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Welfare effects of job security provisions under imperfect insurance markets

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WELFARE EFFECTS OF JOB SECURITY PROVISIONS UNDER IMPERFECT INSURANCE MARKETS[1]

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1. Introduction

Davis and Haltiwanger (1990) and Dunne, Roberts and Samuelson (1989a, 1989b) have documented the large amount of job creation and job destruction at the establishment level in the U.S. manufacturing sector. These features are not particular to the U.S. labor market, as the O.E.C.D studies document (199?). Many countries have adopted policies that affect this process. An important example are severance payments. Lazear (1990) shows that mandated severance payments are extremely restrictive in several countries. For example, he reports that the number of months of wages that employers must pay to blue collar workers with ten years of experience at the time of employment termination is 16 months in Italy, 14 months in Spain and 12 months in Norway. The experience rated unemployment system in the U.S. is another example of government induced firing costs. Under this system, the tax liabilities of employers are determined based on their past employment experience. According to Anderson and Meyer (1993) an employer that fires a worker pays on average about 60 cents of each dollar of unemployment benefits that the worker receives.

Specially in countries with large severance payments, there is much debate about the consequences of these policies. The case in favor of "labor market flexibilization" is that these policies are unnecessary and that they impose a large burden on employers. Their case goes along the following lines. Businesses profitability is dramatically reduced not only from the firing payments themselves, but from the adjustment costs introduced by the firing restrictions. The aggregate consequences are lower business formation, investment, output, employment and wages. The case in favor of "job security provisions" is, most of the times, based on the premise that there are large firing uninsurable costs that workers must bear. In particular, workers face borrowing constraints and they suffer from the possibility of being caught in long unemployment spells with relatively few assets. Severance payments not only help workers get through their unemployment periods, but the firing costs they impose on employers reduce the rate of job destruction and therefore reduce both the unemployment rate and the idiosyncratic risk that workers face. Both cases, in favor and against job security provisions, are reasonable from a theoretical perspective. Which effect is more important is a quantitative matter, and requires analysis.

Previous work on the effects of firing restrictions include, among others, Bentolila and Bertola (1990), Hopenhayn and Rogerson (1990) and Veracierto (1995). Bentolila and Bertola (1990) study the problem of a monopolist facing a stochastic demand under hiring and firing costs. They find that firing costs increase the average employment of the monopolist. The other two studies mentioned above are general equilibrium analyses. They consider economies with perfect insurance markets, where the competitive equilibrium without interventions is Pareto optimum. Introducing firing penalties in these contexts can only decrease welfare. These studies can then be interpreted as measuring how quantitatively important the case against firing restrictions can be in an economy where these polices are completely unnecessary. Veracierto (1995) finds that firing penalties have very large effects in such a context. Removing a firing tax equivalent to one year of wages increases output, consumption and investment by 8 per cent and employment by 6 per cent, comparing steady states. The steady state welfare gain from removing this policy is also considerable: 2.4 per cent in terms of consumption. This welfare estimate is surprisingly large compared to other Harberger triangles measured in the literature (such as the costs of inflation and business cycles).

This paper extends previous work by introducing a role for job security provisions. It assumes that workers reallocation is costly and that they have no access to insurance markets. In particular when workers are fires, they must exert effort to search for a new job, going through unemployment spells of stochastic length. Since some of the production inefficiencies introduced by firing restrictions are still present, the paper provides a useful framework to analyze the relative importance of the positive and negative effects of job security provisions.

The production side of the economy shares features with Hopenhayn and Rogerson (1990) and Veracierto (1995). Output is produced by a large number of heterogeneous establishments which receive time varying idiosyncratic productivity shocks, that determine their expansion, contraction or death. We assume that establishment hire workers by posting wages, which they commit to keep constant during the tenure of the employees. Establishements fire workers at their discretion and rent capital in competitive markets. New establishments can be created at a fixed cost. On the other hand, households are risk averse and face borrowing constraints. At any point in time agents are either employed, unemployed or retired. Employed agents receive wage payments, but are subject to being fired the following period and becoming unemployed. Unemployed agents do not earn income but can find a job the following period with a probability that depends on their search intensity. A life cycle motive for saving is introduced by assuming that both employed and unemployed face an exogenously constant probability of retiring the next period. Retired agents earn zero income for the rest of their lives and face a constant probability of dying. Agents that die are immediately replaced by descendants, thus keeping population constant. Newborns start their lives as unemployed and inherit the assets left by their parents. Parents do not care about the utility of the descendants. Feasibility requires that the employment expansion and contraction process of establishments be closely tied to the flow of agents across employment states. In particular, the sum of all layoffs across establishments must be equal to the flow of agents from employment to unemployment. Similarly, the sum of all hires must be equal to the flow of agents from unemployment to employment. Agents' decisions consist of how much to save every period and, in case they are unemployed, how much time to search. Their savings is the only way agents have to insure against long unemployment spells.

