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LABOR MARKET POLICIES IN A SECTOR SPECIFIC SEARCH MODEL WITH HETEROGENEOUS FIRMS AND WORKERS

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Abstract

This paper analyzes the effects of unemployment benefits and minimum wage policies in a noncompetitive labor market with two sectors, two types of workers and sector specific search. It finds that those policies can shift the job composition towards low-wage jobs and that they will never increase the number of high-wage jobs. Welfare can only increase because of reduced social vacancy creation costs. The paper is an extension of Acemoglu (2001) who finds in the homogeneous-worker random search version of the model that the mentioned labor market policies can shift the job composition toward high-wage jobs, increase the number of high-wage jobs and welfare.

Keywords: *Unemployment, Labor Market Policy, Search and Matching Models, Efficiency.*

JEL Classification: *E24, J31, J38, J64.*

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I. Introduction

There is still an ongoing debate about the labor market effects of employment protection legislation. The empirical evidence on the effects of stringent labor market regulations seems inconclusive in many aspects. This paper focuses on the effect of labor market policies on the composition of employment. It analyzes the effect of labor market policies in a two-sector search and matching model with heterogeneous workers. The paper is based on Acemoglu (2001) who develops a noncompetitive labor market with a high-wage and a low-wage sector and homogeneous workers. In that study instituting labor market policies such as an unemployment benefit and a minimum wage can shift job composition toward highwage jobs and even increase the total number of high-wage jobs. Since the decentralized equilibrium is inefficiently biased toward low-wage jobs, these labor market regulations may increase welfare through the improvement in job composition. I find that if there is an exogenous distribution of skills across workers, the beneficial effects of these labor market policies are reduced. Job composition does not necessarily improve after an increase in the unemployment benefits, and neither an increase in unemployment benefits nor a minimum wage will increase the number of high-wage jobs. Nonetheless, these policies can still increase welfare.

In Acemoglu (2001) each sector produces an intermediate good that is used to produce a final good. This aggregate production function introduces an interesting link between the labor market conditions in the two sectors that is reflected in the prices of the respective goods. As mentioned, this economy consists of a high and a low-wage sector. The source of this wage distribution is a higher capital creation cost in the high-wage sector that leads to higher prices and wages there. The equilibrium of the model is characterized by two endogenous variables: an overall labor market tightness θ that determines the total number of employed workers (and filled vacancies), unemployed workers and unfilled vacancies; and a fraction of low-wage vacancies ϕ determining job composition. Given rent sharing over the production surplus between firms and workers, the decentralized equilibrium of this economy has an inefficiently high fraction of low-wage jobs. Acemoglu (2001) proposes two labor market policies intended to improve job composition and welfare. He finds that unemployment benefits or a minimum wage that is binding in the low-wage sector can shift job composition toward high-wage jobs, increase the number of jobs in this sector and increase welfare. A higher minimum wage gives firms an incentive to open more high-wage jobs because there is a lower profit from low-productivity investments. Higher unemployment insurance increases the duration of unemployment because workers prefer to wait for a better job rather than accepting a low-wage job offer. Both policies have the same overall effect of increasing labor productivity because they shift employment towards more high-wage jobs.

The only source of wage inequality in Acemoglu (2001) is the difference in capital creation costs between the two sectors. It seems more realistic to relate wage inequality to some distinguishing characteristic between workers. In this case, not all workers have the necessary skill to work in the high-wage capital-intensive sector.

Albrecht and Vroman (2002) introduce this type of skill requirement in a two-sector matching model in which high-wage workers can find jobs in either the low or the high-wage sector. Dolado, Jansen and Jimeno (2003) extend Albrecht and Vroman (2002) by allowing for on-the-job search by high-skill workers while working in low-wage jobs. These papers assume random matching; that is, workers apply to jobs at random regardless of skill requirements.

In this paper, I introduce worker heterogeneity and I assume a directed meeting process in the sense that only high-skill workers can search among the high-wage vacancies, and similarly for low-skill workers. The model has two essentially independent labor markets that are linked through their contribution to aggregate output. This connection is reflected in the prices of the goods produced in the two sectors. The equilibrium of the heterogenous-worker version of the model is characterized by the labor market tightness in the low-wage sector and the corresponding labor market tightness in the high-wage sector. These two variables determine overall labor market tightness and the distribution of vacancies between the two sectors. The efficiency implications of the model are standard, i.e. the total number of vacancies and job composition are efficient if the bargaining parameter β is equal to the Hosios (1990) value in both sectors.

