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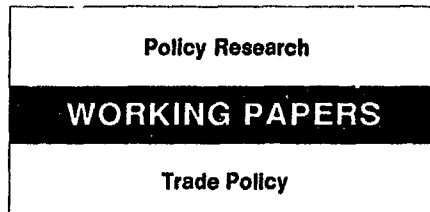
Policy Research Department
The World Bank
August 1993
WPS 1170

Job Search by Employed Workers

The Effects of Restrictions

**Avner Bar-Ilan
and
Anat Levy**

Some firms offer high wages in return for their workers' implicit commitment not to search for better jobs. Some firms that cannot afford to pay wages that guarantee lifetime attachment pay lower wages, but impose no restrictions on searches for better jobs. When the separation bond takes the form of a transfer between the employer and the employee, employment is unaffected in most cases. But when it is forfeited to a third party, employment among all types of workers falls.



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This paper — a product of the Trade Policy Division, Policy Research Department — is part of a larger effort in the department to study the impact of labor market institutions and policies on economic performance. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Dawn Ballantyne, room N10-023, extension 37947 (August 1993, 29 pages).

Within the framework of a general equilibrium search model, Bar-Ilan and Levy study the effect of institutional restrictions on workers' job mobility.

The model generates endogenous job searches on the job and off the job with two forms of labor contracts emerging and coexisting in equilibrium.

One form of contract involves the workers' long-term commitment to the firm ('reversed tenure'): Some firms offer high wages in return for their workers' commitment not to search for better jobs.

The other is a short-term contract requiring no such commitment: Some firms that cannot afford to pay wages that guarantee lifetime attachment pay lower wages, have lower turn-

over costs, but impose no restrictions on searches for better jobs.

Bar-Ilan and Levy study the effects on employment of exogenous restrictions on mobility — in the form of a transfer from the quitting worker, made either to the employer or to a third party. These transfers, the separation bonds, are typically the benefits lost by the quitting worker, such as vested pension. Restrictions of this type, by crowding out the firms that allow on-the-job searches for employment, directly increase unemployment.

When restrictions on workers' mobility take the form of a zero-sum transfer, there is no real effect so long as the transfer is below some bound — the worker loses nothing. When the separation bond is prohibitively large, or when it is forfeited to a third party, employment among all types of workers falls.

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Job Search by Employed Workers: The Effects of Restrictions

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**This research was partially supported by funds granted to the Foerder
Institute for Economic Research by the John Rauch Fund.**

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1. INTRODUCTION

The objective of this paper is to study within a general equilibrium framework the economic implications of institutional frictions to labor mobility. It thus extends theoretical analyses of this problem, such as Lazear (1990), done in a less detailed setup.

The equilibrium framework which is the basis to the model we introduce was developed by Albrecht and Axell (1984) and used by Eckstein and Wolpin (1990). The novelty of Albrecht and Axell is endogenous determination of nondegenerate wage offer distribution in a general equilibrium model. Since search on the job is not allowed, there are two wage levels in equilibrium. The lower wage should be high enough to induce the workers to accept this wage offer and lose for good the option to work at the higher wage firms.

We extend this model by permitting the individual to continue the search while working. This endogenizes the extent of the restrictions on search. In equilibrium some firms will choose to offer high wages in return for a commitment of their workers not to search for better jobs. Other firms, which cannot afford to pay the wage that guarantees lifetime attachment, pay lower wages, but impose no restrictions on search on-the-job. This characterizes two forms of labor contracts, short and long-term contracts, which coexist in equilibrium, and a wage offer distribution which amounts to three wage levels.

It is demonstrated that observed limitations on mobility of workers might be the outcome of voluntary arrangements evolved endogenously. We then proceed to study the employment effects of exogenous restrictions on mobility. These restrictions take the form of a transfer from the quitting worker made either to the employer or to a third party.

Restrictions of the latter type, by crowding out the firms which allow search on-the-job, have a direct effect of increasing unemployment. In addition, the mechanism underlying the general equilibrium model introduces negative externality on the existing firms, and reduces the proportion of the firms paying the highest wage. This increases unemployment further, not only among those who are directly involved in search on-the-job, but among other groups of workers as well.

On the other hand, there is a range of sizes of transfer made to the firm, in which the transfer has no real effect on the economy. In this region, similar to Lazear (1990), any exogenous intervention is neutralized by endogenous arrangements developed in the economy. However, this offsetting mechanism works only up to a certain exogenous transfer. Above this limit, general equilibrium forces ruin the feasibility of neutralizing arrangements. In this case unemployment increases up to the level that corresponds to Eckstein and Wolpin's (1990) version of Albrecht and Axell (1984), where any mobility of workers is blocked.

The structure of this paper is as follows. Sections 2 to 4 analyze the equilibrium assuming that the transfer goes to a third party. Section 2 derives the terms of labor contracts which emerge in equilibrium, while section 3 presents the labor supply functions implied by these contracts. The equilibrium outcome is determined in section 4. Section 5 studies the nature of the equilibrium when the transfer is assumed to go to the employer, while economic implications of exogenous restrictions on mobility are analyzed in section 6. Section 7 deals with the related question of the employment effects of unemployment compensation.

2. DETERMINATION OF LABOR CONTRACTS

Employment contracts in our model specify the wage, w_i , and a separation bond B_i , posted by workers in firms offering contract i and is forfeited in the event that they move to another firm. We first consider the case in which the forfeited bond goes to a third party.¹ In each period an individual is allowed to search for a job. Both search on and off-the-job are allowed. Individuals searching for a job draw at random from a wage distribution which, in equilibrium, is determined endogenously.

¹ The forfeited bond is added to the Θ defined below. For instance, it goes to a global fund which is distributed among all individuals. Discussion of employee's bonds can be found in Dickens et. al. (1989) and Bar-Ilan (1991).

The search strategy is optimal, in the sense that it maximizes the individual's lifetime utility. The per-period utility is additive in consumption, c , and leisure, m , such that $u = c + vm$, where the consumption good c is the numeraire.² There are two types of workers that differ in their imputed value, v , of leisure. We denote the two types by v_0 and v_1 where $v_0 < v_1$. The fraction of the v_0 individuals is β . In all other respects, including market productivity, all workers are identical.

The per-period utility of a working individual with leisure $m = 0$ is $w + \Theta$, where Θ is the income paid irrespective of market activity. An unemployed ($m=1$) v_1 individual derives a utility of $v_1 + b + \Theta$ where b represents unemployment compensation.

We show below that there are three different labor contracts in equilibrium:

$$w_0 = v_0 + b \quad B_0 = 0 \quad (1a)$$

$$w_1 = v_0 + b + \frac{\gamma_2 (1-\tau) (v_1 - v_0)}{1 - (1-\gamma_2) (1-\tau)} \quad B_1 \geq \frac{v_1 - v_0}{1 - (1-\gamma_2) (1-\tau)} \quad (1b)$$

$$w_2 = v_1 + b \quad B_2 \geq 0 \quad (1c)$$

where τ is the probability that the individual will not survive to the next period and γ_2 is the fraction of firms offering the highest wage, w_2 . An individual will draw a wage offer w_1 with probability γ_1 , where $(\gamma_0 + \gamma_1 + \gamma_2)$ is the wage offer probability and $p = 1 - (\gamma_0 + \gamma_1 + \gamma_2)$ is the probability of not getting a wage offer.