In this framework we introduce severance payments regulations which require employers to pay a fix amount to workers at the time of employment termination. We analyze severance payments equivalent to one month of wages and one quarter of wages. We find that introducing severance payments to an economy with no other interventions leaves output, capital and consumption virtually unchanged while unemployment slightly decreases. Welfare becomes higher with the introduction of severance payments but the effect is almost negligible: the welfare gains are only 0.05% in terms of consumption when severance payments are one month of wages (and they are even smaller when severance payments are one quarter of wages). This result is extremely surprising since the model has several features to bias the results towards obtaining large benefits from severance payments: 1) the reallocation of workers across establishments creates unemployment, 2) workers do not have access to insurance markets, 3) the labor contracts available do not allow workers to get insurance from employers, 4) firms do not internalize the costs of firing workers, and 5) searching for a job provides disutility while being employed is as enjoyable as having leisure (under this assumption agents strongly dislike losing their jobs). Given the negligible welfare benefits obtained in an environment with these (substantial) frictions and the large welfare costs that previous work found in environments without frictions, we conclude that the policy recommendation that the theory provides is to stay away from severance payments.

Our analysis also provides a welfare evaluation of the U.S. unemployment insurance system versus the U.K. system. There are important differences between both systems: 1) in the U.S. the unemployment insurance system is experience rated (employers pay about 60 cents per each dollar of unemployment benefits that laid-off workers receive on average), while in U.K. it is not, 2) the replacement ratio is about 60% in the U.S. while it is about 36% in the U.K., 3) the U.S. imposes a maximum duration of unemployment benefits of six months, while in the U.K. there are no such restrictions, and 4) the U.K. imposes severance payments of about one month of wages, while in the U.S. there are no mandated severance payments. We find that output, capital and consumption are lower under U.K. policies than in the U.S., and that the unemployment rate is higher. But in terms of welfare U.K. policies are somewhat better since they lead to a smoother stream of consumption and leisure[1].

Nevertheless, we find that both the U.K. and the U.S. systems lead to lower output, capital and consumption and to higher unemployment rates than those that would be obtained under no interventions. In terms of welfare, both U.K. and U.S. policies perform badly compared to laissez faire: the welfare cost of U.S. policies is 0.56% in terms of consumption, while the welfare cost of U.K. policies is 0.45%.

The paper is organized as follows. Section 2 describes the economy. Sections 3 describes a competitive equilibrium with labor market regulations. Section 4 describes the computation algorithm and the calibration procedure. Finally, Section 5 performs the policy analysis and reports the results.

2. The economy

The economy is populated by a unit measure of ex-ante identical agents. Their preferences are given by:

$$E \sum_{t=0}^{\infty} \beta^t \Upsilon_t u(c_t, 1-\eta_t)$$

where:

$$u(c_t, 1-\eta_t) = \frac{[c_t(1-\eta_t)^{\alpha}]^{1-\phi} - 1}{1-\phi}$$

and where c_t is consumption, $0 < \eta_t < 1$ is the search intensity, $0 < \beta < 1$ is the subjective time discount factor, Y_t is and indicator of being alive at time t, $\phi \geq 0$ and $\alpha \geq 0$. The time endowment of each agent is normalized to one. The search intensity η_t is equal to zero if the agent is employed. The search technology specifies that the probability that an unemployed agent finds a job the following period (μ) depends on the search intensity level according to the following function:

$$\mu = \eta^{\sigma} \qquad , \text{ where } 0 < \sigma < 1.$$

At every period, active agents face a constant probability ζ of retiring, i.e. of permanently losing their labor productivity. Retired agents face a constant probability ς of living one more period. With probability $(1 - \varsigma)$ the retired agent dies and is immediately replaced by a descendant which starts his life as an unemployed. These parameters describe completely the evoluction of the indicatr Y_t. Agents do not value the utility of their descendants.

In every period output is produced by a large number of establishments. Each establishment uses capital (k) and labor (n) as inputs into a decreasing returns to scale production technology given by:

$$y_t = s_t k_t^{\theta} n_t^{\gamma}, \qquad 0 < \theta + \gamma < 1$$

where s_t is an idiosyncratic productivity shock. Under free entry, decreasing returns to scale would lead to an infinite number of establishments of infinitesimal size. The introduction of a fixed entry cost below will preclude this possibility and will generate a well defined size distribution of establishments.

The idiosyncratic shock s_t takes a finite number of values and follows a first order markov process with transition matrix Q. This process is assumed to be such that: 1) starting from any initial value, with probability one s_t reaches zero in finite time, and 2) once s_t reaches zero, there is zero probability that s_t will receive a positive value in the future. Given these assumptions, it is natural to identify a zero value for the productivity shock with the death of an establishment.[2] The evolution of the idiosyncratic shocks will determine the expansion and contraction of establishments.

There is a technology that allows for entry of new establishments. This technology specifies that if ξ units of goods are allocated to it, a new establishment is created the following period. Initial productivity shocks s_t for the newly created establishments are randomly drawn from a distribution ψ. These draws are

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Output can be either consumed, invested in physical capital, or invested in establishment creation. There is a standard linear technology to accumulate capital given by:

$$K_{t+1} = (1 - \delta) K_t + I_t$$

where K_t is capital, I_t is investment and δ is the depreciation rate.

3. Competitive Equilibrium

In the competitive equilibrium described below we focus on a particular class of labor contracts: wage posting. We assume that before workers join any particular employer, the current state of the establishment is unverifiable to the worker. The only information available to the worker about the establishment is the posted wage rate. The worker will receive this wage while the employment relation lasts. Once a worker joins an establishment, its individual state is revealed to him but the wage rate cannot be renegotiated. This class of labor contracts guarantees that all establishments pay exactly a same wage rate and that workers cannot obtain insurance from their own employers.

