	(12.30)***	(14.65)***
soc8	0.669	0.675	0.660	0.659	0.613	0.638
(professional)	(17.88)***	(17.11)***	(17.78)***	(11.15)***	(9.42)***	(10.88)***
soc9	0.749	0.751	0.734	0.724	0.680	0.710
(managers/admin.)	(16.62)***	(16.05)***	(16.51)***	(10.83)***	(9.41)***	(10.70)***
hourpay	0.015	0.016	0.017	0.020	0.021	0.023
	(5.31)***	(5.71)***	(6.16)***	(5.32)***	(5.73)***	(6.24)***

supervision task	0.123	0.126	0.118	0.092	0.084	0.081
	(5.37)***	(5.62)***	(5.27)***	(2.64)***	(2.43)**	(2.33)**
urgency				-0.130	-0.109	-0.116
				(5.94)***	(4.86)***	(5.32)***
Constant	-4.873	-4.891	-4.861	-5.426	-5.460	-5.429
	(39.22)***	(40.19)***	(39.15)***	(14.77)***	(15.05)***	(14.92)***
Observations	3053	3053	3053	1220	1220	1220
Adjusted R-squared	0.60	0.62	0.62	0.67	0.68	0.68

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

1: reference value “16-18”
2: reference value “<100”
3: reference value “Overloaded”
4: reference value “Expanding fast”
5: reference value “0= Major constraint on activities”
6: reference value “London/SE”
7: reference value “Routine/unskilled”

Table 6: FE Regression - channel cost

	Main			Urgency		
	(1)	**(2)**	**(3)**	**(1')**	**(2')**	**(3')**
Contract	-0.026			0.064		
	(2.52)**			(4.35)***		
conxsoc1		0.124			-0.090	
		(5.23)***			(1.99)**	
conxsoc2		-0.283			-0.091	
		(8.86)***			(1.44)	
conxsoc3		-0.241			0.021	
		(5.44)***			(0.26)	
conxsoc4		0.074			0.415	
		(2.72)***			(10.26)***	
conxsoc5		-0.299			-0.136	
		(5.45)***			(0.59)	
conxsoc6		-0.022			0.043	
		(1.15)			(1.36)	
conxsoc7		-0.025			0.097	
		(1.24)			(3.71)***	
conxsoc8		0.021			0.044	
		(1.15)			(1.89)*	
conxsoc9		-0.109			0.124	
		(1.96)**			(0.68)	
conxsic1			0.416			0.390
			(4.19)***			(3.07)***
conxsic2			0.086			-0.054
			(1.12)			(0.17)
conxsic3			-0.407			-0.201
			(11.83)***			(2.57)**
conxsic4			-0.285			-0.243
			(4.33)***			(1.08)
conxsic5			-0.007			-0.000
			(0.04)			(0.00)
conxsic6			-0.182			-0.063
			(4.57)***			(1.09)
conxsic7			-0.269			-0.787
			(2.50)**			(3.48)***
conxsic8			0.016			0.286
			(0.46)			(4.94)***
conxsic9			0.024			0.081
			(2.05)**			(5.07)***
Workers' character.:						
female	0.004	-0.001	0.007	-0.050	-0.082	-0.040
	(0.56)	(0.09)	(1.02)	(4.06)***	(6.58)***	(3.28)***
Age:[1]						
19-24	0.010	0.018	0.020	0.232	0.239	0.304
	(0.63)	(1.05)	(1.22)	(6.41)***	(6.63)***	(7.41)***
25-34	0.035	0.045	0.038	0.248	0.258	0.312
	(2.16)**	(2.68)***	(2.33)**	(6.54)***	(6.90)***	(7.27)***
35-44	0.013	0.017	0.016	0.211	0.180	0.271
	(0.78)	(0.98)	(0.92)	(5.53)***	(4.81)***	(6.32)***
45-54	0.028	0.034	0.028	0.152	0.152	0.216
	(1.45)	(1.69)*	(1.46)	(3.72)***	(3.69)***	(4.71)***
55 and over	0.020	0.046	0.031	0.078	0.099	0.132
	(0.65)	(1.50)	(1.01)	(0.91)	(1.17)	(1.49)
white	-0.090	-0.093	-0.084	-0.130	-0.181	-0.136
	(8.75)***	(8.71)***	(8.32)***	(8.69)***	(9.86)***	(9.16)***
disability	-0.001	-0.009	-0.010	-0.252	-0.386	-0.256

	(0.07)	(0.42)	(0.47)	(5.63)***	(8.02)***	(5.75)***
worker	0.028	0.019	0.019	-0.032	0.003	-0.040
	(3.57)***	(2.54)**	(2.43)**	(2.12)**	(0.20)	(2.63)***
former employee	-0.128	-0.124	-0.133	-0.210	-0.209	-0.198
	(10.02)***	(9.95)***	(10.66)***	(9.97)***	(10.18)***	(9.46)***
Job characteristics:						
Standard recruitment procedures	-0.027	-0.025	-0.016	-0.088	-0.104	-0.094
	(1.59)	(1.50)	(1.00)	(3.29)***	(3.95)***	(3.56)***
SOC:[2]						
soc2	-0.063	0.071	0.006	-0.072	-0.044	-0.043
(operatives/assembly)	(3.42)***	(3.32)***	(0.30)	(2.02)**	(0.86)	(1.11)
soc3	0.073	0.143	0.074	-0.185	-0.231	-0.207
(sales)	(3.51)***	(6.51)***	(3.62)***	(5.05)***	(5.96)***	(5.59)***
soc4	0.292	0.305	0.285	0.308	0.171	0.300
(protect./personal service)	(21.28)***	(19.82)***	(21.12)***	(13.21)***	(6.29)***	(12.99)***
soc5	0.166	0.218	0.115	0.472	0.341	0.294
(craft/skilled service)	(7.55)***	(9.09)***	(5.21)***	(10.17)***	(6.45)***	(4.38)***
soc6	0.317	0.357	0.304	0.291	0.284	0.268
(clerical/secretarial)	(26.88)***	(26.73)***	(26.19)***	(13.95)***	(11.84)***	(12.79)***
soc7	0.726	0.757	0.712	0.695	0.659	0.681
(assoc. profess./technical)	(56.81)***	(53.11)***	(56.48)***	(33.10)***	(27.47)***	(32.55)***
soc8	0.662	0.679	0.638	0.545	0.524	0.524
(professional)	(43.58)***	(39.13)***	(42.26)***	(22.76)***	(18.90)***	(21.74)***
soc9	0.715	0.743	0.688	0.575	0.603	0.563
(managers/admin.)	(33.90)***	(32.99)***	(32.84)***	(13.98)***	(13.93)***	(13.80)***
hourpay	0.006	0.006	0.007	0.026	0.026	0.027
	(4.00)***	(4.01)***	(4.53)***	(11.33)***	(11.02)***	(11.78)***
supervision task	0.046	0.053	0.057	0.044	0.019	0.050
	(4.71)***	(5.40)***	(5.84)***	(2.81)***	(1.22)	(3.19)***
urgency				0.040	0.045	0.029
				(2.90)***	(3.34)***	(2.10)**
Constant	-5.397	-5.454	-5.417	-5.335	-5.233	-5.382
	(133.91)***	(134.47)***	(136.93)***	(87.18)***	(81.62)***	(84.45)***
Observations	6994	6994	6994	3355	3355	3355
Adjusted R-squared	0.86	0.87	0.87	0.92	0.93	0.92

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

1: reference value “16-18”
2: reference value “Routine/unskilled”

