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THE IMPACT OF BENEFIT SANCTIONS ON EQUILIBRIUM WAGE DISPERSION AND JOB VACANCIES

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The impact of benefit sanctions on equilibrium wage dispersion and job vacancies

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Abstract

Usually, the literature on benefit sanctions focuses on the effects on labour supply. In this paper, we integrate commuting costs in an equilibrium job search model with wages posting to analyse the effects of job search monitoring on labour demand. We show that benefit sanctions increase job creation, but degrade the job quality and the average job-productivity. In addition, we emphasise that the optimal UB system is characterised by using both benefit sanctions and the mutualisation of commuting costs.

Keywords: Wage dispersion, Job search, sanctions, Monitoring.
JEL: J31, J63, J68

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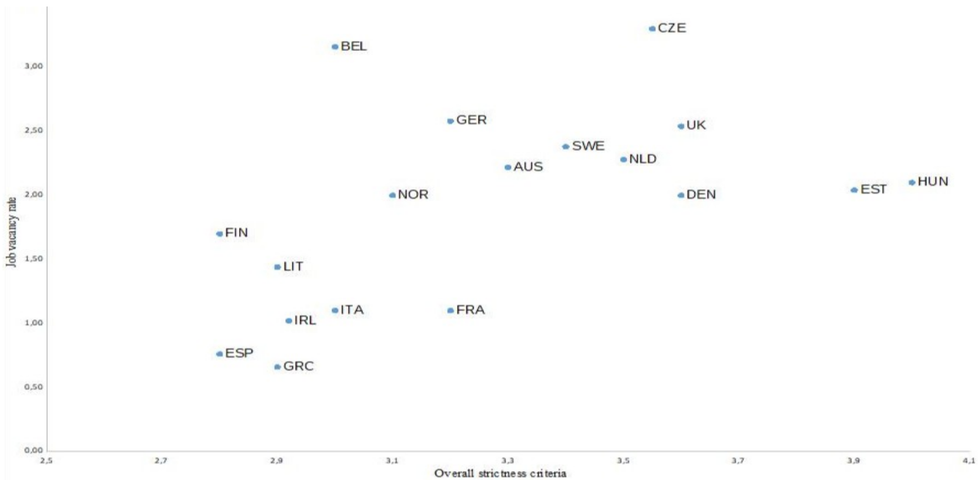
1 Introduction

Public provision of unemployment insurance (UI) reduces the risk of income fluctuations for workers. It is well established that this protection improves both the welfare and the job match quality of risk-averse individuals (Tatsiramos (2014)). However, there is a lot of evidence that UI has disincentive effects. In particular, the presence of moral hazard leads unemployed workers to reduce their search efforts and to be more selective in their job search. This behaviour is causing an increase in unemployment, and governments must find the optimal trade-off between protecting the unemployed and limiting the effects of moral hazard. Several policy instruments are available to public decision makers to provide an optimal UI design: benefit levels, eligibility conditions, the monitoring and sanctions of unemployed workers. The effects of issuing sanctions on the job search of unemployed workers has been analysed by many papers. Our paper contributes to the literature on job search monitoring by introducing firms' reaction to stricter sanctions. For public decision-makers, the introduction of benefit sanctions aims to make the use of vacancies' stock more effective by forcing unemployed workers to accept job offers. Graph 1 presents the job vacancy rate and the level of strictness eligibility criteria (Job-search requirements and penalties for refusal) for 18 European countries. Paradoxically, it appears that the countries whose job vacancy rate is the highest are those where the control of unemployed workers is the strictest. Of course, as Grubb (2001) and Venn (2012) point out, the cross-country comparison of the severity of sanctions is a complicated exercise. Labour market institutions, the behaviour of advisors of the employment agency, or the existence of several job search channels may interfere with the law on the control of unemployed workers. In addition, the job vacancy rate is also influenced by other explanatory factors, such as the educational system or the role of the unions. Nevertheless, we do not observe a lower job vacancy rate in countries introducing benefit sanctions.

In this paper, we argue that stricter monitoring of unemployed workers changes the behaviour of firms' labour demand. We focus especially on the job refusals' issue. This drives us to use a wage posting framework where job vacancies and the wage distribution are endogenous, in line with Mortensen (2000). As a firm does not have an interest in posting a job that will never be filled, we assume that refusals are due to heterogeneous commuting costs for unemployed workers. Thus, only unemployed workers located far from the Central Business District refuse the lowest wages. We show that refusal control reduces the unemployment rate, but this policy encourages firms to post lower wages while running the risk of a higher turnover rate.

The role of commuting costs is well-known in the job search theory literature. Diamond (1981) builds a model by assuming risk-neutral workers and externalities due to mobility costs. These externalities lead to an inefficient equilibrium that can be improved by the introduction of unemployment compensation. In recent years, many papers have focused on the interactions between the labour market and mobility costs (Coulson and al. (2001),

Figure 1: Unemployment benefit sanctions and job vacancy rate



Sources: Eurostat and Langenbucher (2015)

Sato (2004), Wasmer and Zenou (2002), Smith and Zenou (2003)). Zenou (2009) provides an exhaustive presentation of the role of mobility costs in a wage setting. Wasmer and Zenou (2006) propose a model of local labour markets, in which workers' search efficiency is affected negatively by distance to jobs. They argue that the land market and the labour market interact in determining the equilibrium unemployment rate. Rupert and Wasmer (2008) use a model in which a job location has an associated commuting time that affects the job acceptance decision. They show that friction in the housing market has a large role in explaining the unemployment rate when commuting costs are high. In particular, differences in housing friction and commuting costs explain a part of the difference in the unemployment rates between the US and Europe. Rupert, Stancanelli, and Wasmer (2009) analyse the role of commute distance in wages' bargaining. The wage impact of one hour of commute is approximately equal to 29%. Zenou (2011) develops an urban-search model with wage posting and shows that commuting cost affects wages and housing prices. Van den Berg and Gorter (1997) structurally analyse a job-search model by using data from the Netherlands Organisation for Strategic Labour Market Research. They provide evidence of an effect of commuting costs on job search. In particular, they show that mobility costs affect females with children more significantly. A structural estimation of the marginal willingness to pay for commuting is given by Van Ommeren, Van den Berg and Gorter (2000). From Dutch longitudinal data, the average willingness to pay for one hour of commuting is estimated to be approximately half of the hourly wage rate.

Using European data, Rupert, Stancanelli and Wasmer (2009) indicate that the distance to travel to a job is the third reason for rejecting a job offer after the type of work

Table 1: Median distance and commuting time in France

	Median distance (km)	Median commuting time (minutes)
High-skilled workers	9.9	27
Medium-skilled workers	9.7	23
Low-skilled workers	7.1	14

Source: French data DADS 2004, INSEE

Table 2: Strictness of job-search monitoring

	Score	
	Job-search monitoring	For repeated refusals
Denmark	2	5
France	4	2
Germany	2	2.5
Netherlands	4	1
Sweden	1	3
United Kingdom	5	3

Source: Venn (2012)

and the wage. Table 1 reports the median distance and the median commuting time in France. More than half of the high-skilled workers have a commuting distance greater than 9.9 kms. In addition, 73% of French employees do not work in their city of residence. Thus, commuting costs appear to be a determining factor in the decision to either reject or accept a job offer (Baccaïni and al. (2007)). Most UI systems require unemployed workers to accept a job offer when the commuting distance is suitable. In Norway, the unemployed workers have to accept a job anywhere in the country, whereas, in the UK they are required to accept a job with a maximum of two hours' per day of commuting time. In France, after six months, geographical mobility can be required and unemployed workers have to accept jobs located 30 kms from their residence. The commuting time cannot exceed two and a half hours for German workers. Italians must accept any job within a radius of 50 kms. In Sweden, a job is suitable if it implies an absence from home of less than twelve hours. The frequency of controls and the severity of sanctions vary from country to country. Venn (2012) compares the eligibility criteria and the severity of sanctions for many OECD countries. The penalty can range from a reduction of benefits for a few days to a definitive exclusion from the UI. In table 2, we report the indicators of Venn (2012) on the strictness of job search monitoring. The score ranges from 1 for the least strict to 5 for the strictest.

