Reducing Supply-Side Disincentives to Job Creation

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At least since Friedman's (1968) American Economic Association Presidential address, macro and labor economists have recognized that a certain level of unemployment is a "natural" consequence of dynamic friction that accompanies the process by which workers are allocated and reallocated among employment opportunities. Friedman (1968) summarizes his famous definition of the natural rate as follows:

> The "natural rate of unemployment," in other words, is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the costs of mobility, and so on.

That the mere existence of unemployment need not imply economic inefficiency is implicit in this definition.. So-is the lack of an equivalence between the natural rate and some ideal or optimal unemployment rate. To put the point another way, reforms that reduce equilibrium unemployment may or may not increase economic welfare.

Still, there seems to be a presumption that natural rates are too high, particularly in most of the economies of Europe. Two culprits are typically identified in the literature, labor market policies intended to compensate for lost earnings as a consequence of unemployment and excessive market power in the hands of employed worker "insiders." According to Layard, Nickell, and Jackman (1991), the large differentials in unemployment rates that prevail across the principal industrialized economies can be attributed to differences in unemployment insurance (UI) systems, wage determination mechanisms, and active labor market policies. Specifically, they find that a particular parameterization of cross-country differences in wage-setting institutions, UI policies, and job creation subsidies explain 91 percent of the variation in unemployment rate averages over the 1983-88 time period across the principal nineteen Organization for Economic Cooperation and Development (OECD) industrial countries. The work of Layard and others is representative of a large literature that reports estimates of the quantitative impact of various labor market policies and institutions on unemployment. Although this literature provides important guidance concerning the possible importance of supply-side factors that influence the level of job creation, the contributions have one common failing: no estimates of the effects of possible reforms on measures of economic welfare, more meaningful than the unemployment rate itself, are ventured.

A review of the evidence on the disincentive effects of labor market policies is presented in the paper. However, the principal purpose is to present quantitative results for a set of computational experiments involving hypothetical reforms of the unemployment insurance system, the payroll tax, employment protection policy, and active labor market policy.[1] The calculations underlying the result reported are derived from an equilibrium model of labor market dynamics, developed by Mortensen and Pissarides (1994) and extended and calibrated by Millard and Mortensen (1994), which is specifically designed to shed light on the issue of the level and distribution of costs and benefits of labor market policy. The intent is to provide information about which of these might be effective as a means of reducing unemployment and improving the efficiency of the labor market without adverse distributional consequences.

What are job creation disincentives?

Layard and others (1991) find that cross-country unemployment rates are positively associated with the liberality of UI benefits and the extent of collective bargaining coverage and are negatively related to the degree of coordination in the wage determination process and to government expenditures that aid job recruiting and training. Although the authors recognize that variation in unemployment rates do not necessarily reflect differences in economic welfare, they argue that the effects of UI and labor bargaining power are likely to yield "too much" unemployment, particularly in Europe. Hence, their recommendations for the United Kingdom include a limitation on the duration of UI benefits, a strong "willingness to work" test as a condition for the receipt of benefits, and an active labor market policy focused on those expected to have long unemployment spells. Active policies include adult training, recruiting subsidies, public employment as the "employer of last resort," and wage subsidies.

Hamermesh (1993) also considers the effects of various labor market policies on unemployment and reviews much of the literature available on the subject. Arguing that labor market participation is relatively inelastic, he concludes that payroll taxes used to finance social security and some portion of unemployment insurance are primarily shifted to wages with small effects on employment. In his view, empirical evidence suggests that the UI system contributes to both the duration and incidence of unemployment and increases participation. His analysis of the effects of a hiring subsidy and employment protection legislation in the context of an adjustment cost model leads him to conclude the former increases both job creation and job destruction while the latter decreases both. Although the net effect of either policy on unemployment is not clear a priori, he argues that employment increases in response to a subsidy and decreases with the cost of firing.

An extensive empirical literature exists on the effects of UI benefits on unemployment duration, much of which is summarized in Layard and others (1991) and in Devine and Kiefer (1991). Contributors to this discussion generally conclude that more generous benefits induce longer unemployment spells. Although estimates of the elasticity of the mean duration of an unemployment spell with respect to the UI benefit range between 0.03 to 1.44, they tend to cluster around 0.4. One very striking result is the effect of the typical six-month limitation on the duration of UI benefits which characterize UI in most of the United States. Meyer (1990) found that the unemployment hazard rises markedly as unemployment benefits are exhausted. When controlling for this effect, his estimate of the duration elasticity with respect to the benefit was 0.6. Although many authors attribute the effect of benefits on unemployment duration to the diminished incentive to search when benefits are paid conditional on remaining unemployed, matching models suggests that the causality runs through the wage to a disincentive effect on job creation as well.

