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Search, Self-Insurance and Job-Security Provisions

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Search, Self-Insurance and Job-Security Provisions[¤]

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Abstract: We construct a general equilibrium model to evaluate the quantitative e¤ects of severance payments in the presence of contracting and reallocational frictions. Key elements of the model are: 1) establishment level dynamics, 3) imperfect insurance markets, and 4) variable search decisions. Contrary to previous studies that analyzed severance payments in frictionless environments, we …nd that severance payments reduce unemployment, produce negative insurance e¤ects and improve welfare levels.

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1. Introduction

Many countries have implemented policies intended to provide workers with higher job-security levels. A common practice in Europe is the imposition of mandated severance payments.[1] The objective of severance payments is not only to provide unemployment compensation to workers, but to deter employers from …ring workers too often. While severance payments can considerably improve job-security levels by lowering …ring rates, their implications for insurance, output, unemployment and welfare are less clear. The purpose of this paper is to develop a framework that can be used to evaluate the consequences of severance payments, weighing both potential costs and potential bene…ts.

An early investigation of the e¤ects of severance payments was undertaken by Bentolila and Bertola [3], who analyzed the partial equilibrium problem of a monopolist facing stochastic demand shocks. They found the …ring costs had larger e¤ects on the propensity to …re than to hire, increasing the average employment of the monopolist.

Later on, Hopenhayn and Rogerson [6] performed a general equilibrium analysis. They considered an economy where output was produced by a large number of establishments subject to idiosyncratic productivity shocks, and analyzed the e¤ects of a …ring tax that was rebated to households as a lump sum transfer. Since they considered a frictionless world with perfect insurance markets, their equilibrium allocation without government interventions was Pareto optimum. As a consequence, …ring taxes had no potential bene…ts: they could only distort the job creation and destruction process. Since households valued leisure and the distortions introduced decreased the productivity of establishments, agents responded to the

[1] Lazear [7] reports that mandated severance payments (for blue collar workers with ten years of tenure) exceed one year of wages in several European countries.

…ring taxes by substituting away from market activities. As a consequence, …ring taxes decreased output, consumption, employment and welfare. In fact, Hopenhayn and Rogerson reported that …ring taxes equal to one year of wages had large negative e¤ects: they decreased employment by 2.5%, consumption by 4.4% and welfare by 2.8%.[2]

This paper extends Hopenhayn and Rogerson [6] analysis by evaluating the e¤ects of severance payments in an economy with frictions.[3] In particular, the economy embodies key elements for weighing potential costs against potential bene…ts of severance payments: 1) establishment level dynamics, 2) reallocation frictions, and 3) absence of insurance contracts.

Similarly to Hopenhayn and Rogerson [6], output is produced by a large number of establishments that receive idiosyncratic productivity shocks. This induce them to expand and contract over time, leading to labor and capital reallocation across establishments. But contrary to Hopenhayn and Rogerson, the reallocation process is costly: workers become unemployed when separated from establishments. Unemployed individuals do not receive wages and must search to …nd new employment. The probability that an unemployed agent …nds a new job depends on his individual search intensity. There are no insurance markets available, and the particular class of labor contracts we allow for precludes workers from obtaining any type of insurance from their own employers. However, individuals can save and accumulate an interest bearing asset which can be used to smooth consumption across

[2] Three features of the Hopenhayn-Rogerson analysis suggest that this welfare cost may be overestimated: 1) the analysis focused on steady state comparisons, 2) it excluded (mobile) physical capital as an alternative factor of production, and 3) there were no potential bene…ts of …ring taxes. Veracierto [14] shows that the …rst two features aren't crucial for the results they obtained. This paper explores the importance of the third.

[3] Our work is closely related to Millard and Mortensen [10], who used the Mortensen and Pissarides [11] matching model to evaluate the e¤ects of alternative labor market policies. Four important di¤erences are that we emphasize individual search decisions instead of an aggregate matching process, our wages are determined by competitive labor markets instead of bilateral bargaining, our agents are risk averse instead of risk neutral, and we emphasize involuntary layo¤s instead of quits.

employment states. Since agents are risk averse and there are no insurance markets, the idiosyncratic risk that they face can result in considerable welfare losses. In this framework, we introduce severance payments and evaluate their effects both on allocations and welfare.

The model is calibrated to match U.S. observations from the National Income and Product Accounts, features of the job creation and destruction process reported by Davis and Haltiwanger [4], the elasticity of the hazard rate with respect to unemployment benefits as measured by Meyer [9], and the average duration of unemployment spells. This is done under policy parameters chosen to reproduce important features of the U.S. unemployment insurance system, such as its replacement ratio, the average duration of benefits, the fraction of laid-off workers that become covered by the system, and its degree of experience rated.

We find that severance payments have the following effects in our economy. First, (similarly to Hopenhayn and Rogerson [6]) productivity is negatively affected. Second, there are no insurance gains. All the contrary, severance payments reduce the stock of assets that agents have for smoothing consumption across employment states. Third, unemployment decreases substantially: both establishments decrease their layoff rates and agents search more intensively. And fourth, welfare improves dramatically: even though average consumption is negatively affected, welfare increases because agents transit fewer times through unemployment.

The paper is structured as follows. The economy is introduced in Section 2. Competitive equilibrium is defined in Section 3. Section 4 describes the parametrization of the model. Section 5 compares the U.S. policy regime with laissaiz-faire and alternative European regimes. Section 6 analyzes the effects of severance payments. Section 7 discusses the role of unemployment insurance in generating high unemployment rates in Europe. And

Section 8 concludes the paper. An algorithm to compute steady state equilibria is provided in the Appendix.

2. The economy

The economy is populated by a measure one of agents every period. Agents experience stochastic lifetimes, evolving from active life to retirement and eventually to death.[4] The probability that an active agent retires is exogenously given by γ. Once an agent retires he faces a constant probability ϑ of surviving to the following period. With probability $(1 - \vartheta)$ the retired agent dies, and is immediately replaced by an offspring who starts life as an active (unemployed) person. Retirement and death realizations are assumed to be independent across agents, leading to a constant number of active agents and retirees over time.[5]

Active agents are either employed or unemployed at any point in time. Unemployed agents become employed depending on their individual search intensities. Agents like to consume, dislike to search, and are indifferent about the well being of their offsprings. Specif-

[4] Retirement makes an agent unproductive for the rest of his life

[5] The life cycle element is introduced to the model economy to improve its performance in two important dimensions. First, it leads to more realistic savings behavior, which is key for evaluating the benefits of job security provisions (savings are an important source of self-insurance for agents). Second, it dramatically improves the accuracy of our numerical computations (which requires a high willingness to save from agents).

ically, their preferences are described by the following utility function:[6]

$$E \sum_{t=0}^{\infty} \beta^{t} \left[\ln c_t + u(1 - \eta_t)\right] \qquad (1)$$

where $0 < \beta < 1$ is the discount factor, c_t is consumption, $0 < \eta_t < 1$ is the search intensity, and u is given by:

$$u(1 - \eta_t) = \alpha \frac{(1 - \eta_t)^{\tau} - 1}{\tau}; \quad \text{with } \alpha > 0, \ \tau > -1; \qquad (2)$$

Consumption possibility sets are such that both employed agents and retirees cannot search (i.e. their η_t must be zero)[7].

Output is produced by a large number of establishments that use capital and labor as factors of production. To motivate the search frictions in the economy, we assume that establishments must produce grouped together at a single geographical location. Every period a new production site is randomly determined and establishments must move as a group to the new location. Unemployed agents ignore the production site of establishments, so they need to search to find it.[8] The probability ξ that an unemployed agent finds the

[6] Preferences were selected to be consistent with the following stylized growth fact: unemployment has no long run-trend while wages grow steadily over time. This requires that income and substitution effects exactly offset each other. Within this class of preferences, a separable utility function is needed to avoid the counterfactual implication that unemployed agents consume more than employed agents. These considerations led to our choice of log utility in consumption.

Observe that these preferences imply a coefficient of relative risk aversion equal to one, which is in the lower range of the most commonly used values. However, our model time period is relatively short, half-a-quarter. As a consequence, a higher elasticity of intertemporal substitution is called for.

[7] Note that (for a same level of consumption) employed agents enjoy as much utility as unemployed agents that do not search. This feature will guarantee the absence of voluntary quits in the competitive equilibrium studied below, simplifying the analysis substantially.

[8] As will be made clear below, while this fiction introduces search frictions in the environment, it will allow for perfectly competitive labor markets. As a consequence, many complicated bargaining issues between workers and establishments will be avoided.

location of establishments depends on his own search intensity level according to the following relation:

$$\xi = \eta^{\sigma}; \text{ where } 0 \le \sigma \le 1. \tag{3}$$

Feasibility allows to allocate any of the agents that find the production site of the economy to any of the existing establishments. However, once an agent joins an establishment he gets attached to it: if for any reason the agent separates (or gets separated) from this establishment, the agent becomes unemployed.