The search monitoring is stricter in the UK and France where the unemployed workers have to provide evidence of their job search activity. Job-refusals' monitoring is stricter in Denmark and the UK, where refusing a job implies a suspension of benefits. In France, unemployed workers are authorised to refuse one job. After the second refusal, unemployment benefits are suspended for two months.

There is a large body of literature on monitoring and sanctions. The starting point of these studies is that unemployment insurance is socially desirable when the workers are risk-averse. Unemployment insurance improves welfare by smoothing consumption (Gruber (1997), Browning and Crossley (2001)). However, more generous unemployment benefits affect the job-finding rate negatively due to the presence of moral hazard. A classic solution to provide incentives to search for a job is to use a declining profile over time. Tatsiramos and Van Ours (2014) and Fredriksson and Holmlund (2006) propose a complete survey. Another solution is to require evidence of job applications and not to allow job refusal. Non-compliance with one of the conditions required by the UI system involves either a temporary or a permanent sanction. The seminal paper of Becker (1968) on crime and punishment argues that the probability of detection and the severity of the sanction give incentives to individuals. The theoretical literature on job-search monitoring points out an ex-ante effect and an ex-post effect (see Ljungqvist and Sargent (1995), Abbring and al. (2005), Boone and van Ours (2006), Van den Berg and Van der Klaauw (2001)). The ex-ante effect is due to deterrence before sanctions are implemented whereas the ex-post effect is explained by the fact that sanctioned unemployed workers attempt to return to work more quickly. Many studies show that introducing monitoring and sanctions improves both the unemployment exit rate and welfare (Van den Berg et al. (2004), Boone et al. (2007), Svarer (2011), Van der Klaauw and Van Ours (2013), Boockmann et al. (2009)). These papers suggest that the size and duration of sanction has a positive effect. McVicar (2008) and Cockx and Dejemeppe (2012) find positive effects of monitoring on the unemployment rate and the job finding rate. This is not the case for Mickelwright and Nagy (2010). Using Swiss data, Arni, Lalive and Van Ours (2013) and Lalive, Van Ours and Zweimuller (2005) find that the effects of receiving a sanction and the effect of receiving a warning letter are similar on the unemployment benefit exit rate and the job-finding rate. Svarer (2011) shows that more severe sanctions have a larger effect on the exit rate. In addition, he finds that the effect of sanctions decreases over the time after the sanctions were imposed. There are a few studies on the ex-ante effect. Jensen and al. (2003) report no evidence of an announcement effect on the transition rates. As shown in the discussion above, the literature on job-search monitoring is focused on the unemployed workers' behaviour. Van den Berg and Vikstrom (2014) estimate the effect of monitoring on wages, but no paper has analysed the effects on job vacancies, wages distribution, and specific capital investments.

Since Burdett and Mortensen (1998) and Mortensen (2000) it is well-known that a wage distribution can be obtained in the presence of homogeneous workers ex-ante. The conjunction of the equilibrium search wage-posting model and of the matching model has led to this result. These theoretical models were confirmed by several non-parametric estimations (In particular see Bontemps and al. (2000) and Postel-Vinay and Robin (2002)). More recently, Hornstein, Krusell, and Violante (2011) show that the existence of on the job search explains a significant share of wage dispersion. According to Carrillo-Tudela (2012), for a given skill level, 40 percent of wage inequality is explained by search friction. Using US data, Hagedorn and Manovskii (2017) show that friction can explain 6% of the variance of log wages. In a job search model, Burdett, Carrillo-Tudela and Coles (2011) and Ortego-Marti (2016) highlight that the possibility of accumulating on-the-job skills and losing them during periods of unemployment increases significantly the level of wage dispersion. Lastly, Tjaden and Wellschmied (2014) introduce reallocation shocks to explain why one third of job transitions lead to wage losses.

In the seminal model of Mortensen (2000), the unemployed never refuse a job offer. As the wages' distribution is endogenous, firms do not post a job whose probability of being filled is zero. In this framework, when unemployed workers are homogeneous, the reservation wage is the same for all individuals. Our contribution consists in integrating a spatial dimension into the Mortensen model (2000). The heterogeneity of commuting costs explains the heterogeneity of reservation wages. Then, we analyse the effects of introducing monitoring on job vacancies, wages' distribution, and specific capital investments. Unsurprisingly, and consistent with empirical work, we find that monitoring improves the unemployment exit rate. However, we also show that sanctions encourage firms to post more bad jobs. The consequences are a higher turnover rate and a drop in specific capital investments. Thus, the drop in unemployment has an ambiguous effect on the level of production. The structure of this paper is as follows: The second section presents the model. In section 3, we discuss the calibration and the results. The final section concludes.

2 A wage posting model with benefit sanctions

Our paper is based on Mortensen's (2000) equilibrium search model with wage posting and human capital. The time is continuous and we assume risk-averse agents who do not have access to the financial markets to smooth their income over time. We take into account the benefit sanctions and the spatial dimension of the job search. In our framework, the commuting distance explains the decision whether to accept a job or not. The city is monocentric, linear, and unbounded. All employed workers commute to the business district (BD), where all the jobs are. The BD is represented by a point $x = 0$. The round-trip cost for a worker whose home is located at a distance x from the BD is ψx. These commuting costs consist of transportation costs and the opportunity cost of time. The population (employed and unemployed) is normalised to 1 for simplicity, and we assume that the distribution $L(x)$ of the location in the city is exogenous.

2.1 Matching and labour market flows

Firms create identical jobs that can either be filled or remain vacant. Free entry implies that the value of a vacancy is zero and determines the optimal number of vacancies v at equilibrium. In line with Burdett-Mortensen (1998), firms post wage offers that both the unemployed and the employed can either accept or reject. A low wage drives a higher turnover. Thus, firms trade-off between wage costs and recruitment costs. The distribution of wage offers $F(w)$ is given by a free entry condition that ensures the same expected profit for each w. This level of iso-profit is determined by a minimum wage $\underline{w}$. As the firms can not propose a wage below $\underline{w}$, we have $F(w) = 0$ for $w \leq \underline{w}$.

The labour force consists of employed $1 - u$ and unemployed workers u, who both search for new opportunities of jobs. To be consistent with Postel-Vinay and Robin (2002), we normalised the search intensity to 1 for unemployed and set the search intensity for employed workers to $\mu < 1$. Thus, the arrival rates of wage offers is greater for unemployed workers: $p_u > p_e$. The number of contacts M between firms and workers depends on the unemployment rate u and the number of vacancies v. The matching function is increasing and concave in the two arguments:

$$M(u, v) = m[u + \mu(1 - u)]^{1-\eta}[v]^{\eta} \tag{1}$$

where $\eta \in (0, 1)$ is the elasticity of matching and m is a parameter to calibrate to reproduce the duration of unemployment. It can be deduced that the total flow of contacts is the sum of the arrival rates of the unemployed and employed workers:

$$M(u, v) = p_u u + p_e(1 - u) \tag{2}$$

with $p_e = \mu p_u = \mu m\left(\frac{v}{u+\mu(1-u)}\right)^{\eta}$. By setting $\mu = 1$, we obtain the modelisation by Mortensen (2000) where $p_e = p_u$. Assuming different search intensity for unemployed and employed workers, our modelisation reproduces the gap between contact rates.