Feldstein (1976) argues that UI encourages layoffs but the effect is offset to the extent that the tax used to finance benefits is paid by the employer and is experience rated, that is, set to reflect the unemployment history of the employer's workforce. Brechling (1981) and Katz and Meyer (1990) provide evidence for the first assertion in the case of manufacturing while more recently Anderson (1993) and Anderson and Meyer (1993) confirm the second for a variety of industries. Indeed, the Anderson and Meyer estimates of the elasticity of the job separation flow with respect to the layoff costs induced by the experience rated portion of the UI tax average about 0.09. However, because an experience rated UI tax also represents a cost of separation, it can be expected to affect job creation adversely as suggested by Burdett and Wright (1990). There is little direct evidence on this point although the literature on employment protection policy supports the contention.

Employment protection policy in Europe either imposes financial penalties on the employer, mandates severance pay, or requires costly procedural delay in order to lay off a worker. Except for the rather weak advanced notification requirement law passed in 1988, there is no mandated federal job security policy in the United States. However, state courts and legislatures have placed limitations on the "employment-at-will" doctrine in recent years which have the effect of imposing an implicit firing cost on employers. (See Kruger, 1991.) As already noted, theory suggests a negative impact of employment protection provisions on both job creation and job destruction so that the effect on unemployment is unclear a priori. Not surprisingly the empirical evidence is mixed. Lazear (1990) finds that increasing severance pay by one month reduces employment per head about 0.4 percent and reduces the labor force participation rate by 0.3 percent. As a consequence, the unemployment rate rises by 0.1 percent. The results of Bentolila and Bertola (1990) suggest that increases in firing costs decrease employment. Abraham and Houseman (1993) find that unemployment is reduced by employment protection policy but also recommend a hiring subsidy to ameliorate the adverse effects on job creation.

Excessive real wage demands are also blamed for unemployment rates that are too high. Modem theories of unemployment that embody this argument include bargaining theory, "efficiency wage" theory, and "inside-outsider" theory. Layard and others (1991) find that higher unemployment rates reflect more extensive collective bargaining coverage in their empirical cross-country study. However, their results also suggest that centralization and coordination in the bargaining process tends to offset this effect. They explain their findings by arguing that worker bargaining power is proxied by the extent of collective bargaining but that in more coordinated and centralized wage determination mechanisms, some account of the general equilibrium disincentive effects of higher wages on job creation is taken.

A simple model of job creation and job destruction

The computational experiments conducted here are based on a model of job creation and job destruction developed by Pissarides and Mortensen (1994) which is extended by Millard and Mortensen (1994) to account for the effects of labor market policy. In this framework, job creation is the outcome of a two-sided matching process in which workers and employers engage in search and recruiting activity. An essential implication of the existence of friction in the job-worker matching process is that wages are determined by some form of bargaining in which the outside option of being unemployed plays the role of determining the sensitivity of the wage to market conditions and rent sharing makes the wage paid by an employer sensitive to that firm's labor productivity. There is also considerable room in this framework for the influence of "insiders" on the wage of the kind emphasized in the work of Lindbeck and Snower (1989) as well as "efficiency wage" effects. These features, together with forward looking decisions by employer and worker participants, determine the natural rate of unemployment.

In the model, job creation is viewed as a decision by an employer to seek a new worker for the purpose of engaging in productive activity that can be expected to generate future profit. Job destruction is reflected in a different employer's decision to terminate an existing employment relationship because the expected profitability of productive activity no longer justifies its continuation. Because the model permits heterogeneity in job-worker match productivity, job creation and job destruction take place at the same time in the aggregate as documented by the recent empirical work of Davis and Haltiwanger (1990, 1992). Furthermore, unemployment in the model reflects the process of reallocating labor from less to more productive economic activities. Mortensen (1994) has shown that this model contains propagation mechanisms capable of capturing the salient features of worker and job flow responses to movements in labor productivity over the business cycle. As the model recognizes both imperfect competition in wage determination and friction in the process that reallocates workers from less to more productive jobs, it implies a reduced formed relationship between unemployment and labor market policy parameters as well as parameters that reflect the relative market power of workers and employers in the wage bargaining process of the type estimated by Layard and others (1991).

Because the model accounts for the forward looking nature of both the decision to initiate and to terminate an employment relationship, the principal equations are quite complicated. Although the essential relationships are reported in the mathematical appendix, the reader is referred to Millard and Mortensen (1994) for the details of the derivations. In order to gain an insight into how labor market policy and wage formation institutions are likely to affect unemployment in the model, the basic properties are sketched below. Fortunately, the essence of the model can be represented intuitively with the aid of two curves that resemble demand and supply relationships.

