Good Jobs versus Bad Jobs

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Abstract

This paper develops a model of non-competitive labor markets in which high wage (good) and low wage (bad) jobs coexist. Minimum wages and unemployment benefits shift the composition of employment towards high wage jobs. Because the composition of jobs in the laissez-faire equilibrium is inefficiently biased towards low wage jobs, these labor market regulations increase average labor productivity and may improve welfare.

1 Introduction

The current debate on labor market regulations focuses on their effects on the level of employment. This paper argues that these measures may have a first-order impact on the composition of employment as well as the number of jobs. I show that in a standard model of the labor market, unemployment insurance and minimum wages induce firms to create more high wage jobs, increase average labor productivity, and may improve welfare. Similar points have been made informally. Unions, for example, often support minimum wages and other regulations arguing that they will improve the quality of jobs (see, e.g., Harrison and Bluestone, 1988). This paper demonstrates that some of these claims, perhaps in a less extreme form, follow from standard economic models.

I develop a simple extension of the standard search model of Diamond (1982), Mortensen (1982) and Pissarides (1990) with two different types of jobs. In the model economy, wage differentials for homogenous workers emerge because different types of jobs have different creation (capital) costs.[1] Search frictions break the link between marginal product and wages, and introduce rent-sharing between firms and workers. Although in many search models an appropriate division of bargaining power can internalize the pecuniary externalities from rent-sharing (e.g. Hosios, 1990a, Pissarides, 1990), in the unregulated (laissez-faire) equilibrium of this economy, the composition of jobs is always inefficiently biased towards low wage jobs. The reason for this inefficiency is a form of "hold-up". A firm with a capital-intensive job, which has already sunk its more expensive investment, is forced to bargain to a higher wage and creates a greater positive (pecuniary) externality on workers. Since firms do not internalize this effect, they open too few high wage and too many low wage jobs.

The more novel results of this framework concern the impact of labor market regulations on the composition of jobs, labor productivity and welfare. With higher unemployment benefits, waiting for high wage jobs is less costly, so some workers, who would have otherwise accepted low wage jobs, wait for high wage (good) jobs.[2] This change in search behavior induces more good jobs to be created. There is also an indirect –general equilibrium– effect: as more good jobs are created, the value of being unemployed increases because workers anticipate a higher probability of getting a high wage job, and they become even less willing to accept bad jobs. The minimum wage has the same overall effect but works somewhat differently. A binding minimum wage increases the wage that bad jobs have to pay, which makes them less profitable and improves the composition of jobs. Both minimum wages and unemployment insurance increase labor productivity because they shift employment towards more capital intensive good jobs. Since there are too few good jobs in the laissez-faire equilibrium, these labor market regulations may even improve welfare.

The general equilibrium effects can also lead to multiple equilibria with different compositions of jobs. In one equilibrium, there are many good jobs, so the outside option of workers is high, and bad jobs can only employ them by paying relatively high wages. This makes bad jobs unprofitable. In the other equilibrium, there are many bad jobs, so the outside option of workers is low. The resulting low wages encourage entry, and increase labor market tightness and vacancy duration. Because good jobs have larger upfront investments, a tighter labor market hurts them more and encourages the creation of bad jobs.

A number of papers are related to this work. First, as noted above, I build on the search models of Diamond (1982), Mortensen (1982) and Pissarides (1990). However, in contrast to these contributions, I analyze a search model with an endogenous distribution of jobs (see also Acemoglu, 1996, 1997, 1999, and Davis, 1995), and emphasize the distortions in the composition of jobs arising from a version of the "holdup problem" (Grout, 1984). Pissarides (1994) also analyzes an economy with heterogeneous jobs, but his focus is the modelling of on-the-job-search in the standard

search setup. None of these papers discuss the impact of labor market regulation on the composition of jobs which is the main focus of this paper. Acemoglu and Shimer (1999a), Diamond (1981) and Marimon and Zilibotti (1999) also consider models in which unemployment benefits may improve welfare, but due to different reasons. The influential paper Burdett and Mortensen (1989) demonstrates that minimum wages may increase employment, while Lang (1987) shows that when there is signaling in the labor market, a minimum wage law may discourage low ability workers from imitating high ability workers and increase welfare. Most closely related are previous multi-sector labor market models with frictions. Bulow and Summers (1986) construct a two sector efficiency wage model. Davidson, Martin and Matusz (1987, 1988) and Hosios (1990b) construct two-sector search models where the equilibrium may be inefficient due to standard search inefficiencies, which is different from the hold-up inefficiency in this paper. None of these papers (except in part Acemoglu and Shimer, 1999a) share the result that minimum wages and unemployment insurance improve the composition of jobs, since this feature crucially relies on search and heterogeneity of jobs.
The plan of the paper is as follows. Section 2 analyzes the basic model. It determines the equilibrium composition of jobs and exposes the link between labor market regulation and the mix of jobs. Section 3 considers some extensions.

2 The Basic Model

2.1 Technology and Preferences

Labor and capital are used to produce two non-storable intermediate goods that are then sold in a competitive market and immediately transformed into the final consumption good. Preferences of all agents are defined over the final consumption good alone. Throughout the paper, I will normalize the price of the final good to 1.

There is a continuum of identical workers with measure normalized to 1. All workers are infinitely lived and risk-neutral.[3] They derive utility from the consumption of the unique final good and maximize the present discounted value of their utility. Time is continuous and the discount rate of workers is equal to r. On the other side of the market, there is a larger continuum of firms that are also risk-neutral with discount rate r.