Employed workers accept offers above their current wage, whereas unemployed workers accept any wage above their reservation wage. As $p_e < p_u$ the reservation wage is greater than is the lump sum of unemployment benefit b. The expected life-time utility of employed workers $W(w, x)$ depends on the wage and the distance from the BD. The reservation wage for unemployed workers located at x from the BD is given by $W(\tilde{w}(x), x) = U(x)$ where $U(x)$ is the expected life-time utility of unemployed workers at x.

Let δ be the exogenous job destruction rate and $F(w)$ be the distribution of wage offers. We denote $l(x)$ and $u(x)$, respectively, as the mass of residents and the mass of unemployed workers located at x from the BD. At the steady state, for each $x \in (0, +\infty)$, the unemployed outflow, $p_u(1 - F(\tilde{w}(x)))u(x)$, is equal to the unemployed inflow, $\delta(l(x) - u(x))$. Therefore, the unemployment rate for each x is:

$$\frac{u(x)}{l(x)} = \frac{\delta}{\delta + p_u(1 - F(\tilde{w}(x)))} \tag{3}$$

Thus, the overall unemployment rate is $u = \int_0^{+\infty} u(x)\,\mathrm{d}x$.
Let $G(w)$ be the distribution of wage earnings across employed workers, $G(w)(1-u)$ represents the mass of employed workers whose wage is below w. At the steady state, the outflow of workers leaving jobs who earn a wage w or less is equal to the inflow into the set of workers with a wage below w:

$$\Big[\delta + p_e(1-F(w))\Big]G(w)(1-u) = p_u \int_{\tilde{w}(0)}^{w} \Big[F(w) - F(z)\Big]u(x(z))\,\mathrm{d}z \tag{4}$$

where $x(z)$ is the distance from the BD for unemployed workers whose reservation wage is z. Therefore, the distribution of wages earned across employed workers can be written as:

$$G(w) = \frac{p_u \int_{\tilde{w}(0)}^{w} \Big[F(w) - F(z)\Big]u(x(z))\,\mathrm{d}z}{(\delta + p_e(1-F(w)))(1-u)} \tag{5}$$

2.2 Match specific capital and wage posting

In this model, we assume that each employer sets a wage offer w and the associated human capital investment $k(w)$. This human capital is specific and can not be transferred to other firms. Once a worker is hired, the expected present value of the employer's future flow of quasi-rents at wage w, $J(w,k)$, solves the following Bellman equation:

$$rJ(w,k) = Q(k) - w + \Big[p_e(1-F(w)) + \delta\Big](V - J(w,k)) \tag{6}$$

where r is the real interest rate, V the value of a vacant job, and $p_e(1-F(w)) + \delta$ the probability of separation. $Q(k)$ is an increasing concave function representing the value of worker productivity. Note that the recent literature on human capital argues that general human capital and specific human capital are complementary (see Kessler and Lülfesmann (2006)). For example, countries investing in general human capital improve the ability of workers to acquire specific human capital. Conversely, firms' decisions on investing in human capital can influence the long-term strategy of investing in general human capital of the workers. Nevertheless, in the short term, firms decide on their specific human capital investment for a given level of general human capital. Thus, in our model, only the specific human capital can vary. General human capital is assumed to be constant, and its effects on productivity are captured in the calibration of the function $Q(k)$.
Free entry implies that wages and vacancies are set to drive the expected return attributable to the posting of a vacancy to zero. The asset value of a vacant job, V, solves the continuous time Bellman equation:

$$rV = \max_{(w,k)\geq 0} \left\{ \Big[\frac{p_e}{v}(1-u)G(w) + \frac{p_u}{v}\int_{\tilde{w}(0)}^{w} u(x(z))\,\mathrm{d}z\Big](J(w,k) - k - V) - c \right\} \tag{7}$$

where c is the flow cost of recruiting per vacancy, and k is the match specific per worker. The probability of filling a vacancy paid w with an unemployed worker is $\frac{p_u}{v}\int_{\tilde{w}(0)}^{w} u(x(z))\,\mathrm{d}z$ and with an employed worker is $\frac{p_e}{v}(1-u)G(w)$. As every combination provides the same profit, the free entry condition and the equations 6 and 7 give:

$$cv = \max_{(w,k)\geq 0} \Omega(w)\Big[\frac{Q(k(w))-w}{r+p_e(1-F(w))+\delta} - k\Big] \tag{8}$$

with

$$\Omega(w) = p_e(1-u)G(w) + p_u\int_{\tilde{w}(0)}^{w} u(x(z))\,\mathrm{d}z \tag{9}$$

Equation 9 represents the probability of filling a job vacancy paid w. By using the definition the mass of unemployed workers located at x from the BD (Eq. 3) and the distribution of wage earnings across employed workers (Eq. 5), the following expression is obtained:

$$\Omega(w) = \frac{\delta p_u}{\delta + p_e(1-F(w))}\int_{\tilde{w}(0)}^{w} \frac{\delta + p_e(1-F(z))}{\delta + p_u(1-F(z))} l(x(z))\,\mathrm{d}z \tag{10}$$

where $l(x(z))$ represents the mass of residents with a reservation wage equal to z when they are unemployed. The optimal investment for any wage offer w is described fully by

$$k(w) = arg\max\{Q(k(w)) - w - (r + p_e(1-F(w)) + \delta)k\} \tag{11}$$

The probability of employed workers finding a better paying job decreases with their current wage w. Thus, the expected duration of a job increases with w. Therefore, firms offering high wages invest more in specific capital. This specific investment is profitable over a longer period. Hence, employed workers at lower wages are less productive even if all workers are identical ex ante. With equation 11, we obtain

$$k'(w) = \frac{-p_e F'(w)}{Q''(k)} > 0 \tag{12}$$

2.3 The steady state

The steady state is characterised by a vacancy rate v and a distribution of wage offers F such that firms are indifferent between every wage in its support. In the present model, the lower bound of the wage distribution is the minimum wage $\underline{w}$. As the first order condition for equation 11 is $Q'(k) = r + p_e(1-F(w)) + \delta$, the minimum match-specific investment solves $Q'(\underline{k}) = r + p_e + \delta$. Thus, the equilibrium vacancy rate is obtained by equation 8 at the lowest wage:

$$cv = \Big[\frac{\delta p_u}{\delta + p_e}\int_{\tilde{w}(0)}^{\underline{w}} \frac{\delta + p_e(1-F(z))}{\delta + p_u(1-F(z))} l(x(z))\,\mathrm{d}z\Big]\Big[\frac{Q(\underline{k}) - \underline{w} - \underline{k}(r + p_e + \delta)}{r + p_e + \delta}\Big] \tag{13}$$

Mortensen (2000) shows that v equals zero is an unstable solution. In this model, there is also one stable solution strictly positive if the minimum wage $\underline{w}$ is not rejected by all residents ($\tilde{w}(0) < \underline{w}$).