Productive activity is the purpose of job-worker matches which are formally equivalent to the concept of an establishment or a firm in the model. Although all workers are assumed to be identical, the relative value of product of a specific match changes from time-to-time in a stochastic manner, an assumption which reflects the unforeseen nature of changes in taste and technology that affect the competitiveness of any existing producing firm. When new matches form, the best current information about which activities are most likely to be profitable in the future is used to determine what will be produced. These assumptions generally imply that new matches are more productive than old and that every match will eventually become unprofitable. Formally, the idiosyncratic shock to productivity implicit in this specification is modeled by supposing that new values arrive with frequency λ and are distributed according to the cdf $F(x)$, that is, idiosyncratic match productivity is a Markov jump process with positive persistence. Hence, the rate at which existing employment relationships are destroyed, equivalently *unemployment incidence,* is $Inc = 6 + \lambda F(R)$ where R is *reservation productivity* and 6 is a parameter reflecting other exogenous reasons for job-worker separation. The reservation productivity is the endogenous value of match productivity below which expected future profitability no longerjustifies continuation of any employment relationship.

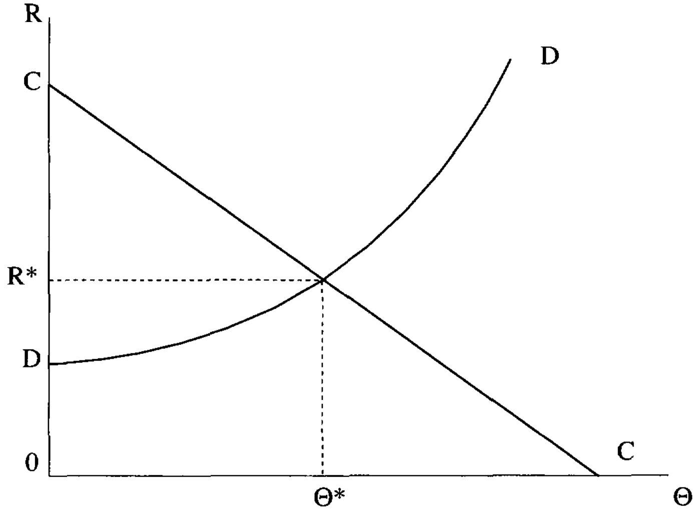
An employer's intention to form a match is signaled by posting a job vacancy. The total cost of recruiting new workers is proportional to the number of vacancies posted. The rate at which vacancies are filled depends on the number of vacancies and the number of workers seeking employment in newly created jobs through a relation which has become known at a *matching function.* Analogous to a production function, a matching function is a relationship between the search and recruiting inputs provided by workers and employers respectively and a resulting flow of new matches, the output. Under familiar regularity conditions and a constant returns to scale assumption, the rate at which unemployed workers are matched with vacant jobs, called the *unemployment hazard,* is an increasing and concave function of the ratio of vacant jobs to searching workers denoted a $m(\Theta)$ where Θ represents the vacancy to searching worker ratio. The endogenous variable is a measure of *market tightness* and $Dur = 1/m(\Theta)$ is the average *duration of a completed unemployment spell.* In the model, market tightness is determined by a free entry condition which requires that the expected present value of future profits less cost of training attributable to filling the marginal vacancy equals the recruiting cost flow required to fill a vacancy.

Unemployment in the model, although a consequence of the transaction friction embodied in the matching function, reflects a continual process by which workers are reallocated from less to more productive activity. The dynamics of unemployment are easily expressed in terms of the notation introduced above. Letting the unit interval represent the available labor force, the flow into unemployment is the product of the employment hazard and the fraction employed, that is, $(\delta + \lambda F(R))(1-Un)$ where Un is the fraction unemployed. The flow out of unemployment is the product of the unemployment hazard and the fraction unemployed, that is, $m(\Theta)Un$. Hence, the *equilibrium or steady-state unemployment rate*, that which equates the two flows, is approximately equal to the product of the incidence of unemployment and the duration of an unemployment spell. Formally,

$$Un \approx \frac{Un}{1-Un} = \frac{\delta+\lambda F(R)}{m(\Theta)} = Dur \times Inc.$$

Because neither worker nor employer can instantaneously or costlessly find an alternative match partner in the market modeled, a match surplus exists equal to the capital value of the match less the sum of the values attributable to seeking alternative match partners. In this context, wage determination is a bilateral bargaining problem which divides this surplus between employer and worker. A specific solution to the problem is not specified in the Mortensen/Pissarides model simply because wage determination institutions vary so much from one industry to another and across countries. Wages can be determined in a highly noncentralized way by bargaining between individual worker and employer pairs as is common in the United States. Bargains between employer and union associations at various levels, the plant, the industry, or even the nation, are common in many other industrialized economies and some manufacturing industries in the United States. In a few countries such as Australia and New Zealand, the public at large as well as representatives of labor and management

Figure 1
Labor Market Equilibrium



are included in the bargaining process. One can expect the extent and use of worker market power to differ across these alternative institutional settings. In the formal model, the workers' share of the quasi-rents associated with an existing match, denoted by β, is regarded as a parameter with value reflecting the extent and use of worker bargaining power. According to Layard and others (1991), the value of β is likely to be higher in more unionized economies but lower the more centralized is the bargaining process.