The production function of an individual establishment is given by:

$$y_t = s_t k_t^{\theta} n_t^{\gamma} \tag{4}$$

where $\theta > 0$, $\gamma > 0$, $\theta + \gamma < 1$, k_t is capital, n_t is labor, and s_t is an idiosyncratic productivity shock. The idiosyncratic shock s_t takes a finite number of values and follows a first order Markov process with transition function 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. The evolution of the idiosyncratic productivity shocks determine the expansion and contraction of establishments over time.

A technology to create new establishments is assumed to be freely available. The technology specifies that if μ units of the consumption good 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 common distribution ψ.

Finally, output can be either consumed, invested in establishment creation, or invested in physical capital. The technology to accumulate capital is given by:

$$K_{t+1} = (1 - \delta)K_t + I_t \tag{5}$$

where K_t is capital, I_t is investment and $0 < \delta < 1$ is the depreciation rate.

3. Competitive equilibrium

This section describes a competitive equilibrium characterized by a complete lack of private insurance markets. The only way agents can privately smooth consumption across employment states is by saving in an interest bearing asset - borrowing is not permitted -. In addition, the particular class of labor contracts we allow for preclude agents from obtaining any insurance from their own employers. The absence of private insurance arrangements combined with the search frictions that plague the environment will open a potentially important role for government interventions.

In this framework we introduce a number of labor market policies commonly observed in actual countries. The first is an unemployment insurance system financed both with regular payroll taxes and firing taxes. Firing taxes are paid by employers to the government whenever they lay off workers. In addition, employers are required to make severance payments directly to workers at the time of their dismissal (the main focus of the paper will be the analysis of this particular policy). We now turn to a detailed description of the steady state competitive equilibria.

3.1. Labor contracts

Labor contracts are restricted to be of the following form: 1) they specify a constant wage rate to be paid as long as the employment relation lasts, and 2) they give the employer the ability to terminate the employment relation at any time (after payment of any severance and firing taxes imposed by the government). Note that these labor contracts provide no insurance to workers.[9]

To simplify the analysis, we assume that before a worker joins any particular establishment its individual state is unverifiable to the worker. This guarantees that at equilibrium the same wage rate will be offered by all hiring establishments. Once a worker joins an establishment, its individual state is revealed to the worker but the wage rate cannot be renegotiated. Under these assumptions the market for new hires will be perfectly competitive since: 1) agents are identical from the point of view of establishments that hire, 2) establishments that hire are ex-ante identical from the point of view of agents, and 3) a large number of unemployed agents find the labor market and a large number of establishments hire workers at any point in time.

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[9] Lazear [7] has noted that if contracts were perfect, severance payments would be neutral: if a government forced employers to make payments to workers at the time of their dismissal, perfect contracts would undo these transfers by specifying opposite payments from workers to employers. In order for severance payments to have any type of effects, some form of incompleteness must be introduced.

The extreme form of rigid labor contracts assumed not only has the advantages of precluding insurance arrangements and making the analysis tractable, but is a natural benchmark to analyze in the absence of an obvious intermediate case. In particular, our results can be interpreted as an "upper bound" estimate for the potential effects of firing restrictions (since more flexible contracts would presumably decrease their effects).

Observe that most previous studies have avoided this difficulty by modelling severance payments as firing taxes. Since in this case payments go to a third party (the government), their effects cannot be undone by private arrangements.

3.2. Establishments' problem

Under the firing penalties imposed by the government, the individual state of an establishment is given by its current productivity shock s and its previous period employment level e. We assume that establishments have access to markets to diversify the risk induced by the idiosyncratic productivity shocks s, and hence seek to maximize expected discounted profits. The maximization problem of an establishment of type $(e; s)$ is described by the following Bellman equation:

$$V(e;s) = \mathrm{MAX}\left\{ s\,k^{\theta} n^{\gamma} - w^{*} n - rk - {-}(e;n) + \frac{1}{1+i} \sum_{s'} V(n;s') Q(s;s') \right\} \qquad (6)$$

where w^{*} is the before payroll tax wage rate, r is the rental price of capital, i is the interest rate, and $-(e; n)$ is a firing cost function given by:

$$-(e;n) = (\varepsilon + \lambda) w^{*} \max\left[e(1-\zeta) - n; 0\right] \qquad (7)$$

Note that whenever the number of workers the establishment currently employs n is smaller than the previous period employment net of retirements $e(1-\zeta)$, the establishment dismisses workers. In this case the establishment must pay $\varepsilon w^{*} + \lambda w^{*}$ as firing penalties for each worker it fires. The first term is paid to the government as firing taxes while the second term is paid directly to the worker as severance (after payroll taxes). Both the firing tax factor ε and the severance payments factor λ are policy parameters exogenously determined by the government.

For future reference we denote by $n(e; s)$ and $k(e; s)$ the current employment and capital optimal decision rules for an establishment with state $(e; s)$:

In what follows, we describe the problems faced by employed, unemployed and retired agents. In solving their problems, households take the decision rules of firms, prices and government policy parameters as given.

3.3. Employed agents' problem

Recall that agents learn the individual state of their employers as soon as they get hired. This is important information to an agent because the probability of being fired depends on the state of the establishment he is employed with. The individual state of an employed agent is then given by his current assets level a and the state of the establishment he works for $(e; s)$. His optimization problem is described by the following Bellman equation:

$$\begin{aligned} H(a; e; s) = \text{MAX} \Big\{ & \ln c + \beta\zeta R(a') + \beta(1-\zeta)\sum_{s'} H(a'; e'; s')\Lambda(e'; s')Q(s; s') + \\ & \beta(1-\zeta)\sum_{s'} [(1-\kappa)U(a'; 0; 1) + \kappa U(a'; 1; 1)][1-\Lambda(e'; s')]Q(s; s') \Big\} \end{aligned} \quad (8)$$

where e' is given by:

$$e' = n(e; s)$$

and the problem is subject to:

$$c + a' \leq (1 + i)a + w \quad (9)$$

$$a' \geq 0 \quad (10)$$

Note from the budget constraint (9) that an employed agent receives income both from interest payments $(1+i)\,a$ and wages w (net of payroll taxes). Also note that equation (10) imposes a borrowing constraint to the agent. The agent derives utility from current consumption $\ln c$ and discounts next period's payoffs at the rate β. Next period's value is given as follows. With probability ζ the agent retires, obtaining a value $R(a')$. With probability $1-\zeta$ the agent does not retire, but is subject to losing his job. Let:

$$\alpha(e;s) = \min\left\{1; \frac{n(e;s)}{(1-\zeta)e}\right\} \tag{11}$$

be the probability of continuing employed that a worker at an establishment of type $(e;s)$ faces at the beginning of the period (where $n(e;s)$ is the current employment decision and e is the past employment of the establishment). Note that agents are fired only when current employment $n(e;s)$ is smaller than previous period employment net of retirements $(1-\zeta)e$. For an agent who is currently employed at an establishment of state $(e;s)$, then:

$$\alpha(e';s') = \min\left\{1; \frac{n(e';s')}{(1-\zeta)e'}\right\}, \text{ where } e' = n(e;s),$$

gives the probability of continuing employed the following period if a shock s' is realized. Since the state of the establishment would be $(e';s')$ in this case, the value obtained by the agent would be given by $H(a';e';s')$. Similarly, $1-\alpha(e';s')$ gives the probability of being fired the following period if a shock s' is realized. In this case the agent faces an expected value given by $(1-\kappa)\,U(a';0;1)+\kappa\,U(a';1;1)$, an expression to be described next.

3.4. Unemployed agents' problem

The function $U(a; b; m)$ gives the value of being unemployed to an agent with current state $(a; b; m)$, where a are the current assets of the agent, b is an indicator of whether the agent is eligible for unemployment benefits or not ($b = 1$ meaning that the agent is eligible), and m is an indicator of whether the agent receives severance payments or not ($m = 1$ meaning that the agent receives severance). At the time an agent gets fired he receives severance payment from his former employer and becomes eligible for unemployment benefits with a probability given by κ (a policy parameter for the government). Consequently $(1 - \kappa)U(a'; 0; 1) + \kappa U(a'; 1; 1)$ in equation (8) is the expected value that an agent faces at the time of being fired. Since severance payments are given once and for all at the time of the firing, m becomes zero after that period. Even though an unemployed agent may be eligible for benefits at any given period, the government cancels his eligibility for the following period with probability $1 - \phi$. Once an agent loses his eligibility he cannot regain it during the current unemployment spell.

