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Deposit-Refund on Labor: A Solution to Equilibrium Unemployment?

BEN J. HEIJDRA and JENNY E. LIGTHART*

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the firm pay a deposit when it fires a worker, to be refunded when it (re-) hires that or another worker?

A deposit-refund scheme on labor is essentially a tax on firing an employee matched by a subsidy on hiring a (new) worker. The deposit acts as a "stick" by providing an incentive to move away from socially "undesirable" behavior, whereas the refund acts as a "carrot" by providing an incentive to move toward "desirable" behavior. By seeking such a policy mix, one can contain the fiscal implications of hiring subsidies; firing taxes reduce firms' incentives to lay off workers and generate government revenues to (partly) finance public spending on hiring subsidies. Schemes that rely solely on hiring subsidies to boost employment may encourage firms to generate high labor turnover—assuming that the subsidy exceeds the recruitment and training costs to the firm—with a view to securing a net gain. Fay (1996) argues that close monitoring in employment-subsidy programs is important to make sure that subsidies are not used to replace subsidized workers whose subsidy has ended nor to recruit workers for recently created temporary vacancies.

The present proposal is not merely academic. Recently, Tilburg University has implemented a subsidy-penalty scheme with a view to increase the proportion of female associate and full professors among its staff. When a new female professor is recruited by a department, the Board of the University disburses a subsidy of 75,000 guilders to that department, which has to pay a penalty of the same amount when a female professor quits or is laid off.[3] This measure was introduced to replace a 50,000-guilder hiring subsidy on female professors, which was not successful because of high quit rates.

This paper analyzes the long-run unemployment effects of deposit-refund schemes on labor. To this end, a modified version of Pissarides' (1990) search-theoretic model of the labor market is employed. This framework allows for flows in the labor market from the creation of new jobs and the (exogenous) destruction of superfluous jobs. It assumes a search process in which firms offering vacancies and unemployed job-seeking workers are brought together in a stochastic fashion. In this type of model, vacancies and unemployment occur simultaneously in equilibrium. Pissarides' model thus differs radically from the aggregate (classical) labor market model in which only unemployed workers (vacancies) are observed when the wage is above (below) its equilibrium value. The model features a search externality that is represented by agents' contact probabilities as a function of labor market tightness: the presence of an additional firm with a vacancy makes it easier for workers to find jobs but harder for firms to fill vacancies. Similarly, an additional unemployed worker makes it more difficult for workers to locate jobs but easier for vacancies to be filled with workers.

So far, the literature on unemployment policy has not studied deposit-refund systems in the context of labor markets.[4] There exists, however, a substantial liter-

[3]Contrary to the above description, the Tilburg scheme applies to both layoffs and quits.

[4]In an accompanying paper Heijdra and Ligthart (2002) study a hiring subsidy cum firing tax in a fully specified macroeconomic model with search externalities.

ature on hiring subsidies, on the one hand, and firing costs on the other. Informal discussions on the beneficial employment effects of hiring subsidies can be found in Fay (1996), Martin (1998), OECD (1994, 2000), and Phelps (1997). The earlier theoretical literature on employment subsidies, which assumes a clearing labor market and homogeneous labor, stresses their employment-enhancing effect,[5] but has neglected the government's budget constraint. Recently, Martin (1998) and the OECD (2000) have informally discussed the fiscal and employment implications of various labor subsidies taking into account the heterogeneity of labor. Formal treatments of labor subsidy policies in a search-theoretic context are developed by Millard and Mortensen (1997) and Mortensen and Pissarides (2001). They show that hiring subsidies reduce unemployment duration, but have an ambiguous effect on the unemployment rate.[6]

The theoretical literature on firing costs—with central contributions including Bertola (1990, 1992), Bentolila and Bertola (1990), and Booth (1997)—generally finds that employment protection provisions reduce the variation of employment over the business cycle, but the effect on the average level of employment is ambiguous. Firing costs create disincentives for firms wanting to fire workers but also discourage hiring because of the discounted costs of possible firing in the future. Bertola (1992) shows that when discount and attrition rates are positive, the average employment effect of firing costs depends on its effect on the marginal product of labor (which is negative), as well as the relative slopes of the labor demand curve in booms and slumps. He argues that if hiring and firing cycles are long—in which case attrition and discount rates are large and thus the present discounted value of firing costs small—employment may increase. However, no consensus has been reached yet in the empirical literature on the employment effects of firing costs (see Hunt, 1994).