Table 7: OLS Regression - channel speed

	Main			Urgency		
	(1)	(2)	(3)	(1')	(2')	(3')
Contract	0.163			0.217		
	(11.07)***			(8.97)***		
conxsoc1		0.254			0.377	
		(5.35)***			(5.58)***	
conxsoc2		0.137			0.265	
		(6.21)***			(6.41)***	
conxsoc3		0.206			0.266	
		(4.97)***			(3.63)***	
conxsoc4		-0.007			0.227	
		(0.12)			(2.81)***	
conxsoc5		0.314			0.097	
		(4.59)***			(0.55)	
conxsoc6		0.217			0.172	
		(7.10)***			(3.59)***	
conxsoc7		0.058			0.049	
		(0.76)			(0.52)	
conxsoc8		0.067			0.031	
		(0.72)			(0.33)	
conxsoc9		-0.459			0.021	
		(2.49)**			(0.04)	
conxsic1			0.282			0.216
			(3.30)***			(1.37)
conxsic2			-0.334			0.253
			(6.08)***			(2.73)***
conxsic3			0.127			0.148
			(4.41)***			(2.95)***
conxsic4			0.286			0.449
			(9.45)***			(8.75)***
conxsic5			0.039			0.247
			(0.20)			(0.65)
conxsic6			0.207			0.296
			(6.36)***			(4.95)***
conxsic7			0.138			0.202
			(2.37)**			(2.27)**
conxsic8			0.213			0.219
			(7.30)***			(5.22)***
conxsic9			-0.036			0.021
			(0.63)			(0.33)
Workers' character.:						
female	0.037	0.042	0.056	0.060	0.053	0.068
	(2.89)***	(3.30)***	(4.43)***	(3.01)***	(2.65)***	(3.42)***
Age:[1]						
19-24	0.085	0.083	0.091	0.285	0.289	0.292
	(3.72)***	(3.60)***	(4.03)***	(8.73)***	(8.72)***	(8.98)***
25-34	0.141	0.144	0.137	0.324	0.340	0.324
	(5.99)***	(6.09)***	(5.92)***	(9.25)***	(9.62)***	(9.24)***
35-44	0.129	0.128	0.128	0.340	0.346	0.328
	(5.11)***	(5.09)***	(5.15)***	(9.00)***	(9.14)***	(8.67)***
45-54	0.182	0.174	0.176	0.357	0.378	0.349
	(5.75)***	(5.42)***	(5.66)***	(7.54)***	(7.88)***	(7.42)***
55 and over	0.190	0.193	0.184	0.241	0.210	0.264
	(2.96)***	(3.01)***	(2.91)***	(1.57)	(1.37)	(1.72)*
white	0.033	0.030	0.024	0.044	0.031	0.044
	(1.62)	(1.46)	(1.18)	(1.32)	(0.91)	(1.31)
disability	0.070	0.068	0.059	-0.235	-0.217	-0.200

	(1.33)	(1.31)	(1.14)	(2.48)**	(2.28)**	(2.12)**
worker	0.005	0.007	0.008	0.071	0.073	0.082
	(0.44)	(0.57)	(0.64)	(3.40)***	(3.48)***	(3.97)***
former employee	0.014	0.017	0.028	0.017	0.037	0.041
	(0.54)	(0.65)	(1.11)	(0.48)	(1.01)	(1.14)
Firms' character.:						
sic2	-0.199	-0.196	-0.012	-0.154	-0.150	-0.145
(metals/minerals)	(4.28)***	(4.22)***	(0.22)	(2.54)**	(2.45)**	(2.21)**
sic3	0.119	0.125	0.139	0.010	0.002	0.035
(metal goods/engineer.)	(2.91)***	(3.05)***	(3.06)***	(0.19)	(0.03)	(0.61)
sic4	0.149	0.153	0.114	0.043	0.034	-0.046
(other manufacturing)	(3.63)***	(3.72)***	(2.47)**	(0.77)	(0.61)	(0.76)
sic5	0.077	0.087	0.136	0.127	0.163	0.132
(construction)	(0.86)	(0.98)	(1.36)	(0.77)	(0.99)	(0.72)
sic6	0.121	0.127	0.120	0.044	0.056	0.013
(distrib./catering)	(2.90)***	(3.04)***	(2.59)***	(0.79)	(1.00)	(0.22)
sic7	0.079	0.103	0.100	-0.019	-0.030	0.001
(transport/commun.)	(1.64)	(2.07)**	(1.65)*	(0.28)	(0.42)	(0.02)
sic8	0.023	0.021	0.030	-0.047	-0.041	-0.051
(banking/insurance)	(0.58)	(0.53)	(0.67)	(0.87)	(0.76)	(0.90)
sic9	0.138	0.154	0.163	-0.020	-0.006	-0.002
(other services)	(3.28)***	(3.66)***	(3.52)***	(0.35)	(0.11)	(0.03)
N° employees in UK:[2]						
100-200	-0.105	-0.107	-0.123	-0.251	-0.258	-0.250
	(2.31)**	(2.37)**	(2.76)***	(3.58)***	(3.66)***	(3.60)***
200-500	0.019	0.023	0.018	-0.109	-0.112	-0.090
	(0.49)	(0.60)	(0.46)	(1.93)*	(1.96)**	(1.59)
500-1000	-0.036	-0.038	-0.047	-0.079	-0.089	-0.068
	(0.95)	(1.02)	(1.25)	(1.33)	(1.49)	(1.16)
1000-2000	0.030	0.035	0.004	-0.028	-0.033	-0.047
	(0.78)	(0.92)	(0.09)	(0.46)	(0.54)	(0.79)
2000-5000	-0.057	-0.064	-0.054	-0.195	-0.195	-0.201
	(1.51)	(1.69)*	(1.45)	(3.20)***	(3.21)***	(3.31)***
5000-10000	-0.061	-0.068	-0.071	-0.132	-0.127	-0.128
	(1.62)	(1.81)*	(1.92)*	(2.30)**	(2.21)**	(2.25)**
10000-50000	-0.033	-0.025	-0.034	-0.127	-0.129	-0.134
	(0.89)	(0.68)	(0.93)	(2.24)**	(2.26)**	(2.38)**
50000-100000	-0.098	-0.092	-0.098	-0.201	-0.194	-0.201
	(2.42)**	(2.27)**	(2.44)**	(3.19)***	(3.07)***	(3.20)***
≥100000	-0.076	-0.080	-0.048	-0.056	-0.061	-0.063
	(1.89)*	(1.99)**	(1.21)	(0.85)	(0.87)	(0.95)
N° employees in the establishment	-0.000	-0.000	-0.000	0.000	0.000	0.000
	(1.64)	(0.90)	(1.90)*	(1.40)	(1.35)	(1.07)
(N° employees)^2	0.000	0.000	0.000	-0.000	-0.000	-0.000
	(2.31)**	(1.56)	(2.70)***	(1.24)	(1.32)	(0.89)
Production intensity:[3]						
at full capacity	0.063	0.073	0.071	0.057	0.063	0.070
	(1.35)	(1.56)	(1.54)	(1.02)	(1.13)	(1.25)
somewhat below f.c.	0.084	0.098	0.096	0.106	0.111	0.127
	(1.75)*	(2.05)**	(2.03)**	(1.83)*	(1.90)*	(2.17)**
considerably below f.c.	0.109	0.117	0.127	0.114	0.104	0.135
	(1.79)*	(1.92)*	(2.11)**	(1.26)	(1.14)	(1.50)
Production trend:[4]						
expanding slowly	0.110	0.105	0.084	0.054	0.039	0.040
	(6.88)***	(6.51)***	(5.17)***	(2.11)**	(1.50)	(1.56)
stable	0.124	0.118	0.100	0.076	0.071	0.068
	(8.24)***	(7.87)***	(6.69)***	(3.19)***	(2.95)***	(2.86)***
contracting slowly	0.032	0.032	0.005	-0.047	-0.048	-0.053