The technology of production for the final good is:

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

where Y_g is the aggregate production of the first input, and Y_b is the aggregate production of the second input, and $\rho < 1$. The elasticity of substitution between Y_g and Y_b is $1/(1-\rho)$ and α parameterizes the relative importance of Y_b. The reason for the use of the subscripts g and b will become clear shortly. This formulation captures the idea that there is some need for diversity in overall consumption/production, and is also equivalent to assuming that (1) is the utility function defined over the two goods. Since the two intermediate goods are sold in competitive markets, their prices are:

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

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

The technology of production for the inputs is Leontieff. When matched with a firm with the necessary equipment (capital k_b or k_g), a worker produces 1 unit of the respective good.[4] The equipment required to produce the first input costs k_g while the cost of equipment for the second input is k_b. Throughout the paper, I assume that $k_g > k_b$.

Before we move to the search economy, it is useful to consider the perfectly competitive benchmark. Since $k_g > k_b$, in equilibrium, we will have $p_g > p_b$. But firms hire workers at the common wage, w, irrespective of their sector. Thus, there will be neither wage differences nor bad nor good jobs. Also, since the first welfare theorem applies to this economy, the composition of output will be optimal.

2.2 Search: The Main Idea

Before the detailed analysis, I can heuristically describe the main result. As soon as we enter the world of search, there will be some rent-sharing. This implies that a worker who produces a higher valued output will receive a higher wage. As noted above, because $k_g > k_b$, the input which costs more to produce will command a higher price, thus in equilibrium $p_g > p_b$. Rent-sharing, then, leads to equilibrium wage differentials across identical workers. That is, $w_g > w_b$. Hence, the terms *good* and *bad* jobs. Next, it is intuitive that since, compared to the economy with competitive labor markets, good jobs have higher relative labor costs, their relative production will be less than optimal. In other words, the proportion of good (high-wage) jobs will be too low compared to what a social planner would choose. The rest of this section will formally analyze the search economy and establish these claims. It will then demonstrate that higher minimum wages and more generous unemployment benefits will improve the composition of jobs and possibly welfare.

2.3 The Technology of Search

Firms and workers come together via a matching technology $M(u, v)$ where u is the unemployment rate, and v is the vacancy rate (the number of vacancies). The underlying assumption here is that search is *undirected*, thus both types of vacancies have the same probability of meeting workers, and it is the total number of vacancies that enters the matching function. Section 3.2 allows for *directed* search whereby workers decide which type of job to apply to. $M(u, v)$ is twice differentiable and increasing in its arguments and exhibits constant returns to scale. This enables me to write the flow rate of match for a vacancy as $\frac{M(u,v)}{v} = q(\theta)$ where $q(.)$ is a differentiable decreasing function and $\theta = \frac{v}{u}$ is the tightness of the labor market. It also immediately follows from the constant returns to scale assumption that the flow rate of match for an unemployed worker is $\frac{M(u,v)}{u} = \theta q(\theta)$ (see Pissarides, 1990). In general, $q(\theta)$, $\theta q(\theta) < \infty$, thus it takes time for workers and firms to find suitable production partners. I also make the standard Inada-type assumptions on $M(u,v)$ which ensure that $\theta q(\theta)$ is increasing in θ, and that $\lim_{\theta \to \infty} q(\theta) = 0$, $\lim_{\theta \to 0} q(\theta) = \infty$, $\lim_{\theta \to \infty} q(\theta)\theta = 0$ and $\lim_{\theta \to 0} q(\theta)\theta = \infty$.

All jobs end at the exogenous flow rate s, and in this case, the firm becomes an unfilled vacancy and the worker becomes unemployed. Finally, there is free entry into both good and bad job vacancies, therefore both types of vacancies should expect zero net profits.

I denote the flow return from unemployment by z which will be thought as the level of unemployment benefit financed by lump-sum taxation.[5] I assume that wages are determined by asymmetric Nash Bargaining where the worker has bargaining power β (see Pissarides, 1990). Nash Bargaining per se is not essential, though rent-sharing is crucial for the results.

Firms can choose either one of two types of vacancies: *(i)* a vacancy for a intermediate good 1 - a *good job*; *(ii)* a vacancy for an intermediate good 2 - *a bad job*. Therefore, before opening a vacancy a firm has to decide which input it will produce, and at this point, it will have to buy the equipment that costs either k_b or k_g. The important aspect is that these *creation* costs are incurred before the firm meets its employees; this is a reasonable assumption, since, in practice, k corresponds to the costs of machinery, which are sector and occupation specific.

2.4 The Basic Bellman Equations

I will solve the model via a series of Bellman equations. I denote the discounted value of a vacancy by J^V, of a filled job by J^F, of being unemployed by J^U and of being employed by J^E. I will use subscripts b and g to denote good and bad jobs. I also denote the proportion of bad job vacancies among all vacancies by ϕ. Then, in steady state:

$$rJ^U = z + \theta q(\theta)\left[\phi J_b^E + (1-\phi)J_g^E - J^U\right] \tag{4}$$

Since this type of equation is rather standard (e.g. Pissarides, 1990), I will only give a brief explanation. Being unemployed is similar to holding an asset; this asset pays a dividend of z, the unemployment benefit, and has a probability $\theta q(\theta)\phi$ of being transformed into a bad job in which case the worker obtains J_b^E, the asset value of being employed in a bad job, and loses J^U; it also has a probability $\theta q(\theta)(1-\phi)$ of being transformed into a good job, yielding a capital gain $J_g^E - J^U$ (out of steady state, $\dot{J}^U$ has to be added to the right-hand side to capture future changes in the value of unemployment). Observe that this equation is written under the implicit assumption that workers will not turn down jobs, which I will discuss further below (see footnote 6). The steady state discounted present value of employment can be written as:

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

for $i = b, g$. (5) has a similar intuition to (4).