We introduce a variety of labor market policies into the competitive equilibrium being analyzed. The first policy are mandated severance payments. This policy requires that employers pay the laid-off workers, a factor λ of the current wage rate at the time of dismissal. At the same time, unemployed agents receive unemployment benefits as long as they are eligible. When receiving unemployment benefits, agents are payed a fraction ρ (the replacement ratio) of the wage rate. Agents lose their unemployment benefits if they retire, find a job, or if the government exogenously terminates their eligibility. We model the duration of unmeployment benefits by assuming that benefits continue from one period to the next with a constant probablity, its persistence is denoted by Φ. The government finances the unemployment insurance system raising two types of taxes: regular payroll taxes and experience rated taxes. Experience rated taxes are imposed to employers at the time of employment termination. They are a fraction ε of the expected discounted value of unemployment benefits that will be collected by a typical unemployed agent.

Under the firing costs imposed by the government, the individual state of an establishment is given by its current productivity shock (s) and its previous employment level (e). The profit maximization problem of an establishment of type (e, s) is described by the following Bellman equation:

$$V(e,s) = \mathrm{MAX} \left\{ s\,k^{\theta} n^{\gamma} - w^{*} n - r\,k - \tau\, w^{*} \max\left[e(1-\zeta) - n, 0 \right] + \frac{1}{1+i} \sum_{s'} V(n,s')\, Q(s,s') \right\}$$

and where w* is the before payroll tax wage rate and μ is the average hazard rate in the economy. Whenever current employment n is lower than previous period's employment e (net of quits), the establishment must pay a factor τ of the current wage per worker that is fired, where

$$\tau = \lambda + \varepsilon\rho \frac{1}{1 - \frac{\Phi(1-\mu)(1-\zeta)}{1+i}}$$

the second term of τ is the experience rated fraction (ε) of the expected present value of unemployment benefits that will be collected by the average unemployed agent. The amount λ w* is paid directly to the worker as severance (after payroll taxes), the rest goes to the government. Notice that the extablishment maximize exptected discounted profits, at the end of this section we provide a rationale for that criterium.

Now we turn to describe the household problem. Households can save in deposits, which pay interest, but are not allowed to borrow. Agents' decisions consist of how much to save every period and, in case they are unemployed, how much time to spend searching. Their savings is the only way agents have to insure against long unemployment spells. Agents also save for their retirement. The risk aversion of agents together with the lack of perfect insurance markets imply that agents will suffer from the idiosyncratic risk associated with changes in employment status. Note that even though agents do not know the type of establishments they are dealing with before they join any particular establishment, its state becomes known right away after they start working for it. This is important information to the agent because, even though they cannot renegotiate the wage contract, the probability of getting fired the following period depends on the state of the establishment (and this is useful information when making savings decisions). The individual state of an employed agent will then be given by his assets level and the state of the establishment they work for. The individual state of an unemployed agent will be his assets level and his eligibility status for collecting unemployment benefits from the government. Lastly, the individual state of a retired agent is just given by his assets level. Under the competitive equilibrium we analyze we will assume that any positive assets left behind by an agent that dies are inherited by his descendant.

When describing the problem of households it will be useful to index the state of establishments by $j \in \{ j_1 , j_2 , \ldots\ldots , j_J \}$, where a past employment level (e) and a current productivity shock (s) is associated with each j. The individual state of employed and unemployed agents will be described by the duple (a, z), where $z \in \{ b_0 , b_1 , j_1 , j_2 , \ldots\ldots , j_J \}$. If $z = j_i$, it means that the agent is currently employed at an establishment of type j_i. If $z = b_0$, it means that the agent is unemployed and not collecting benefits. Finally if $z = b_1$, it means that the agent is unemployed and collecting benefits. The problem that households face is described by the following Bellman equations:

Retired agents' problem:

$$R(a) = \text{MAX} \left\{ u(c,1) + \beta\, \varsigma\, R(a') \right\}$$

subject to:

$$c + a' \leq a\,(1 + i)\,, \qquad a', c > 0$$

where ς is the survival rate of the retired agents.

Employed agents' problem:

$$H(a,j) = \text{MAX} \left\{ u(c,1) + \beta\,(1-\zeta) \sum_{z'} H\!\left(a' + \frac{w\,\lambda_{z'}}{1+i}, z'\right) \Pi(j,z') + \beta\, \zeta\, R(a') \right\}$$

subject to

$$c + a' \leq a\,(1 + i) + w\,, \qquad a', c \geq 0$$

where $\lambda_{z'} = \lambda$ if $z' = b_1$, and $\lambda_{z'} = 0$ otherwise.

Unemployed agents' problem:

$$H(a,b) = \text{MAX} \left\{ u(c, 1-\eta) + \beta\,(1-\zeta)\,\eta^{\sigma} \sum_{j'} H(a',j')\,\Pi(b,j') \right.$$

$$\left. + \beta\,(1-\zeta)(1-\eta^{\sigma}) \sum_{b'} H(a',b')\,\Pi(b,b') + \beta\,\zeta\,R(a') \right\}$$

subject to:

$$c + a' \leq a\,(1 + i) + \chi(b)\,\rho\, w\,, \qquad a', c > 0$$

where $\chi(b) = 1$ if $b = b_1$, and $\chi(b) = 0$ otherwise.