For the wage distribution (w_i, γ_i) to be an equilibrium, the highest wage, w_2 , should be the pure reservation wage of the v_1 individual, i.e. $(v_1 + b)$. The wage w_2 will not be larger than $(v_1 + b)$ since a higher wage does not increase the labor supply, but increases wage expenditures, and therefore must

² The notation in this section follows closely that of Albrecht and Axell (1984).

reduce profits. Similarly, $w_2 < (v_1 + b)$ will not attract any v_1 individual. The bond B_2 can take any nonnegative value, since it does not enter the profit function of the firms, and a worker with wage w_2 will never quit. Thus $w_2 = v_1 + b$; $B_2 \geq 0$, as in (1c).

Any wage below w_2 can attract workers of type v_0 only. We show below that for this case, two types of contracts exist in equilibrium. The first is a lifetime contract in which the firm offers high wages and the worker makes a commitment not to quit, i.e. there exists a "reversed tenure," given to the firm by its employees in return for a wage premium. The second type of labor contract is a short term contract in which the worker is allowed to search on-the-job and quit in case he finds a better job. In equilibrium a worker is indifferent between the two types of labor contracts.

When a v_0 individual rejects a wage $w < w_2$ offered to him in order to search for a w_2 job, then his lifetime expected utility V^* is:

$$V^* = v_0 + b + \theta + (1-\tau) \left[\frac{\gamma_2 (w_2 + \theta)}{\tau} + (1-\gamma_2) V^* \right]. \quad (2)$$

When the v_0 worker accepts the w job offer and continues searching on-the-job for the w_2 contract, then his expected lifetime utility is:³

$$V^* = w + \theta + (1-\tau) \left[\frac{\gamma_2 (w_2 + \theta)}{\tau} - B\gamma_2 + (1-\gamma_2) V^* \right] \quad (3)$$

³ Implicit in equation (3) is the assumption of a costless search, whether the worker is employed or not. A possible extension is to allow for a non-symmetric search cost, where it is more costly to search while working.

where $B \geq 0$ is the separation bond posted by the worker when he accepts the w contract and is forfeited when he quits and accepts the w_2 offer. If the worker accepts and keeps the w job for life, then:

$$V^* = \frac{w + \theta}{r} \quad (4)$$

In equilibrium the worker should be indifferent between the three alternatives. This is equivalent to the reservation wage property which states that wage offers are determined such that individuals are indifferent to whether accepting or rejecting them. Equating V^* from equations (2) and (4), together with equation (1c), gives the wage of the lifetime contract, w_1 , as:

$$w_1 = v_0 + b + \frac{\gamma_2 (1-r) (v_1 - v_0)}{1 - (1-\gamma_2) (1-r)} \quad (5)$$

Equating V^* from equations (2) and (3) yields:

$$w = v_0 + b + (1-r)\gamma_2 B \quad (6)$$

Equation (6) represents all the labor contracts (w, B) which keep the worker indifferent between accepting and rejecting a contract which allows search on-the-job. When the separation bond increases, for a given γ_2 , the worker must be compensated by a higher wage. Since w , but not B , enters the profit function of firms, the profit maximizing labor contract is zero separation bond and the lowest possible wage, that is:

$$w_0 = v_0 + b; \quad B_0 = 0 \quad (7)$$

We have found in equation (5) the lowest wage w_1 which can induce a lifetime commitment on the part of the employees. The separation bond supporting this commitment, B_1 , must not be smaller than the value given by equation (6) after substitution of w_1 , that is:

$$B_1 \geq \frac{v_1 - v_0}{1 - (1 - \gamma_2)(1 - \tau)} . \quad (8)$$

We have thus identified the possibility of the existence of three different labor contracts. The (w_2, B_2) contract offers a wage which is high enough to attract and keep all types of workers, since it clearly dominates all other contracts from the workers' point of view. The other contracts, (w_0, B_0) and (w_1, B_1) , are equivalent for the employees since the expected lifetime utility derived from both contracts is the same. The (w_1, B_1) is a lifetime contract in which the worker agrees, for a wage premium, to keep the same job for as long as he lives. On the other hand, the wage w_0 is low and equals the pure reservation wage of the v_0 worker, but he or she can move to a job that yields a higher expected lifetime utility. Any wage w , $w_0 < w < w_1$, will not be supported in equilibrium since, with this wage, the only possible contract is a short-term one; given that, the firm would rather offer a wage w_0 . Since in this case the cost of search is the same when employed or not, the worker is willing to accept a job that compensates for the value of foregone leisure and then continues to search.

3. DETERMINATION OF LABOR SUPPLY

Firms set the wage rate in order to maximize profits. A higher wage may increase the labor supply to a firm for three reasons. First, as in Albrecht and Axell (1984), a high enough wage might induce the v_1 individuals, who value leisure highly, to accept a wage offer instead of rejecting it and staying at home. Second, a high wage can induce workers to implicitly sign a lifetime contract with the firm; and

third, a higher wage may induce v_0 workers who search on the job to accept more lucrative labor contract.

Firms are heterogenous with linear production technology, as in Albrecht and Axell. The output per worker, λ , is constant for each firm and is distributed across firms with a cumulative distribution function $A(\lambda)$, where the parameter λ takes values on $[0,1]$.⁴ The profit $\pi(w;\lambda)$ of a firm with productivity λ which offers a wage w is $(\lambda-w)\ell(w)$, where $\ell(w)$ is the labor supply, which, in our model, is identical to the employment level.

In equilibrium firms will be distributed either as in figure 1 or as in figure 2. The curve $\pi(w_i; \lambda)$ cuts the horizontal axis at the point $\lambda = w_i$, and its constant slope is $\ell(w_i)$. Since $w_0 < w_1 < w_2$ and as we show below $\ell(w_0) < \ell(w_1) < \ell(w_2)$, $\pi(w_i; \lambda)$, $i = 0, 1, 2$, are as depicted in figures 1 and 2. The situation depicted in figure 1 presents four groups of firms. The least productive firms, when λ satisfies $0 \leq \lambda < w_0$, cannot afford to pay the lowest wage rate w_0 , the pure reservation wage of the v_0 individuals. These firms would be inactive, and their fraction in the population, denoted by p , is $p = A(w_0)$. A second group of firms offers the wage rate w_0 , but does not restrict the search of its employees for a better job. The fraction of firms in this group, γ_0 , is $\gamma_0 = A(\lambda_0^*) - A(w_0)$, where λ_0^* is defined by $\pi(w_0; \lambda_0^*) = \pi(w_1; \lambda_0^*)$. The third group of firms offer v_0 individuals a premium for a life-time contract in the form of a wage $w_1 > w_0$. The fraction of firms in this group is $\gamma_1 = A(\lambda_1^*) - A(\lambda_0^*)$ where λ_1^* is defined by $\pi(w_1; \lambda_1^*) = \pi(w_2; \lambda_1^*)$. Finally, the most productive firms offer the highest wage w_2 , and the fraction γ_2 of firms in this group is $\gamma_2 = 1 - A(\lambda_1^*)$.

In the equilibrium described in figure 2 there are two types of active firms. In this case the "loyalty" wage premium is so high such that the (w_1, B_1) contract is not a profit maximizing policy for any firm. This situation happens when $\lambda_1^* \leq \lambda_0^*$, whereas when $\lambda_1^* > \lambda_0^*$ there will be three types of active

⁴ The structure of the supply side bears some similarity to that of Lucas and Prescott (1974).

firms in equilibrium. In the equilibrium of figure 2 we have $\gamma_0 = A(\lambda_2^*) - A(w_0)$, $\gamma_1 = 0$, and $\gamma_2 = 1 - A(\lambda_2^*)$, where λ_2^* is defined by $\pi(w_0; \lambda_2^*) = \pi(w_2; \lambda_2^*)$.