The two endogenous variables of the model, reservation productivity R and market tightness O, are somewhat analogous to "price" and "quantity" respectively in the standard supply and demand framework. The equilibrium pair of values is determined by two relationships that are respectively downward and upward sloping as illustrated in Figure 1. (The mathematical representations of these curves are presented in the mathematical appendix.) Specifically, employers post vacancies in numbers that equate the cost of recruiting with the expected future profits attributable to hiring a worker. As the latter declines with reservation productivity, this condition implies the downward sloping relation between market tightness and reservation productivity labeled CC in Figure 1. Reservation productivity is determined in large measure by the wage. Because the wage received by workers in any rational bargaining outcome is sensitive to the value of the outside option of searching for a job while unemployed, the wage in a marginal job increases with market tightness. Hence, the productivity at which employers can no longer expect profits in the future, the reservation productivity by definition, increases with market tightness. This positive relationship between R and **O** is illustrated by the curve labeled DD in Figure 1. The equilibrium pair of values, labeled (R^*, Θ^*) in Figure 1, lies at the sole intersection of the two curves. The labels remind the reader that the curve CC represents the job creation decision while DD reflects job destruction.

The qualitative effects of policy and wage determination on unemployment

Specific labor market policies and wage formation institutions affect the position of one or both of the curves in Figure 1. Hence, hypothetical changes in either shift the curves and the associated equilibrium reservation productivity and market tightness pair. For example, an increase in UI benefits increases the value of the unemployment option to workers. As a consequence, the wage paid increases at every value of market tightness which induces an upward shift in the job destruction relation, DD in Figure 1. As the job creation condition CC is not directly affected, at least when the benefit increase is assumed to have no effect on taxes, the equilibrium reservation productivity rises. As the increase in R induces a movement up along the CC curve, the equilibrium rate of job creation as reflected in market tightness, 0 , is adversely affected. Hence, unemployment rises because both its incidence and the duration increase.

An increase in worker bargaining power, reflected in the share of match surplus received by the workers represented by the parameter β, has the same effect on the job destruction relation DD as an increase in the UI benefit because the wage paid increases with β at every value of Θ. However, an increase in the workers' share also decreases future profitability, so that CC shifts to the left. For both reasons, equilibrium market tightness falls but the effect on the equilibrium reservation productivity is ambiguous. In other words, other things equal, the theory suggests that unemployment spell durations are longer in economies in which workers receive a larger share of match surplus although the difference in spell frequency is unclear.

Although any increase in a payroll tax, such as that used to finance social security in the United States and most European countries, is shifted to workers to some extent by a decrease in the wage, the incidence of the tax is shared between worker and employer given a bargaining model of wage determination even when worker participation is perfectly inelastic. By implication, the wage plus tax bill increases with the payroll tax rate which in turn implies that DD shifts up in Figure 1 in response to an increase in the tax rate. Because expected future profitability also falls with the tax, CC shifts down. Hence, the qualitative effects of a payroll tax are similar to those of an increase in the workers' share parameter.[2]

Employment protection policy is represented in the formal model as a tax on layoffs. Under the assumption that employers must pay this tax when a worker is let go, an increase implies a decrease in the productivity at which layoffs occur. Were there no other effects, the resulting shift down in the DD curve in Figure 1 results in a decrease in reservation productivity and an increase in market tightness induced by the movement along the downward sloping CC curve. However, an employer when contemplating job creation takes account of the possibility that the job will be destroyed in the future, a contingency that will require payment of the tax. Hence, an increase in the firing tax reduces the future profitability of a current vacancy, that is, CC in Figure 1 also shifts down. If this direct effect of the tax offsets the indirect effect of the movement along the CC curve induced by the shift in DD, the result can be a reduction in job creation as well as job destruction. The existing empirical evidence seems to suggest precisely this outcome although the net effect on unemployment is unclear both in theory and practice.

Active labor market policy is incorporated in the model as a subsidy to the employer per new worker hired, an arrangement similar to the New Jobs Tax Credit of 1977. The direct effect on job creation of a hiring subsidy is to reduce the cost of hiring which shifts CC everywhere to the right in Figure 1 given reservation productivity. Because this shift induces movement up along the job destruction condition DD, the net effect is an increase in market tightness as well as an increase in reservation productivity. Because the effects of a hiring subsidy on unemployment duration and incidence tend to offset one another, the net qualitative effect on the equilibrium unemployment rate is ambiguous. The positive effect on job destruction was used as an argument against the original jobs credit even though it reflects more rapid replacement of less with more productive jobs.

Of course, an analysis of the effects of possible policy reforms on only unemployment is incomplete and can be misleading. The bottom line must include evidence on whether economic benefits can be attributed to the reform proposed. Because the productivity of the employed is endogenous as well as the level of employment in the model, aggregate net output does not always move with the level of employment. For example, a hiring subsidy both encourages job creation and job destruction. However, because the new jobs are more productive than those destroyed, labor productivity and the wage of those who remain employed increases. Hence, the overall economic welfare of workers can increase even if the net effect on employment were negative. Conversely, employment protection policy may reduce unemployment but yet decrease worker welfare as well because such a policy reduces the rate at which low productive jobs are replaced by more productive ones.