The model at hand shows that deposits and refunds on labor push up economy-wide wages, increase the vacancy rate, and reduce the equilibrium rate of unemployment. Intuitively, the scheme provides an implicit subsidy (that is, the interest earned on the "deposit") to firms hiring new employees. The model gives a very stylized description of the labor market, however; employees work (full time) during their entire life, they do not voluntarily quit jobs, and workers are either employed or unemployed, in which case they are looking for a job. As the discussion section argues, if firms can freely set working hours, deposit-refund schemes on labor are likely to induce firms experiencing bad business conditions to impose shorter working hours on their workforce as a substitute for firing them. Accordingly, the variance of employment over the business cycle is stabilized. Some observers may claim that this contributes to undesirable rigidities in the labor market.

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[5]Experiments with employment subsidies in the United States and Italy—as reported in Woodbury and Spiegelman (1987) and Felli and Ichino (1988)—have generally been successful in increasing employment.

[6]These papers extend Pissarides' (1990) framework by endogenizing the job destruction process. Because their analytical framework yields indeterminate employment effects of hiring subsidies, this paper employs the much simpler Pissarides model, which assumes a fixed job destruction rate. As a result, the model cannot take into account firms' incentives to replace nonsubsidized employees by subsidized (the so-called displacement effect).

I. A Search Model of the Labor Market

Suppose that there is a fixed labor force, L, of which a fraction u is unemployed per unit of time.[7] The flow into unemployment originates from an exogenous job destruction process that causes a proportion s of occupied jobs to dissolve. Separations may be caused by structural shifts in demand or by changes in productivity and are interpreted as "firing" because in equilibrium workers strictly prefer employment to unemployment. Only unemployed laborers search for a job, thus excluding on-the-job search by workers. Likewise, the firm is not searching for workers to replace incumbent (but unsatisfactory) workers. Vacancies are created by new firms or by incumbent firms reopening previously destroyed jobs.

At each instant of time, uL unemployed workers and vL vacancies on offer engage in a stochastic matching process, where v is the vacancy rate. The number of successful matches depends on the number of unemployed workers, $U \equiv uL$, and the total number of vacancies, $V \equiv vL$, according to the following matching function:

$$\begin{gathered} xL = G(U,V), \\ G_U > 0, G_{UU} < 0, G_V > 0, G_{VV} < 0, G_{UU}G_{VV} - G_{UV}^2 > 0, \end{gathered} \tag{1}$$

where xL is the total number of matches, x denotes the matching rate, and $G(.,.)$ is a linearly homogeneous function. By defining $g \equiv xL/V = x/v$, the matching function can be rewritten to yield $g = g(\theta)$, with $g'(\theta) < 0$.[8] The probability that a firm finds a worker in the time interval dt is given by $g(\theta)\mathrm{d}t$, where $\theta \equiv V/U$ denotes the vacancy-unemployment rate, which is a measure of labor market tightness. Then, the expected duration of a vacancy is given by $1/g(\theta)$. Similarly, $f(\theta) \equiv \theta g(\theta)$ is the probability of an unemployed worker finding a job, so that $1/f(\theta)$ is the expected duration of an unemployment spell.

In the aggregate, unemployment evolves according to the difference between the average number of unemployed workers who find a job, that is $f(\theta)uL\mathrm{d}t$, and the average number of workers entering the unemployment pool, $s(1 - u)L\mathrm{d}t$. This yields the following equilibrium rate of unemployment:

$$u = \frac{s}{s + f(\theta)}, \tag{2}$$

which is strictly greater than zero.

Wages are taken as given during the search process. After an individual worker and firm meet each other, however, wages are determined through negotiations.

[7]This section builds on Pissarides (1990), which is amended to allow for a deposit-refund scheme on labor.

[8]Job-seeking workers flow out of the unemployment pool according to a Poisson process with rate x/v.

Firm Behavior

Assume that there are many risk-neutral firms, each of which has one job that is either filled or vacant. If the job is filled, the representative firm rents physical capital, k, at the constant rate of interest,[9] r, to produce output according to a constant returns-to-scale production function, $F(k,1)$, which satisfies the usual properties. If the job is vacant, the firm actively searches for a suitable worker and is incurring search cost, γ_0, per unit of time.

Suppose that a firm hiring a worker receives a fixed one-off subsidy of b from the government, but when it fires that worker it must pay a tax of b. This is like a variant—in fact, the reverse—of a cash-refund scheme on bottles where consumers have to pay a fixed amount on buying a filled bottle and receive a refund (set at the same rate) when the empty bottle is properly disposed of.[10] In the model, it is assumed that workers do not voluntarily quit jobs (in which case the firm would not need to pay a firing tax).