Similarly, when matched, both vacancies produce 1 unit of their goods, so:

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

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

for $i = b, g$, where I have ignored the possibility of voluntary job destruction which will never take place in steady state.

Since workers and firms are risk-neutral and have the same discount rate, Nash Bargaining implies that w_b and w_g will be chosen so that:

$$\begin{aligned}(1-\beta)(J_b^E - J^U) &= \beta(J_b^F - J_b^V) \\ (1-\beta)(J_g^E - J^U) &= \beta(J_g^F - J_g^V)\end{aligned} \tag{8}$$

Note that an important feature is already incorporated in these expressions: workers cannot pay to be employed in high wage jobs: due to search frictions, at the moment a worker finds a job, there is bilateral monopoly, and this leads to rent-sharing over the surplus of the match.

As there is free-entry on the firm side, it should not be possible for an additional vacancy to open and make expected net profits. Hence:

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

Finally, the steady state unemployment rate is given by equating flows out of unemployment to the number of destroyed jobs. Thus:

$$u = \frac{s}{s+\theta q(\theta)}. \tag{10}$$

2.5 Characterization of Steady State Equilibria

A steady state equilibrium is defined as a proportion ϕ of bad jobs, tightness of the labor market θ, value functions J_b^V, J_b^F, J_b^E, J_g^V, J_g^F, J_g^E and J^U, prices for the two goods, p_b and p_g such that equations (3), (4), and (5), (6), (7), (8) and (9) for both $i = b$ and g are satisfied. The steady state unemployment rate is then given by (10).[6]

In steady state, both types of vacancies meet workers at the same rate, and in equilibrium workers accept both types of jobs, therefore $Y_b = (1-u)\phi$ and $Y_g = (1-u)(1-\phi)$. Then, from (3), the prices of the two inputs can be written as:

$$\begin{aligned}p_g &= (1-\alpha)(1-\phi)^{\rho-1}\left[\alpha\phi^\rho + (1-\alpha)(1-\phi)^\rho\right]^{\frac{1-\rho}{\rho}} \\ p_b &= \alpha\phi^{\rho-1}\left[\alpha\phi^\rho + (1-\alpha)(1-\phi)^\rho\right]^{\frac{1-\rho}{\rho}}.\end{aligned} \tag{11}$$

Simple algebra using (5), (6), (8) and (9) gives:

$$w_i = \beta\left(p_i - rk_i\right) + (1-\beta)rJ^U \tag{12}$$

as the wage equation. Intuitively, the surplus that the firm gets is equal to the value of output which is p_i minus the flow cost of the equipment, rk_i. The worker gets a share β of this, plus $(1-\beta)$ times his outside option, rJ^U. Using (6) and (7), the zero-profit condition (9) can be rewritten as:

$$\frac{q(\theta)(1-\beta)\left(p_b - rJ^U\right)}{r+s+(1-\beta)q(\theta)} = rk_b \tag{13}$$

$$\frac{q(\theta)(1-\beta)\left(p_g - rJ^U\right)}{r+s+(1-\beta)q(\theta)} = rk_g. \tag{14}$$

A firm buys equipment that costs k_i, which remains idle for a while due to search frictions (i.e. because $q(\theta) < \infty$). This cost is larger for firms that buy more expensive equipment and open good jobs. They need to recover these costs in the form of a higher net flow profits: i.e. $p_g - rk_g > p_b - rk_b$. From rent-sharing, this immediately implies that $w_g > w_b$. More specifically, combining (12), (13) and (14), we get :

$$w_g - w_b = \frac{(r+s)(rk_g - rk_b)}{q(\theta)} > 0 \tag{15}$$

Therefore, wage differences are related to the differences in capital costs and also to the average duration of a vacancy. In particular, when $q(\theta) \to \infty$, the equilibrium converges to the Walrasian limit point, and both w_g and w_b converge to rJ^U, so wage differences disappear. The reason is that in this limit point, capital investments never remain idle, thus good jobs do not need to make higher net flow profits. Also, with equal creation costs, i.e., $k_b = k_g$, wage differentials disappear again.

Finally, (4) gives the value of an unemployed worker as

$$rJ^U = G(\theta,\phi) \equiv \frac{(r+s)z + \beta\theta q(\theta)\left[\phi(p_b - rk_b) + (1-\phi)(p_g - rk_g)\right]}{r+s+\beta\theta q(\theta)} \tag{16}$$

It can easily be verified that $G(.,.)$ is continuous, strictly increasing in θ, and strictly decreasing in ϕ. Intuitively, as the tightness of the labor market, θ, increases, workers find jobs faster, thus rJ^U is higher. Also as ϕ decreases, the greater fraction of good jobs among vacancies increases the value of being unemployed since $w_g > w_b$ (i.e., $J_g^V > J_b^E$). The dependence of rJ^U on ϕ is the general equilibrium effect mentioned in the introduction: as the composition of jobs changes, the option value of being unemployed also changes.

