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 insurance shift the composition of employment towards high wage jobs. Because the composition of jobs in the unregulated equilibrium is inefficiently biased towards low wage jobs, these labor market regulations will increase average labor productivity and may improve welfare.

Keywords: Job Composition, Minimum Wages, Search, Unemployment Insurance, Wage Differentials.

JEL Classification: D83, J24, J31.
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 jobs as well as the number of jobs. I show that in a simple and rather 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: some commentators point out that average labor productivity has grown more slowly in the less regulated U.S. labor market than in the more regulated European markets over the past two decades (see Houseman, 1995, for some numbers), and unions often support minimum wages and other regulations arguing that they will improve the quality of jobs (see some of the discussion in 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 very tractable extension of the standard and relatively well-known 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. 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, 1990, 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”. Firms sink their creation and capital costs before meeting workers. So a firm with a higher capital job, who has already sunk its

\[1\] 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 paying 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).
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. When unemployment benefits increase, waiting for high wage jobs will become less costly for workers, and a number of them who were previously accepting bad jobs will prefer to wait for good jobs. 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, making them less profitable, and therefore, increases the number of good 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 also improve welfare. The general equilibrium effects, mentioned above, can also lead to multiple equilibria with different compositions of jobs. In one equilibrium, because there are many good jobs, workers are unwilling to accept low wage jobs, making good jobs relatively more profitable.

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, 1999a, and Davis, 1995). 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 (1999), 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 (see the discussion Card and Krueger, 1995). 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, 1999) 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. Section 4 concludes. The Appendix contains an example of multiplicity.

2. The Basic Model

2.1. Technology and Preferences

There are three produced commodities. 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 of this economy. 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. 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 $r$.

$^2$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 (1999) for a model of search and risk-aversion.
The technology of production for the final good is:

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

(2.1)

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 \( \alpha \) 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 (2.1) is the utility function defined over the two goods (see the Appendix for an example where the two inputs are perfect substitutes).

Since the two intermediate goods are sold in competitive markets, their prices are:

\[ p_b = \alpha Y_b^{\rho-1}Y^{1-\rho} \quad \text{and} \quad p_g = (1 - \alpha)Y_g^{\rho-1}Y^{1-\rho} \]  

(2.2)

The technology of production for the inputs is Leontief (see Section 3.4 for other formulations). When matched with a firm with the necessary equipment (capital), a worker produces 1 unit of the respective input.\(^3\) 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 capital costs are higher in the production of one of the inputs, that is \( k_g > k_b \), in equilibrium, we will have \( p_g > p_b \). But firms irrespective of their sector will hire workers at the same wage, \( w \). 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

\(^3\) 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. I also assume that capital can be turned into consumption goods instantaneously.
who produces a higher valued output will tend to 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 \( p_g > p_b \). Then from rent-sharing, there will be 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, and demonstrates that the results do not depend on undirected search. \( M(u, v) \) 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 \( q(\cdot) \) 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

\[
\frac{M(u, v)}{u} = \theta q(\theta) \quad \text{(see Pissarides, 1990)}.
\]

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 \( \theta \), and that

\[
\lim_{\theta \to \infty} q(\theta) = 0, \quad \lim_{\theta \to 0} q(\theta) = \infty, \quad \lim_{\theta \to \infty} q(\theta) \theta = 0 \text{ and } \lim_{\theta \to 0} q(\theta) \theta = \infty.
\]

I also assume that 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.\(^4\) I assume that wages are determined by asymmetric Nash Bargaining where the worker has bargaining power \( \beta \) (see Pissarides, 1990). Nash Bargaining per se is not essential. The important feature is the presence of *rent-sharing*.

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 the 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, and to investments in know-how. As commented above, both types of vacancies face the same probability of meeting a worker: the only difference between these two jobs is that the first good (\( g \)) has higher *creation* costs than the second (\( b \)).