There are several things worth noting. (i) the wage rate that enters in the households problem is the after payroll taxes wage rate, (ii) we assume that agents cannot carry negative assets, which is motivated by the posibility of an infinitly long string of zero income, (iii) only when an employed worker is fired (i.e. does not retire and transits from j to b_1) he receives severance payments from the employer. (iv), unemployed agents receive unemployment benefits given by the replacement ratio ρ times the wage rate only if they are eligible (i.e. if they are in state b_1). (v) agents leisure is only required to search, but not to work, this is done to avoid voluntary quits, (vi) retired agents do not receive wages nor unemployment benefits, finally (vii) the transition probabilities $\Pi(.,.)$ that agents take as given are endogenously determined (at equilibrium, they must be consistent with the decision rules of establishments).

Finally, there is a competitive banking sector which accepts deposits from households at the interest rate i and holds physical capital and establishments as counterpart to these deposits. There are zero costs to intermediate deposits into capital and establishments. Given that there is a large number of establishments, banks can hold a perfectly diversified portfolio of them. This explain why it was appropiate to assume that the objective function of an establishment was to maximize the expected discounted value of profits, the discount factor being the market interest rate.

We now define a steady state equilibrium formally:

Definition: A **steady state equilibrium** is a { $V(e,s)$, $k_{e,s}$, $n_{e,s}$, $H(a,z)$, $R(a)$, $g_H(a,z)$, $\eta(a,b)$, $g_R(a)$, C, K, $x(e,s)$, v, $\Pi(z,z')$, $y_H(a,z)$, $y_R(a)$, w, w^*, i }such that:

Utility and profit maximization:

E1) $V(e,s)$ is the value function of establishments and $k_{e,s}$ and $n_{e,s}$ are the associated decision rules

E2) $H(a,z)$, and $R(a)$ are the value functions of active and retired agents respectively; $g_H(a,z)$, $\eta(a,b)$, $g_R(a)$ are the corresponding decision rules; and $y_H(a,z)$, $y_R(a)$ are the invariant distributions generated by these decision rules.

<u>Free entry condition</u>:

E3) $$\xi = \frac{1}{1+i} \sum_{s'} \psi(s') V(0,s)$$

<u>Aggregate consistency conditions</u>:

E4) $$x_{ns'} = \sum_{es:\, n_{es} = n} x_{es}\, Q(s,s') + \psi(s') v$$

E5) $$L = \frac{\sum_{s'} \sum_{es} \max\left[n_{es}(1-\zeta) - n_{n_{es}s'}, 0 \right] Q(s,s')\, x_{es}}{\sum_{es} n_{es} x_{es}}$$

E6) Π is consistent with the decision rules of establishments and with the persistence of unemployment benefits Φ.

<u>Market clearing conditions</u>:

E7) $$C + \delta K + \xi v = \sum_{e,s} s\, n_{es}^{\gamma} k_{es}^{0} x_{es}$$

E8) $$N = \sum_{es} n_{es} x_{es}$$

E9) $$K = \sum_{es} k_{es} x_{es}$$

E10) $$\Lambda = \frac{\sum_{es} \pi_{es} x_{es} - \xi \nu}{i} + K$$

where

$$\Lambda = \sum_{z} \int a \; y_H(da,z) + \sum_{a} \int a \; y_R(da) - S$$

$$S = \sum_{j} \int y_H(da,j) \; H(j,b_1) \; \frac{\lambda w}{1+i}$$

Government budget constraint:

E11) $$(w'-w)N + \varepsilon \rho w' \int y_H(da,b_1) + \lambda (w'-w) L N = \rho w \int y_H(da,b_1)$$

where E3) is that the present expected value of a newly created establishment be equal to the fixed entry cost; E4) is that the measure of establishments across different types (x_{es}) be the one generated by the individual employment decisions of establishments, the stochastic process for the idiosyncratic productivity shocks, and the number of new establishments being created each period (ν); E5) is that the aggregate lay-off rate be the one generated by establishments decision rules; E6) imposes that the transition probabilities across individual states be consistent with the optimal decision rules of establishments; E6) is market clearing for the consumption good; E8) is market clearing for labor; E9) is market clearing for capital; E10) is market clearing for assets (note that severance payments must be subtracted average a to get average asset holdings, since they were added in the formulation to the employed agents' problem); and E11) is the government budget constraint, i.e. that the government raises enough revenues (left hand side) to pay unemployment benefits (ρ w) to all unemployed agents collecting benefits (right hand side). The government has three sources of revenues: payroll taxes collected from all employed agents (first term), experience rated taxes (second term) and payroll taxes from severance payments (third term).

4. Calibration and computation of steady state

Below we describe how to compute a steady state equilibrium for the case when ε is equal to zero[3]. The problem is reduced to solving one equation in one unknown. The unknown will be the interest rate i, while the equation to be solved is derived below. We proceed in several steps:

1) Fix the interest rate at some arbitrary value i
2) Given this interest rate, fix the wage rate at some value w* and solve the problem of establishments described above to find V_{es}, π_{es}, k_{es}, and n_{es} (all as functions of w*). Then, find w^* such that the free entry condition E3) is satisfied.
3) Fix the number of establishments being created each period (v) to be equal to one. Given the individual decision rules of establishments found in 2), we iterate on the law of motion for x in E4) to find the stationary x_{es}. Note that this x_{es} is the correct measure up to the yet unknown scaling factor v (x is proportionate to v in E4).
4) Given the decision rules of establishments found in 2), and the x found in 3), we compute the aggregate lay-off rate from E5). Note that this L is the correct value since x enters both in the numerator and the denominator (the still unknown scaling factor of x cancels out).
5) Given the L found in 4) and the decision rule of establishments, we construct

the transition probabilities Π.