A steady-state equilibrium is characterized by the intersection of two loci: *bad job locus,* (13), and the *good job locus,* (14) (both evaluated with (11) and (16) substituted in). Figure 1 draws these two loci in the θ-ϕ plane. (14), along which a firm that opens a good job vacancy makes zero-profits, is upward sloping: a higher value of ϕ increases the left hand side, thus θ needs to change to increase the right-hand side (and reduce the left-hand side through $G(\theta, \phi)$). Intuitively, an increase in ϕ implies a higher p_g (from equation (11)). So to ensure zero profits, θ needs to increase to raise the duration of vacancies. In contrast, (13) cannot be shown to be decreasing everywhere. Intuitively, an increase in ϕ reduces p_b, thus requires a fall in θ to equilibrate the market, but the general equilibrium effect through J^U (i.e. that a fall in ϕ reduces J^U) counteracts this and may dominate. This issue is discussed further in the next subsection.

Here, I start with the case in which $\rho \leq 0$, so that good and bad jobs are gross complements. In this case, it is straightforward to see that as ϕ tends to 1, (13) gives $\theta \to \infty$ whereas (14) implies $\theta \to 0$. Thus, the bad job locus is above the good job locus. The opposite is the case as ϕ goes to zero. Then by the continuity of the two functions, they must intersect at least once in the range $\phi \in (0,1)$. The next proposition summarizes these results:

Proposition 1. Suppose that $\rho \leq 0$. Then, a steady state equilibrium with $\phi \in (0,1)$

always exists and is characterized by (11), (12), (13), (14) and (16). In equilibrium, for all $k_g > k_b$, we have $p_g > p_b$ and $w_g > w_b$.

When $\rho > 0$, an equilibrium continues to exist, but does not need to be interior, so one of (13) and (14) may not hold. A particular example of this is discussed in the next subsection.

2.6 Multiple equilibria

Since (13) can be upward sloping over some range, more than one intersections, hence multiple equilibria, are possible. (13) is more likely to be upward sloping when relative prices change little as a result of a change in the composition of jobs. Therefore, to illustrate the possibility of multiple equilibria, I consider the extreme case where $\rho = 1$, so that goods g and b are perfect substitutes, and there are no relative price effects. Furthermore, I assume that $1 - 2\alpha > r(k_g - k_b)$. In the absence of this assumption, good jobs are not productive enough, and will never exist in equilibrium.

The absence of substitution between good and bad jobs immediately implies that $p_g = 1 - \alpha > p_b = \alpha$. The equilibrium can then be characterized diagrammatically. To do this, totally differentiate (13) and (14), with $p_g = 1 - \alpha$ and $p_b = \alpha$, which gives

$$\left.\frac{d\theta}{d\phi}\right|_i = \frac{-\frac{\partial G(\theta,\phi)}{\partial \phi}}{\frac{\partial G(\theta,\phi)}{\partial \theta} - k_i \frac{(r+s)(1-\beta)q'(\theta)}{(1-\beta)q(\theta)^2}\frac{\partial G(\theta,\phi)}{\partial \theta}} > 0 \tag{17}$$

where $i = b$ is zero profit condition for bad jobs, (13), and $i = g$ is the zero profit condition for good jobs, (14). The derivative in (17) is positive, irrespective of whether it is for good or bad jobs, because $rJ^U = G(\theta, \phi)$ is decreasing in ϕ and increasing in θ, while $q'(\theta) < 0$. Since $k_b < k_g$, this equation also immediately implies that (13) is steeper than (14). So (13) has to intersect (14) from below if at all, in which case there will be three equilibria, as shown in Figure 2.[7] The first is a "mixed strategy" equilibrium at the point where the two curves intersect. The other two equilibria are more interesting. When $\phi = 0$, we have $\theta_g > \theta_b$, so that it is more profitable to open a good job (see Figure 2).[8] Hence there is an equilibrium in which all firms open good jobs. It is not profitable for firms to open a bad job, because when $\phi = 0$, workers receive high wages and have attractive outside options; so a firm that opens a bad job will be forced to pay a relatively high wage, making a deviation to a bad job unprofitable. In contrast, at $\phi = 1$, we have $\theta_g' < \theta_b'$, so it is an equilibrium for all firms to open bad jobs. Intuitively, when all firms open bad jobs, the outside option of workers is low, so firms bargain to low wages, making entry relatively profitable. In equilibrium, θ has to be high to ensure zero profits. But a tight labor market (a high θ) hurts good jobs relatively more since they have to make larger upfront investments. The multiplicity of equilibria in this model illustrates the strength of the general equilibrium forces that operate through the impact of job composition on the overall level of wages.

2.7 Welfare

To analyze the welfare properties of equilibrium, I look at the total steady state surplus of the economy, defined as total output minus total costs, i.e. the *net* output of the economy. This measure is what an agent would care about before entering the economy (as is the convention in these models, see Hosios, 1990a, Pissarides, 1990). Total surplus (in steady state) can be written as:

$$TS = (1-u)\left[\phi(p_b - rk_b) + (1-\phi)(p_g - rk_g)\right] - \theta u\left(\phi r k_b + (1-\phi) r k_g\right) \tag{18}$$

Total surplus is equal to total flow of net output, which consists of the number of workers in good jobs ($(1-\phi)(1-u)$) times their net output (p_g minus the flow cost of capital rk_g), plus the number of workers in bad jobs ($\phi(1-u)$) times their net product ($p_b - rk_b$), minus the flow costs of job creation for good and bad vacancies (respectively, $\theta u(1-\phi)rk_g$ and $\theta u \phi r k_b$).