### 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 \( \phi \). Then, in steady state:

\[
 r J^U = z + \theta q(\theta) \left[ \phi J^E_b + (1 - \phi) J^E_g - J^U \right]
\]

\(^4\)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, there is a time limit; 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).
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, $J_U$ 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. If $p_b$ were sufficiently small relative to $p_g$, workers would not take bad jobs. However, in this case, there would be no bad jobs in the steady state, i.e. $Y_b = 0$, and the price of their output, $p_b$, will be infinite. Thus this additional qualification is ignored.\footnote{There is another possibility: if $J^U = J_b^E$, then workers may accept these jobs with some probability $\zeta < 1$. However, such an allocation cannot be a “stable” equilibrium: if a small measure of bad jobs closed their vacancies, this would imply a lower $Y_b$, and thus $p_b$ would increase and all workers would accept these jobs with probability 1. I therefore ignore this possibility as well.}

The steady state discounted present value of employment can be written as:

$$rJ_i^E = w_i + s(J_U - J_i^E)$$

(2.4)

for $i = b, g$. (2.4) has a similar intuition to (2.3).

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

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

(2.5)

$$rJ_i^V = q(\theta)\left(J_i^F - J_i^V\right)$$

(2.6)

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:

$$(1 - \beta)(J_b^E - J_U) = \beta(J_b^F - J_b^V)$$

(2.7)

$$(1 - \beta)(J_g^E - J_U) = \beta(J_g^F - J_g^V)$$
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:

$$J_i^V = k_i.$$ (2.8)

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

$$u = \frac{s}{s + \theta q(\theta)}.$$ (2.9)

**2.5. Characterization of Steady State Equilibria**

A steady state equilibrium is defined as a proportion $\phi$ of bad jobs, tightness of the labor market $\theta$, value functions $J_b^V$, $J_b^F$, $J_g^E$, $J_g^V$, $J_g^F$, $J_g^E$ and $J^U$, prices for the two goods, $p_b$ and $p_g$ such that equations (2.2), (2.3), and (2.4), (2.5), (2.6), (2.7) and (2.8) for both $i = b$ and $g$ are satisfied. The steady state unemployment rate is then given by (2.9).

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 (2.2), the prices (and the value of production) of the two inputs can be written as:

$$p_g = (1 - \alpha)(1 - \phi)^{\rho - 1}\left[\alpha\phi + (1 - \alpha)(1 - \phi)\right]^{\frac{1}{\rho}}$$

$$p_b = \alpha\phi^{\rho - 1}\left[\alpha\phi + (1 - \alpha)(1 - \phi)\right]^{\frac{1}{\rho}}.$$ (2.10)

Simple algebra using (2.4), (2.5), (2.7) and (2.8) gives:

$$w_i = \beta(p_i - rk_i) + (1 - \beta)rJ^U$$ (2.11)

as the wage equation. In words, 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
\( \beta \) of this, plus \( (1 - \beta) \) times his outside option, \( rJ^U \). Now, using (2.5) and (2.6), the zero-profit condition (2.8) can be rewritten for \( i = b, g \) as:

\[
\frac{q(\theta)(1 - \beta)(p_b - rJ^U)}{r + s + (1 - \beta)q(\theta)} = rk_b
\]

(2.12)

\[
\frac{q(\theta)(1 - \beta)(p_g - rJ^U)}{r + s + (1 - \beta)q(\theta)} = rk_g.
\]

(2.13)

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 obviously 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 \( w_g > w_b \). In fact, combining (2.11), (2.12) and (2.13), we get:

\[
w_g - w_b = \frac{(r + s)(rk_g - rk_b)}{q(\theta)} > 0
\]

(2.14)

Therefore wage differences are related to the differences in capital costs and also to the average duration of a vacancy. In particular, with \( q(\theta) \to \infty \), which gives the Walrasian limit point of the search economy, both \( w_g \) and \( w_b \) converge to \( rJ^U \) and 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 once again disappear.

Finally, the value of an unemployed worker is solved from (2.3) as:

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

(2.15)