	(1.61)	(1.64)	(0.25)	(1.43)	(1.47)	(1.64)
contracting fast	0.055	0.052	0.060	-0.090	-0.091	-0.081
	(1.39)	(1.30)	(1.53)	(1.32)	(1.34)	(1.20)
changeble	0.179	0.208	0.180	0.122	0.121	0.113
	(5.82)***	(6.51)***	(5.86)***	(2.62)***	(2.52)**	(2.42)**
workforce is:[5]						
1	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
2	-0.159	-0.171	-0.096	0.106	0.107	-0.062
	(1.89)*	(2.03)**	(1.15)	(0.38)	(0.38)	(0.22)
3= satisfactory	0.092	0.071	0.132	-0.190	-0.171	-0.273
	(1.15)	(0.89)	(1.67)*	(0.69)	(0.62)	(0.99)
4	-0.093	-0.118	-0.046	-0.355	-0.351	-0.447
	(1.17)	(1.49)	(0.59)	(1.29)	(1.27)	(1.62)
5	-0.089	-0.118	-0.057	-0.211	-0.203	-0.304
	(1.16)	(1.52)	(0.76)	(0.77)	(0.74)	(1.11)
6	-0.019	-0.035	-0.005	-0.195	-0.201	-0.312
	(0.24)	(0.46)	(0.07)	(0.71)	(0.73)	(1.14)
7= major strenght	-0.048	-0.072	-0.021	-0.201	-0.203	-0.297
	(0.63)	(0.94)	(0.28)	(0.74)	(0.74)	(1.09)
Region:[6]						
South West	0.127	0.120	0.140	-0.040	-0.036	-0.031
	(5.03)***	(4.66)***	(5.60)***	(1.03)	(0.95)	(0.81)
West Mids	0.058	0.065	0.056	-0.049	-0.032	-0.060
	(2.75)***	(3.04)***	(2.71)***	(1.41)	(0.89)	(1.72)*
E Mids/East	0.060	0.056	0.059	0.015	0.031	0.010
	(3.33)***	(3.07)***	(3.34)***	(0.52)	(0.99)	(0.32)
York/Humber	-0.093	-0.090	-0.072	0.027	0.038	0.009
	(3.69)***	(3.55)***	(2.90)***	(0.66)	(0.90)	(0.23)
North West	0.120	0.128	0.137	0.061	0.059	0.064
	(5.37)***	(5.65)***	(6.22)***	(1.93)*	(1.85)*	(2.03)**
North	0.037	0.052	0.023	-0.036	-0.031	-0.031
	(1.46)	(2.00)**	(0.91)	(0.90)	(0.77)	(0.79)
Wales	-0.054	-0.048	-0.021	-0.099	-0.072	-0.085
	(1.24)	(1.10)	(0.48)	(1.20)	(0.88)	(1.04)
Scotland	0.109	0.117	0.117	-0.007	0.013	0.013
	(4.24)***	(4.50)***	(4.59)***	(0.18)	(0.34)	(0.34)
Job characteristics:						
Standard recruitment procedures	-0.076 (3.25)***	-0.072 (3.10)***	-0.080 (3.49)***	-0.095 (2.83)***	-0.080 (2.38)**	-0.081 (2.42)**
SOC:[7]						
soc2	0.003	0.039	0.033	-0.022	0.014	-0.036
(operatives/assembly)	(0.13)	(1.27)	(1.27)	(0.55)	(0.26)	(0.89)
soc3	-0.182	-0.165	-0.172	-0.263	-0.213	-0.243
(sales)	(6.56)***	(5.30)***	(6.21)***	(6.62)***	(4.55)***	(6.07)***
soc4	-0.253	-0.179	-0.223	-0.351	-0.295	-0.321
(protect./personal service)	(8.06)***	(4.80)***	(7.10)***	(6.88)***	(4.50)***	(6.17)***
soc5	-0.278	-0.275	-0.265	-0.359	-0.288	-0.363
(craft/skilled service)	(8.59)***	(7.59)***	(8.21)***	(7.48)***	(5.32)***	(7.45)***
soc6	-0.255	-0.238	-0.259	-0.358	-0.285	-0.359
(clerical/secretarial)	(9.86)***	(8.00)***	(9.98)***	(9.24)***	(6.09)***	(9.23)***
soc7	-0.484	-0.452	-0.479	-0.497	-0.421	-0.497
(assoc. profess./technical)	(15.67)***	(13.36)***	(15.70)***	(11.43)***	(8.40)***	(11.49)***
soc8	-0.626	-0.602	-0.631	-0.556	-0.485	-0.555
(professional)	(18.85)***	(16.85)***	(19.14)***	(11.56)***	(9.03)***	(11.59)***
soc9	-0.561	-0.518	-0.560	-0.588	-0.522	-0.592
(managers/admin.)	(14.01)***	(12.21)***	(14.16)***	(10.81)***	(8.74)***	(10.91)***
hourpay	0.000	0.001	0.003	-0.002	-0.001	-0.003
	(0.19)	(0.45)	(1.18)	(0.55)	(0.48)	(1.04)

supervision task	0.052	0.040	0.048	-0.016	-0.020	0.005
	(2.56)**	(1.98)**	(2.42)**	(0.57)	(0.69)	(0.18)
urgency				0.077	0.080	0.061
				(4.32)***	(4.30)***	(3.41)***
Constant	5.350	5.320	5.299	5.510	5.430	5.596
	(48.50)***	(48.25)***	(48.05)***	(18.43)***	(18.11)***	(18.81)***
Observations	3053	3053	3053	1220	1220	1220
Adjusted R-squared	0.49	0.50	0.51	0.57	0.57	0.58

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

1: reference value “16-18”
2: reference value “<100”
3: reference value “Overloaded”
4: reference value “Expanding fast”
5: reference value “0= Major constraint on activities”
6: reference value “London/SE”
7: reference value “Routine/unskilled”