By offering higher wages, firms improve both the acceptance rate and the retention rate. This explains why $F(w)$ is not a degenerate distribution. However, there is an upper support $\bar{w}$ for the wage distribution. In our framework, we assume that commuting costs are low enough for all residents to accept the highest wage. In other words, no resident of the city is located in an unemployment trap: $L(x(\bar{w})) = 1$. From $F(\bar{w}) = 1$, the maximum match-specific investment solves $Q'(\bar{k}) = r + \delta$. Because every element in the support $[\underline{w}, \bar{w}]$ must yield the same profit, the distribution of wages at the steady state solves

$$\left[\frac{\delta + p_e(1 - F(w))}{\delta + p_e}\right]\left[\frac{r + p_e(1 - F(w)) + \delta}{r + p_e + \delta}\right] \tag{14}$$

$$= \left[\frac{Q(k(w)) - w - k(r + p_e(1 - F(w)) + \delta)}{Q(\underline{k}) - \underline{w} - \underline{k}(r + p_e + \delta)}\right]\left[\frac{\int_{\tilde{w}(0)}^{w} \frac{\delta + p_e(1-F(z))}{\delta + p_u(1-F(z))} l(x(z))\,\mathrm{d}z}{\int_{\tilde{w}(0)}^{\underline{w}} \frac{\delta + p_e(1-F(z))}{\delta + p_u(1-F(z))} l(x(z))\,\mathrm{d}z}\right]$$

2.4 Commuting costs, sanctions, and reservation wage

Employed workers and unemployed workers have an instantaneous utility function $\Gamma(\zeta)$ where ζ denotes the level of consumption. As agents do not have access to the capital market[1], the consumption equals net income at each period. For unemployed workers, the consumption is equal to the unemployment benefits b net of the lump sum tax τ. Employees receive a wage w and must pay a tax τ as well as the commuting costs ψx. Their net income is $w - \tau - \psi x$. The risk aversion assumption implies $\Gamma'(.) > 0$ and $\Gamma''(.) < 0$. We consider a CRRA specification:

$$\Gamma(\zeta) = \frac{c^{1-\sigma}}{1 - \sigma} \tag{15}$$

where σ is the coefficient of relative risk aversion. When an unemployed worker refuses a job offer, unemployment benefits drop from b to $\hat{b}$ during one period. This means that the fall in value in the case of sanction is $\theta = \Gamma(b-\tau) - \Gamma(\hat{b}-\tau)$. We note the effective sanction rate ρ. From the point of view of unemployed workers, only the effective sanction rate determines their strategy of accepting job offers. Thus, ρ includes the probability of being monitored and detected. Finally, we assume that each unemployed worker monitored costs Δ by period. Thus, the aggregate costs of monitoring are $u\rho\Delta$.

[1]In the presence of precautionary savings, the benefit sanctions would be less dissuasive. Agents could do without unemployment insurance benefits temporarily by accumulating savings.

The Bellman equations for unemployed and employed workers are, respectively:

$$rU(x) = \Gamma(b-\tau) + p_u \int_{\tilde{w}(x)}^{\overline{w}} \Big[W(w',x) - U(x)\Big]\, \mathrm{d}F(w') - p_u F(\tilde{w}(x))\rho\theta \quad (16)$$

$$\begin{aligned} rW(w,x) &= \Gamma(w-\tau-\psi x) + p_e \int_{w}^{\overline{w}} \Big[W(w',x) - W(w,x)\Big]\, \mathrm{d}F(w') \quad (17) \\ &+ \delta\Big[U(x) - W(w,x)\Big] \end{aligned}$$

where $p_u F(\tilde{w}(x))$ is the probability of refusing a job for unemployed workers located at a distance x. For every distance x from the BD, the reservation wage solves $W(\tilde{w}(x), x) = U(x) - \rho\theta$. The following condition is obtained:

$$\begin{aligned} \Gamma(\tilde{w}(x) - \tau - \psi x) &= \Gamma(b-\tau) + (p_u - p_e) \int_{\tilde{w}(x)}^{\overline{w}} \Big[W(w',x) - W(\tilde{w}(x),x)\Big]\, \mathrm{d}F(w') \\ &- \Big[p_u + r + \delta\Big]\theta \quad (18) \end{aligned}$$

Unsurprisingly, the reservation wage increases with the distance x and decreases with the intensity of the sanction θ.

To compare different steady-states, we assume that the lump sum tax τ adjusts to finance unemployment benefits and the costs of monitoring. The budget constraint is defined by:

$$\tau = (b + \rho\Delta) \int_{\tilde{w}(0)}^{\tilde{w}(+\infty)} u(x(z))\, \mathrm{d}z + (\hat{b} - b) p_u \rho \int_{\tilde{w}(0)}^{\tilde{w}(+\infty)} F(z) u(x(z))\, \mathrm{d}z \quad (19)$$

3 Equilibrium wage dispersion and job vacancies

3.1 Calibration

We consider a quarterly calibration of the model. We begin by setting the value of several parameters from external information. Then, we calibrate the remaining parameters by replicating stylised facts of the French economy. We normalise the minimum wage at 1. Therefore, b is set at 0.75, which means that the replacement ratio ($\frac{b}{w}$) is lower for the highest paid workers. This calibration is consistent with the French legislation, where the replacement ratio is equal to 75% of the minimum wage and 60% of the average wage. The parameter r, and η are taken from from Mortensen and Pissarides (1999). We use Cooley and Hansen (1995) for the calibration of the relative risk aversion. Postel-Vinay and Robin (2002) provide information on the job destruction rate and the job finding rate. In particular, the ratio $\mu = \frac{p_e}{p_u}$ is 0.33. To set the value of commuting costs, we consider that $x = 1$ represents a distance of 50 kms from the BD. Thus, ψ is the cost for employed workers located 50 kms from the BD. This cost includes the commuting time and the mobility expenses. For these individuals, the daily transport time is greater than 1h30 (on average 2h), *i.e.*, the financial equivalent of 18.75% of a working day. In addition, for these workers, mobility expenses are of the order of 15% of the minimum wage (Baccaini (2007) and Zilloniz (2015)). Consequently, we set ψ equal to 0.3375, which implies for our calibration of $L(.)$, an average commuting cost equivalent to 8.25% of the minimum wage (see annex). We set the distribution of residents in the city $L(.)$ to reproduce the data of Baccaini (2007). We use a lognormal distribution with a mean of 0.2 and a standard deviation of 0.8. Graph 2 reports the empirical French data and the distribution of commuting distances for our calibration of $L(.)$. Setty (2019) reports that monitoring costs range from 4\$ to 60\$. Boone and al. (2007) estimate this cost at 0.7% of the average wage. Thus, we set $\Delta = 0.0075$ and $\rho = 0$ for the benchmark calibration.