It is straightforward to locate the set of allocations that maximize total social surplus. This set would be the solution to the maximization of (18) subject to (10). Inspecting the first-order conditions of this problem, it can be seen that decentralized equilibria will not in general belong to this set, thus a social planner can improve over the equilibrium allocation. The results regarding the socially optimal amount of job creation are standard (Hosios, 1990a; Pissarides, 1990): if β is too high, that is $\beta > \eta(\theta)$ where $\eta(\theta)$ is elasticity of the matching function, $q(\theta)$, then there will be too little job creation, and if $\beta < \eta(\theta)$, there will be too much. Since this paper is concerned with the composition of jobs, I will not discuss these issues in detail. Instead, I will show that irrespective of the value of θ, the equilibrium value of ϕ is always too high; that is, there are too many bad jobs relative to the number of good jobs.

To prove this claim, it is sufficient to consider the derivative of TS with respect to ϕ at $z = 0$ (note the constraint, (10), does not depend on ϕ):

$$\frac{dTS}{d\phi} = (1-u) \cdot \left[\frac{d(\phi p_b + (1-\phi)p_g)}{d\phi}\right] - (1-u+u\theta) \cdot \{rk_b - rk_g\} \tag{19}$$

For the composition of jobs to be efficient at the laissez-faire equilibrium, (19) needs to equal zero when evaluated in the equilibrium characterized above. Some simple algebra using (10), (11), (13) and (14) to substitute out u, and k_i gives (details of the algebra available upon request):

$$\left.\frac{dTS}{d\phi}\right|_{dec.\ eq.} = \frac{\theta q(\theta)}{s+\theta q(\theta)} \cdot \left(1 + \frac{(s+q(\theta))(1-\beta)}{r+s+(1-\beta)q(\theta)}\right) \cdot (p_b - p_g) < 0$$

This expression is always negative, irrespective of the value of θ, so starting from laissez-faire equilibrium, a reduction in ϕ will increase social surplus. Therefore:

Proposition 2. Let $\phi^s(\theta)$ be the value of ϕ that the social planner would choose at labor market tightness θ, and $\phi^*(\theta)$ be the laissez-faire equilibrium with $z = 0$, then $\phi^*(\theta) > \phi^s(\theta)$ for all θ. That is, in the laissez-faire equilibrium, the proportion of bad jobs is too high.

The intuition is simple; in a decentralized equilibrium, it is always the case that $w_g > w_b$. Yet, firms do not take into account the higher utility they provide to workers by creating a good job rather than a bad job, hence there is an uninternalized positive externality, which leads to an excessively high fraction of bad jobs in equilibrium. Search and rent-sharing are crucial for this result. Search ensures that firms have to share the ex post rents with the workers, and they cannot induce competition among workers to bid down wages. Firms would ideally like to contract with their workers on the wage rate before they make the investment decision, but search also implies that they do not know who these workers will be, thus cannot contract with them at the time of investment (Acemoglu, 1996).

2.8 The Impact of Minimum Wages and Unemployment Benefits

As is usual in models with potential multiple equilibria, only the comparative statics of "extremal" equilibria are of interest. Therefore, I assume in this subsection that the economy is in an equilibrium where (14) cuts (13) from below.[9] Now consider an increase in z which corresponds to the UI system becoming more generous. Both the bad job locus, (13), and the good job locus, (14), will shift down (to the dotted curves in Figure 1). Hence, θ will definitely fall. It is also straightforward to verify that (13) will shift by more, therefore, ϕ is unambiguously reduced.[10] Intuitively, with ϕ unchanged, relative prices and hence wages will be unchanged, but then with the higher unemployment benefits, workers would prefer to wait for good jobs rather than accept bad jobs. This increases w_b and reduces ϕ (the fraction of bad jobs). Furthermore, a more generous unemployment benefit not only increases the fraction of good jobs, but may also increase the total number of good jobs. Totally differentiating

(13) and (14), we obtain that the total number of good jobs will increase if and only if:

$$w_g - w_b > \left(\frac{1}{\eta(\theta)} - 1\right) u(1-\phi) \left(\frac{d(p_g - p_b)}{d\phi}\right)$$

where recall that $\eta(\theta)$ is the elasticity of $q(\theta)$. This inequality is likely to be satisfied when the two inputs are highly substitutable, i.e. ρ close to 1; when wage differences are large; when $\eta(\theta)$ is close to 1; and/or when unemployment is low to start with. Thus, it is only increases in unemployment benefit starting from moderate levels that increase the number of good jobs.

The impact on welfare depends on how large the effect on θ is relative to the effect on ϕ. We can see this by totally differentiating (18) after substituting for u. This gives a relationship between θ and ϕ, drawn as the dashed line in Figure 1, along which total surplus is constant. Shifts of this curve towards North-East give higher surplus. When this curve is steeper than (14), a higher z can improve welfare, and this is the case drawn in Figure 1. For example, if β is very low to start with, then unemployment will be too low relative to the social optimum (see Hosios, 1990a, Pissarides, 1990), and in this case an increase in z will unambiguously increase total welfare.[11]

More generally, irrespective of whether total surplus increases, a more generous unemployment benefit raises average labor productivity, $\phi p_b + (1-\phi)p_g$, which is unambiguously decreasing in ϕ. Therefore, when unemployment benefits increase, the composition of jobs shifts towards more capital intensive good jobs, and labor productivity increases.