If β differs from the Hosios value and workers are heterogeneous like in this paper unemployment benefits and/or a minimum wage do not necessary lead to an improvement in job composition and they never lead to an increase in the number of high-wage jobs. A higher unemployment benefit increases workers' outside options and wages and reduces firms profits. Workers in both sectors find it better to stay unemployed for longer spells and enjoy the higher unemployment benefits and as a result unemployment in both sectors increases. Then and contrary to Acemoglu (2001) there cannot be an increase in job creation in either sector. Job composition can either increase or decrease depending on the different effect of the higher unemployment benefit on labor market tightness in both sectors. Welfare may increase not because of an improvement in job composition but due to a reduction in the standard search frictions externalities if there is too much job creation. A binding minimum wage in the low-wage sector can improve job composition. The reason is that it hits directly that sector, reducing profits and the number of jobs there, and indirectly through a negative price effect in the high-wage sector. Since the reduction in employment is stronger in the low-wage sector than in the other, job composition improves. In this case, the improvement in job composition is due only to a reduction in the number of low-wage jobs. Again, welfare can increase but only because of the reduced social cost of vacancies associated with lower labor market tightness in both sectors[1].

The rest of this study is structured as follows. In the next section, I present the heterogeneous worker sector specific search model. Section III describes the steady state equilibrium. In Section IV I turn to the analysis of efficiency and the effects of policy. Section V presents the numerical exercises that illustrate the effects of unemployment benefits and minimum wage policies. Conclusions are presented in Section VI. Finally, an Appendix at the end of the paper includes a proof of the uniqueness of the equilibrium.

II. Model

2.1 Basic assumptions

The model is a standard search model in the spirit of Pissarides (2000) with two intermediate good sectors (Acemoglu, 2001) and an exogenous distribution of skills as in Albrecht and Vroman (2002). Wages are determined through Nash bargaining.

This economy consumes one final consumption good with price 1 that is produced with two intermediate non-storable goods that are sold in a competitive market. Preferences are defined over this final consumption good.

There is a continuum of workers with mass equal to 1 and an exogenous distribution of skills across workers with a larger fraction $p > 1/2$ of the work-force having the low-skill level, and a fraction $(1 - p)$ having the high skill level. All the individuals are infinitely lived and risk neutral. The discount rate of workers is r. On the other side of the market, there is a continuum of firms that are also risk neutral with discount rate r. The technology of production of the final good is a CES,

$$Y = \left(\alpha Y_b^{\rho} + (1-\alpha) Y_g^{\rho}\right)^{1/\rho} \tag{1}$$

where Y_b is the aggregate production of the intermediate output of a bad-job sector b and Y_g the corresponding output of a good-job sector g. It is assumed that $\rho < 1$ and α measures the share of Y_b in the final good production function. This aggregate function can also be thought as a utility function. The first order conditions of the aggregate economy problem lead to the following equilibrium prices for the two intermediate goods,

$$p_b = \alpha Y_b^{\rho-1} Y^{1-\rho} \tag{2}$$

$$p_g = (1-\alpha) Y_g^{\rho-1} Y^{1-\rho}. \tag{3}$$

These two intermediate goods are produced via a Leontief technology that uses both capital and labor. When matched with a firm with necessary equipment (k_b, or k_g) a worker produces one unit of a b or a g good. It is assumed that $k_g > k_b$ and this difference in capital creation costs between sectors leads to a difference in prices, namely $p_g > p_b$.

Finally, a job is described by its skill requirements and it is assumed that only low-skill workers can be hired in the bad-job sector, and only high-skill workers can work in the good-job sector.

2.2 Search and meeting process

At any moment in time a job is either filled or vacant and a worker is either employed or unemployed. Unemployed workers and firms offering vacancies have to spend resources in order to meet each other. When a vacant job is filled with an unemployed worker production takes place and this filled job generates a rent. As usual it is assumed that workers and firms meet according to a matching function $M(u, v)$ where u is the unemployment rate and v is a vacancy rate expressed as the number of vacant jobs as a fraction of the labor force. This matching function is twice differentiable, increasing in both arguments and has constant returns to scale. The fact that different jobs have different skill requirements implies that workers can then focus their search efforts on the jobs compatible with their skills. This gives rise to the directed search assumption followed in the model. Then the model has two matching functions, one for bad jobs and another for good jobs.

The constant returns to scale assumption in the matching functions implies that $M(u_i, v_i) / v_i = q(\theta_i)$. $\theta_i = v_i / u_i$ is defined as the tightness of the labor market in sector i, where $i = b, g$.

The function $q(\theta_i)$ represents the flow rate at which vacancies meet unemployed workers and is decreasing in θ_i. In addition, $M(u_i, v_i) / u_i = \theta_i q(\theta_i)$ is the flow rate at which unemployed workers meet unfilled vacancies and is increasing in θ_i. I also assume that the Inada conditions hold.

Unemployment persists in the steady state because some of the existing jobs break up at the exogenous rate s, providing a flow into unemployment. When a job breaks up the worker becomes unemployed and the job becomes an unfilled vacancy. When a worker is unemployed she receives an unemployment benefit z that is financed with lump sum taxes.