It can easily be verified that \( G(\ldots) \) is continuous and strictly increasing in \( \theta \) and strictly decreasing in \( \phi \). Intuitively, as the tightness of the labor market, \( \theta \), increases workers find jobs faster, thus \( rJ^U \) is higher. Also as \( \phi \) decreases, the proportion of good jobs among the open vacancies increases, and since \( w_g > w_b \), the value of being unemployed increases. The dependence of \( rJ^U \) on \( \phi \) is the general equilibrium effect mentioned in the introduction: as the composition of jobs changes, the option value of being unemployed changes too.
A steady-state equilibrium is characterized by the intersection of two loci: bad job locus, (2.12), and the good job locus, (2.13) (both evaluated with (2.10) and (2.15) substituted in). Figure 1 draws these two loci in the $\theta$-$\phi$ plane. (2.13), along which a firm that opens a good job vacancy makes zero-profits, is upward sloping: a higher value of $\phi$ increases the left hand side, thus $\theta$ needs to change to increase the right-hand side (and reduce the left-hand side through $G(\theta, \phi)$). Intuitively, a higher value of $\phi$ implies that $p_g$ goes up from (2.10), and this makes the creation of good jobs more profitable, and thus $\theta$ needs to increase to raise the duration of vacancies and equilibrate the market. In contrast, (2.12) cannot be shown to be decreasing everywhere. Intuitively, an increase in $\phi$ reduces $p_b$, thus requires a fall in $\theta$ to equilibrate the market. However, the general equilibrium effect through $J^U$ (i.e. that a fall in $\phi$ reduces $J^U$) counteracts this and may dominate. Nevertheless, it is straightforward to see that as $\phi$ tends to 1, (2.12) gives $\theta \to \infty$ whereas (2.13) implies $\theta \to 0$. Thus, the bad job locus is above the good job locus. The opposite is the case as $\phi$ 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.** A steady state equilibrium always exists and is characterized by (2.10), (2.11), (2.12), (2.13) and (2.15). In equilibrium, for all $k_g > k_b$, we have $p_g > p_b$ and $w_g > w_b$.

Since (2.12) can be upward sloping over some range, more than one intersections are possible. Hence multiple equilibria cannot be ruled out. Appendix A constructs an example of multiple equilibria, illustrating the strength of the general equilibrium effects at work. Intuitively, when a large fraction of jobs are good and pay high wages, the outside option of workers, $rJ^U$, is sufficiently high that bad jobs are forced to pay quite high wages to be profitable, and hence most firms prefer to open good jobs. In contrast, when there are only a few good jobs, the outside option of workers is low, and bad jobs can hire workers at low wages and make high profits, hence most firms prefer to open these low wage jobs.
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, which 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:

\[ TS = (1 - u) [\phi(p_b - r k_b) + (1 - \phi)(p_g - r k_g)] - \theta u (\phi r k_b + (1 - \phi) r k_g). \]  

(2.16)

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 \((p_g \text{ minus the flow cost of capital } r k_g)\), plus the number of workers in bad jobs \((\phi(1 - u))\) times their net product \((p_b - r k_b)\), minus the flow costs of job creation for good and bad vacancies (respectively, \(\theta u(1 - \phi)r k_g\) 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 (2.16) subject to (2.9) (with \(\dot{u} = 0\)).

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 \(\beta\) is too high, there will be too little job creation and if \(\beta\) is too low, 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 \(\theta\), the equilibrium value of \(\phi\) 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 \(\phi\) at \(z = 0\) (note the constraint, (2.9), does not depend on \(\phi\)):

\[ \frac{dTS}{d\phi} = (1 - u) \cdot \left[ \frac{d(\phi p_b + (1 - \phi)p_g)}{d\phi} \right] - (1 - u + u\theta) \cdot \{r k_b - r k_g\}. \]  

(2.17)

(2.17) needs to equal zero for the composition of jobs to be efficient. Let me now evaluate (2.17) at the decentralized equilibrium. Some simple algebra using (2.9), (2.10), (2.12)
and (2.13) to substitute out $u$, and $k_i$ gives (details of the algebra available upon request):

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

Because this expression is always negative, irrespective of the value of $\theta$, it implies that in equilibrium, a reduction in $\phi$ will always increase social surplus. Therefore:

**Proposition 2.** Let $\phi^*(\theta)$ be the value of $\phi$ that the social planner would choose at labor market tightness $\theta$, and $\phi^*(\theta)$ be the laissez-faire equilibrium with $z = 0$, then $\phi^*(\theta) > \phi^*(\theta)$ for all $\theta$. 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 the workers by creating a good job rather than a bad job, hence there is an uninternalized positive externality. This externality leads to an excessively high fraction of bad jobs being created 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 again search implies that they do not know who these workers will be, thus cannot contract with them at the time of investment.