We now turn to the derivation of the labor supply and the unemployment rate. In each period there are k individuals and n (active and inactive) firms in the economy. The constant probability of death per period is τ , and therefore τk individuals are born and die in every period.

Denote the ratio of individuals to firms, k/n , by μ . The number of individuals who accept a job within a w_0 firm in each period is

$$\tau\mu\beta[1 + p(1-\tau) + p^2(1-\tau)^2 + \dots] = \frac{\tau\mu\beta}{1 - p(1-\tau)}.$$

The first term is the number of v_0 individuals per firm entering the economy. The second expression denotes v_0 surviving individuals who searched unsuccessfully in the previous period, and so on. The labor supply $\ell(w_0)$ is therefore:

$$\ell(w_0) = \frac{\tau\mu\beta}{1 - p(1-\tau)} (1 + (1-\tau)(1-\gamma_2) + (1-\tau)^2(1-\gamma_2)^2 + \dots) \quad (9)$$

$$\ell(w_0) = \frac{\tau\mu\beta}{[1 - p(1-\tau)][1 - (1-\tau)(1-\gamma_2)]} \quad (10)$$

The second term in equation (9) denotes the surviving individuals who accepted a w_0 job offer in the previous period and did not get a w_2 offer currently, and so on.

The number of acceptances per period for w_0 and w_1 firms is identical. The attrition rate of workers in w_1 firms is, however, a result of death only, since the implicit contract of w_1 firms is lifetime contract. Hence $\ell(w_1)$ is:

$$\ell(w_1) = \frac{\tau \mu \beta}{1 - p(1 - \tau)} [1 + (1 - \tau) + (1 - \tau)^2 + \dots] = \frac{\mu \beta}{1 - p(1 - \tau)} \quad (11)$$

Individuals of type v_1 accept jobs only within firms which offer a w_2 wage. The number of acceptances per period of v_1 individuals is

$$\tau \mu (1 - \beta) [1 + (1 - \tau)(1 - \gamma_2) + (1 - \tau)^2(1 - \gamma_2)^2 + \dots] = \frac{\tau \mu (1 - \beta)}{1 - (1 - \tau)(1 - \gamma_2)}$$

Again, the first term denotes newborn v_1 individuals, the second expression those who searched unsuccessfully in the previous period, and so on. Since workers in w_2 firms stay in their firm as long as they are alive, the labor supply of v_1 individuals to each w_2 firm is

$$\frac{\mu (1 - \beta)}{1 - (1 - \tau)(1 - \gamma_2)}$$

In addition, each v_0 individual who is offered wage w_2 as his first job offer, accepts this offer and never quits. This is identical to the labor supply to w_1 firms, $\ell(w_1)$. Moreover, v_0 individuals working in w_0 firms search on the job for w_2 jobs. For any w_0 firm, the number of workers moving to w_2 firms in each period is $\ell(w_0)(1 - \tau)\gamma_2$. Multiply this by γ_0/γ_2 to get $\ell(w_0)(1 - \tau)\gamma_0$ as the number of workers moving from w_0 firms to each w_2 firm in any period. Since these workers are also loyal to their new firm, the extra supply of labor via this channel is $\ell(w_0)(1 - \tau)\gamma_0/\tau$. Summing the three sources of labor supply to w_2 firms, we have

$$\ell(w_2) = \frac{\mu (1 - \beta)}{1 - (1 - \tau)(1 - \gamma_2)} + \ell(w_1) + \frac{\gamma_0}{\tau} (1 - \tau) \ell(w_0) \quad (12)$$

where $\ell(w_2) \geq \ell(w_1) \geq \ell(w_0)$.

In order to derive the unemployment rate, notice that in every period there are $\tau k(1-\beta)(1-\gamma_2)$ individuals of type v_1 who search for the first time, $\tau k(1-\beta)(1-\gamma_2)^2(1-\tau)$ who search for the second time, and so on. Total number of v_1 individuals searching while unemployed is:

$$\tau k(1-\beta)(1-\gamma_2)[1+(1-\gamma_2)(1-\tau) + (1-\gamma_2)^2(1-\tau)^2 + \dots] = \frac{\tau k (1-\beta) (1-\gamma_2)}{1 - (1-\gamma_2) (1-\tau)}$$

The expression for v_0 individuals is similar, with the obvious replacement of $(1-\beta)$ by β and $(1-\gamma_2)$ by p . The total number of unemployed v_0 individuals is therefore $\tau k\beta p/[1-p(1-\tau)]$. The unemployment rate S is

$$S = \frac{\tau \beta p}{1-p(1-\tau)} + \frac{\tau (1-\beta) (1-\gamma_2)}{1 - (1-\gamma_2) (1-\tau)} \quad (13)$$

The unemployment rate among v_0 individuals, S_0 , is

$$S_0 = \frac{\tau p}{1-p(1-\tau)} \quad (14)$$

while S_1 , the unemployment rate among v_1 workers, is:

$$S_1 = \frac{\tau (1-\gamma_2)}{1 - (1-\gamma_2) (1-\tau)} \quad (15)$$

Since $p = 1 - (\gamma_0 + \gamma_1 + \gamma_2) < 1 - \gamma_2$, we have $S_0 < S_1$.

4. EQUILIBRIUM WAGE DISTRIBUTION

Up until now we have established the existence of three types of labor contracts and the associated labor supply. We now turn to the endogenous derivation of the fraction of firms offering each contract, which completes the determination of the equilibrium in the economy.

Recall that the cutoff productivity λ_0^* is defined by $\pi(w_0; \lambda_0^*) = \pi(w_1; \lambda_0^*)$, or

$$\lambda_0^* = w_1 + \frac{(w_1 - w_0) \ell(w_0)}{\ell(w_1) - \ell(w_0)} \quad (16)$$

Similarly, we have

$$\lambda_1^* = w_2 + \frac{(w_2 - w_1) \ell(w_1)}{\ell(w_2) - \ell(w_1)} \quad (17)$$

$$\lambda_2^* = w_2 + \frac{(w_2 - w_0) \ell(w_0)}{\ell(w_2) - \ell(w_0)} \quad (18)$$

Substituting the labor supply functions yields

$$\lambda_0^* = v_1 + b. \quad (19)$$

$$\lambda_1^* = v_1 + b + \frac{(v_1 - v_0) \beta \tau}{\beta \gamma_0 (1 - \tau) + (1 - \beta) [1 - p (1 - \tau)]} > \lambda_0^*. \quad (20)$$

Since $\lambda_1^* > \lambda_0^*$ for all parameter values, there cannot be two wage levels in equilibrium, and the cutoff productivity λ_2^* and figure 2 are irrelevant. This can be summarized as a proposition:

PROPOSITION 1: There are three possible types of equilibria in the economy. When $v_0 + b > 1$, there will be no active firms; when $v_0 + b \leq 1$ and $\lambda_1^* > 1$, the only labor contract offers a wage $w_0 = v_0 + b$; when $\lambda_1^* \leq 1$, all three labor contracts described in equation (1) will coexist.