Before opening a vacancy, the firm must incur a capital creation cost k_i. According to Acemoglu (2001) this is a reasonable assumption "since, in practice, k_i corresponds to the costs of machinery, that is sector or occupation specific".

As mentioned above, the differential costs of opening a vacancy in either the bad or the good job sector imply price and productivity differences between the sectors. There is some rent implied by the production of a good job that is transferred in part to the employees via higher wages determined in a Nash bargaining process.

There is also free entry of vacancies which determines a zero net value of vacancies condition. In steady-state equilibrium, firms and workers maximize their respective objective functions, given the matching and separation technologies, the value of vacancies equals zero, and the flow of workers into unemployment is equal to the flow of workers out of unemployment.

2.3 Asset values and wages

This model generates two types of matches, good-job vacancies with high-skill workers and bad-job vacancies with low-skill workers. A match occurs when the surplus that it implies is nonnegative. The value of this surplus is determined by the value placed by firms and workers on the different possible states in which they can be. Let rJ_i^U be the value of being unemployed in sector i, rJ_i^E the value of being employed, rJ_i^F the value of filling a job i, and rJ_i^V to the value of a vacancy in i. Then a match is formed in sector i iff $J_i^E + J_i^F \geq J_i^U + J_i^V$.

Starting from the worker side, a worker of skill level i who is unemployed will value her state as follows,

$$\begin{aligned} rJ_b^U &= z + \theta_b q(\theta_b)\left[J_b^E - J_b^U \right] \\ rJ_g^U &= z + \theta_g q(\theta_g)\left[J_g^E - J_g^U \right], \end{aligned} \tag{4}$$

where rJ_b^U and rJ_g^U are the discounted values of being unemployed for low and high-skill workers, respectively. I use the subscripts b and g because the low-skill (high-skill) group can only find bad (good) jobs. These values include the current value of the unemployment benefit z that workers receive while unemployed plus the net value of finding a job $\left[J_i^E - J_i^U \right]$ weighted by the probability $\theta_i q(\theta_i)$ of meeting a vacancy. It is assumed that z is financed with a lump sum tax τ, where $\tau = z\,(u_b + u_g)/(1 - u_b - u_g)$. Similarly the discounted value of being employed in either the bad or the good job are,

$$rJ_i^E = w_i + s\left(J_i^U - J_i^E\right). \tag{5}$$

While employed, workers receive a wage w_i but face a probability s of losing their job and starting an unemployment spell.

On the firm side, when a vacancy is filled the worker produces one unit of the good with value p_i and is being paid w_i. Then rJ_i^F, the value of filling a job i is,

$$rJ_i^F = p_i - \tau - w_i + s\left(J_i^V - J_i^F\right). \tag{6}$$

Similarly, the discounted value of a vacancy rJ_i^V is,

$$rJ_i^V = q(\theta_i)\left(J_i^F - J_i^V\right). \tag{7}$$

After workers and firms meet there is rent sharing over the surplus of the match and wages are determined by Nash bargaining conditions,

$$(1-\beta)\left(J_i^E - J_i^U\right) = \beta\left(J_i^F - J_i^V\right), \tag{8}$$

where β is the share of the net surplus of the match going to workers.

There is free entry of vacancies which implies that in equilibrium there are zero rents from vacant jobs and then,

$$J_i^V = k_i. \tag{9}$$

Finally, there is a steady-state condition for unemployment in every sector implying that the flows out of unemployment should be equal to the flow into unemployment,

$$\begin{aligned} q(\theta_b)\theta_b u_b &= s(p - u_b) \\ q(\theta_g)\theta_g u_g &= s(1 - p - u_g). \end{aligned}$$

It follows that the respective steady state number of unemployed workers in sectors b and g are

$$u_b = \frac{sp}{q(\theta_b)\theta_b + s}$$
$$u_g = \frac{s(1-p)}{q(\theta_g)\theta_g + s}. \quad (10)$$

III. Equilibrium

In equilibrium both workers and firms will have taken decisions that maximize their respective objective functions taking as given the actions of the other agents. The equilibrium is defined as a tightness of the labor market θ_i, value functions and prices of both goods such that equations (2) to (10) are satisfied.

In equilibrium $Y_b = p - u_b$ and $Y_g = 1 - p - u_g$. After substitution, the prices of the two inputs are then

$$p_g = (1-\alpha)(1-p-u_g)^{\rho-1}\left[\alpha\left(p-u_b\right)^{\rho} + (1-\alpha)(1-p-u_g)^{\rho}\right]^{(1-\rho)/\rho}$$
$$p_b = \alpha(p-u_b)^{\rho-1}\left[\alpha\left(p-u_b\right)^{\rho} + (1-\alpha)(1-p-u_g)^{\rho}\right]^{(1-\rho)/\rho}. \quad (11)$$

The price of the good (bad) job product is decreasing (increasing) in θ_g and increasing (decreasing) in θ_b. The intuition is that an increase in θ_i reduces u_i and implies an increase in Y_i that decreases its price and increases the price of the other good.