6) Given the interest rate i above, we fix $w = 1$ and solve the households' problem described above to find $H(a,z)$, $R(a)$, $g_H(a,z)$, $\eta(a,b)$, $g_R(a)$. Given these decision rules, we find the stationary distributions $y_H(a,z)$, $y_R(a)$. Note that given the functional form for the preferences we use, the aggregate amount of assets under the invariant distribution A is homogeneous of degree 1 with respect to w.

7) The number of retirees, of unemployed and of employed (N), are obtained from the invariant distributions $y_H(a,z)$, $y_R(a)$

8) Given N, and the invariant distribution of agents, the after tax wage rate w is found so that government budget constraint E11) holds with equality. The aggregate amount of assets A held by households is then multiplied by w to obtain the correct number (note that A was found fixing w to one).

9) We now compute the correct scaling factor v for x, so that E8) is satisfied:

$$v = \frac{N}{\sum_{es} n_{es} x_{es}}$$

The x is then multiplied by v to obtain the correct measure across establishments types.

10) The aggregate stock of capital K is then obtained from E9)

11) Finally, we check if the interest rate i in 1) is an equilibrium interest rate by verifying that condition E10) is satisfied.

We now describe the calibration procedure. The time period of the model economy was selected to be half a quarter. The steady state equilibrium of the model economy was calibrated to U.S. observations. For this purpose, policy parameters were selected to resemble U.S. labor market policies. In particular, λ was set to zero (i.e. there are no mandated severance payments in the U.S.). Estimates for the replacement ratio ρ for the U.S. range between 0.5 and 0.66. Consequently, we picked a value for ρ of 0.60. The persistence of unemployment benefits Φ was chosen so that the expected duration of benefits be equal to six months, the maximum duration of benefits in the U.S. Anderson and Meyer (1993) estimate that employers pay 60 cents per each dollar of unemployment benefits laid-off workers receive on average. Accordingly, we selected ε to be 0.60.

The number of parameters to determine in the firms side depends critically on the number of values that the idiosyncratic productivity shock s can take. Tractability requires considering only two possible positive values. We chose to normalize the lowest productivity shock to one, so s takes values in the set $\{0, 1, \kappa\}$. This leaves one parameter to determine in the initial distribution ψ, four in the transition matrix Q, one for the entry cost ξ and one for the high productivity shock κ. Since these parameters are important determinants of the establishment dynamics of the model, their values were selected to reproduce several features of U.S. establishment dynamics.

An important set of observations on (manufacturing) establishment dynamics concerns "job creation" and "job destruction" data. Davis and Haltiwanger (1990) defined "job creation (destruction) between periods t and t+1" to be the sum of employment increases (decreases) across all establishments that expand (contract) between periods t and t+1, divided by the average employment level in the manufacturing sector between periods t and t+1. Job creation (JC) was further split into employment increases due to births of establishments (JCB) and employment increases due to continuing establishments (JCC). Similarly, job destruction (JD) was split into employment decreases due to deaths of establishments (JDD) and employment decreases due to continuing establishments (JDC). Davis and Haltiwanger reported values for job creation and destruction corresponding to data from the Longitudinal Research Datafile. Their quarterly mean values for the period between 1972:2 and 1988:4 are reported in the upper portion of Table 2. Roughly, both JCB and JDD are about 0.73% while both JCC and JDC are about 4.81%. Another important observation concerns the persistence of job creation and job destruction in the data. Davis and Haltiwanger reported that about 67% of the jobs created during a year still exist the following year, while about 82% of the jobs destroyed during a year are still destroyed the following year.

In practice, the transition matrix Q was restricted to be of the following form:

$$\begin{pmatrix} 1 & 0 & 0 \\ \beta & \omega(1-\beta) & (1-\omega)(1-\beta) \\ \beta & (1-\omega)(1-\beta) & \omega(1-\beta) \end{pmatrix}$$

i.e. a process that treats the low and the high productivity shocks symmetrically. The parameters β, ω and κ were then selected to reproduce the following three observations: 1) JCB = JCD = 0.73% a quarter, 2) JCC = JDC = 4.81% a quarter, and 3) the annual persistence of both job creation and destruction is about 75%. On the other hand, the parameter ξ was chosen so that the average establishment size in the model economy is about 61.7 employees, same magnitude as in the data.

We must also select $\psi(1)$ which determines the distribution over initial productivity shocks. If we would allow for a large number of possible idiosyncratic productivity shocks, it would be natural to chose a ψ to reproduce the same size distribution of establishments as in the data. With only two values for the idiosyncratic shocks this approach does not seem restrictive enough since we can pick any two arbitrary employment ranges in the actual size distribution to calibrate to. For this reason we chose to follow the same principle as in the choice of Q and pick $\psi = (0.5, 0.5)$, i.e. a distribution that treats the low and the high productivity shock symmetrically (note that these choices of Q and ψ imply that at steady state there will be as many establishments with the low shock as with the high shock).