A minimum wage has a similar effect on job composition. Consider a minimum wage $\underline{w}$ such that $w_b < \underline{w} < w_g$, so it is only binding for bad jobs. The equation for J_b^F now becomes: $J_b^F = \frac{p_b - \underline{w} + sk_b}{r+s}$. Then, (13) changes to:

$$q(\theta)\frac{p_b - \underline{w}}{r + s + q(\theta)} = rk_b. \tag{20}$$

Since at a given θ, the left-hand side of (20) is less than that of (13), the impact of higher minimum wages is to shift the bad job locus, curve (13), in Figure 1 down. The good job locus is still given by (14), but now, combining (4) and (5),

$$rJ^U = G(\theta, \phi) \equiv \frac{(r+s)z + \beta\theta q(\theta)\left[\phi \underline{w} + (1-\phi)(p_g - rk_g)\right]}{r + s + \theta q(\theta)(1-(1-\beta)(1-\phi))}$$

Since $\underline{w} > w_b$, both curves shift down in Figure 1, but as in the case of unemployment benefits, (13) shifts down by more, so both ϕ and θ fall. Again, the rise in minimum wages can increase the number, not just the proportion, of good jobs and total welfare. Moreover, for the same decline in θ, an increase in minimum wages reduces ϕ more than an increase in z, therefore, minimum wages appear to be more powerful in shifting the composition of employment away from bad towards good jobs. Overall:

Proposition 3. Both the introduction of a minimum wage $\underline{w}$ and an increase in unemployment benefit z decrease θ and ϕ. Therefore, they improve the composition of jobs and average labor productivity, but increase unemployment. The impact on overall surplus is ambiguous.

This section only reported the response of the steady state to changes in policy. Transitory dynamics are more involved but do not change the basic predictions. Essentially, in response to an increase in z (or a binding minimum wage, $\underline{w}$), the economy stops creating bad jobs for a while and creates only good jobs. Therefore, the short-run impact of the policy changes will be quite large. Overall, in finite time, the right fraction of good and bad jobs is achieved, but the unemployment rate adjusts more slowly. As a full analysis of transitory dynamics requires considerably more notation, the details are left out.

3 Extensions

3.1 Endogenous Search Effort

In the above analysis, although higher unemployment benefits and minimum wages improve the composition of jobs and potentially welfare, they always increase unemployment. However, this not a general result. If we also include a margin of choice on the worker side, this result no longer holds. In this subsection I briefly outline the simplest way of modeling this by introducing search effort (see, for example, Pissarides, 1990).

I assume that the matching function is given as $M(\bar{e}u, v)$ where $\bar{e}$ is the average search effort of unemployed workers. Similar equations can now be written but θ needs to be defined as: $\bar{\theta} = \frac{v}{\bar{e}u}$. Throughout this section, I will only consider symmetric steady state equilibria in which all workers use the same strategy, thus $e = \bar{e}$. The probability that a worker searching at intensity e finds a job is $e\bar{\theta}q(\bar{\theta})$ where $\bar{\theta} = \frac{v}{\bar{e}u}$. I also assume that the flow cost of choosing search effort e is $c(e)$ where $c(.)$ is a strictly increasing, differentiable and convex function. Then, the Bellman equations for the firm are unchanged and for the worker only (4) changes and is replaced by:

$$rJ^U = z - c(e) + e\bar{\theta}q(\bar{\theta})\left[\phi J_b^E + (1-\phi)J_g^E - J^U\right] \tag{21}$$

Also, (10) now becomes:

$$u = \frac{s}{s + \bar{e}\bar{\theta}q(\bar{\theta})}$$

Differentiating (21), we get the condition for e to be chosen optimally, and evaluating this in equilibrium, i.e. $e = \bar{e}$, we obtain:

$$\bar{\theta}q(\bar{\theta})\left[\phi J_b^E + (1-\phi)J_g^E - J^U\right] = c'(\bar{e})$$

As before, for given $\bar{e}$ an increase in the minimum wage will reduce $\bar{\theta}$, but with endogenous search effort, it will also increase $\bar{e}$ (as long as it increases J_b^E). Therefore, the overall impact on u is ambiguous: if the change in e is large enough, unemployment may fall because the increase in wages caused by the minimum wage legislation encourages all workers to search more. This model with variable search effort therefore offers an alternative and complementary explanation to Burdett and Mortensen's (1989) model for why in the instances studied by Card and Krueger (1995) higher minimum wages did not reduce employment of affected workers, and may have even increased it slightly.

The analysis of an increase in unemployment benefit is similar. However, the impact of unemployment benefits on employment is now more negative. This is because, in contrast to an increase in minimum wage which tends to encourage search, a higher level of z creates a standard moral hazard effect and discourages search effort.

3.2 Directed Search

In practice workers do have some information about which sectors pay higher wages. Therefore, a model of directed search where workers decide which type of job to apply to may describe the functioning of the labor market better. This subsection briefly discusses the extension of the model to include directed search.