Using equations (5) to (9) the wage equations are

$$w_b = \beta(p_b - \tau - rk_b) + (1-\beta)rJ_b^U \quad (12)$$

$$w_g = \beta(p_g - \tau - rk_g) + (1-\beta)rJ_g^U \quad (13)$$

Wages in job i are then a weighted average of the surplus that the firm gets (output per worker minus capital creation cost) and the flow value of unemployment. As mentioned workers get a fraction β of that surplus.

The unemployment values are given by (4) with (6), (7), (12) and (13) substituted in,

$$rJ_b^U = G_b(\theta_b,\theta_g) = \frac{(r+s)z + \beta\theta_b q(\theta_b)(p_b - \tau - rk_b)}{r+s+\beta\theta_b q(\theta_b)} \quad (14)$$

$$rJ_g^U = G_g(\theta_b,\theta_g) = \frac{(r+s)z + \beta\theta_g q(\theta_g)(p_g - \tau - rk_g)}{r+s+\beta\theta_g q(\theta_g)} \quad (15)$$

These unemployment values are weighted averages of the unemployment benefit z and the expected income from future employment. As opposed to the standard model where the unemployment value is increasing in labor market tightness there are two countervailing effects of a change in θ_i on the value of unemployment for a worker in sector i. First, as usual, an increase in θ_i implies that workers find jobs faster which has a positive effect on J_i^U. Second, the higher θ_i implies a lower price p_i which reduces J_i^U. Note also that a higher θ_i increases J_j^U because of the positive cross price effects mentioned above.

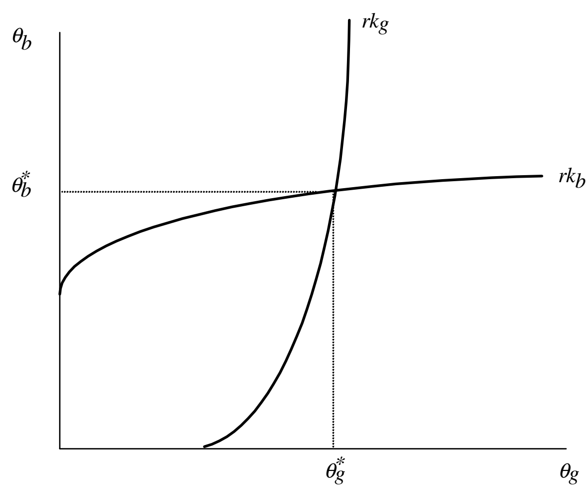
The equilibrium values of vacancies are obtained using (6) and (7) to rewrite (9) as

$$rJ_b^V = rk_b = \frac{q(\theta_b)(1-\beta)(p_b - \tau - rJ_b^U)}{r+s+(1-\beta)q(\theta_b)} \tag{16}$$

$$rJ_g^V = rk_g = \frac{q(\theta_g)(1-\beta)(p_g - \tau - rJ_g^U)}{r+s+(1-\beta)q(\theta_g)} \tag{17}$$

rJ_i^V is decreasing in θ_i and increasing in the cross labor market tightness θ_j where $j \neq i$. It is shown in the Appendix that an increase in labor market tightness in a sector implies a reduction in the probability of meeting a worker and also in the net value of filling the vacancy in that sector. Also, an increase in θ_j leads to an increase in $\left(p_i - rJ_i^U\right)$ which increases rJ_i^V.

FIGURE 1



Finally, the steady state values of θ_b and θ_g are determined by the intersection of the loci formed by equations (16) and (17) with (11), (14) and (15) substituted in. Given $\frac{\partial rJ_i^V}{\partial \theta_i} < 0$ and $\frac{\partial rJ_i^V}{\partial \theta_j} > 0$ both curves are upward sloping as shown in Figure 1.[2]

Equations (16) and (17) imply $\frac{\partial \theta_i}{\partial rk_i} < 0$ and $\frac{\partial \theta_i}{\partial rk_j} < 0$. In Figure 1, a decrease in rk_b shifts the bad-job-locus equation to the left. The increase in θ_b implies a higher p_g and an increase in θ_g is required to restore equilibrium along the good-job-locus given by (17). It can also be shown that $\frac{\partial \theta_i}{\partial r} < 0$, $\frac{\partial \theta_i}{\partial s} < 0$, $\frac{\partial \theta_i}{\partial \beta} < 0$, $\frac{\partial \theta_i}{\partial z} < 0$.