The remaining parameters to calibrate are β, α, σ, ζ, ς, γ, θ, and δ. The stock of capital in the model economy was identified with plant, equipment and inventories. Consequently, physical investment was associated in the National Income and

Product Accounts with non-residential investment plus change in business inventories. The empirical counterpart of consumption was identified with personal consumption expenditures in non-durable goods and services. Measured Output was then defined to be the sum of these investment and consumption measures. For simplicity we assumed that the entrepreneurial investment in new establishments goes unmeasured in the National Income and Product Accounts. At steady state , investment is given by $I = \delta K$. Using an annual capital-output ratio of 1.7 and an investment-output ratio of 0.15, the half-a-quarter depreciation rate δ was estimated to be 0.011.

The annual interest rate was selected to be 4 per cent . This is a compromise between the average real return on equity and the average real return on short-term debt for the period 1889 to 1978 as reported by Mehra and Prescott (1985). Given the interest rate i and the depreciation rate δ, the capital share parameter θ was selected to match the capital-output ratio in the U.S. economy. The labor share parameter γ was in turn selected to replicate a labor share in National Income of 0.60 (this is the value found in Cooley and Prescott, 1995).

The probability ζ of an active agent continuing to be active the following period was selected so that the average duration of the active life of agents be 40 years. The probability of a retired person surviving one more period, was similarly selected to match an average duration of retirement of 20 years.

From observations reported by Barron and Mellow (1981) it follows that unemployed agents spend about 7.5% of their discretionary time searching. Given that the average duration of unemployment is one quarter (2 model periods), the average hazard rate μ must be 0.5. Matching this hazard rate with a search intensity of 0.075 requires a σ of about 0.27.

Estimates for the risk aversion parameter ϕ range widely, but most of the applied public finance studies use values between 1 and 10, with the mayority on the lower end. Also, given the relatively short model period that we used, we chose a value of $\phi = 1.5$ in our experiments. For a given value for λ, parameters α and β are chosen to generate an average hazard rate μ of 0.5 and induce households to hold the aggregate value of assets given in condition E10) when they face an annual interest rate of 4 per cent.

Parameters corresponding to a model period of half a quarter, and the corresponding steady state equilibrium values are listed in Tables 1 and 2.

5. Policy experiments

In this section we examine the quantitative effects on allocations and welfare of different labor market policies. We compare the steady states of economies with identical structural parameters (those selected in the previous section) but that differ in their policy regimes.

Tables 3 and 4 display the results of our experiments. Reported variables are: aggregate output (Y), aggregate capital (K), aggregate consumption (C), standard deviation of consumption across agents (σ[C]), average leisure (1-η), standard deviation of leisure across agents
(σ[1-η]), aggregate layoff rate, aggregate hazard rate, unemployment rate and a welfare measure. The welfare measure reported is the proportionate increase in permanent consumption needed to make average utility across agents in the economy under laissez fare (no interventions) be the same as in the economy under consideration. Table 3 presents three possible scenarios. The first two columns report the effects of going from laissez faire to U.S.A. policy parameters (the calibrated case), i.e. of setting the replacement ratio ρ to 0.60, the experience rated parameter ε to 0.60 and the persistence of unemployment benefits Φ to 0.75. We see that output, capital, and consumption are lower under U.S. policy parameters than under laissez faire, but the effects are not large (the biggest effect is on output which declines by 0.37%). With respect to the labor market we see somewhat stronger effects: the layoff rate decreases from 2.86% to 2.84%, while the hazard

rate decreases from 54.17% to 50.02%. The drop in the hazard rate dominates the effect on the unemployment rate, raising it from 5.49% to 5.90%. The decrease in the fraction of time that unemployed agents spend searching compensates the effect of the increase in the number of unemployed agents: average leisure being left roughly unchanged. Both consumption and leisure become smoother under U.S. policy parameters. The standard deviation of consumption is 0.28% lower while the standard deviation of leisure is 18.18% lower. We see that even though U.S. policies smooth consumption and leisure, the welfare effects are dominated by the drop in average consumption: welfare is 0.56% lower in terms of consumption under U.S. policies than under laissez faire.

The last column shows the effects of moving to U.K. policy parameters. In the U.K. the replacement ratio is lower than in the U.S. ($\rho = 0.36$), but there are no limits to the number of periods that agents can collect unemployment benefits ($\Phi = 1$). Opposed to the U.S., in the U.K. there are no experience rated taxes ($\varepsilon = 0$) but employers are required to pay severance payments whenever they fire workers. Average severance payments are about one month of salary ($\lambda = 0.67$). We see in Table 3 that U.K. labor policies are even more contractionary than U.S. policies: output, capital, and consumption are lower than in the U.S., while unemployment is (slightly) higher. The layoff rate is the same under U.S. and U.K. policies: the higher unemployment rate in U.K. is determined by a lower average hazard rate. Both consumption and leisure are considerable smoother under U.K. policies than under U.S. policies. In terms of welfare, U.K. is slightly better off than the U.S. but is still worse than under laizzez faire: welfare is 0.45% lower in terms of consumption compared to laissez faire.