Table 3: Quarterly benchmark computation

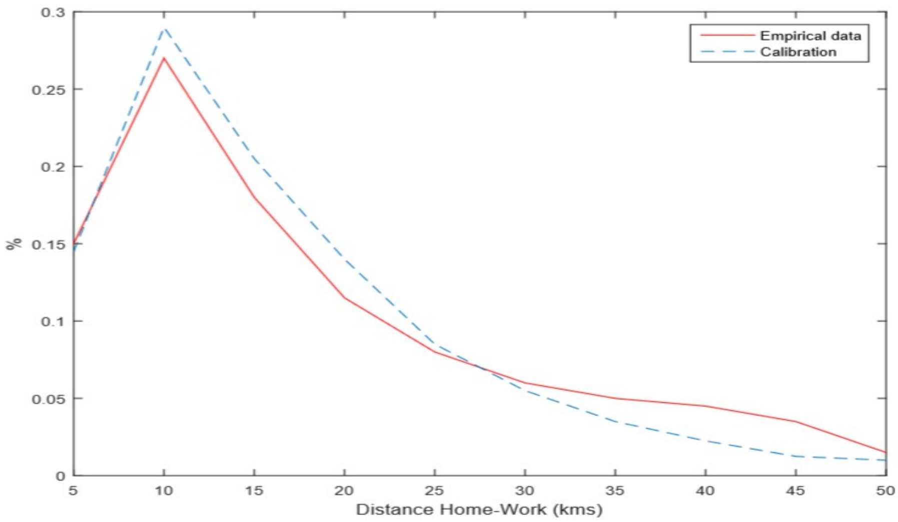
Parameters		Values	Targets
Interest rate	r	0.01	Yearly interest rate of 4%
The elasticity of the matching function	η	0.5	Mortensen and Pissarides (1999)
Relative risk aversion	σ	2	Cooley and Hansen (1995)
The minimum wage	$\underline{w}$	1	Normalisation to 1
Unemployment benefits	b	0.75	French legislation
The job destruction rate	δ	0.025	Postel-Vinay and Robin (2004)
Search intensity of employees	μ	0.33	Postel-Vinay and Robin (2002)
Commuting costs	ψ	0.338	To obtain the average commuting cost
Matching efficiency	m	1.880	To obtain the contact rate $p_u = 0.303$
Cost per vacancy	c	0.33	To obtain the rate of vacancy $v = 0.01$
Exogenous productivity	$\bar{Q}$	1	To obtain the wages distribution
Endogenous productivity	$\{\alpha, \varphi\}$	$\{0.1, 0.66\}$	
The monitoring rate	ρ	0	For the benchmark calibration
Monitoring costs	Δ	0.0075	Setty (2016), Boone and al. (2007)

The matching efficiency is set to reproduce the contact rate $p_u = 0.303$, *i.e.*, an unemployment rate of 9%. Given p_u, the cost per vacancy c is calibrated to obtain a job vacancy rate of 1% (Eurostat (2018)). Finally, we specify a functional form for the function of productivity. We use the following specification (see Chéron et al. (2008)):

$$Q(k) = \bar{Q} + \alpha \frac{k^{\varphi}}{\varphi} \tag{20}$$

The parameters $\bar{Q}$, α, and φ are set to reproduce the wages distribution of low-skilled workers. The equilibrium of the model is characterised by $f(.)$, $\tilde{w}(.)$, v, and τ. When these values are known, it is possible to deduce the other values of the model. To solve the model numerically, we assume an arbitrary value for the reservation wages $\tilde{w}$, job vacancies v, the contact rate Ω, and the tax τ. Then, we can compute the value of posting a job for $w = \underline{w}$. As each job offers the same expectation of profit, we use equation 14 to solve $f(.)$. We iterate on value functions to find the reservation wages and to deduce the distribution $g(.)$ and $u(.)$. Then, we can compute a new value for job vacancies v and use equations 10 and 19 to determine a new guess for Ω and τ. We repeat this procedure as long as the set of values $f(.)$, $\tilde{w}(.)$, v and τ have not converged.

Figure 2: Commuting distance



3.2 Effects on labour demand

Table 4 reports the effects of the benefit sanctions on labour demand. The first line shows the numerical simulation for the benchmark calibration. To estimate the impact of benefit sanctions, we use eight criteria: the unemployment rate u, the job vacancies v, the average wage offered by firms $E(f)$, the Mean-min ratio $E(g)/\underline{w}$, the consumption equivalent welfare $\hat{\zeta}$, the aggregate output $\hat{Q}$, the average job productivity q, and the flow of investment to the new workers I. The consumption equivalent welfare is defined by $r\Upsilon = \Gamma(\hat{\zeta})$, where the expected welfare Υ is:

$$\Upsilon = \int_0^{+\infty} \Big[\int_{\tilde{w}(x)}^{+\infty} W(w,x) g(w|x)\,\mathrm{d}w \Big] (1 - u(x))\,\mathrm{d}x + \int_0^{+\infty} U(x)u(x)\,\mathrm{d}x \qquad (21)$$

The aggregate investment is defined by:

$$I = \int_0^{+\infty} \Big[\int_{\tilde{w}(x)}^{+\infty} k(w) f(w)\,\mathrm{d}w \Big] p_u u(x)\,\mathrm{d}x \qquad (22)$$

Finally, the aggregate output is:

$$\hat{Q} = (1-u)\int_{\underline{w}}^{+\infty} Q(k(w))g(w)\,\mathrm{d}w \tag{23}$$

The second line of table 4 reports the numerical exercise where the commuting costs do not exist ($\psi = 0$). As in our model, job rejections can only be explained by the distance from the BD, this simulation measures the economic inefficiency induced by the mobility costs. The removal of commuting costs reduces the unemployment rate from 9% to 6.96%. The absence of job rejections is not the only cause of this fall in unemployment rate. Indeed, we observe an increase in the number of job vacancies: v rises from 0.0100 to 0.0119. The intuition for this result is simple: when unemployed workers accept all the proposals, the average duration of vacancy decreases. As a result, recruitment costs are lower, which implies an increase in jobs posted by firms. In other words, the decline in unemployment is explained partly by a higher labour demand. The removal of commuting costs does not only affect the number of jobs created. The average wage offered by firms drops from 1.1000 to 1.0924. The absence of job rejection allows firms to offer less generous wages without increasing the average length of time to hire a worker. As a result, the Mean-min ratio in the economy drops from 1.1998 to 1.1908.
This change in the distribution of wages has adverse consequences for the productivity of the economy. Indeed, workers hired at low wages are more likely to leave their jobs. The rise in job turnover deters firms in investing in specific capital. We observe a drop in aggregate investment and, necessarily in the average job productivity. Nevertheless, we notice an improvement of the aggregate output. This is clearly the outcome of the drop in unemployment due to the acceptance of all job offers. Finally, the consumption equivalent welfare improves considerably, from 0.9811 to 1.0695. This increase is the result of the removal of commuting costs that improves the net income of workers. Table 8 reports the average commuting cost. This is equivalent to 8.25% of the average wage for the entire population and can be up to 32% for the most distant workers. Naturally, the disappearance of this commuting cost would improve the consumption equivalent welfare of individuals.

Table 4: Effects of benefit sanctions on job creation

Numerical exercise	Unemployment rate (u)	Vacancies (v)	Average wage offered ($E(f)$)	Mean-min ratio ($E(g)/\underline{w}$)	Welfare $\hat{\zeta}$
$b = 0.75$, $\hat{b} = 0.75$, $\rho = 0$	9.00 %	0.0100	1.1000	1.1998	0.9811
$\psi = 0$	6.96 %	0.0119	1.0924	1.1908	1.0695
$b = 0.75$, $\hat{b} = 0.50$, $\rho = 1$	7.45 %	0.0115	1.0942	1.1930	0.9903
$b = 0.75$, $\hat{b} = 0.25$, $\rho = 1$	6.96 %	0.0119	1.0924	1.1908	0.9948

Does the introduction of sanctions make it possible to compensate for the existence of commuting costs? In other words, is it possible to converge our model towards the