When $v_0 + b > 1$ the participation rate in the whole labor market is zero. The case $\lambda_1^* > 1$ means that there is no firm which finds it optimal to offer a wage which is high enough to induce the v_1 individuals to work. In this case one group of individuals will never participate in the job market. Since this degenerate situation is not very interesting, we focus from now on on the case where $\lambda_1^* \leq 1$. Notice also that both λ_0^* and λ_1^* are functions of exogenous parameters only. This is because $p = A(w_0) = A(v_0 + b)$ and $\gamma_0 = A(\lambda_0^*) - A(w_0) = A(v_1 + b) - A(v_0 + b)$.

Our model shares some common predictions with other studies which allow search on the job, such as Burdett (1978) and Mortensen (1986). In particular, we provide a general equilibrium explanation for the observed negative association between the propensity to separate from a job and the wage earned, a result found also by Burdett using a partial equilibrium model. The mechanism underlying this result is, however, somewhat different. In Burdett (1978) workers have a weaker incentive to quit when the wage is higher, since the payoff for additional search is lower, given exogenous wage distribution. In our model, employees of w_2 firms do not quit for a similar reason, since the probability of finding a higher paying job is zero. In addition, a unique feature of our model is the fact that the intermediate wage, w_1 , is voluntarily conditional upon not quitting. The highest wage, w_2 , is therefore not attractive to w_1 workers since it should be discounted by the value of their separation bond, B_1 . Quitting in our model occurs from the lowest wage firms only, which implies the negative relation between quit rate and the wage earned.⁵

⁵ A related, but different result is derived by Burdett and Mortensen (1980) which show that wage differentials reflect the compensation required for a difference in layoff probabilities. In our model the duration of time in the job increases with the wage, since it reflects commitment on the part of the employees, not layoffs.

Another prediction made here is a positively sloped wage-experience profiles⁶ for part of the population, that is, v_0 individuals who start at a low wage w_0 and eventually find a higher-paying job w_2 . This provides an alternative explanation to the standard argument of accumulated human capital while employed, which can also generate the upward sloping earnings profile.

Our model has also the flavor of combining implicit contracts and search, as in Burdett and Mortensen (1980) and Mortensen (1986). There is a tendency in our labor market to generate employee-employer relationships that can last for some time, and appeal to some segments of the work force.

5. BOND GOES TO THE EMPLOYER

We now study the equilibrium when the assumption that the forfeited separation bond goes to a third party is replaced by the assumption that the bond goes to the employer. To that end, the following proposition can be stated:

PROPOSITION 2: The resulting equilibrium does not change when the separation bond goes to the employer and not to a third party. The only difference might occur for the nominal terms of the (w_0, B_0) labor contract.

PROOF: The assumption that the bond goes to the employer might make a difference for firms offering the w_0 wage, since these firms can now collect the B_0 bond of their quitting employees. Since a separation bond $B_0 > 0$ requires a higher wage w_0 , given by equation (6), in order to induce workers to take the (w_0, B_0) contract rather than continue searching, equation (1a) should be replaced by (1a'):

⁶ A similar result was found also by Burdett (1978).

$$w_0 = v_0 + b + (1-\tau) \gamma_2 B_0 \quad \frac{v_1 - v_0}{1 - (1-\gamma_2)(1-\tau)} > B_0 \geq 0 \quad (1a')$$

Any combination (w_0, B_0) satisfying (1a') yields the same lifetime expected utility V^* , given, for instance, by equation (2). Similarly, the profit $\pi(w_0; \lambda)$ is the same for all (w_0, B_0) contracts of equation (1a'). This is obvious since $(1-\tau)\gamma_2\ell(w_0)$ workers move to w_2 firms from any w_0 firm in each period, and we have:

$$\pi(w_0; \lambda) = (\lambda - w_0)\ell(w_0) + (1 - \tau)\gamma_2\ell(w_0)B_0 = (\lambda - v_0 - b)\ell(w_0).$$

Clearly, changing the assumption about the party collecting the bond does not have an impact on w_1 and w_2 firms, whose workers never quit. Hence the equilibrium depicted in figure 1 does not change. The distribution of firms, labor supply and all equations derived in the previous sections still hold, except for equation (1a). Notice that when B_0 attains or exceeds its upper bound $(v_1 - v_0)/[1 - (1 - \gamma_2)(1 - \tau)]$ of (1a'), workers will never quit since they are better off at the w_0 firm rather than accepting a w_2 job offer and paying the separation bond B_0 . In this case the (w_0, B_0) labor contract becomes a lifetime contract, yielding a lower profit than $(\lambda - v_0 - b)\ell(w_0)$ to the firm. Hence B_0 must be lower than its upper bound in equation (1a').

We have thus come to the apparently surprising conclusion that whether the bond goes to a third party or to the employer does not make any real difference. The conventional wisdom is that payments made to a third party are necessarily distorting. What we see here is that in a general equilibrium context, and when the bond is determined endogenously, the same equilibrium is attained irrespective of the nature of the bond. When the bond is assumed to go to a third party, workers and firms circumvent this constraint by writing contracts in which either the bond is zero, as in (1a), or the bond is never paid, as in (1b) and (1c). When the bond goes to the firm, both sides can agree upon a menu (w_0, B_0) of wages

and bonds, given by equation (1a'), which is neutral in its effect on workers and firms. We can now proceed to the determination of the equilibrium when the separation bond is not determined endogenously, but is rather enforced exogenously by some institutional or other arrangement.

6. RESTRICTED SEARCH AND UNEMPLOYMENT

Lazear (1990) presents the theoretical arguments for and against job security provisions at the firm level. He concludes that "It is also true that severance pay effects are neutral only when payment made by the firm is received by the worker. There can be no third-party intermediary receiving any of the payment. If this occurs, then incentives are necessarily distorted." (Lazear, 1990, p.702).

Lazear's conclusion that severance pay made by the employer to the employee is neutral with respect to its effect on employment, is based upon the ability to contract around this constraint, in the form of the worker "buys" his job from the firm. If this is not possible, then any kind of severance pay is distortionary, as in Gavin (1986).

We study here the possible distortionary effects of separation bonds. Since whether the firm has to pay the worker when they split or vice versa should not make any difference, severance pay and separation bonds being analogous. We can therefore extend the analysis of exogenous restrictions on separation of workers and firms to a general equilibrium framework. In particular, we would like to understand whether the market generates ways to offset these restrictions, such that there are circumstances in which the imposition of restrictions on separation does not have any real effect, as obtained by Lazear (1990) in a partial equilibrium framework.

6.1. Bond Goes to a Third Party

Assume initially that a prohibitively large separation bond, going to a third party when forfeited, is exogenously imposed. Clearly, there is some bond B^* (calculated below) such that for any bond B , $B \geq B^*$, all separation is blocked. In this case, our model reduces to that of Eckstein and Wolpin (1990),

which is a version of Albrecht and Axell (1984) when individuals can draw job offers from active or inactive firms, i.e., $p > 0$. In this case there are no firms which pay the low wage w_0 . Instead, the lowest wage possible is w_1 , which compensates the workers for the lost option to work at the high wage w_2 .