Suppose that workers can apply to the good job or bad job sector. The number of bad jobs matches is given by $M(u_b, v_b)$ and that for good jobs is given by $M(u_g, v_g)$, where u_i is the number of unemployed workers applying to i-type jobs and v_i is the number of i-type vacancies.[12] The assumption that both sectors have exactly the same matching function is for simplicity and highlights that differences in the technology of matching are not the source of the results. Since $M(.,.)$ exhibits constant returns to scale, the flow rate of a match for a worker applying to sector i is $\theta_i q(\theta_i)$, and the flow rate of match for a type i-vacancy is $q(\theta_i)$. The steady-state value of an unemployed worker applying to sector i is:

$$rJ_i^U = z + \theta_i q(\theta_i)\left[J_i^E - J_i^U\right] \tag{22}$$

For there to be both types of jobs, we require that $rJ^U = rJ_b^U = rJ_g^U$. The other Bellman equations (5), (6), (7), the wage equation (8), and the zero-profit condition (9) are the same as above. Now, we have to determine θ_b and θ_g separately, and the aggregate production of bad and good intermediate goods are : $Y_b = (1 - u_b)\lambda$ and $Y_g = (1 - u_g)(1 - \lambda)$ where λ is the fraction of workers applying to the bad job sector. The price equation (11) is also modified accordingly.

An equilibrium exists, and since (12) still applies, we have $w_g > w_b$. Worker indifference between the two sectors, $rJ_b^U = rJ_g^U$, also implies that $\theta_b q(\theta_b) > \theta_g q(\theta_g)$, that is workers who apply to bad jobs suffer shorter unemployment spells. This is in line with the evidence cited in the introduction that high wage jobs attract longer queues (Holzer, Katz and Krueger, 1995). Labor market regulations have the same effects as before in this model. First, a higher level of z at given θ_b, θ_g, u_b and u_g would lead to $rJ_g^U > rJ_b^U$, encouraging more workers to apply to the good job sector. To ensure the indifference condition for workers, $rJ_b^U = rJ_g^U$, p_g and w_g have to decline, so the production of good g and the fraction of workers applying to the good job sector, $1 - \lambda$, will increase and the price of the output of sector g will fall. Therefore, the unemployment benefit once again shifts the composition of employment towards high wage jobs. Minimum wages will again work more directly by pushing w_b up, thus reducing profits from opening bad jobs, and encouraging the creation of more good jobs.

Welfare implications are now more complicated, and depend on whether the bargaining power of workers, β, is greater than or less than the elasticity of the matching function, $\eta(\theta)$ (Hosios, 1990a). When $\beta > \eta(\theta)$, there will be too little job creation, and the composition of jobs will be biased towards low-wage jobs. The reason why directed search does not necessarily help in solving the inefficiency problem is that firms are unable to commit to wages, which are still determined by bargaining after matching takes place.[13]

3.3 Unemployment Benefits Conditional on Past History

The analysis so far considered an unemployment insurance system that pays a constant amount z to all unemployed workers. In practice, the level of benefits depends on the earnings history of individual workers, often with a progressive form. This can be incorporated into the model by introducing two levels of unemployment benefits, z_g and z_b, such that workers previously employed in a good job receive z_g, while those previously employed in a low-wage job receive z_b. The analysis becomes considerably more complicated, in part because the value to obtaining a certain job includes future unemployment benefits that the worker will receive after being employed at this job. The main results are unaffected, but we obtain the additional result that an increase in the progressivity of unemployment benefits increases the fraction of low wage jobs. Notice that in this setup, workers have a further reason to wait for high wage jobs, since these are associated with a higher unemployment benefit, z_g, in the future. An increase in the progressivity of the unemployment benefit system, which corresponds to a decrease in z_g relative to z_b, therefore weakens this motive and makes workers more willing to take low-wage jobs. This encourages the creation of more bad jobs.

3.4 Capital-Labor Substitution

The technology of production used so far is Leontieff and each firm employs only one worker. So there is no room for capital-labor substitution within firms. It is instructive to investigate whether the results generalize to the case with capital-labor substitution and diminishing return to labor. With diminishing returns, the exact form of bargaining becomes important. If workers bargain as a group against the firm, for example in the form of a union, the results so far immediately generalize. The more involved case is the one where the firm bargains individually with each worker. This case has been analyzed by Stole and Zwiebel (1996) who use a bargaining concept similar to the Shapley value. A striking result of their analysis is that, when a firm bargaining with each employee individually faces a perfectly elastic demand curve, it will hire more workers than a wage-taking firm. It will do so to reduce the productivity contribution of a marginal worker and to hold down workers to their outside option. In our context, suppose that a firm in the g sector has the production function $k_g^{1-\gamma} l_g^{\gamma}$ and a firm in the b sector has the production function $k_b^{1-\eta} l_b^{\eta}$ where $\eta > \gamma$, ensuring that the b sector is more labor-intensive. It is straightforward that a wage taking firm facing a wage of v would choose $l_g = \gamma^{1/(1-\gamma)} p_g^{1/(1-\gamma)} v^{-1/(1-\gamma)} k_g$. Stole and Zwiebel (1996)'s Result 1 implies that a firm bargaining with its employees individually will instead hire $\widehat{l}_g = (2\gamma)^{1/(1-\gamma)} (1+\gamma)^{-1/(1-\gamma)} p_g^{1/(1-\gamma)} v^{-1/(1-\gamma)} k_g > l_g$, and pay v to all of its employees. Similar expressions apply for sector b firms; they too pay v to all their employees, so wage differentials across workers disappear.