### 2.7. The Impact of Minimum Wages and Unemployment Benefits On Steady States

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 (2.13) cuts (2.12) from below. Now consider an increase in $z$ which corresponds to the UI system becoming more generous. Both the bad job locus, (2.12), and the good job locus, (2.13), will shift down (to the dotted curves in Figure 1). Hence, $\theta$ will definitely fall. It is also straightforward to verify that
(2.12) will shift by more, therefore, \( \phi \) is unambiguously reduced.\(^6\) Intuitively, with \( \phi \) 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 \( \phi \).

The impact on welfare depends on how large the effect on \( \theta \) is relative to the effect on \( \phi \). We can see this by totally differentiating (2.16) after substituting for \( u \). This gives a relation between \( \theta \) and \( \phi \) along which total surplus is constant, which is drawn as the dashed line in Figure 1. Shifts of this curve towards North-East give higher surplus. When this curve is steeper than (2.13), a higher \( z \) can improve welfare, and this is the case drawn in Figure 1. For instance, if \( \beta \) is very low to start with, then unemployment will be too low relative to the social optimum (see Hosios, 1990), and in this case an increase in \( z \) will unambiguously increase total welfare.\(^7\) Note also that total surplus increases only if the total number of good jobs increases. That is, if the improvement in the composition of jobs came purely from the destruction of low wage jobs, total surplus could never go up. Therefore, the theory offered here predicts that the general response to an increase in unemployment benefits is a shift away from bad jobs towards creating more good jobs. In fact, some simple algebra after totally differentiating (2.12) and (2.13) establishes 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 \( \eta(\theta) \) is the elasticity of \( q(\theta) \). This inequality is likely to be satisfied when the two inputs are highly substitutable, i.e. \( \rho \) close to 1; when wage differences are large; when \( \eta(\theta) \) is close to 1; and/or when unemployment is low to start with. This analysis also shows that a very high level of unemployment benefit, by increasing \( u \), will unambiguously reduce the total number of good jobs. Thus, it is only increases in unemployment benefit (or minimum wage) starting from moderate levels that increase the number of good jobs (and potentially welfare).

\(^6\)To see this formally, totally differentiate (2.12) and (2.13) with respect to \( \theta, \phi \) and \( z \), and write \( A(d\theta \ d\phi)' = bdz \) where \( A \) is a \( 2 \times 2 \) matrix and \( b = (1 \ 1)' \). It is straightforward to see that in a “stable” equilibrium \( \det A > 0 \) and \( a_{11} - a_{21} = \frac{\eta(\theta)(r+s)(r_k-k)}{q(\theta)^2} < 0 \) which gives \( \frac{d\phi}{dz} < 0 \).

\(^7\)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 \( \beta \) 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.
An important point is that irrespective of whether total surplus increases, a more generous unemployment benefit raises average labor productivity. To see this note that average labor productivity is equal to $\phi p_b + (1 - \phi)p_g$, and is decreasing in $\phi$. Thus when unemployment benefits increase, the composition of jobs shifts towards more capital intensive good jobs and labor productivity increases.

Next, consider a minimum wage $w$ such that $w_b < w < w_g$. Therefore, the minimum wage will be binding for bad jobs but not for good jobs. This implies that the equation for $J^F_b$ becomes (in steady state): $J^F_b = \frac{p_b - w + sk_b}{r + s}$. Then, (2.12) changes to:

$$q(\theta)\frac{p_b - w}{r + s + q(\theta)} = rk_b. \quad (2.18)$$

Since at a given $\theta$, the left-hand side of (2.18) is less than that of (2.12), the impact of higher minimum wages is to shift the bad job locus, curve (2.12), in Figure 1 down. The good job locus is still given by (2.13), but now, we have, combining (2.3) and (2.4),

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

instead of (2.15). Since $w > w_b$, both curves shift down in Figure 1, but as in the case of unemployment benefits above, (2.12) shifts down by more, so both $\phi$ and $\theta$ fall. Again, the rise in minimum wages can increase total welfare and will often increase the number, not just the proportion, of good jobs. It can also be established that for the same decline in $\theta$, an increase in minimum wages reduces $\phi$ 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 $w$ and an increase in unemployment benefit $z$ decrease $\theta$ and $\phi$, therefore, 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, $w$), 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 $\theta$ needs to be defined as: $\theta = \frac{v}{\bar{e}u}$. 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 (2.3) changes to:

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

(3.1)

Also, (2.9) now becomes:

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

Differentiating (3.1), we get the condition for $e$ to be chosen optimally, and evaluating this in equilibrium, i.e. $e = \bar{e}$, we obtain:

$$ \bar{\theta}q(\bar{\theta}) \left[ \phi J_b^E + (1 - \phi) J_g^E - J^U \right] = c'(e) $$
As before, for given \( \bar{e} \) an increase the minimum wage will reduce \( \theta \), but with endogenous search effort, it will also increase \( \bar{e} \) (as long as it increases \( J^{E}_{b} \)). Therefore, the overall impact on \( u \) is ambiguous: if the change in \( e \) is large enough, unemployment may fall because the higher wages induced by the minimum wage legislation encourage 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 may have somewhat increased employment.

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 \( z \) discourages search effort.

### 3.2. Directed Search

In practice workers know which jobs 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 section briefly demonstrates that our results generalize to the case of 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.\(^8\) The assumption that both sectors have exactly the same matching function is for simplicity and highlights that differences in the technology of matching is not the source of the results. Since \( M(., .) \) exhibits constant returns to scale, the flow rate of 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:

\[
 rJ_{i}^{U} = z + \theta_{i}q(\theta_{i}) \left[ J_{i}^{E} - J_{i}^{U} \right] 
\]

(3.2)

For there to be both types of jobs, we require that \( rJ_{i}^{U} = rJ_{b}^{U} = rJ_{g}^{U} \). The other Bellman equations (2.4), (2.5), (2.6), the wage equation (2.7) and the zero-profit condition (2.8)\(^8\) See Acemoglu and Shimer (1997, 1999) for a detailed analysis of directed search with wage posting.

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\(^8\) See Acemoglu and Shimer (1997, 1999) for a detailed analysis of directed search with wage posting.
are the same as above. Now in equilibrium we have to determine $\theta_b$ and $\theta_g$ separately, and the aggregate production of bad and good intermediate goods are now given as: $Y_b = \phi\theta_b q(\theta_b) u_b$ and $Y_g = (1 - \phi)\theta_g q(\theta_g) u_g$, and (2.10) is accordingly modified.

An equilibrium can again be shown to exist. Because (2.11) still applies, in equilibrium we will have that $w_g > w_b$. Since in equilibrium $rJ^U_b = rJ^U_g$, it must be the case 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). The same welfare results apply since good jobs are again creating an additional positive externality on workers by paying them higher wages, and thus there are too low a fraction of good jobs relative to bad jobs. Finally, labor market regulations will have the same effects as before also. First, a higher level of $z$ at given $\theta_b, \theta_g, u_b$ and $u_g$ will make $rJ^U_g > rJ^U_b$, thus it will increase $u_g$ and reduce $u_b$, and also increase $\theta_g$ relative to $\theta_b$. As a result, the fraction of good jobs will increase. Minimum wages will again work more directly by pushing $w_b$ up, thus increasing $\theta_g$ relative to $\theta_b$.

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 depend on the earnings history of individual workers, often with a progressive form. We can capture this quite easily our 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 rest of the 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. This is because a higher unemployment benefit in the future, which is effectively attached to an high wage job, makes workers more unwilling to take low wage jobs, and an increase in the progressivity of the benefits reduces this effect, encouraging the creation of more
low wage jobs.

3.4. Capital-Labor Substitution

The technology of production used so far is Leontief, implying that 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 the workers bargain as a group against the firm, then 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, in a labor market where each firm faces a perfectly elastic demand curve, a firm subject to inter-firm bargaining will hire more workers than a wage-taking firm, but as a result it would be able to reduce the productivity contribution of a marginal worker and hold down all 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 the 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 facing an outside wage $v$ would hire $\hat{l}_g = (2\gamma)^{1/(1-\gamma)}(1+\gamma)^{-1/(1-\gamma)}p_g^{1/(1-\gamma)}v^{-1/(1-\gamma)}k_g > l_g$ and would pay $v$ to all of its employees. Similar expressions apply for sector $b$ firms and they too pay $v$ to all their employees.