It is straightforward to show, either directly or using Eckstein and Wolpin, that with no search on-the-job the labor supply is

$$\varrho(\hat{w}_1) = \frac{\mu\beta}{1 - \hat{p}(1 - \tau)} \quad (21)$$

$$\varrho(w_2) = \varrho(\hat{w}_1) + \frac{\mu(1 - \beta)}{1 - (1 - \hat{\gamma}_2)(1 - \tau)} \quad (22)$$

where the expressions for \hat{w}_1 , \hat{B}_1 and w_2 are given in equation (1), and a "hat" denotes the restricted separation model. Notice that w_2 , but not w_1 , is numerically identical in the two models, because $\hat{\gamma}_2 \neq \gamma_2$. The fraction of firms paying \hat{w}_1 and w_2 is:

$$\hat{\gamma}_1 = A(\hat{\lambda}_1^*) - A(\hat{w}_1) \quad (23)$$

$$\hat{\gamma}_2 = 1 - A(\hat{\lambda}_1^*) \quad (24)$$

and $\hat{p} = A(\hat{w}_1)$ is the probability of not drawing a job offer from an active firm in a given period.

The cutoff productivity $\hat{\lambda}_1^*$ that distinguishes between \hat{w}_1 and w_2 firms is:

$$\hat{\lambda}_1^* = v_1 + b + \frac{(v_1 - v_0) \beta \tau}{(1 - \beta) [1 - \hat{p} (1 - \tau)]} \quad (25)$$

The expressions for the unemployment rate in the whole population, \hat{S} , and among v_0 and v_1 individuals, \hat{S}_0 and \hat{S}_1 , respectively, are the same as in equations (13), (14), and (15). The unemployment rate increases with \hat{p} and decreases with $\hat{\gamma}_2$. Since $p = A(w_0) < \hat{p} = A(\hat{w}_1)$ and $\gamma_2 > \hat{\gamma}_2$ (since $\lambda_1^* < \hat{\lambda}_1^*$), then $S_0 < \hat{S}_0$ and $S_1 < \hat{S}_1$, where S_0 and S_1 correspond to zero exogenous bond, as in sections (2)-(4). That is, relative to the unconstrained search unemployment, imposing binding separation bonds increase unemployment for both groups of individuals.

Assume now that the exogenous separation bond B satisfies $0 \leq B < B^*$. For these values of B there are three wage levels in equilibrium, and the model is basically the one presented in sections (2)-(4), with the following changes. The wage w_0 and the bond B_0 take the lowest possible values, which are the values that maximize profit, i.e. from equation (6):

$$w_0 = v_0 + b + (1 - \tau)\gamma_2 B \quad B_0 = B. \quad (1a'')$$

The cutoff productivity λ_0^* has to change accordingly. Substituting w_0 of (1a'') in equation (16) yields:

$$\lambda_0^* = v_1 + b - \tau B. \quad (19')$$

The expressions for (w_1, B_1) , (w_2, B_2) , λ_1^* , γ_0 , γ_1 , γ_2 , S_0 , and S_1 all stay as in sections (2)-(4), even though the numerical solution is, of course, different. Taking the total derivative with respect to B we obtain:

$$\frac{d\lambda_1^*}{dB} = \frac{(v_1 - v_0) \beta \tau (1 - \tau) [(1 - \tau) a(w_0) \gamma_2 + \beta \tau a(\lambda_0^*)]}{[(1 - \beta) (1 - p (1 - \tau)) + \beta \gamma_0 (1 - \tau)]^2 + (v_1 - v_0) \beta \tau (1 - \tau)^2 a(w_0) a(\lambda_1^*) B} \geq 0$$

$$\frac{d\gamma_2}{dB} = -a(\lambda_1^*) \frac{d\lambda_1^*}{dB} \leq 0$$

$$\frac{dS_1}{dB} = \frac{-\tau}{[1 - (1-\tau)(1-\gamma_2)]^2} \frac{d\gamma_2}{dB} \geq 0$$

The larger the exogenous bond B is, the higher the unemployment rate among v_1 individuals, S_1 . This rise in S_1 takes place as long as $B < B^* = \min(\hat{B}_1) = (v_1 - v_0) / [1 - (1 - \hat{\gamma}_2)(1 - \tau)]$, as presented by the curve "acd" in figure 3. Points a and c represent the unemployment levels corresponding to the unconstrained case of our model, and to the constrained model of Albrecht and Axell (1984), respectively. As long as $B < B^*$, there are firms with productivity λ which is larger or equal to w_0 in equation (1a'') and smaller than \hat{w}_1 (which is w_1 in (1b) for $\gamma_2 = \hat{\gamma}_2$), that can make positive profit offering (w_0, B_0) contract, but lose money offering an (\hat{w}_1, \hat{B}_1) contract. Therefore, as long as $B < B^*$ there will be some w_0 firms with productivity λ distributed on the range $(w_0(B), \lambda_0^*)$. When $B \geq B^*$ the economy will consist of firms offering lifetime contracts (\hat{w}_1, \hat{B}_1) and (w_2, B_2) only. Any marginal increase in B above B^* does not change the unemployment rate further.

Studying the effect of the exogenous bond B on the unemployment rate S_0 of v_0 individuals we obtain:

$$\frac{dS_0}{dB} = \frac{\tau}{[1 - (1 - \tau)p]^2} \frac{dp}{dB}$$

$$\frac{dp}{dB} = a(w_0) (1-\tau) \left[\gamma_2 - a(\lambda_1^*) B \frac{d\lambda_1^*}{dB} \right] =$$

$$a(w_0) (1-\tau) \gamma_2 - \frac{\gamma_2 + \frac{\beta \tau a(\lambda_0^*)}{(1-\tau) a(w_0)}}{1 + \frac{[(1-\beta)(1-p(1-\tau)) + \beta \gamma_0 (1-\tau)]^2}{(v_1 - v_0) \beta \tau (1-\tau)^2 a(w_0) a(\lambda_1^*) B}}$$

Hence, the convergence of S_0 from the unrestricted level corresponding to $B = 0$ to the higher level of the constrained model of Eckstein and Wolpin, is not necessarily monotonic.

The intuition behind the eventual reduction in unemployment as the separation bond decreases is as follows. Restrictions on separation or search on-the-job, whether institutional, moral or other, as in Albrecht and Axell (1984) and Eckstein and Wolpin (1990), force firms to pay for the lost option to search. However, this represents an unexploited profit opportunity. Firms whose productivity is lower than the wage w_1 that includes the option value, but higher than the leisure reservation wage w_0 , can make positive profits by offering a lower wage than w_1 , but also freedom to continue the search. Thus, when the restrictions on search are relaxed, more firms with short-term labor contracts will be able to compete in the market place. This tends to lower unemployment among the v_0 individuals who are less selective in terms of job acceptances.

Although none of the v_1 individuals will accept a job within the w_0 firms which became active when the restrictions on search were lifted, these new firms reduce unemployment also among the v_1 workers indirectly, via the general equilibrium mechanism. Workers in w_0 firms search for w_2 jobs, with higher lifetime utility, rather than w_1 firms, which do not raise their utility. The transition of workers from w_0 to w_2 firms raise the labor supply of v_0 individuals to w_2 firms relative to w_1 firms. Hence, w_1 firms which with the restricted search were marginally better off paying w_1 rather than w_2 , would be willing to pay the higher wage w_2 , realizing that with unrestricted search the gain in labor supply of paying the higher wage is larger. Since there are more firms that can pay the reservation wage of the v_1 individuals, the unemployment among them falls. Notice that the increase in γ_2 with unrestricted search drives the wage w_1 up, $dw_1/d\gamma_2 > 0$. In order to induce individuals to take the w_1 job when the probability of a w_2 job is higher, the wage premium in w_1 should be larger. The increase in w_1 , when the wage w_2 does not change, contributes also to the switch of the marginal w_1 firms to the w_2 category. Again, unemployment among v_1 individuals falls with search on-the-job of the v_0 individuals.