Let J_F and J_V denote the present value of profits of a firm with a filled job and a vacancy, respectively. Assume perfect capital markets so that firms can borrow freely at the market rate of interest. Then, the following arbitrage equation can be derived for a firm having a vacancy:

$$rJ_V = -\gamma_0 + g(\theta)\left[J_F + b - J_V\right]. \tag{3}$$

Equation (3) says that the capital cost of the firm, rJ_V, should equal the firm's expected return on investment, which consists of two parts: (i) the fixed-search costs that are incurred per time unit; and (ii) the expected capital gain when it finds a worker. The latter is equal to the sum of the gain in present value from filling the vacancy (that is, $J_F - J_V$) *and* the subsidy payment received from the government, weighted by the probability of finding a suitable candidate. The number of firms/jobs is determined by the zero-profit condition—free entry and exit of firms will occur until all profit opportunities from new vacancies are equal to zero. This implies the following expression for the present value of an occupied job:

$$J_V = 0 \Rightarrow J_F = \gamma_0/g(\theta) - b. \tag{4}$$

Equations (3)–(4) show that b acts like an *implicit subsidy* to firms with a vacancy: the expected search costs, $\gamma_0/g(\theta)$, are reduced by the subsidy payment received from the government.

[9]Assuming a small open economy for which the world rate of interest is given.

[10]In case of a deposit-refund on labor, the firm is the buyer of the services of the nonreproducible commodity "labor." Then, the firm receives a subsidy if it hires one unit of labor, while in the case of bottles the firm supplies the reproducible commodity (bottled beverages) at a fixed charge.

For a firm with a filled job, the steady-state arbitrage equation reads as follows:

$$rJ_F = F(k,1) - (r+\delta)k - w - s[J_F + b], \tag{5}$$

where w denotes the wage rate and δ is the rate of depreciation. The left-hand side of equation (5) represents the expected return on an occupied job, which is composed of the surplus created in production and the expected capital loss owing to job destruction (that is, $s(J_F + b)$). If the job is destroyed, the firm not only loses the value of the occupied job, but must also pay back the deposit on its worker to the government. Since the job destruction rate, s, is exogenous, the firm can do nothing to reduce the probability of an adverse job-destroying shock.

The firm chooses the amount of capital it wants to rent such that the value of the firm is maximized:

$$\underset{\{k\}}{\text{Max}}\,(r+s)J_F \equiv F(k,1) - (r+\delta)k - w - sb. \tag{6}$$

This yields the usual condition equating the marginal product of capital to the rental charge on capital:

$$F_k(k,1) = r + \delta, \tag{7}$$

and the marginal condition for labor:

$$F_N(k,1) - w = \frac{(r+s)\gamma_0}{g(\theta)} - rb, \tag{8}$$

where N is employment and subscripts denote partial derivatives. Equation (8) shows that labor receives less than its marginal product, owing to the positive search costs.[11] However, the capital value of the deposit acts like a subsidy on the use of labor.

Worker Behavior

Workers are homogeneous, live forever, and are risk-neutral. Therefore, they care only about the expected discounted value of their income. It is assumed that each worker with a job supplies one unit of labor inelastically. Let Y_E and Y_U denote the present-discounted value of the expected stream of income of, respectively, an

[11]Note that $(r + s)J_F = F_N(k,1) - w - sb$. Equation (8) is obtained by using this result in equation (4).

employed worker and an unemployed worker. An unemployed worker receives an exogenously given income, z, during his or her search and expects to move into a job with probability $f(\theta)$.[12] Then, the following steady-state arbitrage condition can be derived for a worker without a job:

$$rY_U = z + f(\theta)\left[Y_E - Y_U\right]. \tag{9}$$

The arbitrage condition says that the return on human capital of an unemployed worker during search—that is, the reservation wage[13]—should equal expected income, which consists of the imputed value of leisure and the capital gain from finding a job.

A worker with a job earns a wage, w, and loses that job at an exogenous rate s. Then, in steady state, permanent income of an employed worker, rY_E, should equal expected income, which exceeds wage income to compensate for the risk of becoming unemployed (and suffer a capital loss of $Y_E - Y_U$):

$$rY_E = w - s\left[Y_E - Y_U\right]. \tag{10}$$

Solving equations (9) and (10) yields expressions for Y_E and Y_U:

$$rY_E = \frac{r(w-z)}{r+s+\theta g(\theta)} + rY_U, \quad rY_U = \frac{(r+s)z + \theta g(\theta) w}{r+s+\theta g(\theta)}, \tag{11}$$

where the first expression shows that for anybody to be willing to search for a job, wages need to exceed the imputed value of leisure.

Wage Setting

When an unemployed worker and a firm offering a vacancy meet, a pure economic rent is created by the encounter, which is equal to the sum of the expected (net) search costs of the worker and the firm. Upon separation this rent will be lost. The division of the rent of a particular firm-worker pairing i is a matter of bargaining over the wage rate, w_i. Using the Nash bargaining solution, the wage rate is set such that the weighted sum of the worker's and firm's net returns is maximized taking behavior in the rest of the labor market as given:

[12]This may represent the imputed value of leisure or income earned in the hidden economy.