IV. Efficiency and Policy Implications

Following Acemoglu (2001) welfare is defined as the sum of profits and wages less the cost of posting vacancies in both sectors. Note that this welfare function does not consider distributional considerations. The welfare function W is then,

$$W = (p - u_b)(p_b - rk_b) + (1 - p - u_g)(p_g - rk_g) - u_b\theta_b rk_b - u_g\theta_g rk_g.$$

The social planner maximizes that welfare function subject to the same matching constraints that affect private choices,

$$\Omega = \max_{\theta_b,\theta_g} \frac{1}{1 + rdt}\left\{\begin{bmatrix} (p - u_b)(p_b - rk_b) - u_b\theta_b rk_b \\ +(1 - p - u_g)(p_g - rk_g) - u_g\theta_g rk_g \end{bmatrix} dt + \Omega'\right\} \text{ subject to}$$

$$u_b' = u_b + s(p - u_b)dt - q(\theta_b)\theta_b u_b dt$$

$$u_g' = u_g + s(1 - p - u_g)dt - q(\theta_g)\theta_g u_g dt.$$

The first order conditions of this problem imply that the decentralized equilibrium ($z = 0$) is efficient iff

$$\eta(\theta_i) = \beta. \tag{18}$$

This is the standard Hosios condition for efficiency. If $\eta(\theta_i) > \beta$ there is too much job creation (a net congestion externality) and if $\eta(\theta_i) < \beta$ there is too little (a net thick market externality). That is, if (18) holds in both sectors the total number of jobs is efficient and there is also an efficient job composition in the decentralized equilibrium. In contrast to the random search model with homogenous workers where there is always an inefficient job composition, the directed search model with two worker types is efficient under the Hosios condition. It seems unlikely thought that this condition holds in practice.

Now consider the policy implications of the model in view of its efficiency properties restricting the analysis to the effect of unemployment benefits and minimum wages:

- *Unemployment benefit.* An increase in the unemployment benefit z reduces θ_i, employment (Y_i) and profits in both sectors. The reduced number of vacancies implies a lower social cost of creating vacancies $u_i\theta_i rk_i$. When θ_i is too high, because there is too much job creation or β is too low, this policy can increase welfare even while it creates more unemployment. The effect on job composition cannot be signed since it depends on the relative change in θ_i in both sectors.

- *Minimum wage.* A binding minimum wage for sector b, such that $w_b < \bar{w} < w_g$, also reduces θ_b. θ_g may also fall if p is small because there will be a reduction in p_g. This policy will lead to a higher fraction of good jobs. Again the minimum wage can increase welfare if there is too much job creation in the decentralized equilibrium.

Table 1 summarizes the main results of this study in comparison to Acemoglu (2001). In that study an increase in z or a binding minimum wage $\bar{w}$ leads to an increase in the fraction of good-job vacancies that corrects the equilibrium inefficiency and then has a positive impact on welfare. There is also a welfare increase that is explained by a reduction in the social cost of posting vacancies implied by a smaller tightness. In the heterogeneous-worker model this is the only source of any increase in welfare.[3]

TABLE 1

WELFARE IMPLICATIONS OF THE DECENTRALIZED EQUILIBRIUM ($z = 0$)

	Acemoglu (2001	Extended model
Total number of jobs	Standard conditions	Standard conditions
Composition of jobs	Always inefficient	Standard conditions

EFFECT OF A WELFARE INCREASING z OR A MINIMUM WAGE $\bar{w}$ ON:

	Acemoglu (2001)	Extended model
Composition of jobs	Improves	Improves/gets worse (for z)
Number of good jobs	Likely to increase	Never increases
Sources of welfare increase	Better composition Lower cost of vacancies	Lower cost of vacancies

V. Numerical Simulations of Labor Market Policies

This section presents the results of numerical simulations of the effects of the two policies and compare their qualitative effects on job composition, the number of good jobs and welfare in the homogeneous- and heterogeneous-worker models. Most of the parameter values were taken from the literature (Albrecht and Vroman, 2002; Dolado, Jansen and Jimeno, 2003). It was used a Cobb Douglas meeting function with a scale parameter of 2 and elasticity 0.5. It was assumed that $\beta = 0.3$ in order to allow for a welfare gain coming from an increase in unemployment benefit or the institution of a minimum wage in both models.The effect of the policies is then analyzed in a context of too much job creation which means that there is a net congestion externality, *i.e.* $\eta(\theta_i) > \beta$.[4]

Tables 2 and 3 present the results of policy simulations for the two models, respectively. They start by assuming a decentralized equilibrium where there is no labor market policy and then consider increasing levels of z. They also show the effects of a binding minimum wage for the bad-job sector, first assuming a 2% increase in the wage in the bad-job sector relative to the decentralized equilibrium wage and then imposing a minimum wage level calculated as the average between the bad- and good-job-sector wage in the decentralized equilibrium (last column of Table 2 and 3, respectively).