The problem of an unemployed agent with current state $(a; b; m)$ is then described by the following equation:

$$U(a; b; m) = MAX \Big\{ \ln c + u(1 - \eta) + \beta\zeta R(a') + \beta(1 - \zeta)\eta\sigma \sum_{e';s'} H(a'; e'; s')\Gamma(e'; s') + \beta(1 - \zeta)(1 - \eta\sigma) \sum_{b'} U(a'; b'; 0)P(b; b') \Big\} \quad (12)$$

subject to:

$$c + a' \leq (1+i)\,a + \rho w \chi(b=1) + \lambda w \chi(m=1) \tag{13}$$

$$a' \geq 0 \tag{14}$$

Equation (13) is the budget constraint of an unemployed agent, χ being an indicator function which is equal to one if its argument is true and zero otherwise. The budget constraint restricts consumption and savings to be less than the sum of interest income $(1+i)\,a$, unemployment benefits ρw (if $b = 1$), and severance payments λw (if $m = 1$). The agent derives utility $\ln c$ from current consumption, utility $u(1-\eta)$ from current search effort and discounts next period's payoffs at the rate β. Next period's expected value is given as follows. With probability ψ the agent retires, obtaining a value $R(a')$. With probability $1-\psi$ the agent does not retire and may become employed with a probability which depends on his current search intensity η. With probability $\eta\sigma$ the agent finds the labor market, in which case the agent joins some randomly determined establishment among those that hire. We use $\Gamma(e';s')$ to denote the fraction of total hiring done by establishments of type $(e';s')$: Then $\sum_{e';s'} H(a';e';s')\,\Gamma(e';s')$ is the expected value to the agent of finding the labor market[10]. With probability $(1-\eta\sigma)$ the agent does not find the market and continues unemployed, obtaining a value which depends on wether the agent is eligible for benefits or not. Let the matrix P describe the transition probabilities between eligibility and ineligibility for unemployment insurance, i.e.

[10] To simplify notation from now on, we treat all the variables, including e and a as if they can take only a finite number of values and write summations instead of integrals.

$$P = \begin{pmatrix} P(b=0;b'=0) & P(b=0;b'=1) \\ P(b=1;b'=0) & P(b=1;b'=1) \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 1-\phi & \phi \end{pmatrix} \tag{15}$$

Then, $\sum_{b'} U(a';b';0)P(b;b')$ gives the expected value of continuing unemployed the following period.

3.5. Retirees' problem

The state of a retiree is simply given by his current assets level a. His problem is described by the following Bellman equation:

$$R(a) = \underset{c;a'}{MAX} \left\{ \ln c + \beta\vartheta R(a') \right\} \tag{16}$$

subject to:

$$c + a' \leq (1+i)a \tag{17}$$

$$a' \geq 0 \tag{18}$$

The budget constraint (17) states that the only income that a retiree receives is interest from previously accumulated assets. The agent derives utility $\ln c$ from current consumption and discounts next period's payoffs at the rate β. With probability ϑ the agent survives into the following period, obtaining a value $R(a')$. With probability $(1-\vartheta)$ the agent dies and obtains a value which we normalize to zero. When the agent dies any remaining assets left behind are immediately inherited by his offspring.

For future reference we denote $g^H(a;e;s)$, $c^H(a;e;s)$, $g^U(a;b;m)$, $c^U(a;b;m)$, $\eta(a;b;m)$, $g^R(a)$ and $c^R(a)$ to be the optimal saving and consumption decision rules for employed and unemployed agents, the optimal search decision rule for unemployed agents, and the optimal saving and consumption decision rules for retired agents, respectively.

3.6. Banks

A competitive banking sector accepts deposits from households at the interest rate i and holds physical capital and establishments as counterpart. Capital is rented to establishments at the rental rate r. Since there are no costs of intermediation, at equilibrium we must have that:

$$r = i + \delta \tag{19}$$

where δ is the depreciation rate of capital.

In addition, since banks can create new establishments according to the technology described in the previous section, the following free entry condition must be satisfied at equilibrium:

$$\mu = \frac{1}{1+i} \sum_{s'} V(0;s')\psi(s') \tag{20}$$

where μ is the fixed input of goods required to create an establishment and ψ is the distribution function over initial productivity shocks. Equation (20) states that the expected discounted value of a newly created establishment must be equal to the fixed entry cost. Note that new establishments arrive with zero previous period employment.

3.7. Aggregate consistency

To define a steady state we need to keep track of the cross sectional distributions of establishments and households. These distributions are generated by the corresponding optimal decision rules, as we describe in this section.

At steady state a time invariant measure x describes the number of establishments across individual states $(e; s)$. If ν is the number of establishments being created then x must satisfy:

$$x(e'; s') = \sum_{e;s:\ n(e;s) = e'} x(e; s)\, Q(s; s') + \psi(s')\nu\chi(e' = 0) \tag{21}$$

Equation (21) states that the number of establishments that next period have past employment e' and current shock s' is equal to the sum of two terms: 1) all those establishments that currently chose employment e' and transit from their current s to the shock s', and 2) all those establishments that are created with initial productivity s' (this term must be included only if $e' = 0$, given that new establishments arrive with zero previous period employment).

At this point it is useful to recall Bellman equation (12) which describes the problem of unemployed agents. In that problem a distribution Γ of new hires across establishment types was used to form expectations about the value of finding the location of the labor market. At equilibrium this distribution must be consistent with the employment decisions of establishments and with the measure x described above. In particular, the fraction of total hiring done by establishments of type $(e'; s')$ must be given by :

$$\Gamma(e'; s') = \frac{\max[0; n(e'; s') - (1 - \zeta)e']\, x(e'; s')}{\sum_{e;s} \max[0; n(e; s) - (1 - \zeta)e]\, x(e; s)} \tag{22}$$

where $n(e;s)$ is the optimal employment decision of an establishment of type $(e;s)$.

The cross sectional distribution of households is characterized by time invariant measures $y^H(a;e;s)$, $y^U(a;b;m)$, and $y^R(a)$ describing the number of employed, unemployed and retired agents across individual states. These measures are those implied by the optimal search rule $\eta(a;b;m)$ and the optimal saving rules $g^H(a;e;s)$, $g^U(a;b;m)$, and $g^R(a)$. In particular, the number of agents that are employed next period in state $(a';e';s')$ is given by the sum of two terms:

$$
\begin{aligned}
y^H(a';e';s') = & \sum_{a;e;s:\ g^H(a;e;s) = a' \text{ and } n(e;s) = e'} (1-\zeta)\, y^H(a;e;s) Q(s;s')\Lambda(e';s') + \\
& \sum_{a;b;m:\ g^U(a;b;m) = a'} (1-\zeta)\, y^U(a;b;m)\eta(a;b;m)^{\sigma}\,\Gamma(e';s')
\end{aligned}
\tag{23}
$$

The first term are all currently employed agents that do not retire, save a', do not get fired at the beginning of the following period, and their employers chose current employment e' while they transit to the shock s'. The second term are all currently unemployed agents that do not retire, save a', find the labor market, and get hired by an establishment of type $(e';s')$.

The number of unemployed agents in state $(a';b';m=1)$ is given by:

$$
y^U(a';b';1) = \sum_{a;e;s:\ g^H(a;e;s) = a'} (1-\zeta)\, y^H(a;e;s)\left[1 - \Lambda(n(e;s);s)\right]\kappa(b') \tag{24}
$$

That is, the number of unemployed agents which receive severance payments and have employment eligibility b' is given by all currently employed agents that do not retire, save a', get fired at the beginning of the following period, and start their unemployment spell under eligibility b'. Abusing notation, we used $\kappa(b')$ to be equal to κ if $b' = 1$ and $1 - \kappa$, otherwise.

On the other hand, the number of unemployed agents in state $(a'; b'; m = 0)$ is given by the following expression:

$$
\begin{aligned}
y^U(a'; b'; 0) \quad = \quad & \sum_{a;b;m:\ g^U(a;b;m)\ =\ a'} (1 - \zeta)\ y^U(a; b; m)\, [1 - \eta(a; b; m)^{\sigma}]\, P(b; b') \ + \\
& \sum_{a:\ g^R(a)\ =\ a'} (1 - \vartheta)\ y^R(a)\ \chi(b = 0)
\end{aligned} \tag{25}
$$

The first term are all currently unemployed agents that do not retire, save a', do not find the labor market, and transit from their current eligibility b to b'. The second term are all those retirees which save a' and die. These agents are replaced by offsprings that inherit their assets and start life being unemployed without benefits, which adds to $y^U(a; b; m)$ only when b specifies no benefits and m specifies no severance payments.

Finally, the number of retirees with asset levels a' is given by the sum of three terms:

$$
y^R(a') = \sum_{a;e;s:\ g^H(a;e;s)\ =\ a'} \zeta y^H(a; e; s) + \sum_{a;b;m:\ g^U(a;b;m)\ =\ a'} \zeta y^U(a; b; m) + \sum_{a:\ g^R(a)\ =\ a'} \vartheta y^R(a) \tag{26}
$$

The first term are all those employed agents that retire and save a', the second term are all those unemployed agents that retire and save a', and the last term are all retired agents that save a' and do not die.

3.8. Government budget constraint

We consider steady state equilibria without public debt. Hence in an equilibrium the government must satisfy the following (flow) budget constraint:

$$\rho w \sum_{a;m} y^U(a;1;m) = (w^* - w) \sum_{a;e;s} y^H(a;e;s) + \tag{27}$$
$$[\varepsilon w^* + \lambda (w^* - w)] \sum_{e;s} \max[0; (1-\zeta)e - n(e;s)]\, x(e;s)$$

The left hand side is the total amount of benefits ρw paid by the government to eligible unemployed agents. The right hand side is the total amount of revenues collected by the government. Revenues consist of two categories: 1) payroll taxes $w^* - w$ received from employed agents, and 2) firing taxes εw^* plus taxes on severance payments $\lambda(w^* - w)$ received from total firings.