6.2. Exogenous Bond Goes to the Employer

Suppose now that a separation bond B_1 , going to the employer when forfeited, is exogenously imposed. As long as the bond B is smaller than $(v_1 - v_0)/(1 - (1 - \gamma_2)(1 - \tau))$, where γ_2 is the ratio of firms offering w_2 wage in the unconstrained equilibrium, the imposition of B does not change the equilibrium, as implied by section 5 in the context of endogenous bonds. The terms of the labor contracts are:

$$w_0 = v_0 + b + (1 - \tau) \gamma_2 B_0 \quad \frac{v_1 - v_0}{1 - (1 - \gamma_2)(1 - \tau)} > B_0 \geq B \quad (1a''')$$

$$w_2 = v_1 + b \quad B_2 \geq B \quad (1c''')$$

while (w_1, B_1) is given by equation (1b).

The unemployment rate is therefore constant at levels S_0 and S_1 for exogenous bond B , $0 \leq B < (v_1 - v_0)/(1 - (1-\gamma_2)(1-\tau))$. Similarly, the unemployment rate is constant at levels $\hat{S}_0 > S_0$ and $\hat{S}_1 > S_1$ when B satisfies $B \geq (v_1 - v_0)/(1 - (1-\hat{\gamma}_2)(1-\tau))$, as shown by "abcd" in figure 3.

When the exogenous bond satisfies:

$$B \in \left[\frac{v_1 - v_0}{1 - (1-\gamma_2)(1-\tau)}, \frac{v_1 - v_0}{1 - (1-\hat{\gamma}_2)(1-\tau)} \right)$$

the equilibrium is not well defined. To understand why this is the case, consider a bond $B_1 = (v_1 - v_0)/[1 - (1-\gamma_2)(1-\tau)]$. In this case the contract (w_0, B_0) is identical to the (w_1, B_1) contract. Employees of the (w_0, B_0) firms will therefore not quit, which implies that (w_0, B_0) firms will either cease being active or offer the (w_1, B_1) lifetime contract. The resulting equilibrium is the one of Eckstein and Wolpin (1990) with all contracts in the economy as lifetime contracts, and when the ratio of w_2 firms is $\hat{\gamma}_2 < \gamma_2$ and with (\hat{w}_1, \hat{B}_1) contract which satisfies $\hat{w}_1 < w_1$, $\hat{B}_1 > B_1$. But once this happens, there is an incentive for all firms previously offering the (w_0, B_0) contract, to offer a contract $(w_0(B), B)$ where $B_1 < B < \hat{B}_1$. In this case $(w_0(B), B)$ employees do quit when they are offered a w_2 wage and the firm collects the bond B . This policy maximizes profit for all firms which offered (w_0, B_0) previously, since it yields the same profit as earlier. But if all these firms offer the $(w_0(B), B)$ contract, we are back in the initial situation; employees will not have the incentive to quit and firms will cease being active and so on.

Thus, the number of active firms when the bond is constrained to the region between B_1 and \hat{B}_1 , is not uniquely determined. Instead there is a dynamics of firms changing their optimal policy in response to changing market conditions.

The reason underlying this phenomenon here and not in the case where the bond goes to a third party is as follows. In the latter case, raising the bond lowers the profitability of the (w_0, B_0) policy and therefore gradually forces (w_0, B_0) firms out of the market; firms with lowest productivity λ are the first to exit. No such gradual reduction of profits happens when the firm collects the forfeited bond. Therefore there is no clear distinction of the nature of the firms who are eventually forced out.

We can now relate our work to the body of literature which deals with the separation of workers and firms. The first issue is the possible existence of a mechanism which neutralizes outside intervention in the nature of the labor contract. According to Lazear (1990), mechanism of this type exists when the intervention takes the form of a financial transfer between the sides of the contract, whereas Gavin (1986) and Emerson (1988) do not consider this possibility. As we observe here, an offsetting mechanism is endogenously evolved in a general equilibrium model. The wage rises with the exogenous bond B , as in (1a''), such that the effect of B on the economy is completely neutralized.

However, although from the point of view of a single firm or worker this offsetting mechanism is feasible for any bond B , general equilibrium forces impose an upper bound on the size of the bond B which can be neutralized. When the imposed B exceeds a certain value, the wage of the contract $(w_0(B_0), B_0 = B)$ is so attractive relative to the best market alternative (w_2, B_2) , such that workers never quit. But this implies that a $(w_0(B_0), B_0 = B)$ contract will not exist, since it is profitable only when the worker quits and the firm collects the bond when he is offered a (w_2, B_2) contract.

We thus conclude that even in a general equilibrium model, there exists a range of values that the separation bonds takes, without having any real effect on the economy. This is the case when the forfeited bond goes to the firm. However, when the bond is large enough, distortionary effects occur.

When the separation bond goes to a third party, any intervention restricting the mobility of workers between jobs, reduces employment. In this case, unlike the previous one, the imposition of the exogenous bond must reduce the combined welfare of the firm and its employees, and therefore no arrangement between them can neutralize the effects of the bond. When the bond rises, unemployment increases up

to the level in which workers' mobility is completely restricted, i.e. the level obtained by Albrecht and Axell (1984) and Eckstein and Wolpin (1990). At this point, the effect of an additional increase in the size of the bond on the employment level is null.

7. UNEMPLOYMENT COMPENSATION

The effect of a rise in unemployment compensation on employment can be summarized as follows:

PROPOSITION 3: When unemployment compensation rises, employment among v_0 individuals falls; a sufficient condition for a decrease in employment of v_1 individuals is $a'(\lambda) \leq 0$, i.e., nonincreasing density of firm-specific productivities.

PROOF:

$$\frac{dS_0}{db} = \frac{\tau}{[1 - (1 - \tau)p]^2} \frac{dp}{db}$$

Since $p = A(w_0)$ and $w_0 = v_0 + b$, then $dw_0/db = 1$ and $dp/db = a(w_0) \geq 0$, the density of the productivity index at the point w_0 . Thus the unemployment rate S_0 among v_0 individuals rises as a result of the decrease in the number of active firms. The effect of a higher b on v_1 employment is given by the following equations:

$$\frac{dS_1}{db} = \frac{\tau}{[1 - (1 - \tau)(1 - \gamma_2)]^2} \frac{d\gamma_2}{db}$$

$$\frac{d\gamma_2}{db} = -a(\lambda_1^*) \frac{d\lambda_1^*}{db}$$

$$\frac{d\lambda_1^*}{db} = 1 + \frac{(v_1 - v_0) \{ \beta \tau (1 - \beta) (1 - \tau) a(w_0) - \beta (1 - \tau) [a(\lambda_0^*) - a(w_0)] \}}{(\beta \gamma_0 (1 - \tau) + (1 - \beta) [1 - p(1 - \tau)])^2}$$

This is positive when $a'(\lambda) \leq 0$ which ensures that $a(\lambda_0^*) \leq a(w_0)$. Only when $a(\lambda_0^*) = a(w_2)$ is much larger than $a(w_0)$, then $d\lambda_1^*/db$ can be negative which makes ds_1/db negative; i.e., a decrease in the unemployment among v_1 individuals when the unemployment compensation b rises. We thus conclude that a higher b increases unemployment among v_0 workers always, and increases unemployment among v_1 workers in most cases. To understand how the reversed result might arise, notice that the change in the proportion γ_0 of w_0 firms is:

$$\frac{d\gamma_0}{db} = a(\lambda_0^*) \frac{d\lambda_0^*}{db} - a(w_0) \frac{dw_0}{db} = a(\lambda_0^*) - a(w_0)$$

When this number happens to be very large there will be a large increase in the number of w_0 firms. This is good news for w_2 firms, since the labor supply $\ell(w_2)$ to these firms rises when more workers eventually move from w_0 to w_2 firms. This can increase the number of w_2 firms, and reduces S_1 , since the mobility of workers adds to the profitability of the w_2 firms. Again, there is a positive contribution to the employment of v_1 workers as a result of the mobility of their v_0 colleagues.