Table 8: FE Regression - channel speed

	Main			Urgency		
	(1)	**(2)**	**(3)**	**(1')**	**(2')**	**(3')**
Contract	0.011			-0.026		
	(1.49)			(2.93)***		
conxsoc1		-0.003			0.072	
		(0.19)			(2.59)***	
conxsoc2		0.116			-0.062	
		(4.83)***			(1.59)	
conxsoc3		0.095			-0.009	
		(2.85)***			(0.17)	
conxsoc4		0.019			0.114	
		(0.91)			(4.60)***	
conxsoc5		0.139			-0.397	
		(3.37)***			(2.83)***	
conxsoc6		0.064			0.030	
		(4.52)***			(1.56)	
conxsoc7		-0.043			-0.027	
		(2.79)***			(1.68)*	
conxsoc8		-0.040			-0.100	
		(2.96)***			(6.99)***	
conxsoc9		-0.048			-0.055	
		(1.15)			(0.50)	
conxsic1			1.037			0.204
			(14.16)***			(2.66)***
conxsic2			0.137			0.162
			(2.42)**			(0.86)
conxsic3			0.082			-0.016
			(3.24)***			(0.33)
conxsic4			0.267			0.007
			(5.49)***			(0.05)
conxsic5			0.159			0.107
			(1.04)			(0.40)
conxsic6			0.070			0.060
			(2.39)**			(1.71)*
conxsic7			0.133			0.061
			(1.68)*			(0.45)
conxsic8			0.045			0.133
			(1.78)*			(3.81)***
conxsic9			-0.031			-0.043
			(3.59)***			(4.48)***
Workers' character.:						
female	0.025	0.027	0.021	0.029	0.023	0.032
	(4.57)***	(4.91)***	(4.02)***	(3.92)***	(2.95)***	(4.35)***
Age:[1]						
19-24	0.048	0.067	0.038	0.093	0.118	0.147
	(3.93)***	(5.32)***	(3.20)***	(4.26)***	(5.36)***	(5.93)***
25-34	0.063	0.084	0.050	0.095	0.121	0.151
	(5.13)***	(6.54)***	(4.16)***	(4.18)***	(5.33)***	(5.82)***
35-44	0.065	0.088	0.054	0.090	0.106	0.145
	(5.11)***	(6.62)***	(4.35)***	(3.95)***	(4.62)***	(5.60)***
45-54	0.034	0.060	0.024	0.011	0.052	0.069
	(2.36)**	(3.94)***	(1.72)*	(0.44)	(2.06)**	(2.50)**
55 and over	0.107	0.125	0.080	0.136	0.184	0.194
	(4.67)***	(5.40)***	(3.60)***	(2.62)***	(3.54)***	(3.63)***
white	-0.003	0.004	0.000	0.010	-0.016	0.009
	(0.40)	(0.48)	(0.02)	(1.10)	(1.44)	(1.05)
disability	0.011	0.018	0.020	0.146	0.159	0.163

	(0.68)	(1.12)	(1.25)	(5.41)***	(5.43)***	(6.07)***
worker	-0.002	0.001	0.003	0.060	0.066	0.061
	(0.35)	(0.23)	(0.45)	(6.64)***	(7.16)***	(6.69)***
former employee	0.040	0.037	0.039	0.068	0.060	0.065
	(4.22)***	(3.93)***	(4.27)***	(5.33)***	(4.80)***	(5.15)***
Job characteristics:						
Standard recruitment procedures	-0.038	-0.039	-0.044	-0.016	-0.007	-0.016
	(3.09)***	(3.13)***	(3.65)***	(1.00)	(0.42)	(0.97)
SOC:[2]						
soc2	0.040	-0.000	0.019	0.022	0.091	0.021
(operatives/assembly)	(2.91)***	(0.02)	(1.39)	(1.02)	(2.92)***	(0.91)
soc3	-0.079	-0.091	-0.071	0.030	0.063	0.044
(sales)	(5.05)***	(5.47)***	(4.68)***	(1.38)	(2.66)***	(1.97)**
soc4	-0.190	-0.191	-0.187	-0.287	-0.305	-0.284
(protect./personal service)	(18.60)***	(16.44)***	(18.81)***	(20.47)***	(18.41)***	(20.34)***
soc5	-0.227	-0.232	-0.214	-0.232	-0.200	-0.225
(craft/skilled service)	(13.87)***	(12.84)***	(13.16)***	(8.32)***	(6.20)***	(5.54)***
soc6	-0.172	-0.183	-0.171	-0.233	-0.208	-0.231
(clerical/secretarial)	(19.58)***	(18.13)***	(19.87)***	(18.62)***	(14.21)***	(18.24)***
soc7	-0.392	-0.380	-0.386	-0.440	-0.422	-0.437
(assoc. profess./technical)	(41.19)***	(35.32)***	(41.40)***	(34.85)***	(28.82)***	(34.54)***
soc8	-0.399	-0.376	-0.385	-0.407	-0.349	-0.398
(professional)	(35.24)***	(28.72)***	(34.52)***	(28.31)***	(20.64)***	(27.29)***
soc9	-0.394	-0.375	-0.385	-0.403	-0.345	-0.399
(managers/admin.)	(25.07)***	(22.05)***	(24.87)***	(16.31)***	(13.06)***	(16.17)***
hourpay	-0.001	-0.002	-0.001	-0.005	-0.007	-0.005
	(0.73)	(1.33)	(0.67)	(3.48)***	(4.76)***	(3.37)***
supervision task	-0.014	-0.025	-0.021	-0.018	-0.032	-0.026
	(1.85)*	(3.36)***	(2.91)***	(1.92)*	(3.29)***	(2.73)***
urgency				0.029	0.021	0.024
				(3.59)***	(2.62)***	(2.84)***
Constant	5.642	5.629	5.649	5.452	5.438	5.389
	(187.92)***	(184.04)***	(193.21)***	(148.19)***	(138.97)***	(139.92)***
Observations	6994	6994	6994	3355	3355	3355
Adjusted R-squared	0.85	0.85	0.86	0.93	0.93	0.93

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

1: reference value “16-18”
2: reference value “Routine/unskilled”

Atypical Contracts and Labor Productivity: Positive or Negative? Research Project

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Abstract

Since the 1980s, many European countries have implemented labor market reforms, affecting mainly the use of fixed-term contracts and temporary-help agencies. This paper develops a matching model with heterogeneous agents in order to analyse the impact of flexible employment contracts on labor productivity. Several channels affects productivity: on one hand, flexible contracts reduce mismatching: low productive jobs are destroyed at no cost with a positive impact on the overall productivity. On the other hand, they imply lower human capital investment, reducing the labor productivity. This paper analyze a third channel: the selection of the employees. Low costs of dismissal reduce the incentive of firms to invest in screening applicants, therefore increasing the uncertainty about their unobserved skills and productivity. The firm is allowed to choose both the type of employment contract and the depth of screening. The model is calibrated and simulated. An economy with only permanent jobs is compared with an economy with both short-term and permanent workers.

JEL codes: C68, E27, J41, J63.
Keywords: Fixed-term contracts, General equilibrium, Heterogeneous agents.

1 Introduction

Since the 1980s, many European countries have implemented labor market reforms, affecting mainly the use of fixed-term contracts and temporary-help agencies. The idea behind this process is twofold: on one hand, labor market rigidities are regarded as the culprit of the poor dynamic of employment in Europe as opposed to US. Furthermore, it is claimed that rigidities hinder the adjustment of workforce to shocks and, therefore, are a burden on the competitiveness of the European economy.

There's a wide literature on the effects of labor market reforms. It focus mainly on labor market outcomes: unemployment level (see Ljungqvist (2002) for a survey) and duration (Guell (2002)), transition to permanent employment (Booth, Francesconi and Frank (2002), Guell and Petrongolo (2004), etc.). But only few papers study the impact of reforms on output and productivity, through general equilibrium models (see Alonso-Borrego et al. (2005), Aguirregabiria and Alonso-Borrego (2004), Veracierto (2003), Blanchard and Landier (2002)).

This paper develops a matching model with heterogeneous agents in order to analyse the impact of flexible employment contracts on labor productivity. Several channels affects productivity: on one hand, flexible contracts reduce mismatching: low productive jobs are destroyed at no cost with a positive impact on the overall productivity. On the other hand, they imply lower human capital investment, reducing the labor productivity. This paper analyze a third channel: the selection of the employees. Low costs of dismissal reduce the incentive of firms to invest in screening applicants, therefore increasing the uncertainty about their unobserved skills and productivity. The firm is allowed to choose both the type of employment contract and the depth of screening.