Table 4 sets the persistence of unemployment benefits (Φ) to one and the experience rated parameter (ε) to zero (i.e. U.K. values) and reports the effects of moving to different replacement ratios and severance levels. These experiments are not only of interest on their own (since they isolate the effects of severance payments and replacement ratios), but are simple enough to shed some light on how the model works. We consider three possible levels of unemployment benefits: none ($\rho = 0.0$), U.K. levels ($\rho = 0.36$) and U.S. levels ($\rho = 0.60$). In turn, there are three possible levels of severance payments: none ($\lambda = 0.0$), one month of wages ($\lambda = 0.67$) and one quarter of wages ($\lambda = 2.0$). Note that the case of $\rho = 0.0$ and $\lambda = 0.0$ corresponds to laissez-faire, while the case of $\rho = 0.36$ and $\lambda = 0.67$ corresponds to U.K. policies.

Consider first the experiment of keeping ρ constant while increasing severance payments. Unless otherwise indicated we will refer to the case of $\rho = 0$. Note that increasing the severance payments impose larger firing penalties to establishments, which react by lowering their layoff rate. On the households side, when severance payments increase agents enter unemployment with larger assets than before. Since agents dislike to search and they now have larger assets to finance consumption while unemployed, agents decide to reduce their search intensity. The consequent drop in the hazard rate is actually dominated by the decrease in the layoff rate. As a result the unemployment rate is reduced as severance payments increase.

Agents do not necessarily decrease their search intensity as severance payments go up. An important margin that agents face when severance payments increase is that the layoff rate decreases. This means that when agents find a job, they become employed for a longer period of time, increasing the return to the search activity. This tends to induce agents to increase their search intensity. This effect actually dominates when ρ is 0.36 and 0.60 and the hazard rate increases as severance payments go up. The reason for this is that when ρ is 0.36 or 0.60 the utility loss of increasing the search intensity is smaller: 1) agents start from a lower search intensity level when ρ is 0.36 or 0.60 than when ρ is 0 (as we'll see below), and 2) the marginal utility of leisure is strictly decreasing.

Aggregate leisure increases slightly when ρ is 0 since both unemployed agents search less and there is less unemployment. In the other cases average leisure could go up or down since there is less unemployment but the search intensity is higher. When ρ is 0.36 it doesn't change, while when ρ is 0.60 it decreases slightly. All this effects are negligible though. This is not surprising since unemployed agents are a small fraction of the total population (almost all the population enjoys leisure equal to one), so average leisure is not much affected.

Aggregate output, capital and consumption remain roughly constant as severance payments increase (when $\rho = 0$). There are two factors determining the effect on output (and indirectly on consumption and investment). On one hand, severance payments increase employment. This tends to increase output. On the other hand, severance payments decrease the amount of output that is obtained with any given amount of labor. To see why this is so, note that the maximum amount of aggregate output that can be produced with a certain level of aggregate employment is obtained when the marginal productivity of labor is equated across establishments. This is what actually takes place when severance payments are zero but not when they are positive, given the adjustment costs introduced. For the case of $\rho = 0$ these two factors offset each other and output remains the same. But for the case when ρ is 0.36 or 0.60, the increase in employment is large enough that output actually increases with severance payments.

The way the standard deviation of consumption and of leisure are affected by the increase in severance payments depends on the level of the replacement ratio parameter ρ. There are two effects on the standard deviation of leisure that can work in opposite directions. On one hand, since severance payments increase employment there are more agents in the economy with the same amount of leisure (equal to one), tending to decrease the standard deviation of leisure. On the other hand, if severance payments increase (decrease) the search intensity of unemployed agents there would be more disparity (similarity) between the leisure enjoyed by the unemployed and the rest of the agents. This tends to increase (decrease) the standard deviation of leisure.

When ρ is 0, we already saw that the hazard rate increases with severance payments. In this case both effects work in the direction of decreasing the standard deviation of leisure. When ρ is 0.36 and 0.60, the hazard rate increases with severance payments and the two effects work in opposite directions. In the case of

$\rho = 0.36$, the increase in search intensity is not big enough so the standard deviation of leisure decreases. But when $\rho = 0.60$ the increase in search intensity is large enough that increases the standard deviation of leisure.

With respect to the standard deviation of consumption, we see that it decreases when ρ is 0 but it increases when ρ is 0.36 or 0.60. That the standard deviation of consumption may increase with severance payments seems puzzling since these policies are supposed to provide agents with insurance. To understand what goes on in the model we must remember that what agents desire to smooth over time is $c_t\ (1-\eta_t)^{\alpha}$. Note that when unemployed, $(1 - \eta)$ is smaller than when employed (η is zero when employed). This means that to smooth $c_t\ (1-\eta_t)^{\alpha}$ over time they will want to consume more when unemployed than when employed, and this difference will be greater the larger the search intensity η is when unemployed. It is not surprising then that the standard deviation of consumption increases with severance payments when ρ is 0.36 or 0.60, since these are exactly the cases when the hazard rate increases with severance payments.

Finally, for every replacement ratio ρ, severance payments equal to one month of wages ($\lambda = 0.67$) lead to higher welfare than when there are no severance payments. Severance payments equal to one quarter of wages ($\lambda = 2$) give lower utility than when they are only one month of wages ($\lambda = 0.67$), but they are still better than without any severance payments.