Suppose now that the increase in unemployment compensation is selective, and given only to v_0 individuals. The comparative statics of this exercise can be summarized as:

$$\frac{dp}{db} = a(w_0) > 0$$

$$\frac{d\lambda_1^*}{db} = \frac{-\beta\tau}{\beta\gamma_0(1-\tau) + (1-\beta)[1-p(1-\tau)]} \left[1 - \frac{a(w_0)(v_1-v_0)(1-\tau)}{\beta\gamma_0(1-\tau) + (1-\beta)[1-p(1-\tau)]} \right]$$

Once again, we get an unambiguous fall in v_0 employment when the selective unemployment compensation increases. This is in contrast with the result obtained by Eckstein and Wolpin (1990) where the unemployment rate \hat{S}_0 does not necessarily rise with a (general or selective) increase in unemployment compensation. The first term in $d\lambda_1^*/db$ is negative, and therefore represents a rise in the proportion γ_2 of w_2 firms and a decrease in the unemployment rate S_1 among v_1 workers. This term appears also in Albrecht and Axell (1984), and it arises since w_2 does not change while w_1 increases with a selective rise in b , and therefore it is relatively more profitable to be a w_2 firm. The other term in $d\lambda_1^*/db$ represents a rise in p and a fall in γ_0 ($d\gamma_0/db = -a(w_0)$) when b increases selectively. This lowers the labor supply and profits of w_2 firms, and therefore increases unemployment among v_1 individuals. The net effect on S_1 can therefore be positive or negative, depending on the parameters' values.⁷ Note that as long as the bond is determined endogenously, the analysis of the effect of a rise in unemployment compensation on unemployment remains the same regardless of whether the bond, when forfeited, goes to the employer or to a third party.

⁷ It is interesting to note that although our model extends the works of Albrecht and Axell (1984) and Eckstein and Wolpin (1990), the comparative statics in their models is much more tedious than here. For example, the unemployment rate among v_0 individuals in Eckstein and Wolpin, \hat{S}_0 , depends positively on $\hat{p} = A(\hat{w}_1)$, and not on $p = A(w_0)$ as in our model. Since \hat{w}_1 , unlike w_0 , depends also on the endogenous variable $\hat{\gamma}_2$, the derivative of \hat{p} with respect to b is quite complicated.