[13]This could also be interpreted as the household's permanent income: the amount the unemployed worker can consume without running down his or her capital.

$$\underset{\{w_i\}}{\text{Max}}\,\Omega \equiv \beta \log\left[Y_E^i - Y_U\right] + (1-\beta)\log\left[J_F^i + b - J_V\right], \tag{12}$$

where the coefficient β (0 ≤ β ≤ 1) can be interpreted as a measure of the worker's bargaining strength and Y_U and J_V are the "threat points" of the worker and the firm, respectively. The rent-sharing rule derived from (12) is given by:

$$\frac{Y_E^i - Y_U}{J_F^i + b - J_V} = \frac{\beta}{1-\beta}. \tag{13}$$

This yields the following wage equation for worker *i*:[14]

$$w_i = (1-\beta)rY_U + \beta\left[F_N(k_i,1) + rb\right]. \tag{14}$$

In symmetric equilibrium, each firm with an occupied job chooses the same capital stock, that is, $k = k_i$. Accordingly, all workers are equally productive so that the wage rate is the same for all worker-firm pairs, $w = w_i$. Using equations (13), (9), and (14), the reservation wage can be written as $rY_U = z + \beta\theta\gamma_0/(1 - \beta)$. Now, by combining this with equation (4), the aggregate wage equation follows:

$$w = (1-\beta)z + \beta\left[F_N(k,1) + rb + \theta\gamma_0\right]. \tag{15}$$

The economy-wide wage is a weighted average of the imputed value of leisure and the firm's surplus, which consists of the marginal productivity of labor, the expected search costs that are saved if a deal is struck, and the implicit subsidy on labor. Accordingly, the deposit rate pushes economy-wide wages up.

II. Model Solution and Allocation Effects

Market Equilibrium and Government

The full model can be summarized by equations (2), (7), (8), and (15). The endogenous variables of the model are *u*, *k*, *w*, and θ. For a fixed capital stock, the model can be solved in a recursive fashion. Equation (7) shows that the optimal

[14]Substituting the arbitrage equation for worker *i*, that is, $rY_E^i = w_i + s(Y_U - Y_E^i)$, and the expected capital gain to firm *i* of filling a vacancy, that is, $(r + s)J_F^i = F_N(k_i, 1) - w_i - sb$, yields equation (14).

capital stock, k^*, is determined by the rental rate of capital, that is $k^* = H(r + \delta)$, with $H' > 0$. Given the capital stock, equations (8) and (15) yield equilibrium values for θ and w, and θ, in turn, determines the equilibrium rate of unemployment (see equation (2)). Because the rate of interest is exogenously given, the wage rate is the only price variable in the model.

The analysis so far has implicitly assumed that the government finances the deposit-refund system through lump-sum taxes on households. The government cannot issue debt and does not provide unemployment benefits to workers. At introduction, all firms having a filled job receive b from the government, so that a lump-sum tax of $T(0) = (1 - u)Lb > 0$ is needed to balance the government budget at time zero. Once the deposit-refund system is operational, job destruction leads to net government receipts, $s(1 - u)Lb$, and new job matches cause net government outlays of $f(\theta)uLb$. Using equation (2), it can be easily shown that the deposit-refund system is budgetary neutral in the steady state.

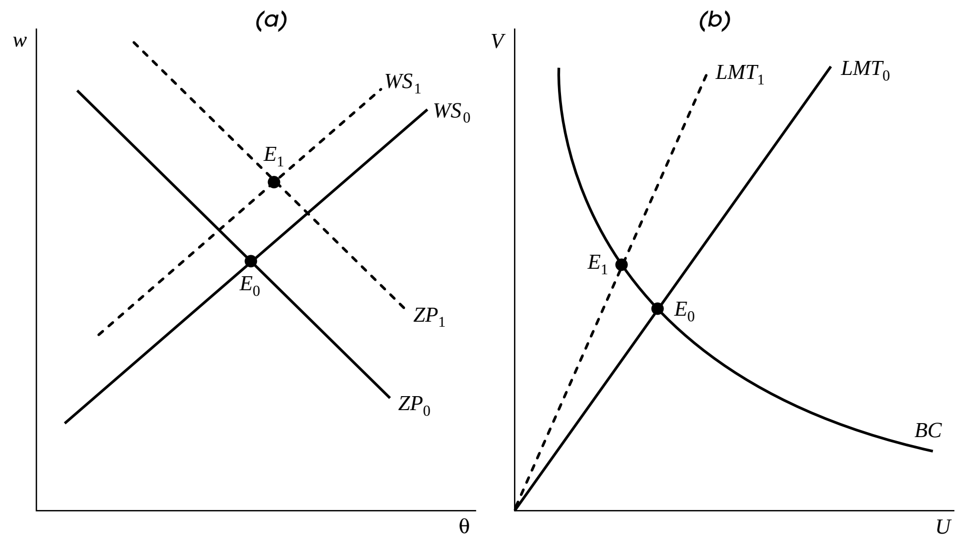
The model can be summarized with the aid of Figure 1. Panel (a) shows equilibrium for labor market tightness and wages. The curve *ZP* represents the zero-profit condition—see equation (8)—and is downward sloping in the (w, θ) space. An increase in wages makes job creation less profitable at a given level of search cost. To restore the zero-profit equilibrium, the search cost to firms must decrease, that is, $g(\theta)$ must increase through a fall in θ. *WS* is the wage-setting curve—see equation (15)—and is upward sloping: at higher labor market tightness the worker receives a larger share of the search costs that are foregone when a deal is struck with a firm. The intersection of the ZP_0 and WS_0 curves yields the equilibrium point E_0. In panel (b) of Figure 1, the line *LMT* through the origin represents the equilibrium vacancy-unemployment ratio (the indicator for labor market tightness). The curve *BC* is the Beveridge curve[15]—represented by equation (2)—which is downward sloping and convex to the origin.[16] Intuitively, when there are less vacancies, unemployment is higher because unemployed find it more difficult to find a job. Equilibrium vacancies and unemployment are at the intersection of the LMT_0 and *BC* curves.