3.9. Market clearing

Markets must clear at equilibrium. In the goods market, consumption plus investment in physical capital, plus investment in new establishments must equal the total amount of output produced by establishments. In particular,

$$C + \delta K + \mu\nu = \sum_{e;s} s\, n(e;s)^{\gamma}\, k(e;s)^{\theta}\, x(e;s) \tag{28}$$

where C is aggregate consumption, K is the aggregate stock of capital, ν is creation of new establishments, and $n(\cdot)$ and $k(\cdot)$ are the employment and capital decisions of establishments.

Note that aggregate consumption is given by :

$$C = \sum_{a,e,s} c^H(a,e,s)\, y^H(a,e,s) + \sum_{a,b,m} c^U(a,b,m)\, y^U(a,b,m) + \sum_{a} c^R(a)\, y^R(a) \tag{29}$$

where c^H, c^U, and c^R are the optimal consumption decisions of employed, unemployed and retired agents respectively.

In the labor market, the number of unemployed agents which find the labor market must equal the total amount of hiring done by establishments:

$$\sum_{a,b,m} (1-\zeta)\, y^U(a,b,m)\,\eta(a,b,m)^{\sigma} = \sum_{e,s} \max[0, n(e,s) - (1-\zeta)e]\, x(e,s) \tag{30}$$

In the market for capital we must have that the aggregate stock of capital supplied by banks must equal the total amount of capital demanded by establishments:

$$K = \sum_{e,s} k(e,s)\, x(e,s) \tag{31}$$

Finally, the asset market must also clear. This condition becomes redundant by Walras law, but is described for sake of completeness. It means that the total amount of savings (deposits) made by households S must equal the total value of the assets A owned by the banking sector, where:

$$S = \sum_{a,e,s} a\, y^H(a,e,s) + \sum_{a,b,m} a\, y^U(a,b,m) + \sum_{a} a\, y^R(a) \tag{32}$$

and:

$$A = K + \frac{\sum_{e;s} \left[s\, k^{\mu} n^{\circ} ¡ w^{¤} n ¡ rk ¡ \text{-}(e;n) \right] x(e;s) ¡ ^{o\,1}}{i} \tag{33}$$

Note that the assets owned by banks consist of the aggregate stock of capital K and the value of the aggregate portfolio of establishments x, which is obtained by capitalizing pro…ts minus the cost of creation .

3.10. De…nition of equilibrium

We are now in condition to de…ne a competitive equilibrium. An equilibrium is a set of prices $fi; r; w^{¤}; wg$, a set of functions $\{V(e;s)$, $n(e;s)$, $k(e;s)$, $H(a;e;s)$, $g^H(a;e;s)$, $U(a;b;m)$, $g^U(a;b;m)$, $´(a;b;m)$, $R(a)$, $g^R(a)\}$, a set of time invariant measures $\{x(e;s)$, $y^H(a;e;s)$, $y^U(a;b;m)$, $y^R(a)\}$, a level of establishments creation ^{o}, a distribution function $¡(e;s)$, and a probability function $¤(e;s)$ such that:

1) given i, r, and $w^{¤}$: $V(e;s)$ is the value function of establishments and $n(e;s)$ and $k(e;s)$ are the associated optimal employment and capital decisions,

2) given i, w, $¤$ and $¡$: $H(a;e;s)$, $U(a;b;m)$, and $R(a)$ are the value functions of employed, unemployed and retired agents respectively, $g^H(a;e;s)$, $g^U(a;b;m)$, $g^R(a)$ and $c^H(a;e;s)$, $c^U(a;b;m)$, and $c^R(a)$ are their corresponding optimal saving and consumption decision rules, and $´(a;b;m)$ is the optimal search decision rule of unemployed agents,

3) the measure $x(e;s)$ across establishment types, the distribution function $¡(e;s)$, and the probability function $¤(e;s)$ are consistent with the individual decisions of establishments and the level of establishments creation ^{o} as given in equations (21), (22), and (11),

4) the measures $y^H(a;e;s); y^U(a;b;m); y^R(a)$ are consistent with the individual decisions

of households as given in equations (23), (24), (25) and (26),

5) the government budget constraint (27) is balanced,

6) the market clearing conditions (28), (30), and (31) hold, and

7) the no arbitrage conditions (19) and (20) are satis…ed.

A recursive algorithm to compute such a competitive equilibrium is described in detail in the appendix.

4. Calibration

Fixing a time period of half-a-quarter, parameters were selected to reproduce important features of the U.S. economy (Table 1 summarizes the calibrated values). We start by describing our choice of policy parameters.

Analyzing a sample of unemployed agents which collected unemployment insurance bene…ts between 1978 and 1983 in twelve U.S. states, Meyer [9] reported that on average people spend about 13 weeks before they either lose their bene…ts or …nd employment. We select the persistence of U.I. bene…ts Á so that agents in our model economy spend about 9 weeks unemployed and collecting bene…ts. This shorter duration is chosen over the 13 weeks reported by Meyer because of the high unemployment rate (8.7 percent) during his sample period.[11]

Evidence presented by Blank and Card [2] suggests that about 50% of laid o¤ workers do not qualify or do not apply for unemployment insurance bene…ts. In line with this

[11] In periods of high unemployment, both agents remain unemployed longer and UI bene…ts are extended over longer periods. This suggests that 13 weeks probably overestimates the duration in normal times. Since we calibrate our model to an unemployment rate of 5.7 percent, a shorter duration is used.

observation, κ was set to 0.50. Anderson and Meyer [1] report that for each dollar paid by the government as unemployment insurance, 60 cents are paid by employers as experience rated taxes. Since these taxes work as firing taxes, ε was chosen so that 60% of total unemployment insurance benefits are financed with firing taxes. On the other hand, the replacement ratio ρ was selected to be 66% which is the value reported by Meyer. Finally, since there are no mandated severance payments in the U.S. economy, λ was set to zero.

The number of parameters to determine on the firms side depends critically on the number of values that the idiosyncratic productivity shock s is allowed to take. Tractability requires considering only three values. Normalizing the lowest positive productivity shock to one, we let s take values in the set $\{0; 1; \bar{s}\}$. Under this number of shocks, only a few parameters must be determined: one in the initial distribution ψ, four in the transition matrix Q, the fixed entry cost μ, and the highest productivity shock $\bar{s}$. Since these parameters are important determinants of the establishment dynamics implied by the model, their values were selected to reproduce important features of U.S. establishment dynamics.

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

$$Q = \begin{pmatrix} 1 & 0 & 0 \\ \pi & \omega(1-\pi) & (1-\omega)(1-\pi) \\ \pi & (1-\omega)(1-\pi) & \omega(1-\pi) \end{pmatrix}$$

i.e. a process that treats the low and the high productivity shocks symmetrically. The parameters π, ω, and $\bar{s}$ were selected to reproduce important observations on job creation and job destruction reported by Davis and Haltiwanger [4]. These are (1) that the average job creation rate due to births and the average job destruction rate due to deaths are both about 0.73% a quarter, (2) that the average job creation rate due to continuing establishments and the average job destruction rate due to continuing establishments are both about 4.81% a quarter, and (3) that the annual persistence of both job creation and destruction is about 75%. On the other hand, the …xed entry cost parameter ¹ was chosen so that the average establishment size in the model economy is about 62 employees, same magnitude as in the data.

We must also select Ã(1) which determines the distribution over initial productivity shocks. If we would allow for a large number idiosyncratic productivity shocks it would be natural to chose Ã to reproduce the same size distribution of establishments as in the data. With only two values for s this approach does not seem restrictive enough, since we could 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 Ã = (0:5; 0:5), i.e. a distribution that treats the low and the high productivity shocks symmetrically. Note that under these choices of Q and Ã, there will be as many establishments in the low shock as in the high shock at steady state.

The remaining parameters to calibrate are ¯, ®, ¿, ¾, ³, #, °, µ, and ±. The stock of capital in the model economy was identi…ed with plant, equipment and inventories. Consequently, physical investment was associated in the National Income and Product Accounts with non-residential investment plus changes in business inventories. The empirical counterpart of consumption was identi…ed with personal consumption expenditures in non-durable goods and services. Measured output was then de…ned 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 then 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 [8]. 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 0.64 (this is the value commonly used in the business cycles literature).

With respect to the demographics of the model, the probability η that an active agent retires the following period was selected so that the average duration of active life is 40 years. The probability ϑ that a retired person survives into the following period was in turn selected to deliver an average duration of retirement of 15 years.