This may suggest that the results here do not generalize to a situation with capital-labor substitution, diminishing returns to labor, and individual bargaining between firms and workers. This is not necessarily the case, however. The main difference between the situation considered by Stole and Zwiebel (1996) and my model is that here the firm cannot costlessly hire new workers. Instead, after a firm purchases the required equipment and opens a vacancy, recruitment of workers will be a slow process, which is the source of all the inefficiencies and the results in the above analysis. Therefore, even if the firm finds it optimal to build up its labor force to $\widehat{l}_g$, there will be an extended period of time during which the productivity of the marginal worker is quite high, and during this period, the firm will have to pay high wages.

Although such a model is quite difficult to solve, it seems natural that this problem would imply higher labor costs for sector g firms than sector b firms, once again biasing the composition of jobs towards low wages.[14]

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Footnotes

[1]This is the theory part of a previous paper entitled "Good Jobs versus Bad Jobs: Theory and Some Evidence". I thank Josh Angrist, Olivier Blanchard, Ricardo Caballero, Peter Diamond, David Genesove, Jonathan Gruber, Alan Krueger, Steve Pischke, Canice Prendergast, Jaume Ventura, two anonymous referees and seminar participants at the EUI Florence, CEPR Rising Inequalities Conference, NBER Summer Institute, MIT, Princeton and SUNY Albany for useful comments and suggestions. Financial support from the World Economic Laboratory at MIT and the National Science Foundation Grant SBR-9602116 are gratefully acknowledged.

[1]In the data, there are large and stable wage differentials among observationally identical workers in different industries and occupations (see Krueger and Summers, 1987,1988). Workers who change industry appear to receive the wage differential between their previous and new job (Krueger and Summers, 1988, Gibbons and Katz, 1992), and high wage jobs have lower quit rates (Krueger and Summers, 1988) and longer worker queues (Holzer, Katz and Krueger, 1991). As in this model, high wage industries and jobs are on average more capital intensive (Dickens and Katz, 1987).

[2]I refer to high wage jobs as "good", especially since in equilibrium there will be too few of these jobs. This does not imply that it is always welfare improving to have more high wage jobs.

[3]The assumption that workers are risk-neutral obviously leaves out the most important role of unemployment insurance, but it also helps to highlight that the impact of unemployment benefits on job composition is distinct from their insurance role. See Acemoglu and Shimer (1999a) for a model of search and risk-aversion.

[4]Since utility is linear, whether we think of k_b and k_g as capital costs or not is immaterial. The assumption that one worker and equipment k_i produces 1 unit of the

corresponding intermediate good is a convenient normalization.

[5]Naturally, unemployment insurance and assistance in the real world do not take this simple form (see for instance, Atkinson and Micklewright, 1991). First, benefits depend upon past employment history and earnings (see Section 3.3 on this); second, unemployment benefits typically expire after a while; and third, there are additional eligibility requirements. Including these complications will not change the main qualitative implications of the analysis (see Mortensen, 1977, for a detailed partial equilibrium analysis of the impact of unemployment insurance on search decisions).

[6]One might wonder at this point whether a different type of equilibrium, with $J^U = J_b^E$ and workers accepting bad jobs with probability $\zeta < 1$, could exist. The answer is no. From equation (8), this would imply $J_b^V = J_b^F$, but in this case, firms could never recover their upfront investment costs.

[7]Alternatively, the two curves may never intersect. In this case, if $\theta_b > \theta_g$ and $\theta_b' > \theta_g'$, then the unique equilibrium is one with bad jobs only, or if $\theta_b < \theta_g$ and $\theta_b' < \theta_g'$, there will only be good jobs.

[8]Firms that open good jobs make zero profits at $\theta = \theta_g$, while firms that open bad jobs make zero profit at $\theta = \theta_b$. Since $\theta_g > \theta_b$, good jobs are more profitable than bad jobs.

[9]It is straightforward to extend the analysis to show that in the case where there are multiple equilibria, labor market regulations make the equilibrium with more good jobs more likely.

[10]To see this formally, totally differentiate (13) and (14) with respect to θ, ϕ and z, and write $\mathbf{A}(d\theta \;\; d\phi)' = \mathbf{b}dz$ where $\mathbf{A}$ is a 2×2 matrix and $\mathbf{b} =(1 \;\; 1)'$. It is straightforward to see that in a "stable" equilibrium $\det \mathbf{A} > 0$ and $a_{11} - a_{21} = \frac{q'(\theta)(r+s)(rk_g - rk_b)}{q(\theta)^2} < 0$

which gives $\frac{d\phi}{dz} < 0$.

[11]Namely $\frac{dTS}{dz} = \frac{\partial TS}{\partial \phi}\frac{d\phi}{dz} + \frac{\partial TS}{\partial \theta}\frac{d\theta}{dz}$. The first term is positive, and if β is sufficiently low that $\partial TS/\partial \theta < 0$, then the second term will be positive too, and an increase in z will unambiguously increase net output.

[12]See Acemoglu and Shimer (1997, 1999b) for a detailed analysis of directed search with wage posting.

[13]See Acemoglu and Shimer (1999b) for a discussion of the differences between directed search and wage posting. The results in Acemoglu and Shimer (1999b) also imply that when $\beta = \eta(\theta)$, the composition of jobs would be efficient.

[14]Also, it can be verified that $\widehat{l}_g/l_g > \widehat{l}_b/l_b$, so the more capital-intensive g sector has to overemploy more than the b sector. This implies that the costs of preventing inter-firm bargaining is higher for sector g firms, again inefficiently biasing employment and production towards the b sector.