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FIGURE 1

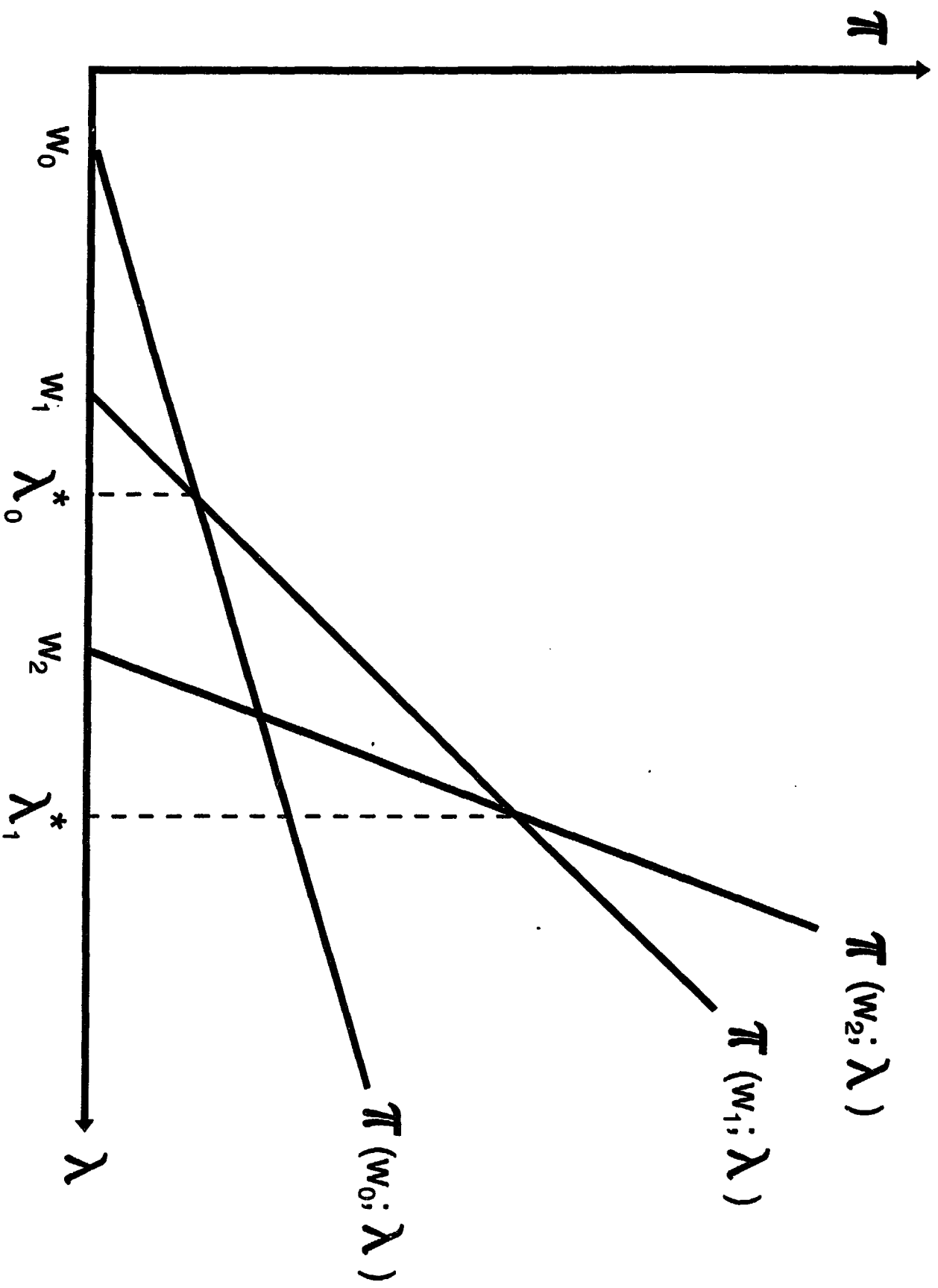
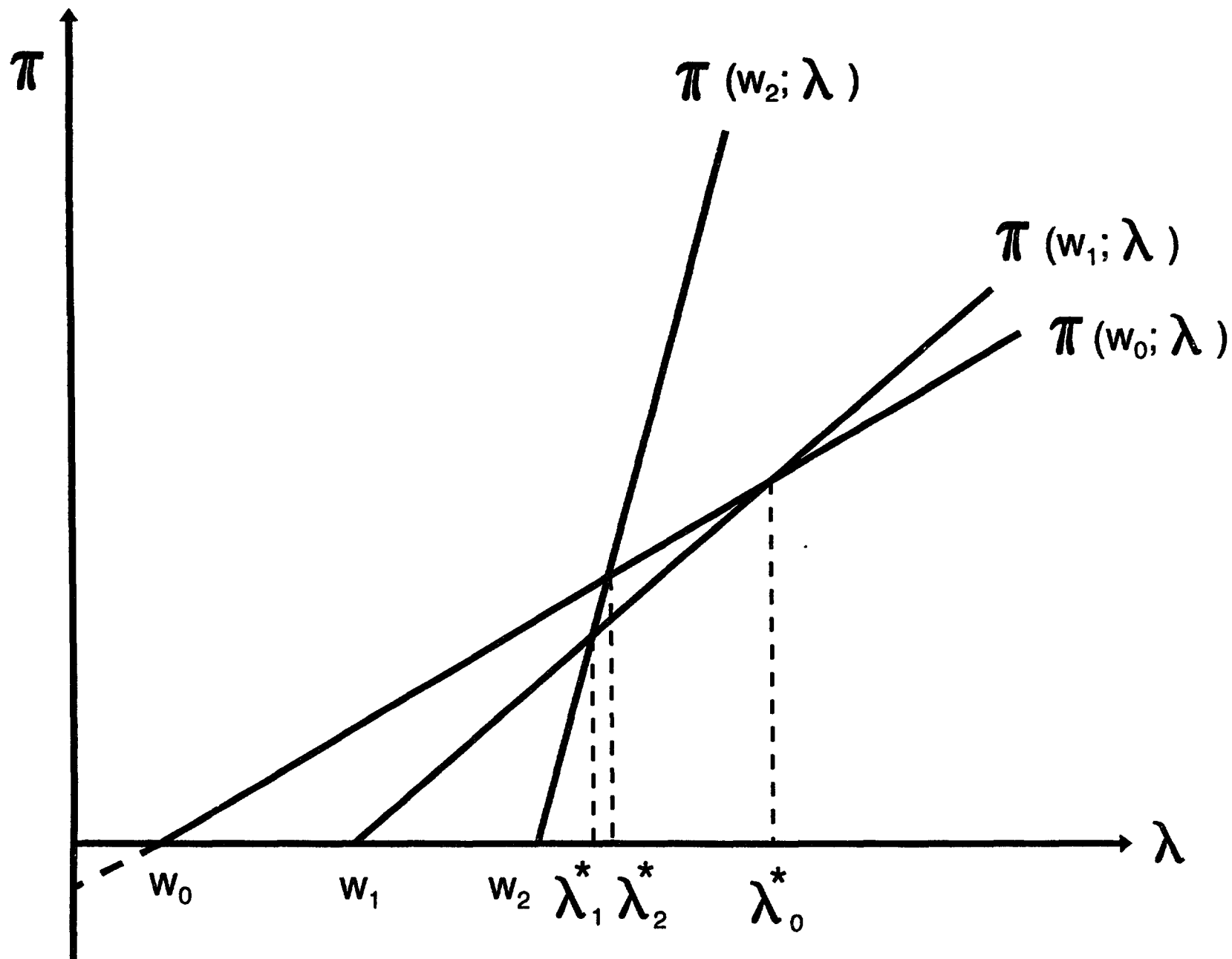
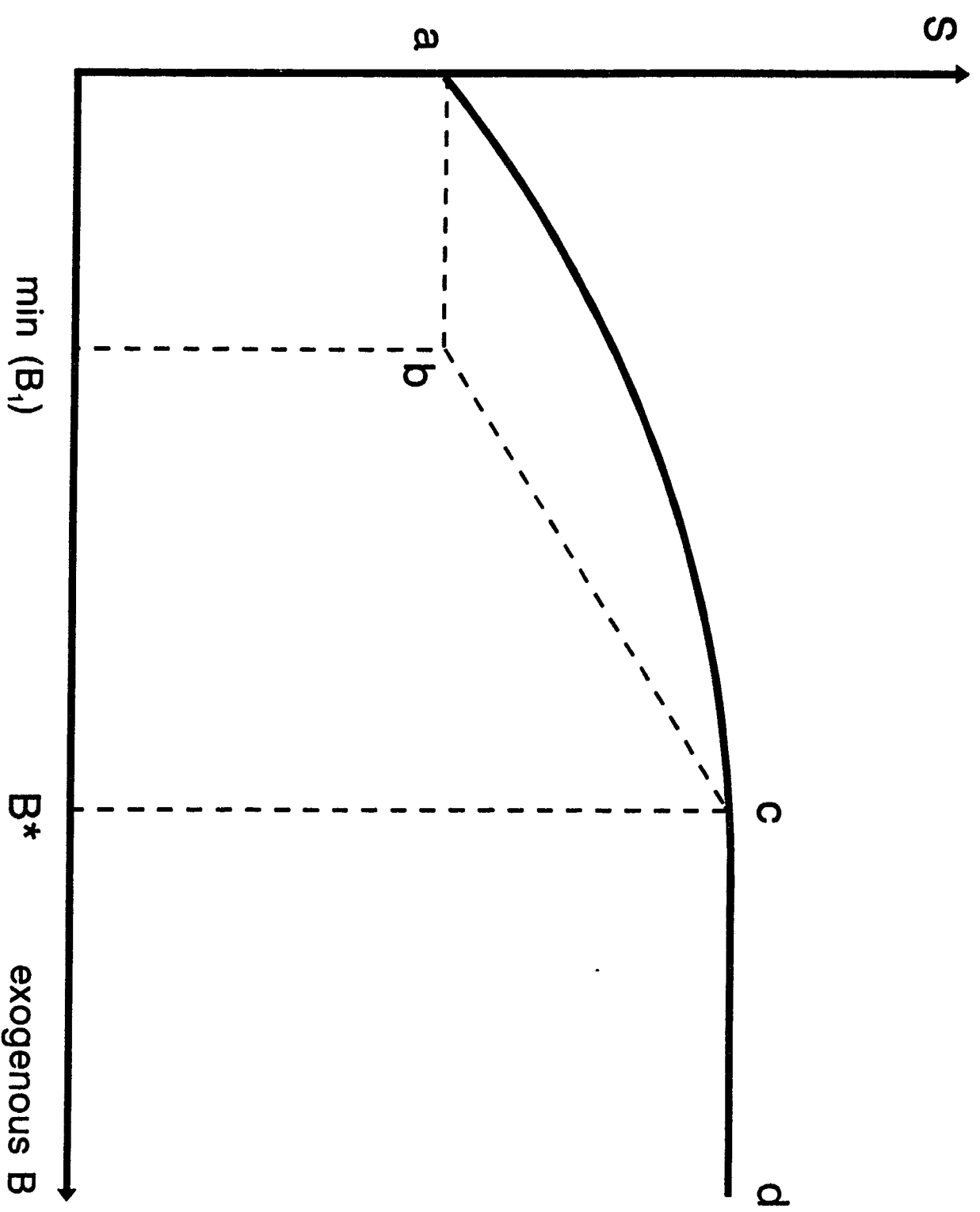


FIGURE 2





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