Allocation Effects

The allocation effects of an increase in the deposit, b, are shown in Figure 1. The appendix derives these results analytically. In panel (a), the zero profit curve shifts up from ZP_0 to ZP_1 because the interest payments the firm earns on an employed worker—a so-called implicit subsidy—increase the value of an occupied job. These interest payments also increase wages via the wage setting equation, as represented by an upward shift of WS_0 to WS_1. Both wages and the vacancy-unemployment ratio rise; that is, the new equilibrium, E_1, lies to the northeast of the initial equilibrium E_0. In panel (b), the *LMT* curve rotates counterclockwise from LMT_0 to LMT_1, whereas the position of the Beveridge curve is unaffected by the increase in the deposit. Given the increased equilibrium vacancy rate, unem-

[15]See Blanchard and Diamond (1989) for further details on the Beveridge curve.
[16]Diminishing returns to inputs in the matching function cause the convex shape.

Figure 1. Deposit-Refund and the Labor Market



ployed workers find it easier to locate a job, and hence the expected duration of an unemployment spell falls, as does the equilibrium unemployment rate.

Efficiency and the Optimal Deposit Rate

The search model features trading externalities, implying that the decentralized market outcome without policy intervention may be below the socially optimal outcome. This section derives the optimal deposit-refund rate in the steady state.

Social welfare is defined as the present discounted value of gross output minus the sum of the social costs of employment (that is, forgone leisure), zN, search costs of hiring firms, $\gamma_0 V$, and (gross) investments, I:

$$\wedge(t) \equiv \int_0^\infty \left[F\big(K(t), N(t)\big) - zN(t) - \gamma_0 \theta(t)\big(L(t) - N(t)\big) - I(t)\right] e^{-rt} \mathrm{d}t, \tag{16}$$

where $N \equiv (1 - u)L$ denotes aggregate employment, $K \equiv \Sigma_i k_i$ is the aggregate capital stock, and $V \equiv \theta(L - N)$ denotes aggregate vacancies. The social planner maximizes equation (16), subject to the employment constraint $\dot{N} = g(\theta)\theta(L - N) - sN$, and the capital accumulation constraint, $\dot{K} = I - \delta K$. The government's problem can be solved using Pontryagin's maximum principle, which yields the following optimality conditions:

$$F_K\left(\hat{k}\right) - (\delta + r) = 0, \tag{17}$$

$$F_N\left(\hat{k}\right)-z+\hat{\theta}\gamma_0-\left[s+\hat{\theta}g\left(\hat{\theta}\right)\right]\lambda=r\lambda-\dot{\lambda}, \tag{18}$$

$$\lambda g\left(\hat{\theta}\right)\left[1-\eta\left(\hat{\theta}\right)\right]-\gamma_0=0, \tag{19}$$

where λ is the co-state variable of the employment constraint, $\hat{k}$ is the firm's capital-labor ratio, the hats indicate socially optimal values, and η is the (absolute) elasticity of the function $g(\theta)$. The condition for the capital stock, equation (17), is similar to equation (7), reflecting the optimality of private investment decisions. Equations (18) and (19) can be written to obtain the steady-state social optimum (with $\dot{\lambda} = 0$):

$$F_N\left(\hat{k}\right)-z=\left[\frac{\eta\left(\hat{\theta}\right)g\left(\hat{\theta}\right)\hat{\theta}+r+s}{g\left(\hat{\theta}\right)\left(1-\eta\left(\hat{\theta}\right)\right)}\right]\gamma_0\equiv\Gamma^S\left(\hat{\theta},\eta\right)\gamma_0. \tag{20}$$