A crucial observation for the analysis of labor market policies is the elasticity of the hazard rate with respect to unemployment benefits. Meyer [9] estimates that a 1% increase in the replacement ratio is associated with a 0.9% decrease in the hazard rate of agents that collect insurance. To obtain such a large response in the model economy both the search technology and preferences must be close to linear. In particular, values of σ and τ equal to 0.98 were needed to reproduce Meyer's observation. In turn, the preference parameter α was chosen to generate an average duration of unemployment spells equal to 1 quarter, about the same magnitude observed in the U.S. economy. Finally, the discount rate factor β was selected to obtain an equilibrium at the annual interest rate of 4% fixed above.

In the rest of the paper we examine the effects of alternative labor market policies. In particular, we compare the steady states of economies subject to the same structural parameters that were determined in this section, but which differ in terms of their policy regimes. We start our analysis by evaluating the consequences of switching from the current U.S. system to laissez-faire and to labor market policies that resemble European systems. The objective is not only to determine the relative benefits of observed labor market regimes, but to establish the empirical relevance of our model economy. We then turn to the main objective of this paper: the analysis of severance payments.

5. Policy Regimes

This section evaluates the current U.S. system versus laissaiz-faire and two policy regimes which resemble european countries. While laissaiz-faire involves no government interventions, the european regimes have generous unemployment insurance systems and severance payments. Table 2 describes the policy parameters for each regime considered and Table 3 reports equilibrium statistics.[12].

We see that moving from U.S. policies to laissaiz-faire has a large positive effect in the job finding rate of unemployed agents. Since the layoff rate increases only slightly, the unemployment rate declines substantially. The associated increase in aggregate employment

[12] We adopt the following conventions for tables describing results in this paper: 1) the benchmark case for the underlying experiment is indicated in bold letters, 2) statistics without meaningful units of measurement are normalized to 100 at the steady state of the benchmark case while the rest of the statistics are expressed in percentages, and 3) the welfare measure reported is the proportionate increase in permanent consumption needed to make average utility across agents in the benchmark case be the same as in the economy under consideration.

is accompanied by similar effects in output, capital and consumption. Aggregate leisure remains unchanged despite the decrease in the leisure of job seekers, because of the smaller number of unemployed agents in the economy. All things considered, welfare is significantly improved under laissez-faire.

We now analyze the consequences of switching to U.K. policies. The U.K. labor market regime differs considerably from the U.S (we rely on Millard and Mortensen [10] for our characterization of U.K policies). In the U.K. the replacement ratio is lower than in the U.S. ($\rho = 0.36$ instead of $\rho = 0.66$), but both the duration of unemployment benefits is considerably longer and much more people become eligible for benefits when laid-off. Correspondingly, we set κ equal to one (all laid-off agents become eligible for benefits) and ϕ to 0.875 (which delivers an average duration of benefits equal to one year). Opposed to the U.S., the U.K. has no experience rated taxes ($\varepsilon = 0$). But employers are required to make severance payments which average about one month of salary ($\lambda = 0.67$).

Table 3 shows that switching to U.K. policies leaves the layoff rate unchanged from its U.S. level, but the job finding rate is lowered significantly. As a consequence, the unemployment rate increases from 5.7% to 8.9%. Capital, output and consumption are negatively affected, but aggregate leisure remains roughly the same (the increase in unemployment is compensated by the larger amount of leisure enjoyed by the unemployed). As a result, welfare decreases by 1.8% relative to the U.S.

Compared to other european countries, the U.K. is a relatively mild system. Several countries have implemented substantially more generous unemployment insurance policies and severance payments, the utmost example being Spain. To evaluate these rather extreme cases we analyze a “high” interventions regime. In this case, the replacement ratio is set to

0.40, the average duration of unemployment bene…ts to 3 years, severance payments to half a year of wages, and all laid-o¤ workers become eligible for unemployment bene…ts.

We see from Table 3 that the “high” case gives rise to results which are qualitatively similar to the U.K. system. However, the e¤ects are much larger: the unemployment rate increases to 10.9% instead of 8.9% and consumption decreases by 5.5% instead of 3.1%. Despite the larger drop in consumption, welfare is not substantially reduced from its U.K. level because of the increase in aggregate leisure.

It is important to note that the unemployment rates predicted by the ”U.S.”, ”U.K.” and ”high interventions” regimes are in line with their empirical counterparts. Moreover, the model predicts little variation in job turnover rates across policy regimes as well as a negative relation between in‡ow rates to unemployment and unemployment durations, which are patterns observed in cross-country data (see [12] and [13]). The satisfactory performance of the model economy along these empirical dimensions provides additional support for its policy implications. With this background, we turn to our analysis of severance payments.

6. Severance payments

This section constitutes the core of the paper. It provides a detailed investigation of the e¤ects of introducing severance payments into the laissaiz-faire economy.

Table 4 reports results for severance payments ranging between 1 month of wages (¸ = 0:67) and 12 months of wages (¸ = 8:0). It shows that severance payments have a positive e¤ect in the job-…nding rate and a negative e¤ect in the layo¤ rate. As a consequence, they lower unemployment. Output and output per employee increase until severance payments reach six months of wages (¸ = 4:0). After that point, they are negatively a¤ected. Consumption follows a similar pattern as output, but becomes considerably more volatile (its standard deviation increases more than its average). On the other hand, aggregate leisure increases substantially. In terms of welfare, severance payments are extremely bene…cial. For instance, severance payments equivalent to one year of wages increase welfare by 3.7% relative to laissaiz-faire.

To understand the e¤ects of severance payments, it will be useful to view them as a particular form of unemployment insurance. Instead of giving severance payments directly to workers when they are laid-o¤, in this alternative policy arrangement establishments pay …ring taxes to the government who in turn rebates them as one time UI bene…ts to the recently laid-o¤ agents. More speci…cally, severance payments (at rate ¸) are equivalent to a UI system with the following properties: 1) all laid-o¤ workers become eligible for bene…ts (· = 1), 2) bene…ts last for exactly one period (Á = 0), 3) bene…ts are as large as the original severance payments (½ = ¸), and 4) the system is fully …nanced by …ring taxes (" = ¸). We refer to 1), 2) and 3) as the unemployment insurance component of severances payments, and to 4) as the …ring tax component. To evaluate the relative importance of these components, we analyze them separately.

6.1. The …ring tax component

This sub-section investigates the …ring penalty role of severance payments. To that end, …ring taxes are introduced to an otherwise laissez-faire economy, where the proceeds are rebated as employment subsidies to establishments (i.e. as negative payroll taxes). Under this policy, households receive no payments from either establishments (¸ = 0) or the government

($\rho = 0$), i.e. no form of unemployment compensation is provided.

Three versions of the model are considered: 1) an economy with full-insurance markets and exogenous job-finding rates, 2) an economy with no insurance markets and exogenous job-finding rates, and 3) an economy with no insurance markets and endogenous job-finding rates (our original case). By gradually incorporating the important margins that firing taxes can potentially affect (mainly: production efficiency, insurance opportunities, and search decisions) we will be able to determine the effects of firing taxes in each of those margins.

6.1.1. Full-insurance markets and exogenous job-finding rate

To isolate the effects of firing taxes on the labor productivity of employed agents and the layoff decisions of establishments, we simplify the model economy considerably by making the job-finding rate exogenous and giving agents full access to insurance markets. In particular, α is set to zero in equation (2) (the utility function is made independent of the search intensity ψ) and $\lambda = \psi^{\sigma}$ is set to a constant. The particular value selected for λ is the job-finding rate underlying the laissez-faire economy of Table 4. Note that since the job-finding rate is exogenous, the unemployment rate is completely determined by the layoff rate chosen by establishments. Also observe that (under full insurance), the interest rate is determined by the discount rate $1/\beta - 1$; and consumption equals the expected present value of labor earnings that agents face at birth.

Table 5 describes the results of this experiment. We see that establishments respond to firing taxes by lowering their layoff rates substantially. This has a large positive impact on aggregate employment.[13] However, output is negatively affected. For instance, when firing

[13] While aggregate employment is determined by the layoff rate of establishments, the number of estab-

taxes are set to one year of wages, employment increases by 1.3% but output decreases by 3%.

This should not be surprising: …ring taxes decrease the amount of aggregate output that can be produced with any amount of aggregate employment. To understand this, note that output is maximized by equating marginal labor productivities across establishments. This is what actually happens under laissez-faire. But when …ring taxes are present, establishments no longer equate wages to marginal labor productivities: they follow $(s; S)$ decision rules.

For small …ring taxes, output remains unchanged since the higher employment level compensates the decrease in productivity. But for …ring taxes larger than three months of wages, the productive ine¢ ciencies outweigh the positive employment e¤ects and output decreases substantially. Note that this negative productivity e¤ect of …ring taxes is exactly the same as that analyzed in Hopenhayn and Rogerson [6]. Similarly to that paper, we …nd it be important in magnitude. In fact, …ring taxes equal to one year of wages have a similar welfare e¤ect as in Hopenhayn and Rogerson [6]: they decrease welfare by 2.9% in terms of consumption and welfare.