TABLE 2

SIMULATION OF THE HOMOGENEOUS-WORKER RANDOM MATCHING MODEL

	Unemployment benefit z				Minimum wage $\bar{w}$	
	0	0.1	0.15	0.2	w_b*1.02	$(w_b + w_g)/2$
θ	4.314	2.746	1.987	1.129	3.512	2.744
u	0.046	0.057	0.066	0.086	0.051	0.057
ϕ	0.780	0.770	0.760	0.755	0.770	0.760
Y_b	0.744	0.726	0.710	0.690	0.731	0.717
Y_g	0.210	0.217	0.224	0.224	0.218	0.226
p_b	0.407	0.410	0.413	0.414	0.410	0.413
p_g	0.675	0.665	0.655	0.650	0.665	0.655
w_b	0.279	0.282	0.284	0.280	0.285	0.290
w_g	0.300	0.298	0.296	0.291	0.298	0.296
W	0.279	0.281	0.282	0.281	0.280	0.281

Parameter configuration: $\rho = 0.6$, $\beta = 0.3$, $s = 0.2$, $\alpha = 0.5$, $r = 0.05$, $k_b = 2$, $k_g = 6$.

TABLE 3

SIMULATION OF THE HETEROGENEOUS-WORKER SECTOR SPECIFIC SEARCH MODEL

	Unemployment benefit z				Minimum wage $\bar{w}$	
	0	0.1	0.15	0.2	w_b*1.02	$(w_b + w_g)/2$
θ_b	6.328	3.935	2.814	1.575	4.555	5.050
θ_g	1.981	1.339	0.985	0.631	1.981	1.981
u_b	0.029	0.036	0.042	0.055	0.034	0.032
u_b	0.017	0.020	0.023	0.028	0.017	0.017
u	0.045	0.056	0.065	0.083	0.050	0.049
ϕ	0.755	0.756	0.757	0.758	0.754	0.755
Y_b	0.721	0.714	0.708	0.695	0.716	0.718
Y_g	0.233	0.230	0.227	0.222	0.233	0.233
p_b	0.414	0.414	0.414	0.414	0.415	0.414
P_g	0.650	0.651	0.652	0.653	0.649	0.650
w_b	0.282	0.282	0.281	0.277	0.288	0.286
w_g	0.289	0.297	0.298	0.299	0.289	0.289
W	0.281	0.283	0.283	0.282	0.282	0.281

In Table 2 an increase in z from 0 to 0.15 reduces the fraction ϕ of bad-job vacancies, increases the number of good jobs (Y_g) and increases welfare (W). A further increase in the unemployment benefit to 0.2 implies an even better job composition, but also a negative impact on the total surplus of bad-job sector matches that implies a net reduction in welfare. Table 2 also shows that welfare can increase even while creating more unemployment. The same conclusion arises when analyzing a binding minimum wage for the low-wage sector.

Table 3 displays the result of the same policy experiments in the heterogeneous-worker sector directed search model using the same parameter configuration and assuming a fraction of low-skill workers $p = 0.75$. Results suggest that while an increase in z from 0 to 0.15 leads to a welfare increase, it increases the fraction of bad-job vacancies and reduces the number of good-jobs. In this case, the welfare gain comes from the reduced social cost of creating vacancies resulting from the decline in labor market tightness. As shown in Table 3, a binding minimum wage for the low-wage sector can produce additional beneficial effects by improving job composition without reducing the number of good jobs and increasing welfare. However, the increased fraction of good-jobs is explained only by a decline in the number of bad-jobs. Again, both policies lead to higher overall unemployment. The objective of these kind of policies under this two-worker type model can only be to reduce the social cost of vacancy creation.

TABLE 4

PERCENT CHANGE IN SELECTED VARIABLES WITH RESPECT TO THE DECENTRALIZED EQUILIBRIUM

	Table 2			Table 3		
Policy Parameter	ϕ	Y_g	W	ϕ	Y_g	W
$z = 0.1$	–1.3	3.3	0.7	0.1	–1.3	0.7
$z = 0.15$	–2.6	6.7	1.1	0.3	–2.6	0.7
$z = 0.2$	–3.2	6.7	0.7	0.4	–4.7	0.4
$\bar{w} = w_b$*1.02	–1.3	3.8	0.4	–0.1	0.0	0.4
$\bar{w} = (w_b + w_g)/2$	–2.6	7.6	0.7	0.0	0.0	0.0