The imputed interest on the present value of future aggregate output net of recruiting and training investments, ***permanent income*** denoted as Y, represents the principal measure of aggregate economic welfare of interest. Indeed, from a purely economic point of view, any policy reform that increases this measure is socially optimal in the sense that the gains to winners exceeds costs to losers. However, compensation of the losers by the winners is not always possible because implementation of the needed transfers is either technically or politically infeasible. To obtain some insight in the distribution of costs and benefits associated with any reform, the effects on the permanent income of workers, denoted as W, are also reported. These measures of economic welfare are defined in the mathematical appendix. For those who wish to study the definition, equation A10, note that aggregate permanent income increases with reservation productivity and decreases with market tightness given the unemployment rate. The first positive partial effect is due to the fact that average productivity increases with reservation productivity. The fact that total cost of recruiting and training increases with the ratio of vacancies to searching workers explains the sign of the second.

Estimates of the quantitative effects of proposed policy reforms

Numerical estimates of the effects of unemployment insurance, the current tax on payroll, a firing tax, and a hiring subsidy on unemployment and economic welfare are reported in this section. The policy parameters of the model include the social security or payroll tax rate denoted as π, the UI benefit replacement ratio ρ, the maximum UI benefit period τ, a parameter ε representing the degree to which the UI tax is experience rated, a firing tax ϕ, and a hiring subsidy ψ. For the purpose of the calibration of the model, these parameters are set at values that approximate current U.S. policy. Specifically, the value $\pi = 0.15$ reflects the fact that employers and workers together pay 15 percent of labor earnings as social security taxes.[3] The mandated weekly benefit replacement ratio is 50 percent of prior weekly earnings and the maximum duration of benefits is six months in the United States. However, the actual fraction of laid-off workers who receive UI benefits is much lower because not all qualify for benefits and because not all those who do qualify claim benefits. In our model, the estimates of fractions eligible for UI, fractions ineligible by reason, and take-up rates for the 1977-1987 period reported by Blank and Card (1991, Table I) suggest that roughly 50 percent of laid-off workers would either not qualify or would not apply. Hence, when appropriately interpreted as the product of the replacement ratio and probability of receipt of benefits, one obtains the parameter value $\rho = 0.25$. As the period of the model is one quarter, the six-month maximum benefit period typical in most of the United States, the maximum benefit period parameter is $\tau = 2$. Anderson and Meyer estimate that an employer can expect to pay sixty cents of each additional dollar of UI benefits received by an employee in the form of higher future UI taxes. In other words, the degree to which the UI tax is experience rated is reflected in the parameter value $\varepsilon = 0.6$. Finally, the baseline values of the firing tax and the hiring subsidy used for the purpose of calibrating the model are zero, reflecting the current lack of either in the United States.

A real rate of interest r of 1 percent per quarter and an exogenous rate at which workers quit to unemployment δ of 1.4 percent per quarter and quit to take a different job $qm(\Theta)$ of 5.6 percent per quarter are values consistent with available empirical information. The elasticity of the matching function with respect to vacancies $\eta = \Theta m'(\Theta)/m(\Theta)$ is set equal to 0.6, the estimate obtained for the United States by Blanchard and Diamond (1989). As the average wage is 78 percent of maximal output in the model, the fact that earnings plus benefits averaged \$31,200 per year in 1990 (See *Statistical Abstract of the United States, 1993,* Table No. 666) implies maximal output per quarter in 1990 dollars equal to \$10,000. Survey information reported in Hamermesh (1993) suggest that \$3,000 and \$2,500 in 1990 represent reasonable estimates of the cost of recruiting and training a worker respectively. Letting output in the most productive job serve as numeraire, these figures and the fact that the average duration of an unemployment spell in the United States is roughly equal to three months imply recruiting and training cost parameters of $c = 0.3$ per vacancy per quarter and $k = 0.25$ respectively.

Although estimates of rent sharing coefficients closely related to β are positive and highly statistically significant in the empirical wage equation literature, the typical point estimate is quite small. See Blanchflower, Oswald, and Sanfrey (1993). However, Abowd and Lemieux (1993) argue that these estimates are badly biased downward for a variety of reasons. Their estimate obtained using Canadian manufacturing data and an instrumental variable approach is 30 percent. Although noncooperative bargaining theory implies a 50 percent share and insider-outsider arguments suggest even larger values for the share, $\beta = 0.3$ is assumed for the purpose of the calculations that follow. The reader is warned that the results are sensitive to the choice of workers' share.