6.1.2. Lack of insurance markets and exogenous job-…nding rate

This case evaluates the e¤ects of …ring taxes on the ability of agents to self-insure through their own savings. For that purpose, we drop the full-insurance assumption from the previous economy but maintain the hypothesis of an exogenous job-…nding rate. Table 6 describes how …ring taxes a¤ect this economy. The e¤ects on productivity, layo¤ decisions and aggregate

lishments in the economy is determined by the aggregate employment level and the average employment size chosen by establishments. Similarly to Bentolila and Bertola [3], the average size of establishments can increase or decrease with …ring taxes. For our parametrization, we …nd that average size actually increases.

employment are similar to the previous economy. As a consequence, we concentrate on the insurance e¤ects of …ring taxes.

The key variable to observe in Table 6 is the aggregate amount of assets in the economy (capital plus the value of establishments), which is reduced substantially. The reason for this is that …ring taxes restrict the ability of establishments to adjust to idiosyncratic shocks, reducing their average pro…ts considerably.[14] A similar e¤ect was present in the full-insurance economy of Table 5. The di¤erence is that in this economy, the lower amount of assets reduces the self-insurance ability of agents (since agents use their stock of assets to smooth consumption across employment states). As a result, consumption becomes more variable and welfare declines to lower levels than those in Table 5.[15]

6.1.3. Borrowing constraints and endogenous job-…nding rate

To evaluate the total e¤ects of …ring taxes, we drop the exogenous job-…nding rate assumption: market structure, preferences and search technology are made identical to the original economy of Table 4. Table 7 reports the e¤ects of introducing …ring taxes to this economy.

We …nd two important results: 1) the e¤ects of …ring taxes are extremely similar to the total e¤ects of severance payments in Table 4, and 2) contrary to the economy of Table 6 (which had no insurance markets and exogenous job-…nding rates), …ring taxes are welfare improving. These results imply that most of the e¤ects of severance payments are accounted

[14] Average pro…ts can decrease even though the free entry condition must be satis…ed, because …ring taxes occurs later in the life of the establishment while the free entry condition weights the initial periods more heavily.

[15] It is interesting to note that the general equilibrium e¤ects of …ring taxes revert the (partial equilibrium) intuition of precautionary savings. The decrease in unemployment risk associated with the lower layo¤ rate of establishments, reduces the willingness of agents to save and tend to push interest rates up. However, the decrease in the value of establishments reduces so much the demand of banks for assets, that equilibrium interest rates actually go down.

by their …ring tax component, and that search decisions are crucial for understanding them. In what follows, we explain the reasons.

We focus our discussion on how …ring taxes a¤ect job-…nding rates, since their e¤ects on productivity, layo¤ decisions and insurance opportunities are similar to the previous two cases. Table 7 shows that …ring taxes have a large positive e¤ect in the job-…nding rate of unemployed agents. The reason is that establishments respond to the …ring taxes by reducing their layo¤ rates, which increases the length of time that agents expect to remain employed once they get hired. This increases the return to the search activity, and induces agents to search more intensively[16].

A consequence of the higher job-…nding rate is that employment increases more in Table 7 than in the economy of Table 6 (with exogenous job-…nding rates). This leads to larger increases in output and consumption. However, the higher consumption levels are not large enough to account for the large positive welfare e¤ects of …ring taxes: consumption levels are not substantially di¤erent from Table 6, but welfare levels are. In fact, Table 7 shows that …ring taxes continue to improve welfare even when consumption is negatively a¤ected.

To understand the welfare bene…ts of …ring taxes, we must consider their e¤ects on leisure. While the leisure of unemployed agents decrease due to their higher search intensities, …ring taxes increase aggregate leisure because of the smaller number of unemployed agents in the economy. For our parametrization, the disutility of search is so large that transiting fewer times through unemployment increases welfare levels even when consumption is negatively a¤ected.

[16] Firing taxes also a¤ect equilibrium wages. However, preferences were selected so that income and substitution e¤ects cancel each other exactly. As a consequence, wages have no e¤ects on the search decisions of agents.

Two features of the model economy explain why the laissaiz-faire economy performs so poorly relative to the economy with …ring taxes: 1) the rigid class of wage contracts considered, which constrain wages to be constant over time, and 2) the information structure previous to hiring, which leads to a same wage rate being paid across all type of establishments. A consequence of these assumptions is that the laissez-faire economy displays an excessive amount of job-turnover: establishments adjust continuously to their idiosyncratic shocks since they face no type of adjustment costs. Firing restrictions play a crucial role in making employers internalize the social costs of …ring workers too often.

6.2. The unemployment insurance component

We now analyze the unemployment insurance component of severance payments. To this end, we consider an unemployment insurance system with the following properties: 1) all laid-o¤ workers become eligible for bene…ts (· = 1), 2) bene…ts last for only one period (Á = 0), 3) bene…ts are as large as the original severance payments of Table 4, and 4) the system is fully …nanced by payroll taxes. Observe that under this policy regime there are no …ring taxes (" = 0) or severance payments (¸ = 0).

To separate the insurance e¤ects from the search e¤ects, we consider two versions of the model economy: 1) an economy with exogenous job-…nding rates, and 2) an economy with endogenous job-…nding rates (our original case). Both economies are subject to borrowing constraints.

6.2.1. Exogenous job-…nding rate

To isolate the insurance role of the UI component of severance payments, we make the job-…nding rate exogenous as in Section 6.1.2, so ® = 0 and » = ´¾ is set to a constant, equal to the average job-…nding rate under laissez-faire. Table 8 reports the e¤ects of increasing the replacement ratio ½.

We see that the aggregate layo¤ rate of the economy is not a¤ected by changes in the replacement ratio. The reason is that the …ring costs faced by establishments are independent of ½. Since the job-…nding rate is exogenous and the layo¤ rate is constant, aggregate employment remains the same.

Replacement ratios have interesting e¤ects in the variability of consumption: for small values of ½ (less than three months of wages) consumption becomes less variable, but for high values of ½ it becomes much more volatile. Since the duration of a typical unemployment spell is short (about two model periods, on average), small values of ½ help agents smooth consumption over their unemployment periods. But high values of ½ make their income streams too variable: agents become overinsured.

In fact, when UI bene…ts are larger than four model periods of wages (½ ¸ 4) unemployed agents end up saving their UI bene…ts to …nance consumption during their employment periods. For ½ = 8 the increase in savings is so signi…cant that the stock of capital is positively a¤ected. This gives rise to small increases in output and consumption. However, welfare is lower due to the larger consumption variability.

6.2.2. Endogenous job-…nding rate

We reintroduce endogenous job …nding rates to evaluate how the UI component of severance a¤ect search decisions: preferences and search technology are made identical to the original economy of Table 4. Table 9 reports the results.

In addition to the insurance e¤ects analyzed in the previous case, we see that higher replacement ratios have a negative e¤ect in the aggregate job-…nding rate of the economy. It is important to note that, since UI bene…ts are paid once and for all at the time that agents are laid o¤ (Á = 0), agents are not subsidized for staying unemployed. The reason why search intensities are lower is that agents enter unemployment with higher assets than before. Since they can a¤ord to remain unemployed longer, they decide to put less e¤ort in the search activity.

Observe that the smaller job-…nding rate decreases aggregate employment, which has a negative e¤ect on output and consumption levels. Since aggregate leisure remains the same (the higher leisure enjoyed by the unemployed is compensated by the larger number of unemployed agents), welfare is lower than in the previous economy with exogenous job-…nding rates (Table 8).

It is important to emphasize that, even though the UI component of severance payments has negative e¤ects on employment, output, consumption and welfare, the e¤ects are small. Most of the e¤ects of severance payments are due to their …ring tax component.

7. Unemployment insurance

The analysis of the previous two sections leave us with an apparent contradiction. Section 5 established that high unemployment experiences in Europe can be explained by labor market policies. On the other hand, Section 6 found that severance payments have large positive effects on aggregate employment. These two findings imply that the high unemployment experiences of Europe must be (over) explained by generous UI systems. The apparent difficulty is that Section 6.2.2 introduced large UI benefits and found small effects in aggregate employment.

This section shows that a combination of large replacement ratios and duration of benefits can indeed generate high unemployment rates, i.e. that the small effects of UI benefits in Section 6.2.2 were a consequence of the short duration of benefits assumed ($\phi = 0$). To do this, we consider the U.S. regime as our benchmark case and analyze one dimensional changes in policy parameters. In particular, we analyze changes in the replacement ratio ρ and the persistence of UI benefits ϕ, while all other policy parameters are set to their benchmark U.S. values. Table 10 shows the results of the experiments.

Similarly to Section 6.2.2, we see that UI benefits have no effects on layoff rates (since firing costs remain the same). On the contrary, higher replacement ratios ρ and longer durations of benefits ϕ have large negative effects on job-finding rates, producing large increases in unemployment. Note that these large negative effects on job-finding rates contrast to those observed in Table 9 (one period duration of UI benefits). This is not surprising. In addition to the wealth effects captured in Table 9, job-finding rates decrease due to an important moral hazard effect: higher UI benefits increase the opportunity cost of finding employment (this is true when UI benefits persist over time). Note that changes in the replacement ratio have much smaller effects than changes in the expected duration of UI benefits.