Table 5: Effects of benefit sanctions on job productivity

Numerical exercise	Aggregate output ($\hat{Q}$)	Average job productivity (q)	Flow of investment
$b = 0.75$, $\hat{b} = 0.75$, $\rho = 0$	1.4561	1.5996	0.0998
$\psi = 0$	1.4657	1.5754	0.0814
$b = 0.75$, $\hat{b} = 0.50$, $\rho = 1$	1.4630	1.5807	0.0861
$b = 0.75$, $\hat{b} = 0.25$, $\rho = 1$	1.4657	1.5754	0.0814

results obtained in the absence of costs? Lines 3 and 4 in tables 4 and 5 answer these questions. In these numerical exercises, we set a sanction rate of 100% ($\rho = 1$), and we vary the income of individuals sanctioned $\hat{b}$ from 0.5 to 0.25. Unsurprisingly, we show that stricter sanctions can reduce the unemployment rate by limiting job rejections. Dividing the benefits by three[2] reduces the unemployment rate from 9% to 6.96%. This policy allows to obtain an economy without job rejections. Graph 3 shows that unemployed workers begin to refuse job offers when they are located at a distance greater than 0.29 from the BD. For these individuals, the commuting cost is 0.095 at each period. This cost has to be compared with the loss of benefits in the case of sanction. It is financially preferable to lose a portion of unemployment benefits for one quarter rather than to pay mobility costs for several years for a low wage. As a result, the local unemployment rate of individuals located beyond a distance of 0.29 ranges from 9% to 27%. Mobility costs act as unemployment traps, where the average duration of unemployment is up to four times higher than is that of an individual in $x = 0$. However, note that the majority of residents are located at a distance less than 0.29. Graph 2 shows clearly that a large number of the residents are located near jobs and accept the offers. For the benchmark calibration, the share of the population refusing the minimum wage is 30.51%. Similarly, 2.96% of unemployed workers refuse a wage of 1.1.

The introduction of benefit sanctions also affects the labour demand. First, the ability to recruit more quickly encourages firms to post more jobs. Thus, monitoring affects both job creation and labour supply behaviour. Furthermore, the obligation to accept any job is an incentive to create jobs of poor quality. Graph 4 compares the wage distribution $g(w)$ of an economy without monitoring and the wage distribution of an economy with monitoring where no job is refused ($\hat{b} = 0.25$). Reduction in average wage offered by firms is one of the consequences of benefit sanctions. Naturally, this leads to a rise in job turnover, and hence, a drop in the flow of investment and average job-productivity (see graph 7). Overall, the introduction of benefit sanctions improves the consumption equivalent welfare. This is the outcome of a fall in unemployment that allows reduction of taxes. However, as shown in graph 4, this is achieved at the expense of individuals who

[2] We use a quarterly calibration. Thus, $\hat{b} = 0.25$ is equivalent to a suspension of unemployment benefits for 2 months (resp. 1 month for $\hat{b} = 0.5$).

Figure 3: Localisation and reservation wage

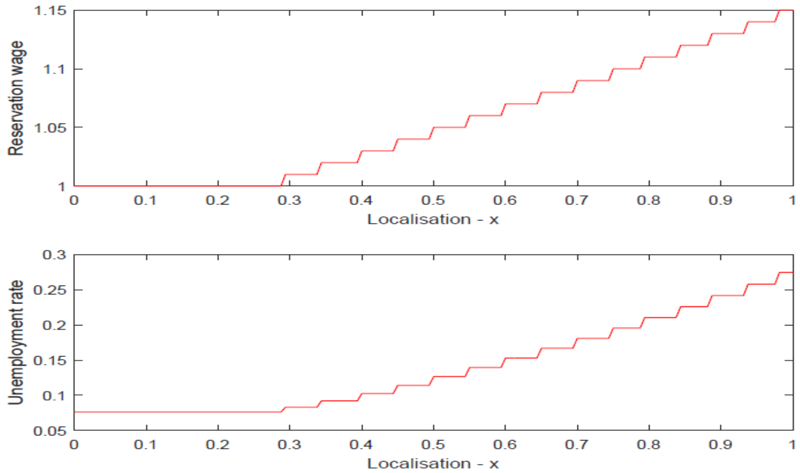
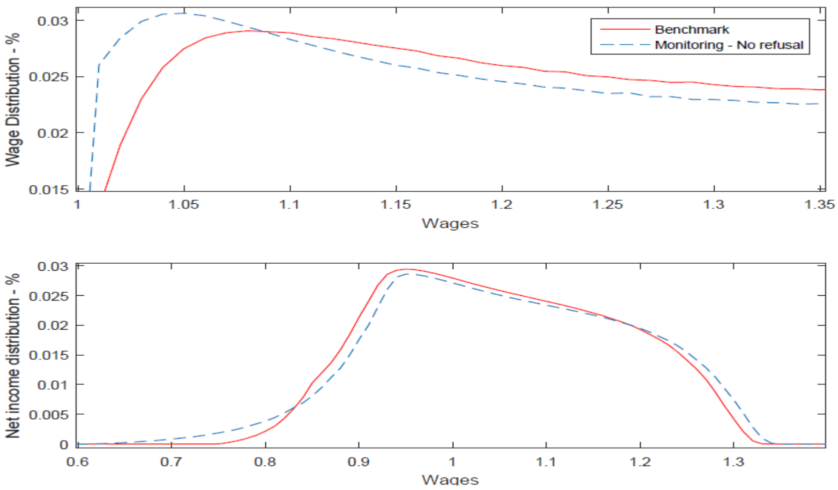


Figure 4: Effects of monitoring on the distribution of wages



are most distant from the BD. For them, the obligation to accept any job means that it is possible that their net income $(w - \tau - \psi x)$ is lower than are unemployment benefits.

3.3 The optimal unemployment benefits system

What is the optimal unemployment insurance in terms of consumption equivalent welfare? Table 6 reports numerical simulations of the model with several sanction systems (ρ and $\hat{b}$). First, we set $b = 0.75$, and the sanction rate varies from 0 to 1. The increase in the sanction rate leads to the same effects as does an increase in the severity of the sanction: (i) A fall in reservation wages, (ii) An increase in jobs created by firms, (iii) A

deterioration in the quality of jobs created, and (*iv*) A drop in specific capital investment and the average job-productivity. If we consider the consumption equivalent welfare, it appears that the optimal sanction is characterised by $\rho = 1$ and $\hat{b} = 0.25$.
One can then wonder whether an increase in unemployment benefits could be the counterpart of more intensive control. Therefore, we search for the optimal unemployment benefits b^* maximising the welfare criterion $\hat{\zeta}$ for each combination (ρ , $\hat{b}$). In the absence of monitoring, it appears necessary to reduce the level of benefits to improve the average welfare of agents ($b^* = 0.69$). This policy reduces the unemployment rate from 9% to 7.70%. This result means that the quantity of job rejections is not optimal in our benchmark calibration and has an impact on household consumption through taxes. By increasing the sanction rate, it becomes possible to improve the level of unemployment benefits. For $\rho = 1$ and $\hat{b} = 0.25$, optimal unemployment benefits are $b* = 0.97$. Then, the welfare criterion is equal to 1.0039. Thus, the introduction of monitoring makes possible a better coverage of the risk of unemployment. The unemployed workers receive a level of unemployment benefits close to the minimum wage.

Notice that this result comes from two assumptions: First, agents have a preference for smoothed incomes over time because they are risk-averse. Second, job rejections are the only cause of moral hazard. We do not consider the issue of the unobservable search intensity. It is interesting to compare the optimality of the sanctions with the optimality of the degressivity of the UI benefits (see Hopenhayn and Nicolini (1997)). Indeed, a degressive unemployment insurance system introduces an automatic reduction of benefits for all individuals who do not find a job. Degressivity does not make a distinction between cheaters and the other unemployed workers. Conversely, unemployment insurance using the benefit sanctions targets only cheaters. Therefore, the optimal system is naturally characterised by a high risk of loss of utility for individuals identified as cheaters, whereas other unemployed workers benefit from a replacement ratio close to 1. Indeed, this UI design allows an optimal smoothing consumption of the unemployed workers who never refuse job offers.