A uniform productivity distribution is assumed of the form $F(x) = (x-\gamma)/(1-\gamma)$. Direct observation provides little information about the value of leisure b, the rate at idiosyncratic shocks arrive λ, and the minimum productivity parameter γ. Given the other parameter values, these were selected so that the steady-state implications of the model are consistent with the average unemployment spell duration (one quarter) and unemployment incidence rate (7 percent per quarter) experienced in the United States over the recent past and with available evidence on the elasticities of unemployment incidence with respect to firing cost (0.09) reported by Anderson and Meyer (1993). The baseline parameter values used in the calculations that follow are summarized in Table 1.

Table 1
Baseline Parameter Values

Interest rate r = 0.01 per quarter	Payroll tax: π = 0.15
E to U transition rate: δ = 0.016 per quarter	UI replacement ratio: ρ = 0.25
E to **E** transition rate: q = 0.054 per quarter	UI benefit period: τ = 2 quarters
Matching elasticity: η = 0.6	UI experience rate: ε = 0.60
Recruiting cost: c = 0.30 per quarter	Firing cost: ϕ = 0
Training cost: k = 0.25	Hiring subsidy: ψ = 0
Worker's share: β = 0.3	
Value of leisure: b = 0.32 per quarter	
Product shock **arrival** rate: λ = 0.10 per quarter	
Minimum productivity: γ = 0.63 per quarter	

As a check, one can compare the model's quantitative implications for behavioral responses to policy at these parameter values with econometric estimates in the literature. For example, Layard and others (1991) find that a 1 percent increase in the UI replacement ratio is associated with an increase in the unemployment rate of 171100th of a percentage point using cross-country OECD data. This model at baseline parameter values implies a slightly smaller but positive response of 0.14 percent. Furthermore, the model's implied elasticity of the average duration of an unemployment spell with respect to UI benefits is 0.5, near the middle of the range of estimates found in the literature.

Computed changes induced in equilibrium unemployment and welfare measures by different labor market policy reforms are reported in Table 2. The effects reported in each row are those induced by the particular reform specified in the first column of the table. The effects of each reform on the unemployment rate, on the duration of an average unemployment spell, and on unemployment incidence are reported in columns two, three, and four respectively. The changes in economic welfare measures, permanent aggregate income and labor earnings plus transfers received per labor force participant per year, are found in the last two columns of the table.[4]

The estimates in the first row of Table 2 reflect the effects of a hypothetical experiment in which the UI benefit replacement ratio is reduced by half. At baseline parameter values, the model implies that the unemployment rate would be reduced from the current 6.5 percent average to 5 percent by this reform. The disincentive effect of UI benefits on job creation is illustrated by the fact that the duration of a typical unemployment spell would fall from three months to less than 2.4 months. Because job destruction is hardly affected, average labor productivity is not changed much by the reform.

Because any reduction in UI benefits would encourage the creation of new jobs but would have little effect on job destruction, aggregate output would increase were benefits reduced. According to the model, net aggregate output would increase by $265 per year per labor market participant were UI benefits reduced by half. Given the 120 million current participants in the U.S. labor market as either employed or job seeking workers, the aggregate income benefit of the reform would be about $31 billion per year. However, the reform would also involve a massive redistribution of income away from workers. Indeed, in the absence of other compensation, average worker permanent income would drop by over $26 billion annually, the difference between the incomes of those who would become employed as a consequence of the reform less the unemployment benefit income losses of those who would remain unemployed.[5] Furthermore, these calculations fail to account for the insurance value of the safety net provided by UI.

Table 2
Unemployment and Welfare Effects of Labor Market Policy Reforms

Reforms	ΔUn Rate (%)	ΔDuration (months)	ΔIncidence (% per qtr.)	ΔOutput/ Participant (1990 $/yr.)	ΔEarnings/ Participant (1990 $/yr.)
50% cut in UI benefits	-1.48	-0.61	-0.31	$265	-$219
50% cut in UI benefit period	-0.78	0.33	-0.14	$145	-$ 83
Fully experience rated UI tax	0.19	0.23	-0.30	-$ 94	$42
50% payroll tax cut	-0.66	-0.26	-0.16	$116	-$ 54
One month wage fire tax	0.52	0.90	-1.14	-$400	-$ 02
One month wage hire subsidy	-1.26	-0.90	0.94	$277	$322

Although the figures suggest that UI is a costly income transfer mechanism, it may well be an efficient insurance scheme. In any case, the magnitude of the income redistribution implied by the model clearly indicates the political resistance that would meet any proposal to reduce UI benefits.

The limitation on the maximum UI benefit period imposed in the United States and Sweden is often cited as a reason for lower unemployment rates relative to Canada in the first case and to other European countries in the second. Estimates of the unemployment and welfare effects in the United States of reducing the maximum benefit period from its current standard of six months to three are presented in the second row of Table 2. The unemployment rate would fall slightly less than four-fifths of a point according to the model, primarily as a consequence of a one-third month drop in unemployment duration. As in the case of a benefit reduction, aggregate output would increase about $17 billion per year, but worker income would fall some $10 billion annually, as a consequence of the reform. Although limiting the benefit period may well be warranted in Europe as a means of reducing the incentive to remain unemployment for long periods, this model does not provide strong support for further limitation in the U.S. case in spite of the rather large unemployment effect.