In terms of welfare, we find that agents are better off when no UI system is in place than in any of the UI systems analyzed. On the contrary, Hansen and Imrohoroglu [5] found that UI benefits can potentially increase welfare in each of the economies they considered. There are two main reasons for this difference. First, we allowed a life cycle motive for savings, which is absent in Hansen and Imrohoroglu [5]. Agents save so much for retirement that they can easily finance their (typically) short unemployment spells without suffering substantial drops in consumption. As a consequence, UI benefits play a minor insurance role in this economy. Second, our model was calibrated to reproduce the large empirical elasticity of the hazard rate with respect to unemployment benefits reported by Meyer [9]. As a result, agents decrease their search intensities considerably in response to the disincentives introduced by the UI system. The associated contractionary effects more than outweigh the weak insurance benefits of the UI system, and lead to substantial welfare losses.

8. Conclusions

We have constructed a general equilibrium model that captures important features for the analysis of job security provisions, mainly: 1) endogenous establishment level dynamics, 2) imperfect insurance markets, and 3) endogenous search decisions. The model was used to evaluate the effects of severance payments.

The main result of the paper is that severance payments can have large positive effects on employment and welfare (contrary to previous studies that analyzed severance payments in frictionless environments). As a consequence, the high unemployment experiences of Europe cannot be explained (in the context of our model) by large severance payments, but by generous UI systems (in particular, by long durations of bene…ts). Interestingly, we …nd that the …ring penalty component of severance payments is crucial for understanding their total e¤ects.

It is important to emphasize the central role that endogenous search decisions have played in our analysis. Severance payments not only decreased unemployment rates due to their negative e¤ects on layo¤ rates, but because of their positive e¤ects on job-…nding rates: agents increased their search intensities substantially in response to the longer employment spells they faced.

Endogenous search decisions were also crucial for generating large welfare bene…ts. When search produced no disutility (job-…nding rates were exogenous) severance payments gave rise to substantial welfare losses through two important mechanisms: 1) a negative productivity e¤ect, and 2) a decrease in the value of establishments (which reduced the amount of assets available for smoothing consumption across employment states). On the contrary, when search produced disutility (job-…nding rates were endogenous) severance payments increased welfare levels because agents transited fewer times through unemployment.

It is important to note several quali…cations to our analysis. First, we restricted ourselves to long-run comparisons. Welfare results may di¤er substantially once transitional dynamics are considered. Second, by abstracting from voluntary quits and emphasizing involuntary layo¤s, we may have overestimated the welfare costs of unemployment. Therefore, we may have overemphasized the welfare role of severance payments in reducing unemployment rates. Finally, we analyzed an extremely rigid class of labor contracts. More ‡exible contracts would tend to (partly) internalize the social costs of …ring workers too often, reducing the role for mandated severance payments.

Regarding these quali…cations, we view our results as being indicative of the type of e¤ects that are missed when abstracting from search frictions and contractual rigidities: the above elements should be incorporated to the analysis before reaching de…nite policy recommendations.

A. Appendix

This appendix describes an algorithm to compute steady state equilibria. The problem will be reduced to solving one equation in one unknown: the interest rate i. The algorithm is given by the following steps:

1) Fix the interest rate at some arbitrary value i.

2) Given this interest rate and the rental rate r obtained from equation (19), …x the wage rate $w^{¤}$ to some arbitrary value and solve the establishments' problem (6) to get the corresponding value function $V(e; s)$ and optimal decision rules $k(e; s)$ and $n(e; s)$ (all as function of $w^{¤}$). Then, …nd the $w^{¤}$ that gives the free entry condition (20).

3) Fix the establishments creation º to one. Given the decision rules of establishments obtained in step 2, iterate with the law of motion for x in equation (21) to …nd the stationary distribution $x(e; s)$ across establishment types. Note that this $x(e; s)$ is correct up to the yet unknown proportional scaling factor º.

4) Use the distribution $x(e; s)$ found in step 3 and the decision rule $n(e; s)$ found in step 2 to construct the probabilities ¤ in (11) and the distribution ¡ in (22). Note that this ¡ is correct since x enters both in its numerator and denominator (the still unknown proportional scaling factor of x cancels out).

4) Fix the after payroll tax wage rate w to one. Then, solve by value function iteration the problems of employed, unemployed and retired agents given by equations (8), (12) and (16). This delivers the saving decision rules $g^H(a; b; m)$, $g^U(a; b; m)$, and $g^R(a)$, as well as the consumption decision rules $c^H(a; b; m)$, $c^U(a; b; m)$, and $c^R(a)$, and the search decision rule ´$(a; b; m)$. Given these decision rules, we …nd the stationary distributions $y^H(a; e; s)$,

$y^U(a;b;m)$, and $y^R(a)$ iterating with equations (23), (24), (25) and (26).

5) Note that under the preferences we use, search decisions are homogenous of degree zero with respect to w. It follows that the left hand side of equation (30) gives the correct number of agents arriving to the labor market every period. Consequently, equation (30) is used to solve for the correct scaling factor ν for x as follows:

$$\nu = \frac{\sum_{a;b;m:\ g^U(a;b;m) = a'} (1-\zeta)\, y^U(a;b;m)\,\eta(a;b;m)^{\sigma}}{\sum_{e;s} \max\left[0; n(e;s) - (1-\zeta)e\right] x(e;s)} \tag{34}$$

The correct measure across establishments types is then obtained by multiplying x by the scaling factor ν.

6) Given the correct x obtained in the previous step, the aggregate stock of capital K is obtained from equation (31).

7) Given w^*, x, y^H, and y^U, the government budget constraint (27) is used to solve for the correct after payroll tax wage rate w.

8) Since under the preferences we use consumption decisions are homogeneous of degree one with respect to w, the aggregate consumption obtained from equation (29) is multiplied by the w found in step 7 to obtain the correct amount of aggregate consumption C:

9) Finally, we check if the interest rate i guessed in step 1 is an equilibrium interest rate by verifying that the market clearing condition for consumption (28) is satisfied. Steps 1 through 9 are repeated under a new guess for the interest rate i.

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TABLE 1

BENCHMARK PARAMETER VALUES

Preferences

$\beta = 0.994248$	$\alpha = 15.5$	$\tau = 0.98$
Time discount	Share search disutility	Curvature search disutility

Technology

$\theta = 0.19$	$\gamma = 0.58$	$\delta = 0.011$	$\mu = 1950.0$	$\sigma = 0.98$
Capital share	Labor share	Dep. rate	Fixed entry cost	Curv. Search Tech.

Productivity Shocks

$s_0 = 0.0$	$s_1 = 1.0$	$s_2 = 2.12$
Exit shock	Low productivity	High productivity

Distribution over Initial Productivity Shocks

$\psi_1 = 0.50$	$\psi_2 = 0.50$
Fraction with s_1	Fraction with s_1

Transition Matrix for Productivity Shocks

$\pi = 0.0037$	$\omega = 0.973$
Exit rate	Persistence

Demographics

$\zeta = 0.0031$	$\vartheta = 0.9917$
Retirement rate	Survival rate (retirees)

Policy parameters (benchmark economy)

$\lambda = 0.0$	$\varepsilon = 0.30$	$\rho = 0.66$	$\phi = 0.50$	$\kappa = 0.50$
Severance	Firing tax	Replacement ratio	Duration UI	Eligibility UI

TABLE 2

POLICY PARAMETERS :

	Unemployment Benefits			Job Security	
	Replacement Ratio : ρ	Duration: 1/(1-ϕ)	Fraction eligible : κ	Severance : λ	Firing tax : ϵ
Laissez Faire	0.00	0.0	0.0	0.00	0.00
US	0.60	1 quarter	0.50	0.0	0.30
Europe UK	0.36	1 year	1.00	0.67 (1 mo.)	0.00
Europe High	0.40	3 years	1.00	4.0 (½ year)	0.00

TABLE 3

POLICY REGIMES

	U.S.	Laissez-faire	European Job-Protection	
			U.K.	High
Job Finding Rate	**51.7 %**	61.0 %	31.8 %	23.6 %
Layoff Rate	**2.8 %**	2.9 %	2.8 %	2.6 %
Unemployment Rate	**5.7 %**	4.9 %	8.9%	10.9 %
Employment	**100.0**	100.8	96.8	94.7
Output	**100.0**	100.8	97.0	94.9
Capital	**100.0**	100.7	97.1	95.8
Consumption	**100.0**	100.8	96.9	94.5
Std. Dev. Consumption	**100.0**	100.9	96.1	94.2
Leisure unemployed	**100.0**	80.9	140.8	157.4
Aggregate leisure	**100.0**	100.0	100.1	100.3
Welfare	**100.0**	100.4	98.2	97.8