- *Motivation:* Productivity is related to unobservable characteristics of the workforce, therefore recruitment phase is important in order to learn the true ability of employees. An alternative is monitoring them and firing bad quality workers.

Ref.: Abowd et al (2002):; Haskel, Hawkes and Pereira (2003); Naypal (2004); Felstead and Gallie (2004); Arulampalam and Booth (1998); Felstead et al. (2001)

2 Model

In this section I present a stochastic job matching model with endogenous job advertising cost. This model is an extension of the matching model developed by Pries (2004) and Pries and Rogerson (2005).

Jobs and workers have many unobservable characteristics that can influence the productivity of the job match. Firms and workers learn about the true quality of the match through the selection process, before forming the match, and on-the-job, through monitoring.

When a worker and a firm meet, each receives the same signal π that correspond to the probability that the match will be good if it is formed. The realization π is a drawing from a known probability distribution $H(\pi)$. Low realization of π may be rejected because of the prospect of a better job match in the future. In the standard matching model, the reservation rule determines whether the job should continue of not after a shock. In this model, the reservation rule determines whether a job should start or not after a meeting. Then, if the match is formed, the worker and the firm enquire further about its quality inferring from the observed output y.

In Pries and Rogerson (2005), firms choose optimally the reservation probability $\bar{\pi}$ and form a match only with those workers characterized by higher π. Pries and Rogerson shows that firms may be more selective depending on different labor market regulations; for istance the reservation probability $\bar{\pi}$ increases with dismissal costs. In their model, the choice of the hiring policy affects the probability to form a match and the expected output of the match but is not related with the cost of posting vacancies. The innovation of this paper is in making the cost of advertising a vacancy endogenous: firms choose how much to invest in recruitment practices in order to better screen applicants and to increase the expected quality of the match.

Furthermore, a model with two types of contracts, permanent and temporary, is developed and compared with the benchmark model.

2.1 Baseline framework: Pries and Rogerson (2005)

2.1.1 HOUSEHOLDS:

There is a continuoum of identical households with total mass equal to one and their preferences are characterized by the following intertemporal utility function:

$$\sum_{t=0}^{\infty} \beta^t (c_t - a n_t)$$

where β is a discount factor, c_t is consumption, $n_t \in [0,1]$ is time spent working, and a represents the disutility of working.

During their infinite life, they have to decide how much to work and how much to consume, according to their budget constraint:

$$\max_{c,n} E_0 \sum_{t=0}^{\infty} \beta^t (c_t - a n_t)$$
$$s.t.\ c_t \leq w_t$$

2.1.2 FIRMS:

There is a continuoum of identical firms with preferences:

$$\sum_{t=0}^{\infty} \beta^t (c_t - k_v v_t)$$

where $k_v \in [0,1]$ is the recruitment cost per vacancy posted, and v_t is the number of vacancies posted in period t..

Each firm holds one job which produce y_t. If the job position is unfilled, the enterpreneur decides whether to post a vacancy, v_t. If a worker is hired, h_t, she will produce y_t and will receive the wage w_t. At the end of each period the worker-enterpreneur pair observed the output and decides whether to continue the employment relationship or to separate, d_{t+1}. Furthermore, jobs can be destroyed by idiosyncratic shocks that occurs at the beginning of each following period with probability λ. The firm's problem is summarized in the following equations:

$$\max_{v_t, d_t, k_v} E_0 \sum_{t=0}^{\infty} \beta^t \left[(y_t - w_t) n_t - k_v v_t \right]$$
$$s.t.\ n_t = n_{t-1} + h_t - d_t$$

2.1.3 LABOR MARKET:

Labor market is characterized by frictions, in the spirit of Mortensen and Pissarides (1994), and by incomplete information, as in Jovanovic (1979). Firms with posted vacancies, v, and unemployed households[1], u, meet

[1] In this model there is no on the job search.

in the labor market at a frequency determined by the function $m(v,u)$.[2] The probabilities that a firm meets a worker and that a worker meets a firm are, respectively, q and p:

$$\begin{aligned} q_t &= \frac{m(v_t,u_t)}{v_t} \\ p_t &= \frac{m(v_t,u_t)}{u_t} \end{aligned}$$

But not all contacts will lead to job matches. Here, production is characterized by stochasticity: jobs and workers have many unobservable characteristics that can influence the productivity of the job match. The match can be either good, and produce y^g, or bad, y^b. When a worker and a firm meet, each receives the same signal π - drawn from a distribution $H(\pi)$ with support $[0,1]$ - that correspond to the probability that the match will be good if it is formed; then, if the expected productivity is high enough, the match is formed. Therefore there will be a threshold level $\bar{\pi}$ which discriminate match formation and match destruction.

Once the match is formed and production is carried on, both firm and worker observe the output y, which is an imperfect signal of the true quality of the match. Following Pries (2004), they assume that

$$y = \bar{y} + \varepsilon$$

where $\bar{y}$ is the true match quality, y^g or y^b, and ε is a noise uniformly distributed on $[-\omega,\omega]$. Therefore, whenever y is lower than $y^g-\omega$, or higher than $y^b+\omega$, the quality of the match is revealed to be bad or good, respectively. Call $\alpha = \frac{y^g-y^b}{2\omega}$ the probability that a match type is revealed.

Jobs are destroyed either because the match is revealed to be bad, with probability $\alpha(1-\pi)$, either because they are hit by a negative exogenous shock, wich follows a Poisson process with arrival rate λ.[3]

The surplus produced by each match is splitted through wage setting, in a Nash barganing solution where the worker's share is δ.

VALUE FUNCTIONS:

1. *Asset values for firms:*

Call $J_e(\pi)$ the value to the firm of being in a match associated with a signal π; and J_u the value to the firm of an unfilled vacancy. They are defined by the flow of expected profits yield, respectively, by a filled or an ufilled employment position.

$$\begin{aligned} J_e(\pi) &= \max\left\{ \begin{array}{c} J_u, \pi y^g + (1-\pi) y^b - w_0(\pi) + \beta(1-\lambda) \\ \left[\alpha\pi J_e(1) + \alpha(1-\pi) J_u + (1-\alpha) J_e(\pi)\right] \end{array} \right\} \\ J_u &= -k_v + \beta\left[q\int J_e(\pi)\, dH(\pi) + (1-q) J_u\right] \end{aligned}$$

[2] It is standard to assume that $m(\cdot,\cdot)$ is of constant return to scale with positive first-order and negative second-order partial derivatives. See Petrongolo and Pissarides (2000) for a detailed discussion and empirical evidence.

[3] For analytical convenience, they assume that an unfilled employment postion never becomes unproductive.

2. *Asset values for workers:*

Let $V_e(\pi)$, be the value to the worker of being in a match; and V_u the value to the worker of being unemployed.

$$\begin{aligned} V_e(\pi) &= \max \left\{ \begin{array}{c} V_u, w_0(\pi) - a + \beta(1-\lambda) \\ \left[\alpha\pi V_e(1) + \alpha(1-\pi)V_u + (1-\alpha)V_e(\pi)\right] + \beta\lambda V_u \end{array} \right\} \\ V_u &= \beta\left[p\int V_e(\pi)\,dH(\pi) + (1-p)V_u\right] \end{aligned}$$

EQUILIBRIUM:
Consider equilibria such that:

1. **employment position are created** –> sufficient condition $J_e > J_u$ when $q = 1$
2. **bad matches are terminated** –> sufficient condition $y^b \leq a$

CHARACTERIZING EQUATIONS:

- Optimal match formation curve: MF is upward sloping in $\bar{\pi} - \theta$ space.