Although considered as a possible reform elsewhere, an experience rated UI tax is currently unique to the U.S. system. The implied effects of fully experience rating the tax, a reform that would require each employer to pay all the UI benefits received by her laid-off employees, are reported in the third row of Table 2. As expected, layoffs would be discouraged but only by a relatively small amount; unemployment incidence would fall from 7 percent per quarter to 6.7 percent. Because increasing the degree of experience rating would be an increase in the effective cost of letting a worker go, job creation would be adversely affected. Although the consequent projected increase in unemployment duration would also be small, about one week, it would more than offset the decrease in unemployment incidence. Hence, the net effect would be a small although probably insignificant increase in the unemployment rate. Again the effects of the reform on aggregate and worker incomes are of opposite sign. These rather ambiguous findings support neither the extension of experience rated tax in the United States nor the adoption of a similar provision in other countries.

The effects of cutting the current 15 percent social security tax by half to 7.5 percent are reported in the fourth row of Table 2. This reform would reduce average unemployment duration by one week as well as unemployment incidence by a small amount. As a consequence of both effects, the unemployment rate would fall by about two-thirds of apoint according to the model. However, here too aggregate income would increase but worker income would fall because the payroll tax finances transfers to working households both in fact and in the model. Furthermore, it is not likely that the gain in aggregate income suggested by the model, about $14 billion annually, would justify either the value of the reductions in pensions and health care for the aged needed or the increase in the deficit or other taxes that would be otherwise required to offset the revenue loss attributable to cutting the payroll tax by 50 percent.

Employment protection policies include severance pay, prior notification requirements, procedural requirements for laying off workers, and firing penalties. As mentioned earlier, considerable controversy over the expected impact of employment protection policy on unemployment exists because of its indirect disincentive effect on job creation. In this analysis, policies designed to discourage layoffs are represented by a financial penalty incurred by the employer when a worker is let go. The effects of a firing tax of this kind equal to $2,500 per worker laid off, one month's pay in 1990 on average, on both the duration of an unemployment spell and on unemployment incidence are quite large.[6] Namely, the impacts reported in the fifth row of Table 2 imply that duration would increase from three to almost four months while incidence would decrease from 7 percent to less than 6 percent per quarter. Because the former is larger in percentage terms than the latter, the net effect implied by the model is an increase in unemployment. In short, the disincentive effect on job creation more than offsets the intended effect of the tax, to reduce unemployment by charging employers for laying off workers. Furthermore, the model implies that the tax would cause a large reduction in aggregate output, $400 per labor force participant per year, and would have virtually no effect on permanent labor income. The decrease in aggregate income is due to both the negative employment effect and to the reduction in labor productivity resulting from the fact that the tax lowers reservation productivity and slows the process by which workers are reallocated to more productive activity.

Active labor market policy is represented in the model by a subsidy to hiring which can either be interpreted as government assistance in the job/worker matching process, government financed training, or as a tax credit per worker hired paid to employers similar to the New Jobs Credit of 1977. In Table 2, the effects of a subsidy equivalent to $2,500 in 1990 per worker hired, the monthly average wage, are reported in the last row. The estimates suggest that a subsidy of this magnitude would reduce the duration of the typical unemployment spell by almost one month but would also increase incidence from 7 percent per quarter to almost 8 percent. Still, the projected net effects on both employment and aggregate income would be positive and relatively large, the unemployment rate would fall by 1.26 points, and aggregate permanent income would increase by $277 per labor force participant or $32 billion annually in the aggregate. The effect on permanent labor income is even larger, an increase of $322 per year per labor market participant, almost $39 billion per year in total. In sum, the figures suggest that a hiring subsidy would be justified on efficiency grounds and would also greatly benefit workers, particularly relative to alternative policies that promote employment protection. Indeed, the beneficial effects on unemployment and aggregate output are larger than those attributed by the model to a 50 percent reduction in unemployment benefits while at the same time worker income would increase by $322 per worker per year rather than decrease.

Marginal dead weight tax losses and subsidy gains

The marginal dead weight loss of a tax is defined as the ratio of the reduction in value of output attributable to the induced distortion of a small increase in the tax divided by the revenue generated by that increase. In other words, it is a measure of marginal cost of the distortion per dollar of revenue generated by the tax. An analogous measure of the marginal gain attributable to a subsidy is the addition to aggregate income per dollar of expenditure. These measures are useful for several purposes. For example, a small subsidy financed with budget balancing increase in the payroll tax is justified on grounds of economic efficiency if and only if the marginal gain per dollar of expenditure exceeds the dead weight loss of an additional dollar of tax revenue. The difference between the dead weight losses associated with two different taxes provides a natural indicator of the more economic means of financing any small increase in expenditure.