In terms of the magnitude of the welfare effects involved, we see that the welfare gain of increasing severance payments to one month of wages ($\lambda = 0.67$) are about 0.05% in terms of consumption. *These are negligible welfare effects.*

Consider now the experiment of fixing $\lambda = 0.0$ while increasing the unemployment replacement ratio ρ (the effects involved are similar when λ is 0.67 and 2.0). Since severance payments are left unchanged, the firing costs that establishments face are the same and the layoff rate doesn't change as unemployment benefits increase. On the contrary, the hazard rate decreases considerably given that agents receive benefits while unemployed and that the expected duration of employment is the same (the layoff rate is unaffected). As a result, the unemployment rate increases. The decrease in employment that follows leads to a decrease in aggregate output, capital and consumption. These effects are substantial: the unemployment rate increases from 5.49% to 6.73% when ρ goes from 0 to 0.60, while output decreases by 1.45% when ρ goes from 0 to 0.60. Both consumption and leisure become smoother as the replacement ratio ρ is increased. In terms of welfare, agents are substantially worse off as unemployment benefits are increased: when ρ increases from 0 to 0.60, the welfare costs are 1.1% in terms of consumption. *These are significant welfare effects.*

Endnotes

1. These results are somewhat different from Millard and Mortensen (1994), where the Mortensen and Pissarides (1994) search model is used to address similar issues.

2. Given that there are no fixed costs to operate an establishment already created, exit will take place only when the idiosyncratic productivity shock takes a value of zero.

3. The only time we solve for a steady state equilibrium for an economy with positive ε is for the case of U.S. policy parameters. But this is exactly the case we calibrate to. We then know the value of the interest rate and the average hazard rate beforehand (since we are calibrating to them), and we thus know the value for the experience rated taxes that firms face. This allows us to solve for a steady state equilibrium just as in the algorithm described in the text, i.e. by first solving the firms problem to get their decision rules.

TABLE 1

PARAMETER VALUES

Preferences				
$\beta = 0.9923596$	$\phi = 1.5$	$\alpha = 2.75$		
Technology				
$\theta = 0.19$	$\gamma = 0.535$	$\delta = 0.011$	$\xi = 2050.0$	$\sigma = 0.26345$
Productivity Shocks				
$s_0 = 0.0$	$s_1 = 1.0$	$s_2 = \kappa = 2.4$		
Distribution over Initial Productivity Shocks				
$\psi_1 = 0.50$	$\psi_2 = 0.50$			
Transition Matrix for Productivity Shocks				
$\beta = 0.0037$	$\omega = 0.9727$			
Demographics				
$\zeta = 0.0031$	$\varsigma = 0.9938$			
Policy parameters				
$\lambda = 0.0$	$\rho = 0.60$	$\varepsilon = 0.60$	$\Phi = 0.75$	

TABLE 2

U.S. Economy:

JCB = 0.62%	JDD = 0.83%
JCC = 4.77%	JDC = 4.89%

Model Economy:

JCB = 0.73%	JDD = 0.74%
JCC = 4.81%	JDC = 4.80%

TABLE 3

Variables	Laissez-Faire	U.S.A.	U.K.
Y	100.00	99.63	99.34
K	100.00	99.74	99.33
C	100.00	99.64	99.38
$\sigma(C)$	100.00	99.72	99.37
$1 - \eta$	100.00	100.07	100.08
$\sigma(1 - \eta)$	100.00	81.82	76.70
layoff rate	2.86 %	2.84 %	2.84 %
hazard rate	54.08%	50.01%	49.11%
unempl. rate	5.49%	5.90%	5.99%
Welfare	100.00	99.44	99.55

TABLE 4

ρ	Variables	λ = 0.00	λ = 0.67	λ = 2.00
0.00	Y	100.00	100.00	99.97
	K	100.00	100.00	99.98
	C	100.00	100.04	100.00
	σ(C)	100.00	99.99	99.98
	1 - η	100.00	100.00	100.01
	σ(1 - η)	100.00	99.29	97.96
0.36	Y	99.23	99.34	99.39
	K	99.21	99.33	99.40
	C	99.29	99.38	99.44
	σ(C)	99.31	99.37	99.47
	1 - η	100.08	100.08	100.08
	σ(1 - η)	76.71	76.70	76.61
0.60	Y	98.55	98.65	98.81
	K	98.52	98.63	98.83
	C	98.61	98.69	98.84
	σ(C)	98.49	98.62	98.88
	1 - η	100.15	100.14	100.14
	σ(1 - η)	60.96	61.42	62.11

TABLE 4 (contd.)

ρ	Variables	λ = 0.00	λ = 0.67	λ = 2.00
0.00	layoff rate	2.86%	2.84%	2.78%
	hazard rate	54.08%	54.03%	53.93%
	unempl. rate	5.49%	5.45%	5.37%
	Welfare	100.00	100.05	100.03
0.36	layoff rate	2.86%	2.84%	2.78%
	hazard rate	49.04%	49.11%	49.24%
	unempl. rate	6.05%	5.99%	5.88%
	Welfare	99.49	99.55	99.55
0.60	layoff rate	2.86%	2.84%	2.78%
	hazard rate	43.98%	44.23%	44.67%
	unempl. rate	6.73%	6.64%	6.45%
	Welfare	98.89	98.93	98.91

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