Table 4 summarizes the results of Tables 2 and 3. It reports the percent change in ϕ, Y_g and W with respect to the decentralized equilibrium values that result from the discussed policy changes in the two models. First, the table shows how the job composition always improves in the random search model and almost always gets worse in the sector specific search model when the different policy changes are introduced. Second, it shows that all the policy changes lead to an increase in employment in the good-job sector in the random search economy and that they never increase the number of good jobs in the directed search heterogeneous-worker model. Third, Table 4 shows that in most cases the random search homogeneous-worker economy experiments greater welfare gains than the directed search heterogeneous-worker one with the different policy changes. This is not surprising given that as Table 1 indicates, the welfare increases in the first model come from both a better job composition and from a reduced social cost of creating vacancies. In the model developed in this paper the welfare gains come only from a reduced social cost of vacancies. Finally, note that in some cases and in both models the welfare gains are decreasing with the policy changes. This has to do to with the net impact of changes in the different components of welfare. The welfare gains are decreasing with higher levels of z or the minimum wage if the associated negative impact of higher unemployment is greater than the positive impact resulting from either a better job composition and/or a reduced social cost of vacancies.

VI. Conclusions

This paper presents a non competitive labor market model with two sectors, two workers and sector specific search and matching. The model is an extension of the homogeneous-worker random matching model developed by Acemoglu (2001). With homogeneous workers and random search, labor market policies such as unemployment insurance and minimum wages can shift job composition toward high-wage jobs, increase the number of high-wage jobs and increase welfare. This paper finds that with heterogeneous workers and sector specific search the beneficial effect of the referred labor market policies is significantly reduced. Indeed, with an increase in an unemployment insurance job composition does not necessarily improve and the number of high-wage jobs never increases. A binding minimum wage for the low-wage sector can lead to a better job composition but without increasing the number of good jobs. Regarding efficiency while the homogeneous-workers and random search model equilibrium is always inefficient the two worker types sector specific search model can be efficient under the standard conditions.

Even though there are obviously many ways in which the model can be extended to enrich the analyisis, this paper is an example of how the effects of labor market policies can be rationalized in different ways.

Notes

1 Again, this could only be possible in the standard case in which the Hosios condition does not hold and there is too much job creation.

2 A proof of uniqueness of the equilibriuni is provided in the Appendix.

3 Note that the two considered policies would be welfare decreasing if $\beta > \eta(\theta_i)$.

4 The assumed value of β is in line with recent empirical evidence for France by Cahuc, Postel-Vinay and Robin (2006).

References

ACEMOGLU, D. (2001). "Good Jobs versus Bad Jobs". *Journal of Labor Economics* 19 (1), pp. 1-21.

ALBRECHT, J. and S. VROMAN (2002). "A Matching Model with Endogenous Skill Requirements", *International Economic Review* 43 (1), pp. 283-305.

CAHUC, P.; F. POSTEL-VINAY and J. M. ROBIN (2006). "Wage Bargaining with On-the-Job Search: Theory and Evidence", *Econometrica* 74 (2), pp. 323-64.

DAVIS, S. (2001). "The Quality Distribution of Jobs and the Structure of Wages in Search Equilibrium", *NBER Working Paper* 8434.

DOLADO, J.; M. JANSEN and J. JIMENO (2003). "On-the-Job Search in a Matching Model with Heterogeneous Jobs and Workers", *IZA Discussion Paper* Nº 886.

PISSARIDES, C. (2000). *Equilibrium Unemployment Theory*, Second Edition, Basil Blackwell, Oxford.

APPENDIX

UNIQUENESS

The equilibrium values of vacancies with the equilibrium value of unemployment substituted in is,

$$rJ_i^V = rk_i = \frac{q(\theta_i)(1-\beta)(p_i - \tau - z)}{r+s+(1-\beta)q(\theta_i)+\beta\theta_i q(\theta_i)} \tag{19}$$

Taking derivatives,

$$\frac{\partial rJ_i^V}{\partial \theta_i} = \frac{q(\theta_i)(1-\beta)\left\{ \begin{array}{l} (p_i - \tau - z)\left[\dfrac{q'(\theta_i)}{q(\theta_i)}(r+s) - q(\theta_i)\beta\right] + \\ \dfrac{\partial p_i}{\partial \theta_i}\left[r+s+(1-\beta)q(\theta_i)+\beta\theta_i q(\theta_i)\right] \end{array} \right\}}{\left[r+s+(1-\beta)q(\theta_i)+\beta\theta_i q(\theta_i)\right]^2} < 0$$

$$\frac{\partial rJ_i^V}{\partial \theta_j} = q(\theta_i)(1-\beta)\frac{\dfrac{\partial p_i}{\partial \theta_j}}{r+s+(1-\beta)q(\theta_i)+\beta\theta_i q(\theta_i)} > 0$$