The steady-state symmetric market condition is as follows:

$$F_N\left(\hat{k}\right)-z+rb=\left[\frac{\beta g(\theta)\theta+r+s}{g(\theta)(1-\beta)}\right]\gamma_0\equiv\Gamma^M(\theta,\beta)\gamma_0. \tag{21}$$

Matching the equations (20) and (21) yields:

$$rb=\gamma_0\left[\Gamma^M(\theta,\beta)-\Gamma^S\left(\hat{\theta},\eta\right)\right]. \tag{22}$$

If the Hosios (1990) condition—saying that $\eta(\theta)$ should equal β—is satisfied, the social optimum is obtained in which all search externalities are fully internalized. Hence, the government should choose a zero deposit rate, $rb = 0$, so that $\hat{\theta} = \theta$.[17] However, if η is smaller than β, implying that firms at the margin cause fewer spillovers to other firms than workers cause to other employees, equilibrium

[17]For a Cobb-Douglas matching function it is easy to show that $\partial\Gamma/\partial\eta<0$, $\partial\Gamma/\partial\theta>0$ and $rdb/d\theta=\partial\Gamma/\partial\theta>0$. In this case, η is a constant so that optimality of the market equilibrium is a knife-edge property

unemployment is above the efficient level. In that case, a flow subsidy at the rate *rb* is needed to yield a socially optimal outcome. Conversely, if η exceeds β, employment should be taxed. In practice, however, it is difficult to determine whether employment should be subsidized or taxed; it all depends on the properties of the matching function—which is hard to estimate on the basis of poorly measured data—and stylized assumptions on the behavior of workers.

III. Discussion[18]

As was pointed out earlier, deposit-refund systems may provide the same economic incentives as pure taxes and subsidies on labor. This is evident from the fact that the "deposit" on a hiring becomes a simple subsidy if an employer decides not to fire an employee. Conversely, an employer that fires an employee—who was hired before the implementation of the scheme—without rehiring a new one has to pay a pure tax. In the steady state, when both hiring and firing takes place, the analysis above has shown that deposit-refund schemes on labor provide for a flow subsidy—from the government to the firm—equal to the interest income earned on the deposit. Of course, if the real rate of interest were zero, the net subsidy to the firm would be zero. At this stage, it should be recognized that the qualitative allocation effects of other fiscal intervention rules such as cuts in unemployment benefits and job-finding bonuses are similar to the proposed deposit-refund scheme; they all reduce the equilibrium rate of unemployment.

How do deposit-refund schemes differ from the aforementioned instruments? Bohm (1981) shows that environmentally motivated deposit-refund systems may provide for stronger or more focused incentives than taxes/subsidies. For example, if beverage containers have been littered, and thus the refund has not been collected on them, someone else may take care of it and claim a refund, which would not happen with a simple fee. Bottles do not necessarily need to be returned to the same store, which increases the flexibility of the scheme. A similar argument applies to deposit-refund schemes on labor; firm B may hire an employee who was fired by firm A so as to cash in the "deposit." Intuitively, the key incentive—increasing employment—is transferred to any firm wanting to hire new people.

Besides providing similar incentives as under taxes and subsidies, deposit-refund schemes in the labor and environmental field avoid some of the disadvantages of these alternatives. The budgetary effects of a deposit-refund may be more attractive to policymakers than pure subsidies. Subsidies create a need for additional government funds, which often need to be raised by distortionary taxes, whereas deposit-refund systems leave the budget intact. Once the funds are raised to establish the deposit-refund system,[19] it will operate on a budgetary neutral

[18]The discussion is kept informal so as to study the features of deposit-refund schemes in a wider context than the rather stylized theoretical model.

[19]A generalized application of the deposit-refund scheme would require a one-off lump-sum tax at introduction to finance ex post disbursement of employment subsidies on the current stock of workers. Applying the scheme at the margin to targeted groups significantly saves on the budgetary outlays needed to set up the system compared with an across-the-board application.

basis in the steady state—given the assumptions set out in the theoretical section[20] —because the inflow of workers matches the outflow. Such schemes fail, however, to be budgetary neutral in steady state when firms go bankrupt: there is no way to recoup the revenues from firing taxes on the workforce laid off. Therefore, in transition economies featuring a large share of restructuring firms, these schemes have limited practicability as an instrument to stimulate employment. Typically, the scheme could be applied to sectors of advanced economies in which the government considers the rate of labor turnover to be "socially excessive" to motivate employers to retain and train their workers. Some industries facing very uncertain final demand patterns—mirrored in their labor demand—may need to be exempted from the scheme.