This may suggest that the results here may not generalize to a situation with capital-labor substitution, diminishing returns to labor and decentralized 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 one here is that here the firm cannot costlessly hire new workers. In particular, in our setup after a firm purchases the required equipment and opens vacancy, recruitment of workers will be a slow process, which was the source of all the inefficiencies and the results in our above analysis. Therefore, even if the firm finds it optimal to build up its labor force to $\hat{l}_g$, there will
be an extended period of time during which the productivity of the marginal worker is quite high, hence 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 $g$ the firms than sector $b$ firms, once again biasing the composition of jobs towards low pay ones.  

4. Conclusion

This paper argues that job composition is endogenously determined, and is responsive to labor market regulations. The key result is that in an unregulated equilibrium, there will be too small a proportion of good jobs and too many bad jobs. Unemployment benefits may improve this situation by encouraging workers to wait for better jobs, and minimum wages work by directly reducing the profitability of bad jobs. Both policies in effect shift the composition of employment towards good jobs.

In a companion paper (Acemoglu, 1999b), I investigate these predictions empirically using data from U.S. states between 1983 and 1993 and exploiting the variations in state level minimum wages and unemployment insurance legislation to identify their effects. I find that higher replacement ratios and minimum wages significantly reduce the number of workers in low wage occupations and industries and increase the number of workers in high wage occupations and industries. I also find that labor productivity in a state increases with higher minimum wages and more generous unemployment benefits. Overall, the results suggest that unemployment benefits and minimum wages may have an important effect on the composition of jobs and average labor productivity.

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9 Also, it can be verified that $\tilde{l}_g/l_g > \tilde{l}_b/l_b$, 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.
5. References


6. Appendix: Multiple Steady State Equilibria

In this appendix, I construct an example of multiplicity to further illustrate the general equilibrium forces at work. First, I take a special case where $\rho = 1$, thus the two goods are perfect substitutes, but good jobs are more productive. In particular, bad jobs produce $y_b$ units where good jobs produce $y_g > y_b$ units of output. Further, instead of Nash Bargaining I adopt the Rubinstein-Shaked-Sutton bargaining solution where

$$ w = \max \left\{ \beta y, r J^U \right\} $$

(assuming that the firm’s outside option does not bind). In words, the worker obtains a fraction $\beta$ of the total surplus unless he prefers not to take the job at this wage, in which case he receives the wage that makes him just indifferent between taking the job and remaining unemployed. Both of these assumptions will accentuate the tendency toward multiplicity and enable me to explicitly construct two equilibria.

**An Equilibrium With Good Jobs:** Suppose there are only good jobs, that is $\phi = 0$. Then $w_g = \beta y_g$ and thus, the tightness of the labor market is determined as:

$$ \frac{(1 - \beta) y_g}{r + s} = \frac{r k_g}{q(\theta_0)} $$

(6.1)

where I use the notation $\theta_0$ to refer to the tightness of the labor market with $\phi = 0$. In this case we have: $r J^U_0 = \frac{r q(\theta_0) y_g}{r + s}$.  

**Lemma 1.** If $rk_b > q(\theta_0) y_b - \max \left\{ r J^U_0, \beta y_b \right\}$, then there exists a steady state equilibrium in which only good jobs are open, that is $\phi = 0$.

Intuitively, no bad job will open if either bad jobs are not profitable enough or the wage expectations of the workers are sufficiently high — because they anticipate to get into good jobs.

**An Equilibrium With Bad Jobs:** Now consider an allocation with only bad jobs, i.e. $\phi = 1$. Then the zero-profit condition is that:

$$ \frac{(1 - \beta) y_b}{r + s} = \frac{r k_b}{q(\theta_1)} $$

(6.2)

and $r J^U_1 = \frac{z + q(\theta_1) \theta_1 \beta y_b}{r + q(\theta_1) \theta_1}$. Clearly, $\beta y_g > r J^U_1$, thus, it follows that:

**Lemma 2.** $rk_g > q(\theta_1) \frac{(1 - \beta) y_g}{r + s}$, then there exists a steady state equilibrium in which only bad jobs are open, that is $\phi = 1$.

Intuitively, when the cost of opening a job is sufficiently high relative to productivity of good jobs, there will only be bad jobs.