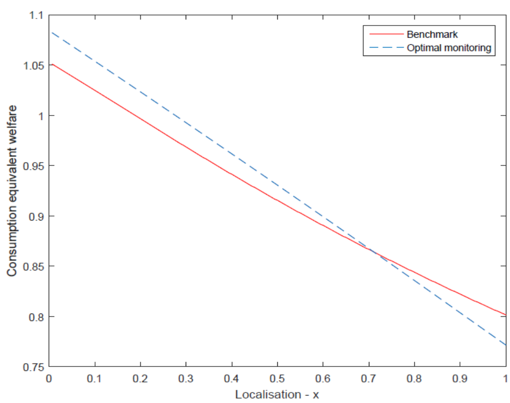
For the optimal equilibrium, the aggregate output is at its maximum (see Table 10). However, the proportion of low wages is highest, and this policy leads to a fall in the flow of investment and average job-productivity. In fact, the improvement in the welfare criterion is largely due to the fall in umployment. At this point in the discussion, an important element deserves to be emphasised. As shown in table 9, 69.49% of unemployed workers do not refuse any job offer. For them, the introduction of monitoring makes it possible to no longer pay tax for the individuals refusing jobs. In return, tax revenues can be redirected to finance an increase in their unemployment benefits. Therefore, this policy is a means of transferring consumption units from the distant minority to the near majority of the business district. Although the overall effect on welfare is positive, the variations depend on the location of individuals. Graph 5 shows the effect of monitoring on the expected

Table 6: Monitoring rate and optimal unemployment benefits

Numerical exercise	Unemployment rate (u)	Vacancies (v)	Average wage offered ($E(f)$)	Mean-min ratio ($E(g)/\underline{w}$)	Welfare $\hat{\zeta}$
$b = 0.75$, $\hat{b} = \epsilon$, $\rho = 0$	9.00%	0.0100	1.1000	1.1998	0.9811
$b = 0.75$, $\hat{b} = 0.50$, $\rho = 0.25$	8.36%	0.0107	1.0973	1.1971	0.9847
$b = 0.75$, $\hat{b} = 0.25$, $\rho = 0.25$	7.35%	0.0116	1.0939	1.1926	0.9914
$b = 0.75$, $\hat{b} = 0.50$, $\rho = 0.50$	7.95%	0.0111	1.0959	1.1952	0.9869
$b = 0.75$, $\hat{b} = 0.25$, $\rho = 0.50$	7.03%	0.0118	1.0927	1.1911	0.9942
$b = 0.75$, $\hat{b} = 0.50$, $\rho = 0.75$	7.63%	0.0113	1.0947	1.1938	0.9888
$b = 0.75$, $\hat{b} = 0.25$, $\rho = 0.75$	6.96%	0.0119	1.0924	1.1908	0.9948
$b = 0.75$, $\hat{b} = 0.50$, $\rho = 1$	7.39%	0.0115	1.0942	1.1930	0.9903
$b = 0.75$, $\hat{b} = 0.25$, $\rho = 1$	6.96%	0.0119	1.0924	1.1908	0.9948
$b^* = 0.69$, $\hat{b} = \epsilon$, $\rho = 0$	7.70%	0.0113	1.0951	1.1942	0.9844
$b^* = 0.71$, $\hat{b} = 0.50$, $\rho = 0.25$	7.73%	0.0113	1.0951	1.1943	0.9856
$b^* = 0.78$, $\hat{b} = 0.25$, $\rho = 0.25$	7.52%	0.0114	1.0941	1.1934	0.9918
$b^* = 0.74$, $\hat{b} = 0.50$, $\rho = 0.50$	7.83%	0.0112	1.0955	1.1947	0.9871
$b^* = 0.86$, $\hat{b} = 0.25$, $\rho = 0.50$	7.22%	0.0117	1.0935	1.1920	0.9981
$b^* = 0.78$, $\hat{b} = 0.50$, $\rho = 0.75$	7.94%	0.0111	1.0959	1.1952	0.9890
$b^* = 0.95$, $\hat{b} = 0.25$, $\rho = 0.75$	7.07%	0.0118	1.0930	1.1913	1.0021
$b^* = 0.83$, $\hat{b} = 0.50$, $\rho = 1$	8.01%	0.0111	1.0960	1.1955	0.9906
$b^* = 0.97$, $\hat{b} = 0.25$, $\rho = 1$	6.96%	0.0119	1.0924	1.1908	1.0039

welfare in function of the localisation. It points out clearly that this policy improves the welfare of the best-endowed workers at the expense of the less fortunate workers, *i.e.*, those most distant from the BD. This outcome is related to the greater dispersion of net income seen previously.

Figure 5: Welfare effects and distance



3.4 Mutualise commuting costs?

We have shown that the introduction of benefit sanctions has ambiguous effects on the labour demand. This policy encourages firms to create more jobs. Nevertheless, the remuneration of these jobs is lower, which leads to a higher job turnover rate and a reduction in specific human capital investment. This result argues in favour of the policies of several Northern European countries (*i.e*, Sweden, the Netherlands, Denmark) where the control of the unemployed workers is often associated with other tools: support for professional training, existence of a minimum wage, or subsidy to firms to develop new production technologies.

Our paper focuses on the role of commuting costs in job refusals. This geographical dimension enables us to show that benefits sanctions increase inequalities in net income between workers who live close to their jobs and those who are forced to accept high mobility costs. As the commuting costs explain the existence of refusals of jobs, we naturally propose to analyse the policy aiming to reduce these costs. Indeed, we may wonder if a partial mutualising of these costs would not be more effective than are the benefit sanctions. In particular, in France, workers can obtain a tax credit based on their mobility expenses and their wage. Therefore, we consider a subsidy to commuting costs. We assume that this subsidy ensures a net income of work at least equal to the net income of an agent at the minimum wage at the location $x = 0$. When the wage is high enough to cover the cost of commuting, the worker no longer receives a subsidy. In other words, the subsidy decreases with the wage. Nevertheless, the worker always improves his net income by accepting higher wages. It should be noted that this subsidy system is not necessarily optimal. The subsidy is defined by:

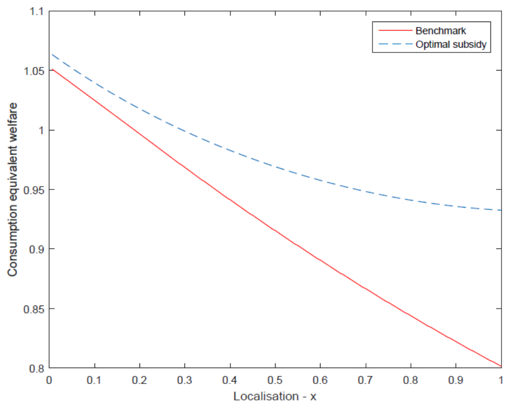
$$Sub(w, x) = \max \left[0, \underline{w} - w + \psi x\right] \tag{24}$$

Table 7 compares economic equilibria without and with subsidies. For the benchmark calibration, the consumption equivalent welfare improves from 0.9811 to 0.9980. For the optimal UB system seen in the previous section, the welfare increases from 1.0039 to 1.0120. Contrary to the benefit sanctions, subsidies for commuting costs transfer consumption units from the workers close to the BD to the workers who are most distant. The gains from job creation are better distributed among the workers. As a result, there is less dispersion of net incomes: The net income of the wealthiest workers increases due to the decline in the number of unemployed workers to finance via the tax, while the commuting cost subsidy guarantees to the poorest workers a net income at least equal to the minimum wage (see graph 6). As the utility function of agents is concave because of risk aversion, this transfer of consumption degrades less the welfare of agents near the BD than it improves the welfare of the most distant agents. Thus, the partial subsidy of mobility costs seems to be a complementary policy to the benefit sanctions. It helps reduce job refusals, encourages the creation of job vacancies, and improves the average welfare of workers.