Bohm (1981) also argues that deposit-refund systems in the environmental field may provide for lower information and enforcement costs. Indeed, in a deposit-refund system on beverage containers the buyer has an incentive to prove that the commodity has been properly disposed of so as to claim the refund. Under a system of taxes, however, the buyer may try to circumvent the tax by disposing of the containers in an improper fashion. A major concern with a deposit-refund scheme on labor relates to its administrative feasibility. The scheme is easily subject to fraud: it can only become operational under the strong assumption that the government can distinguish quits from layoffs.[21] Otherwise, a group of workers and employers can get together at the expense of the government. For example, an employee working at firm A quits and is subsequently rehired by firm B, where an employee quits to be rehired by firm A. Even if quits could be distinguished from layoffs, the government needs to set up a monitoring system to ensure that firms laying off people make their deposit repayments. Monitoring costs are likely to remain limited when the number of participating firms in the scheme is not too large. In addition, an effective penalty system must be implemented to enforce compliance of firms with firing tax payments.

Environmentally motivated deposit-refund schemes assume that the commodity eventually needs to be disposed of in some form. In the case of labor this is less clear, because labor may leave due factors beyond the control of the employer. First, if mandatory retirement applies, firms employing workers up to the retirement age could keep the subsidies received in the past on currently retiring employees. In this way, hiring old (but less productive) workers may be promoted. Under a flexible retirement arrangement, however, firms may have an incentive to push old, unproductive workers into early retirement schemes to escape the burden of the firing tax. Second, a lot of workers exit jobs through voluntary quits, from which was abstracted in the model of Section I. If the worker terminates the employment contract, firms enjoy a larger net benefit—they receive a hiring subsidy without having to pay the firing tax—at the cost of higher budgetary outlays to the government. Allowing for voluntary separations in the

[20]In practice, in evaluating the budgetary implications, the government should also take into account the saved unemployment benefits that it otherwise would have provided to unemployed workers and the lost resources on workers who voluntarily quit.

[21]Unless it is also the government's objective to penalize quits. This seems to be the aim of the scheme applied by Tilburg University.

model creates a moral hazard problem: firms may abuse workers to induce them to quit (or even perhaps ask them to quit and share the gain with them) so that they do not have to pay the firing tax. However, the very existence of firing taxes may also give rise to moral hazard for employers: workers are more likely to shirk because firing costs make it more costly for firms to fire employees.

Besides these considerations, there are a number of other aspects, related to the practical relevance of the deposit-refund scheme in general, that merit further discussion. Opponents of active labor market policies argue that subsidy-tax schemes on labor lead to rigidities in the labor market. An argument against job security provisions (that is, a firing tax) is that firms are likely to freeze the average size of their workforce over the business cycle—through varying working hours—to avoid firing costs during economic downturns.[22] This may delay or even cancel the sometimes needed efficiency-enhancing restructuring in enterprises. If firms cannot vary working hours, the deposit-refund scheme may exacerbate the variation of employment over the business cycle rather than dampening it (as is the case with a system of only firing costs). New and growing firms are expected to expand employment more than without the scheme because they receive the current subsidy payments on new workers whereas the expected firing costs in the future are discounted at a positive rate. Firing costs will not discourage hiring as long as the subsidy payments exceed the expected present discounted value of future firing costs. Restructuring firms, however, face immediate (undiscounted) firing costs if they cannot vary average working hours.

The theoretical model assumed equal hiring subsidies and firing taxes. This makes perfect sense for commodities with a high rate of turnover such as bottles and car batteries. However, if turnover is low—in the case of labor, a worker may be employed at a firm for more than 35 years—and deposit rates are not indexed for inflation, it is not a priori clear whether this is an optimal strategy.[23] In an inflationary environment, firms receive a larger net real benefit when a match dissolves (the real value of the firing penalty is below the real value of the hiring subsidy) at increased net real costs to the government. Observers may claim that this provides a rationale—in addition to voluntary quits and retirement—for a firing tax greater than the hiring subsidy. In general, the following rule should apply: the difference between the firing tax and the job creation subsidy must be greater than or equal to zero; otherwise, the firm could earn unbounded returns by choosing a very high rate of labor turnover.

[22]Bertola (1990, 1992) uses a simple dynamic (partial) equilibrium model to show the stabilizing effect of firing costs on the average level of employment. Also, Abraham and Houseman (1993) find that German companies—which typically face stronger employment protection policies than U.S. enterprises—rely much more on the adjustment of average work hours, including the use of part-time work, to reduce total labor input during recessions.

[23]Even though the optimal deposit rate could be determined in theory, ascertaining the optimal rate in practice may not be an easy task because estimates of the net marginal social costs of unemployment are not readily available.