The slope of the bad and good job locus equations are then,

$$\frac{d\theta_b}{d\theta_{g_B}} = -\frac{\dfrac{\partial rJ_b^V}{\partial \theta_g}}{\dfrac{\partial rJ_b^V}{\partial \theta_b}} = -\frac{\dfrac{\partial p_b}{\partial \theta_g}}{(p_b - \tau - z)\dfrac{(q'(\theta_b)/q(\theta_b))(r+s) - q(\theta_b)\beta}{r+s+(1-\beta)q(\theta_b)+\beta\theta_b q(\theta_b)} + \dfrac{\partial p_b}{\partial \theta_b}} > 0$$

$$= -\frac{\dfrac{\partial p_b}{\partial \theta_g}}{\left[rk_b / (q(\theta_b)(1-\beta))\right]\left[(q'(\theta_b)/q(\theta_b))(r+s) - q(\theta_b)\beta\right] + \dfrac{\partial p_b}{\partial \theta_b}}$$

$$\frac{d\theta_b}{d\theta_{g\ G}} = -\frac{\dfrac{\partial rJ_g^V}{\partial\theta_b}}{\dfrac{\partial rJ_g^V}{\partial\theta_b}} = -\frac{(p_g - \tau - z)\dfrac{(q'(\theta_g)/q(\theta_g))(r+s) - q(\theta_g)\beta}{r+s+(1-\beta)q(\theta_g)+\beta\theta_g q(\theta_g)} + \dfrac{\partial p_g}{\partial\theta_g}}{\dfrac{\partial p_g}{\partial\theta_b}} > 0$$

$$= \frac{\left[rk_g/(q(\theta_g)(1-\beta))\right]\left[(q'(\theta_g)/q(\theta_g))(r+s) - q(\theta_g)\beta\right] + \dfrac{\partial p_g}{\partial\theta_g}}{-\dfrac{\partial p_g}{\partial\theta_b}}$$

Just for simplicity but without lost of generality to any CRS case consider a Cobb Douglas matching function $q(\theta_i) = \theta_i^{-1/2}$ to obtain

$$\frac{\partial p_i}{\partial\theta_j} = -\frac{\theta_i(\theta_i^{1/2}+s)}{\theta_j(\theta_j^{1/2}+s)}\ \frac{\partial p_i}{\partial\theta_i},$$

and now compare the slope of both loci,

$$\frac{d\theta_b}{d\theta_{g\ B}} - \frac{d\theta_b}{d\theta_{g\ G}} = \frac{\dfrac{\partial p_b}{\partial\theta_b}\ \dfrac{\theta_b(\theta_b^{1/2}+s)}{\theta_g(\theta_g^{1/2}+s)}}{\left[rk_b/(\theta_b^{-1/2}(1-\beta))\right]\left[-(r+s)/2\theta_b - \theta_b^{-1/2}\beta\right] + \dfrac{\partial p_b}{\partial\theta_b}} - \frac{\left[rk_g/(\theta_g^{-1/2}(1-\beta))\right]\left[-(r+s)/2\theta_g - \theta_g^{-1/2}\beta\right] + \dfrac{\partial p_g}{\partial\theta_g}}{\dfrac{\partial p_g}{\partial\theta_g}\ \dfrac{\theta_g(\theta_g^{1/2}+s)}{\theta_b(\theta_b^{1/2}+s)}}$$

$$= \frac{\theta_b(\theta_b^{1/2}+s)}{\theta_g(\theta_g^{1/2}+s)}\left(\frac{\partial p_b}{\partial\theta_b} \Big/ \left\{\left[rk_b/(\theta_b^{-1/2}(1-\beta))\right]\left[-(r+s)/2\theta_b - \theta_b^{-1/2}\beta\right] + \frac{\partial p_b}{\partial\theta_b}\right\} - \right.$$

$$\left.\left\{\left[rk_g/(\theta_g^{-1/2}(1-\beta))\right]\left[-(r+s)/2\theta_g - \theta_g^{-1/2}\beta\right] + \frac{\partial p_g}{\partial\theta_g}\right\} \Big/ \frac{\partial p_g}{\partial\theta_g}\right) < 0$$

Then the good job locus is always steeper than the bad job locus assuring that the equilibrium is unique. Note that for the case of perfect substitutes ($\rho = 1$) the bad job locus is a horizontal line and the good job locus is a vertical line.

It can be shown that as $\theta_b \to 0$ the production is concentrated mostly in the good job sector which has $\theta_g > 0$ and finite. In that case $p_b \to 0$, $u_b \to p$, and all the low-skill workers receive the unemployment benefit z. This can be a case in which the cost of opening vacancies, the capital creation cost, is huge. Then firms will not open vacancies in sector b and only the good job sector prevails. In that situation $p_g = (1 - \alpha)^{1/\rho}$ and the equilibrium value of vacancies is obviously $rJ_g^V = rk_g = \dfrac{q(\theta_g)(1-\beta)((1-\alpha)^{1-\rho} - z)}{r + s + (1-\beta)q(\theta_i) + \beta\theta_i q(\theta_i)}$. The opposite occurs when $\theta_g \to 0$.