Table 7: Commuting cost subsidies

Numerical exercise	Unemployment rate (u)	Vacancies (v)	Mean-min ratio ($E(g)/\underline{w}$)	Welfare $\hat{\zeta}$
$b = 0.75$, $\hat{b} = \epsilon$, $\rho = 0$	9.00%	0.0100	1.1998	0.9811
$b^* = 0.97$, $\hat{b} = 0.25$, $\rho = 1$	6.96%	0.0119	1.1908	1.0039
With commuting subsidies				
$b = 0.75$, $\hat{b} = \epsilon$, $\rho = 0$	6.96%	0.0119	1.1908	0.9980
$b^* = 0.85$, $\hat{b} = \epsilon$, $\rho = 0$	6.96%	0.0119	1.1908	1.0051
$b^* = 0.99$, $\hat{b} = 0.5$, $\rho^* = 0.75$	6.96%	0.0119	1.1908	1.0115
$b^* = 0.99$, $\hat{b} = 0.25$, $\rho^* = 0.50$	6.96%	0.0119	1.1908	1.0120

Figure 6: Welfare effects, distance and commuting subsidies



4 Concluding remarks

This paper provides several contributions to the literature. Foremost, we integrate a spatial dimension into the canonical model of Mortensen (2000). Then, we analyse the effects of commuting costs on wage distribution. In particular, we show that, by posting higher wages, firms can expand their recruitment pool by attracting unemployed workers whose homes are the most distant from the business district. Then, we use our model to evaluate the effects of benefit sanctions on labour demand. Naturally, the introduction of monitoring leads to a decrease in job rejections. In addition, our results also suggest that benefits sanctions have a positive effect on job creation by reducing recruitment costs for firms. Simultaneously, firms can offer lower wages without being afraid of refusals from the unemployed workers. The deterioration in the quality of jobs leads to an increase in the level of job rotation and, therefore, in the specific capital investment. In the end, the average job-productivity decreases.

As job rejections are explained by commuting costs, we test a complementary policy of benefit sanctions: Mutualisation of commuting costs. In other words, a tax credit for employed workers who are most distant from the BD that is funded by all agents. We show that this policy improves the welfare when agents are risk-averse. Indeed, it encourages acceptance of a job by transferring consumption units from the wealthiest workers to the poorest. This result suggests that the optimal policy is to accompany the benefit sanctions with commuting cost subsidies.

Several criticisms can be directed at our results. In particular, we assume that the distribution of residents (and firms) in the city is exogenous. In other words, the labour market does not affect either the cost of housing or the localisation of agents. However, it is natural to assume that high commuting costs can lead to a fall of the housing price at the city's periphery. In this case, the localisation of individuals may have no effect. Nevertheless, for France, the empirical data do not seem to support this hypothesis. Although the housing price is lower on the periphery of cities, spatial localisation affects the return to work and the net income of households.

5 Annex

Figure 7: Specific capital investments

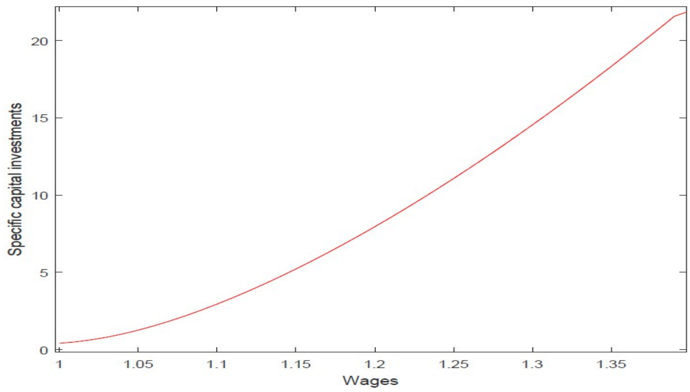


Table 8: Commuting cost

Distance from BD (x)	Mass of employed workers	Aggregate commuting costs	Average commuting cost
0 - 0.25	0.57	0.026	0.046
0.25 - 0.50	0.25	0.029	0.116
0.5 - 0.75	0.07	0.014	0.196
0.75 - $+\infty$	0.02	0.007	0.320
0 - $+\infty$	0.91	0.0751	0.0825

Table 9: Job refusal rate

Wage	$w = 1$	$w = 1.05$	$w = 1.1$	$w = 1.15$
Share of the population refusing	30.5%	9.8%	2.96%	0.2%

Table 10: Monitoring rate and optimal unemployment benefits - Job productivity

Numerical exercise	Aggregate output ($\hat{Q}$)	Average job productivity (q)	Flow of investment
$b = 0.75$, $\hat{b} = \epsilon$, $\rho = 0$	1.4561	1.5996	0.0998
$b = 0.75$, $\hat{b} = 0.50$, $\rho = 0.25$	1.4599	1.5931	0.0943
$b = 0.75$, $\hat{b} = 0.25$, $\rho = 0.25$	1.4634	1.5795	0.0852
$b = 0.75$, $\hat{b} = 0.50$, $\rho = 0.5$	1.4608	1.5870	0.0907
$b = 0.75$, $\hat{b} = 0.25$, $\rho = 0.5$	1.4656	1.5763	0.0820
$b = 0.75$, $\hat{b} = 0.50$, $\rho = 0.75$	1.4632	1.5841	0.0878
$b = 0.75$, $\hat{b} = 0.25$, $\rho = 0.75$	1.4657	1.5754	0.0814
$b = 0.75$, $\hat{b} = 0.50$, $\rho = 1$	1.4638	1.5807	0.0861
$b = 0.75$, $\hat{b} = 0.25$, $\rho = 1$	1.4657	1.5754	0.0814
$b^* = 0.75$, $\hat{b} = \epsilon$, $\rho = 0$	1.4619	1.5839	0.0885
$b^* = 0.71$, $\hat{b} = 0.50$, $\rho = 0.25$	1.4617	1.5842	0.0887
$b^* = 0.78$, $\hat{b} = 0.25$, $\rho = 0.25$	1.4636	1.5827	0.0868
$b^* = 0.74$, $\hat{b} = 0.50$, $\rho = 0.5$	1.4615	1.5854	0.0896
$b^* = 0.86$, $\hat{b} = 0.25$, $\rho = 0.5$	1.4639	1.5779	0.0840
$b^* = 0.78$, $\hat{b} = 0.50$, $\rho = 0.75$	1.4608	1.5869	0.0907
$b^* = 0.95$, $\hat{b} = 0.25$, $\rho = 0.75$	1.4646	1.5759	0.0825
$b^* = 0.83$, $\hat{b} = 0.50$, $\rho = 1$	1.4615	1.5888	0.0912
$b^* = 0.97$, $\hat{b} = 0.25$, $\rho = 1$	1.4657	1.5754	0.0814

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