IV. Conclusion

Firms firing workers impose costs upon society in terms of unemployment benefits, retraining, and other labor market measures. The formal literature on active labor market policies has suggested using (marginal) employment subsidies or hiring subsidies as one way to deal with the problem of unemployment. This paper explores a new policy strategy—a subsidy-tax scheme on labor—as an alternative to budgetary costly employment subsidy schemes. It is shown—using a simple search-theoretic model of the labor market—that if a firm pays a tax when it fires a worker to be reimbursed when it (re)hires that or another worker, the economy-wide wage goes up, the natural rate of unemployment declines, and the vacancy rate increases. Intuitively, the interest earned on the deposit during the time the firm employs the worker acts as an implicit subsidy on hiring a new worker.

Theoretically, a deposit-refund scheme seems to be a useful policy instrument to reduce the equilibrium rate of unemployment, but there are some limitations to its appeal. First, it could be argued that it creates additional rigidities in the labor market because employers may want to stabilize their average labor force—possibly through varying the average hours worked per person—out of fear for firing costs during downturns. Consequently, efficiency-enhancing restructuring in firms through massive layoffs may be delayed. However, the scheme could potentially be implemented at the margin—applying only to new recruits above a certain threshold—in sectors or employment categories where governments want to motivate employers to retain and train their employees. Second, it could create a moral hazard: firms experiencing bad business conditions may try to push employees into voluntarily quitting rather than firing them. However, employees with permanent contracts may be encouraged to shirk more as firing them becomes more costly to the firm. Third, there is no way of recouping firing taxes from firms going through bankruptcy procedures. Finally, the deposit-refund scheme is susceptible to fraud; because the government is unable to distinguish quits from layoffs, firms and employees may get together at the expense of the government. Even if the government could distinguish quits from layoffs, the scheme is administratively demanding because a monitoring plus penalty system needs to be in place to enforce compliance with firing tax payments.

APPENDIX

This appendix derives the analytical results of an increase in the deposit rate. Loglinearizing equations (8) and (15), holding the rate of interest constant, yields the following system of equations:

$$\begin{bmatrix} \eta(\theta)\left(w - rb - F_N\right) & -1 \\ -\beta\gamma_0\theta & 1 \end{bmatrix} \begin{bmatrix} \tilde{\theta} \\ dw \end{bmatrix} = \begin{bmatrix} -1 \\ \beta \end{bmatrix} \quad r\mathrm{d}b, \tag{A.1}$$

where $\tilde{\theta} \equiv \mathrm{d}\theta/\theta$ and $\eta(\theta) \equiv G_U / f(\theta)$ is the absolute value of the elasticity of the $g(\theta)$ function (with $0 < \eta(\theta) < 1$). Solving for $\tilde{\theta}$ and dw yields the following expressions:

$$\tilde{\theta} = \tilde{v} - \tilde{u} = \frac{(1-\beta) r \mathrm{d}b}{\eta(\theta)\left(F_N + rb - w\right) + \beta\theta\gamma_0} > 0, \tag{A.2}$$

$$\mathrm{d}w = \frac{\beta\left[\theta\gamma_0 + \eta(\theta)\left(F_N + rb - w\right)\right] r \mathrm{d}b}{\eta(\theta)\left(F_N + rb - w\right) + \beta\theta\gamma_0} > 0. \tag{A.3}$$

The vacancy-unemployment ratio and wages both rise as a result of the increase in the deposit rate.

By loglinearizing the Beveridge curve (equation (2)), using $\theta \equiv V/U$, $u \equiv s/(s+f)$, and $f(\theta) \equiv \theta g(\theta)$, the following equation is obtained:

$$\tilde{v} = \left(\frac{1}{1-\eta(\theta)}\right)\tilde{s} - \left(\frac{s + f(\theta)\eta(\theta)}{f(\theta)\left(1-\eta(\theta)\right)}\right)\tilde{u}, \tag{A.4}$$

where $\tilde{v} \equiv \mathrm{d}v/v$, $\tilde{u} \equiv \mathrm{d}u/u$, and $\tilde{s} \equiv \mathrm{d}s/s$. The Beveridge curve is downward sloping because $0 < \eta(\theta) < 1$. Substituting equation (A.2) in (A.4) and setting $\tilde{s} = 0$ yields:

$$\tilde{v} = \left(\frac{\left[s + f(\theta)\eta(\theta)\right](1-\beta) r \mathrm{d}b}{\left(f(\theta) + s\right)\left[\eta(\theta)\left(F_N + rb - w\right) + \beta\theta\gamma_0\right]}\right) > 0, \tag{A.5}$$

so that a rise in the deposit rate increases the vacancy rate.

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