**Multiple Equilibria:** First, it is straightforward to see, using (6.1) and (6.2), that when $r J^U_0 < \beta y_b$, the condition in Lemma 1 and that in Lemma 2 cannot be simultaneously satisfied. However, the situation changes when $r J^U_0 > \beta y_b$; in this case, the condition for the equilibrium with $\phi = 0$ to exist can be written as:

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whereas the condition for the equilibrium with \( \phi = 1 \) to exist can be written as (using (6.2)):

\[
\frac{k_b(1 - \beta)y_g}{k_g} > \frac{ry_b - z + q(\theta_0)\theta_0 (y_b - \beta y_g)}{r + q(\theta_0)\theta_0} \tag{6.3}
\]

Suppose (6.4) holds, and let us increase \( y_g \) while keeping \( k_g y_g \) constant, then the left-hand side of (6.3) is constant (and so is \( \theta_0 \) from (6.1)), but the right hand side becomes smaller, hence (6.3) and (6.4) can be simultaneously satisfied. Thus:

**Proposition 4.** If \( rJ^U_0 > \beta y_b \), then both a steady state equilibrium with \( \phi = 0 \) and one with \( \phi = 1 \) can coexist.

When \( \phi = 0 \), the value of being unemployed \( rJ^U \) is low because there are no good jobs around, thus the outside option of workers does not bind, and bad jobs can hire workers at low wages. At these low wages, bad jobs are more profitable than good jobs, and no firm wants to open good jobs. In contrast, when \( \phi = 1 \), workers know that they can rapidly obtain a good job, and \( rJ^U \) is high, and this makes the outside option of a worker bind when he meets a bad job. This implies that a bad job will have to pay relatively high wages to be able to employ the worker, and at these relatively high wages, bad jobs are not as profitable as good jobs.

Finally, it can be seen that the impact of labor market regulations work is similar to that in the text. The higher is \( z \), the more likely is (6.3) to hold, and thus the more likely is a good job equilibrium to exist. Also similarly, if a minimum wage \( w \) is imposed higher than \( \beta y_b \), bad jobs will be forced to pay higher wages and good jobs will be unaffected, thus creation of bad jobs will be discouraged. Therefore, both higher unemployment benefits and minimum wages encourage the creation of good jobs. Moreover, in this case, the general equilibrium aspects of such policy intervention can be seen most clearly: a more generous unemployment benefit does not just create a few more good jobs, but by increasing \( rJ^U \), it makes an equilibrium with only good jobs possible.
7. Addendum for the Referees: Details for Welfare

First notice that:

\[ \phi p_b + (1 - \phi)p_g = ((1 - \alpha)(1 - \phi) + \alpha \phi^\rho) \cdot [\alpha \phi^\rho + (1 - \alpha)(1 - \phi)^{\rho}]^{\frac{1 - \rho}{\rho}} \]  
\[ \quad = [\alpha \phi^\rho + (1 - \alpha)(1 - \phi)^{\rho}]^{\frac{1}{\rho}} \]  
\[ (7.1) \]

Then, using (7.1) and (2.9), (2.17) can be written as

\[ \frac{dTS}{d\phi} = \frac{\theta q(\theta)}{s + \theta q(\theta)} \left[ \alpha \phi^{\rho - 1} - (1 - \alpha)(1 - \phi)^{\rho - 1} \right] \left[ \alpha \phi^\rho + (1 - \alpha)(1 - \phi)^{\rho} \right]^{-\frac{1 - \rho}{\rho}} \]
\[ + \frac{\theta q(\theta)}{s + \theta q(\theta)} (rk_b - rk_g) \]

Then, using the definition (2.10) and (2.12-2.13) to substitute for \( rk_b - rk_g \), we obtain

\[ \frac{dTS}{d\phi} = \frac{\theta q(\theta)}{s + \theta q(\theta)} \cdot (p_b - p_g) + \frac{q(\theta) + s}{s + \theta q(\theta)} \cdot \frac{\theta q(\theta)(1 - \beta)(p_b - p_g)}{r + s + (1 - \beta)q(\theta)} \]
\[ = \frac{\theta q(\theta)}{s + \theta q(\theta)} \cdot \left( 1 + \frac{(s + q(\theta))(1 - \beta)}{r + s + (1 - \beta)q(\theta)} \right) \cdot (p_b - p_g) < 0. \]
Figure 1: Equilibrium Determination

(2.12) Bad Job Locus

(2.13) Good Job Locus

TS