TABLE 4

SEVERANCE PAYMENTS

Months of wages	λ = 0.0 None	λ = 0.67 1 mo.	λ = 2.0 3 mo.	λ = 4.0 6 mo.	λ = 8.0 12 mo.
Job Finding Rate	**61.0 %**	61.4 %	62.1 %	63.8 %	70.5 %
Layoff Rate	**2.9 %**	2.8 %	2.8 %	2.6 %	2.1 %
Unemploym. Rate	**4.9 %**	4.8 %	4.7 %	4.3 %	3.2 %
Employment	**100.0**	100.1	100.2	100.6	101.7
Output	**100.0**	100.2	100.5	100.7	99.5
Capital	**100.0**	100.3	100.8	101.5	101.5
Assets	**100.0**	99.7	99.0	98.0	94.2
Consumption	**100.0**	100.1	100.2	100.3	98.7
Std. Dev. Consump.	**100.0**	100.2	100.7	101.5	102.1
Leisure unemployed	**100.0**	99.2	97.3	93.1	75.9
Aggregate leisure	**100.0**	100.0	100.1	100.2	100.5
Welfare	**100.0**	100.2	100.7	101.6	103.7

TABLE 5

FIRING TAXES REBATED AS EMPLOYMENT SUBSIDIES
Complete Insurance Markets, Exogenous Search Intensity

Months of wages	**ϵ = 0.0** **None**	**ϵ = 0.67** **1 mo.**	**ϵ = 2.0** **3 mo.**	**ϵ = 4.0** **6 mo.**	**ϵ = 8.0** **12 mo.**
Job Finding Rate	**61.0 %**	61.0 %	61.0 %	61.0 %	61.0 %
Layoff Rate	**2.9 %**	2.8 %	2.8 %	2.6 %	2.0 %
Unemploym. Rate	**4.9 %**	4.9 %	4.7 %	4.5 %	3.7 %
Interest Rate	**4.0 %**	4.0 %	4.0 %	4.0 %	4.0 %
Employment	**100.0**	100.1	100.1	100.4	101.3
Output	**100.0**	100.0	100.0	99.7	97.0
Capital	**100.0**	100.0	100.0	99.7	97.0
Assets	**100.0**	99.3	98.0	95.8	89.1
Consumption	**100.0**	100.0	100.0	99.7	97.1
Std. Dev. Consump.	**100.0**	100.0	100.0	100.0	100.0
Leisure unemployed	**Not def.**	Not def.	Not def.	Not def.	Not def.
Aggregate leisure	**Not def.**	Not def.	Not def.	Not def.	Not def.
Welfare	**100.0**	100.0	100.0	99.7	97.1

TABLE 6

FIRING TAXES REBATED AS EMPLOYMENT SUBSIDIES
No Insurance, Exogenous Job-Finding Rate

Months of wages	ϵ = 0.0 None	ϵ = 0.67 1 mo.	ϵ = 2.0 3 mo.	ϵ = 4.0 6 mo.	ϵ = 8.0 12 mo.
Job Finding Rate	**61.0 %**	61.0 %	61.0 %	61.0 %	61.0 %
Layoff Rate	**2.9 %**	2.8 %	2.8 %	2.6 %	2.0 %
Unemploym. Rate	**4.9 %**	4.9 %	4.7 %	4.5 %	3.7 %
Interest rate	**4.0 %**	4.0 %	4.0 %	3.9 %	3.8 %
Employment	**100.0**	100.1	100.1	100.4	101.3
Output	**100.0**	100.2	100.4	100.6	98.9
Capital	**100.0**	100.3	100.8	101.4	100.7
Assets	**100.0**	99.7	99.1	97.9	93.3
Consumption	**100.0**	100.1	100.3	100.2	98.3
Std. Dev. Consump.	**100.0**	100.2	100.7	101.1	100.0
Leisure unemployed	**Not def.**	Not def.	Not def.	Not def.	Not def.
Aggregate leisure	**Not def.**	Not def.	Not def.	Not def.	Not def.
Welfare	**100.0**	100.0	99.7	99.2	96.1

TABLE 7

FIRING TAXES REBATED AS EMPLOYMENT SUBSIDIES
No Insurance, Endogenous Job-Finding Rate

Months of wages	ϵ = 0.0 None	ϵ = 0.67 1 mo.	ϵ = 2.0 3 mo.	ϵ = 4.0 6 mo.	ϵ = 8.0 12 mo.
Job Finding Rate	**61.0 %**	61.7 %	63.3 %	66.2 %	74.6%
Layoff Rate	**2.9 %**	2.8 %	2.8 %	2.6 %	2.0 %
Unemploym. Rate	**4.9 %**	4.8 %	4.6 %	4.2 %	3.1 %
Employment	**100.0**	100.1	100.3	100.7	101.9
Output	**100.0**	100.2	100.6	100.9	99.5
Capital	**100.0**	100.4	101.0	101.7	101.2
Assets	**100.0**	99.8	99.2	98.2	93.8
Consumption	**100.0**	100.2	100.4	100.6	98.8
Std. Dev. Consump.	**100.0**	100.3	101.0	101.6	101.0
Leisure unemployed	**100.0**	98.2	94.2	86.9	65.3
Aggregate leisure	**100.0**	100.0	100.1	100.2	100.5
Welfare	**100.0**	100.3	100.8	101.9	104.2

TABLE 8

UNEMPLOYMENT INSURANCE WITH DURATION OF BENEFITS EQUAL TO ONE MODEL PERIOD

Exogenous Job-Finding Rate

Months of wages	ρ = 0.0 None	ρ = 0.67 1 mo.	ρ = 2.0 3 mo.	ρ = 4.0 6 mo.	ρ = 8.0 12 mo.
Job Finding Rate	**61.0 %**	61.0 %	61.0 %	61.0 %	61.0 %
Layoff Rate	**2.9 %**	2.9 %	2.9 %	2.9 %	2.9 %
Unemploym. Rate	**4.9 %**	4.9 %	4.9 %	4.9 %	4.9 %
Employment	**100.0**	100.0	100.0	100.0	100.0
Output	**100.0**	100.0	100.0	100.0	100.2
Capital	**100.0**	100.0	100.0	100.0	100.3
Consumption	**100.0**	100.0	100.0	100.0	100.1
Std. Dev. Consump.	**100.0**	99.9	99.9	100.2	101.6
Leisure unemployed	**Not def.**	Not def.	Not def.	Not def.	Not def.
Aggregate leisure	**Not def.**	Not def.	Not def.	Not def.	Not def.
Welfare	**100.0**	100.0	100.0	99.9	99.7

TABLE 9

UNEMPLOYMENT INSURANCE WITH DURATION OF BENEFITS EQUAL TO ONE MODEL PERIOD

Endogenous Job-Finding Rate

Months of wages	ρ = 0.0 None	ρ = 0.67 1 mo.	ρ = 2.0 3 mo.	ρ = 4.0 6 mo.	ρ = 8.0 12 mo.
Job Finding Rate	**61.0 %**	60.6 %	59.8 %	58.6 %	56.0 %
Layoff Rate	**2.9 %**	2.9 %	2.9 %	2.9 %	2.9 %
Unemploym. Rate	**4.9 %**	4.9 %	5.0 %	5.1 %	5.3 %
Employment	**100.0**	100.0	99.9	99.8	99.6
Output	**100.0**	100.0	99.9	99.8	99.8
Capital	**100.0**	99.9	99.8	99.8	100.0
Consumption	**100.0**	100.0	99.9	99.8	99.7
Std. Dev. Consump.	**100.0**	99.9	99.8	100.0	100.9
Leisure unemployed	**100.0**	101.0	103.0	106.2	112.8
Aggregate leisure	**100.0**	100.0	100.0	100.0	100.0
Welfare	**100.0**	100.0	99.9	99.9	99.5

TABLE 10

UNEMPLOYMENT INSURANCE
(Variations around US parameters)

DURATION of UI BENEFITS

Average duration UI benefits	ϕ = 0.0 ½ qtrs	ϕ = 0.50 1 qtrs	ϕ = 0.75 2 qtrs	ϕ = 0.875 4 qtrs	ϕ = 1.0 forever
Job Finding Rate	61.2 %	**51.7 %**	37.1 %	22.1 %	0.7 %
Unemploym. Rate	4.9 %	**5.7 %**	7.8 %	12.4 %	81.8 %
Capital	100.8	**100.0**	97.8	93.1	19.7
Consumption	100.9	**100.0**	97.8	93.0	19.4
Std. Dev. Consump.	100.9	**100.0**	97.7	92.9	19.1
Welfare	100.5	**100.0**	98.5	94.9	24.6

REPLACEMENT RATIOS of UI BENEFITS

Replacement ratio as fraction of wages	ρ = 0.0	ρ = 0.25	ρ = 0.50	ρ = 0.67	ρ = 0.75	ρ = 1.0
Job Finding Rate	61.3 %	57.9 %	54.1 %	**51.7 %**	50.4 %	47.1 %
Unemploym. Rate	4.8 %	5.1 %	5.4 %	**5.7 %**	5.8 %	6.2 %
Capital	100.9	100.6	100.2	**100.0**	99.9	99.4
Consumption	100.9	100.6	100.2	**100.0**	99.9	99.4
Std. Dev. Consump.	101.0	100.7	100.3	**100.0**	99.8	99.4
Welfare	100.5	100.3	100.1	**100.0**	99.9	99.6