  The match is formed only if the surplus $S(\pi)$ is positive, i.e. if the signal is higher than the threshold $\bar{\pi}$

$$S(\bar{\pi}) = 0 \to \frac{v}{u}\frac{\delta}{1-\delta}k_v = y^b - a + + \left[1 - \beta(1-\lambda)(1-\alpha)\right] g(\bar{\pi})\,\bar{\pi} \tag{1}$$

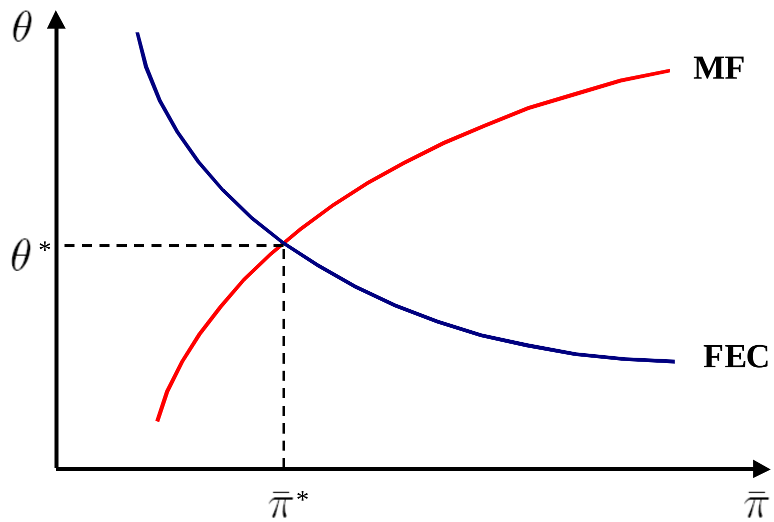
$$g(\bar{\pi}) = \frac{y^g - y^b}{1 - \beta(1-\lambda)(1-\alpha\bar{\pi})} \quad \text{slope of } S(\bar{\pi})$$

- Free entry condition: FEC is downward sloping in the space $\bar{\pi} - \theta$.

  Firms post vacancies as long as its value is positive. Competition ensure that, in equilibrium, the value of a vacant position is null.

$$J_u = 0 \to k_v = \beta q(1-\delta)\,g(\bar{\pi})\int_{\bar{\pi}}^{1}(\pi - \bar{\pi})\,dH(\pi) \tag{2}$$

Equilibrium is defined by the intersection of the two curves.



2.2 Extension:

In this model, if employers want to be more selective, i.e they want to increase the threshold level $\bar{\pi}$, they have to invest more in the recruitment process:

$$k_v = k_v(\bar{\pi}) \quad k_v'(\bar{\pi}) > 0 \quad k_v''(\bar{\pi}) \geq 0$$

The intuition is that, in order to receive better applicants, the firm has to exert more effort in advertising the job.

To ease the analytical solution, I simplify the positive relationship between k_v and $\bar{\pi}$ into a linear function: $k_v = k\bar{\pi}$.

2.2.1 BENCHMARK

In the benchmark model, only permanent employment contracts are allowed and separations imply the payment of dismissal costs.Those costs, k_d, are not transferred to the worker, but they are wasted resources. Therefore, they do not affect the household's problem, but only the firm's problem:

$$\max_{v_t, d_t, k_v} E_0 \sum_{t=0}^{\infty} \beta^t \left[(y_t - w_t) n_t - k_v(\bar{\pi}) v_t - k_d d_t \right]$$
$$s.t.\ n_t = n_{t-1} + h_t - d_t$$

VALUE FUNCTIONS:

1. *Asset values for firms:*

   Given the existence of firing costs, I need to distinguish between newly formed matches, $I = 0$, and ongoing matches, $I = 1$. In the former case, the firm and the worker have just met and they are deciding whether to form a match. Then the firm is not required to pay dismissal costs in the event that the match is not formed and the outside option is J_u. In the latter, the match has already been formed, therefore dismissal costs are due in case of match destruction, and the outside option turns $J_u - k_d$.

$$\begin{aligned} J_0^P(\pi) &= \max \left\{ \begin{array}{c} J_u^P, \pi y^g + (1-\pi) y^b - w_0^P(\pi) + \beta(1-\lambda) \\ \left[\alpha\pi J_1^P(1) + \alpha(1-\pi) J_1^P(0) + (1-\alpha) J_1^P(\pi)\right] - \beta\lambda k_d \end{array} \right\} \\ J_1^P(\pi) &= \max \left\{ \begin{array}{c} J_u^P - k_d, \pi y^g + (1-\pi) y^b - w_1^P(\pi) + \beta(1-\lambda) \\ \left[\alpha\pi J_1^P(1) + \alpha(1-\pi) J_1^P(0) + (1-\alpha) J_1^P(\pi)\right] - \beta\lambda k_d \end{array} \right\} \\ J_u^P &= -k_v^P + \beta\left[q^P \int J_0^P(\pi)\, dH(\pi) + \left(1-q^P\right) J_u^P\right] \end{aligned}$$

2. *Asset values for workers:*

$$\begin{aligned} V_0^P(\pi) &= \max \left\{ \begin{array}{c} V_u, w_0^P(\pi) - a + \beta(1-\lambda) \\ \left[\alpha\pi V_1^P(1) + \alpha(1-\pi) V_1^P(0) + (1-\alpha) V_1^P(\pi)\right] + \beta\lambda V_u \end{array} \right\} \\ V_1^P(\pi) &= \max \left\{ \begin{array}{c} V_u, w_1^P(\pi) - a + \beta(1-\lambda) \\ \left[\alpha\pi V_1^P(1) + \alpha(1-\pi) V_1^P(0) + (1-\alpha) V_1^P(\pi)\right] + \beta\lambda V_u \end{array} \right\} \\ V_u^P &= \beta\left[p^P \int V_0^P(\pi)\, dH(\pi) + \left(1-p^P\right) V_u\right] \end{aligned}$$

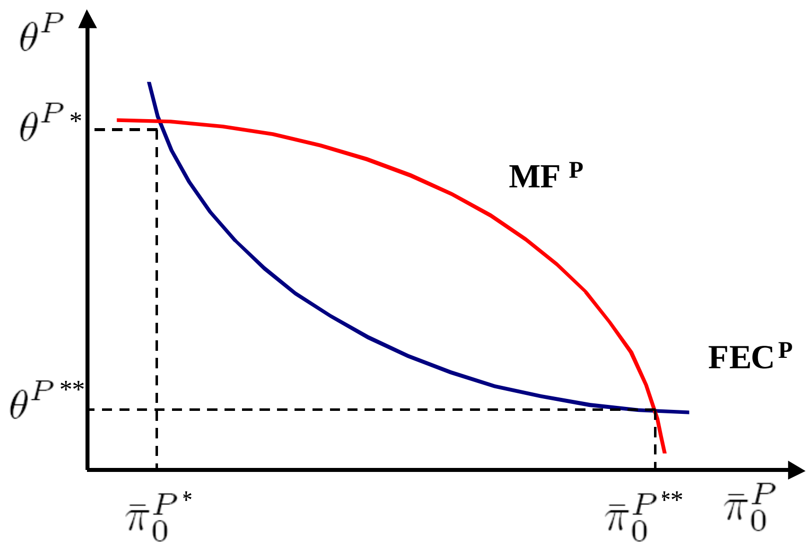
CHARACTERIZING EQUATIONS:

- Optimal match formation curve: MF is downward sloping and concave.

$$\begin{aligned} S_0^P(\pi) &= 0 \rightarrow \frac{v}{u}\frac{\delta}{1-\delta} k_v^P\left(\bar{\pi}_0^P\right) = y^b - a + (1-\beta) k_d + \left[1-\beta(1-\lambda)(1-\alpha)\right]\left[g\left(\bar{\pi}_0^P\right)\bar{\pi}_0^P - k_d\right] && (3) \\ g\left(\bar{\pi}_0^P\right) &= \frac{y^g - y^b + \beta(1-\lambda)\alpha k_d}{1-\beta(1-\lambda)\left(1-\alpha\bar{\pi}_0^P\right)} && (4) \end{aligned}$$

- Free entry condition: FEC is downward sloping in the space $\bar{\pi}_0^P - \theta^P$ and is convex.

$$J_u^P = 0 \rightarrow k_v^P\left(\bar{\pi}_0^P\right) = \beta q (1-\delta)\, g\left(\bar{\pi}_0^P\right) \int_{\bar{\pi}_0^P}^1 \left(\pi - \bar{\pi}_0^P\right) dH(\pi) \quad (5)$$



Given the shape of the curves, two equilibria can arise, i.e. two strategies are available:

1. TURNOVER: high θ^{P**} and low selectivity threshold $\bar{\pi}_0^{P**}$ $\rightarrow$low k_v^{P**}: firms invest low amount in recruiting workers and hire most of the applicants. Therefore the probability to detect a bad worker and to dismiss her, $\alpha\left(1-\bar{\pi}_0^{P**}\right)$, is high; and many vacancies are posted each period. Jobs last short time and are less productive.

2. SCREENING: low θ^{P*} and high selectivity threshold $\bar{\pi}_0^{P*}$ $\rightarrow$ high k_v^{P*}: firms invest high amount in recruiting workers and hire only the applicant with high signal. Then, few workers are dismissed because the probability to detect a bad worker, $\alpha\left(1-\bar{\pi}_0^{P*}\right)$, is low; and a low number of vacancies is issued. Jobs last longer and are more productive.

2.2.2 STATIC ANALYSIS

- *The effect of k_d on $\bar{\pi}_0^P$ and θ*

  MF shifs down-left

  FEC shifts up-right

1. TURNOVER$\rightarrow$TURNOVER: an increase in k_d reduces θ^P and increases $\bar{\pi}_0^P$.

2. SCREENING$\rightarrow$SCREENING: an increase in k_d increases θ^P and lowers $\bar{\pi}_0^P$.

The net effect is ambiguous.

2.2.3 DUAL LABOR MARKET

Now two types of contracts are allowed: permanent and temporary contracts. Temporary arrangements differ from permanent ones by null firing costs and one period duration. Temporary workers may be renewed as permanent at the end of the period.

In this model firms choose which kind of contract to post, while wokers can only choose whether to search for a job or not, but are randomly assigned to one type of contract offer.

Probabilities that a firm meet a worker:[4]

$$
\begin{aligned}
q_t^P &= \frac{m^P\left(v_t^P - \xi\left(1-\lambda\right)T_t, u_t\right)}{v_t^P - \xi\left(1-\lambda\right)T_t} = \frac{m^P\left(x_t^P, u_t\right)}{x_t^P} \\
q_t^T &= \frac{m^T\left(v_t^T, u_t\right)}{v_t^T}
\end{aligned}
$$

Probabilities that a worker meet a vacant job:

$$
\begin{aligned}
p_t^P &= \frac{m^P\left(v_t^P - \xi\left(1-\lambda\right)T_t, u_t\right)}{u_t} \\
p_t^T &= \frac{m^T\left(v_t^T, u_t\right)}{u_t}
\end{aligned}
$$

VALUE FUNCTIONS:

1. *Asset values for firms:*

Before the match is formed, the firm decides whether to post vacancy for a permanent job or a temporary job. Same value functions than before but I have to distinguish between the permanent contracts P and the temporary contracts T

$$
\begin{aligned}
J_0 &= \max\left\{J_0^P\left(\pi\right), J_0^T\left(\pi\right)\right\} \\
J_0^T\left(\pi\right) &= \max\left\{\begin{array}{c} J_u^T, \pi y^g + \left(1-\pi\right)y^b - w_0^T\left(\pi\right) + \beta\left(1-\lambda\right) \\ \left[\alpha\pi J_1^P\left(1\right) + \alpha\left(1-\pi\right)J_1^T\left(0\right) + \left(1-\alpha\right)\max\left\{J_u^T, J_1^P\left(\pi\right)\right\}\right] \end{array}\right\} \\
J_0^P\left(\pi\right) &= \max\left\{\begin{array}{c} J_u^P, \pi y^g + \left(1-\pi\right)y^b - w_0^P\left(\pi\right) + \beta\left(1-\lambda\right) \\ \left[\alpha\pi J_1^P\left(1\right) + \alpha\left(1-\pi\right)J_1^P\left(0\right) + \left(1-\alpha\right)J_1^P\left(\pi\right)\right] - \beta\lambda k_d \end{array}\right\} \\
J_1^T\left(\pi\right) &= \max\left\{\begin{array}{c} J_u^T, \pi y^g + \left(1-\pi\right)y^b - w_1^T\left(\pi\right) + \beta\left(1-\lambda\right) \\ \left[\alpha\pi J_1^P\left(1\right) + \alpha\left(1-\pi\right)J_1^P\left(0\right) + \left(1-\alpha\right)J_1^P\left(\pi\right)\right] - \beta\lambda k_d \end{array}\right\} \\
J_1^P\left(\pi\right) &= \max\left\{\begin{array}{c} J_u^P - k_d, \pi y^g + \left(1-\pi\right)y^b - w_1^P\left(\pi\right) + \beta\left(1-\lambda\right) \\ \left[\alpha\pi J_1^P\left(1\right) + \alpha\left(1-\pi\right)J_1^P\left(0\right) + \left(1-\alpha\right)J_1^P\left(\pi\right)\right] - \beta\lambda k_d \end{array}\right\} \\
J_u^C &= -k_v^C + \beta\left[q^C \int J_0^C\left(\pi\right)dH\left(\pi\right) + \left(1-q^C\right)J_u^C\right] \qquad C = P, T
\end{aligned}
$$

[4] Vacancies posted as a permanent job are filled either with new matches, either through renewal of temporary workers. Call ξ the probability of renewing a temporary worker as a permanent one:
$\xi = \alpha E\left(\pi^T | \pi^T > \bar{\pi}^T\right) + \left(1-\alpha\right)E\left(\pi^T | \pi^T > \max\left\{\bar{\pi}^T; \bar{\pi}^P\right\}\right)$

Note: if the firm post a temporary job, the next period it can choose wheter to dismiss and search for another temporary worker, J_u^T, or renew the actual worker as permanent, $J_1^P(\pi)$.

2. *Asset values for workers:*

   Note that V_u does not depend on the type of contract because I assumed that workers are randomly assigned to either one or the other contract.

$$\begin{aligned} V_I^C(\pi) &= \max \left\{ \begin{array}{c} V_u, w_I^C(\pi) - a + \beta(1-\lambda) \\ \left[\alpha\pi V_1^P(1) + \alpha(1-\pi)V_u + (1-\alpha)\max\left\{V_u; V_1^P(\pi)\right\}\right] + \beta\lambda V_u \end{array} \right\} \\ V_u &= \beta\left[p^T \int V_0^T(\pi)\,dH(\pi) + p^P \int V_0^P(\pi)\,dH(\pi) + \left(1-p^T-p^P\right)V_u\right] \end{aligned}$$

3. **CHOICE OF THE CONTRACT**

   The firm chooses to post a vacancy for the type of contract that maximizes the value of the job:

$$J_0 = \max\left\{J_0^P(\pi), J_0^T(\pi)\right\}$$

which is equivalent to maximes the surplus.
It can be prooved that:

$$S_0^P(\pi) = S_1^T(\pi) < S_0^T(\pi)$$

It follows that all vacancy openings are posted as temporary jobs.

Therefore, firms open vacancies for temporary jobs. Then, if the job has not been destroyed by idiosyncratic shocks,

- if the match is revealed to be bad → the worker is fired
- if the match is revealed to be good → the worker is renewed as permanent
- if the match is still of unknown type → the firm chooses between two strategies:

1. fire the worker and hire a new temporary one;
2. renew the worker as permanent.

CHARACTERIZING EQUATIONS:

1. *MARKET FOR TEMPORARY WORKERS*

- Optimal match formation MF^T is downward sloping and concave

$$S_0^T(\pi) = 0 \tag{6}$$

$$\frac{\delta}{1-\delta} k_v^T\left(\hat{\pi}_0^T\right)\theta^T = y^b - a + \left[1-\beta(1-\lambda)(1-\alpha)\right]\hat{\pi}_0^T g\left(\hat{\pi}_0^T\right) - \beta^2(1-\lambda)(1-\alpha)\left[1-(1-\lambda)\left(1-\alpha+\alpha\hat{\pi}_0^T\right)\right]\alpha k_d \tag{7}$$

- Free entry condition FEC^T is downward sloping

$$J_u^T = 0 \rightarrow k_v^T\left(\hat{\pi}_0^T\right) = \beta(1-\delta) q^T \int_{\hat{\pi}_0^T}^1 \left(\pi - \hat{\pi}_0^T\right) g\left(\hat{\pi}_0^T\right) dH(\pi) \tag{8}$$

- Renewal function RF^T

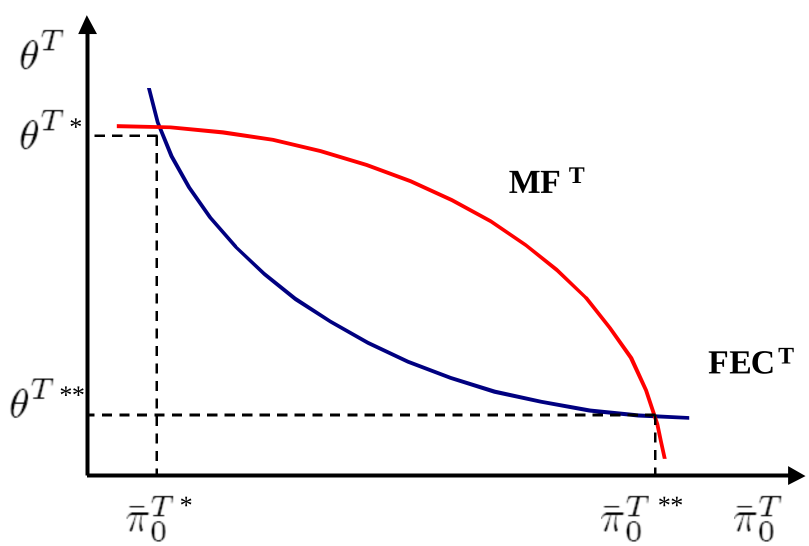
$$S_1^T(\pi) = 0$$

Once I know the equilibrium value of $\hat{\pi}_0^T$ I can derive $\hat{\pi}_1^T$ using the following equality:

$$g\left(\hat{\pi}_0^T\right) = \frac{y^g - y^b - \beta^2(1-\lambda)\left[1-(1-\lambda)(1-\alpha+\alpha\pi)\right]\alpha k_d}{1-\beta(1-\lambda)\left(1-\alpha\hat{\pi}_0^T\right)} = \frac{y^g - y^b}{1-\beta(1-\lambda)\left(1-\alpha\hat{\pi}_1^T\right)} = g\left(\hat{\pi}_1^T\right) \tag{9}$$

2. *MARKET OF PERMANENT WORKERS:*

It can be prooved that all workers renewed as permanent are continued, unless they are detected as bad or the job is destroyed.



Two equilibria means that 2 strategies are available:

1. TURNOVER: high θ^T and low $\hat{\pi}_0^T$ $\rightarrow$ low k_v^T: firms invest low amount in recruiting workers and hire most of the applicants.
2. SCREENING: low θ^T and high $\hat{\pi}_0^T$ $\rightarrow$ low k_v^T: firms invest high amount in recruiting workers and hire only the applicant with high signal

2.2.4 STATIC ANALYSIS

- *The effect of k_d on $\hat{\pi}_0^T$, $\hat{\pi}_1^T$ and θ^T*

  MF shifs down and becomes tighter

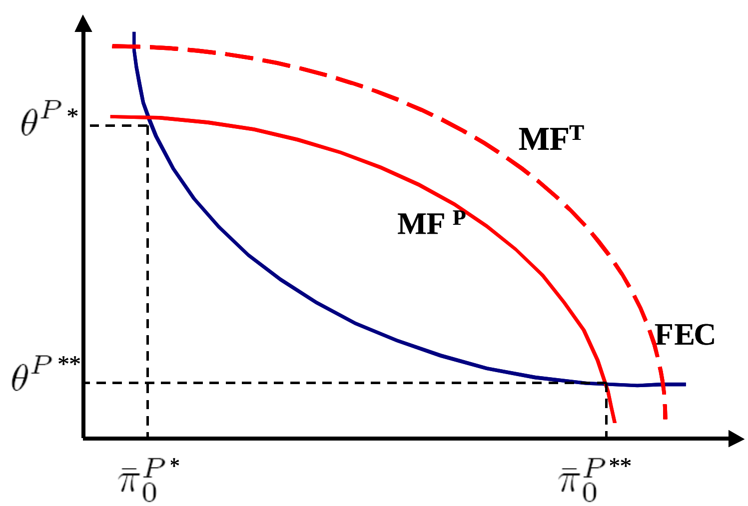
  FEC shifts down-left

1. TURNOVER→TURNOVER: an increase in k_d reduces θ^T and increases $\hat{\pi}_0^T$.
2. SCREENING→SCREENING: an increase in k_d increases θ^T and lowers $\hat{\pi}_0^T$.

$\hat{\pi}_1^T$ is positively correlated with $\hat{\pi}_0^T$, therefore it moves in the same direction.
The net effect is ambiguous.

2.2.5 COMPARE

Comparing the two models I can derive the effects of labor market reforms easing the use of temporary contracts.



The introduction of temporary contracts shift the matching formation curve up, from MF^P to MF^T.

- TURNOVER, TURNOVER: in a dual labor market the threshold signal $\bar{\pi}$ is lower and the market tightness θ is higher than in a market with only permanent contracts: firms post more vacancies and hire workers with lower expected productivity.

- SCREENING, SCREENING: in a dual labor market the threshold signal $\bar{\pi}$ is higher and the market tightness θ is lower than in a market with only permanent contracts: firms post less vacancies and hire workers with higher expected productivity.

The net effect is ambiguous.

3 Work in progress:

- Calibration
- Simulation:
  - simulate the steady state of an economy with only permanent contracts (benchmark) and an economy with both types of contract.
  - compare results.

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