In a dynamic context, the relevant measures of net output, tax revenue, and expenditure are the present value of future stream equivalents because the time distribution of reform effects on these streams generally differ. See Judd (1987). For the model at hand, this measure of marginal gain per dollar of hiring subsidy and the analogous measures of marginal dead weight loss of a tax penalty on layoffs and a payroll tax are computed and reported in Table 3 for alternative calibrations of the model. In other words, the estimates reported in each row of the table are for the particular parameter combinations listed in the first column. All parameters other than those listed are set at the baseline values reported in Table 1. In each case, the value of leisure b and the minimum productivity parameter γ are chosen so that the model's steady-state unemployment duration and incidence match recent U.S. experience given the workers' share parameter β. Hence, the variation in results reported in the table provides a test of sensitiv-

Table 3
Marginal Gain per $ of Hiring Subsidy Expenditure and Dead Weight Losses per $ of Firing and Payroll Tax Revenue

Calibrated Parameter Values	Hiring Subsidy	Firing Tax	Payroll Tax
$\beta = 0.1, \beta = 0.54, \gamma = 0.72$	0.27	-0.16	-0.10
$\beta = 0.2, b = 0.45, \gamma = 0.68$	0.47	-0.41	-0.07
$\beta = 0.3, b = 0.32, \gamma = 0.63$	0.73	-0.71	-0.06
$\beta = 0.4, b = 0.16, \gamma = 0.56$	1.07	-1.11	-0.05
$\beta = 0.5, b = 0.00, \gamma = 0.47$	1.56	-1.68	-0.05

ity with respect to the uncertainty that exists about the value of β. Finally, the marginal effects of a hiring subsidy, firing tax, and a payroll tax are reported across the remaining three columns in the right panel of Table 3.

To interpret the information reported in Table 3, I begin by considering the marginal effects when workers' share is at its base line value of 30 percent, that is, $\beta = 0.3$. The first result reported in the middle row of the table implies that a small hiring subsidy yields an addition to aggregate income of $0.73 per dollar of subsidy provided that lump sum financing were available. The net gain in the absence of lump sum taxation depends on which tax is used to finance the subsidy. As the marginal cost of a dollar of revenue financed with a firing tax is $0.71 and with a payroll tax is $0.06 for these base line parameter values, the hiring subsidy yields a positive net return in either case but a substantially larger one in the case of payroll tax financing, at least at the margin.[7] As an implication of the large differential in the distortions caused by the two taxes at these parameter values, it also follows that experience rating the UI tax is an inefficient device for funding UI benefits. In particular, a net gain in output equal to the difference, sixty-five cents on the dollar, is realized by reducing the degree of experience rating and financing the revenue loss by a compensating increase in the payroll tax. In sum, the results reported in the third row of Table 3 support the suggestions implicit in the estimates of policy impacts reported in Table 2. Namely, a hiring subsidy does offset the disincentive effects of UI benefits and payroll taxes on job creation. Furthermore, increasing the degree of experience rating and/or adding employment protection measures would discourage job creation and reduce economic welfare.

The other rows of Table 3 suggest that the general conclusions of the computational experiment at baseline parameters are valid for other values of the worker share as well although the magnitudes of the marginal effects do depend on β. In particular, the marginal gain attributable to a hiring subsidy rises steeply with the value of the workers' share of match rent parameter β as does the differential marginal dead weight loss of a firing tax relative to a payroll tax. The reason is that a higher worker share of match surplus reduces the expected return that employers can expect to realize from such an investment. Conversely, if workers' share is sufficiently low, then employers have an incentive to overinvest in job creation. Indeed, in the absence of other distortions, Diamond (1982) and Hosios (1990) have shown that a tax on hiring rather than a subsidy is called for when workers' share is less than one minus the elasticity of the matching function with respect to vacancies. However, even when the workers' share of match surplus is a mere 10 percent, the marginal gain in output per dollar of hiring subsidy exceeds the dead weight loss of a dollar collected through either a payroll or a firing tax.

Concluding remarks

The computational experiments conducted in the paper makes use of the Mortensen and Pissarides (1994) equilibrium labor market model calibrated by Millard and Mortensen (1994) to be consistent with unemployment experience and policy in the United States. The results suggest that the provisions of the UI system have important disincentive effects on job creation. Specifically, the model implies that a 50 percent reduction in UI benefit levels would decrease the natural unemployment rate in the United States by almost one and one-half percentage points. Although the implied gain in aggregate output attributable to the reform is **$31** billion per year, the projected decrease in worker annual income is also large, some **$26** billion per year. The effects of reducing the maximum length of the unemployment benefit period by 50 percent all have the same signs but are about half the magnitudes. Finally, these figures do not account for the lost value of the safety net provided by UI that would occur were benefit level or period reduced. In short, the redistribution of income away from workers is large and calls into question any suggestion to curtail either the unemployment insurance benefit levels or maximum benefit period in the United States.

Employment protection is sometimes recommended as a means of reducing unemployment even though the net effect of imposing a cost of firing on employers is theoretically ambiguous because of the disincentive that such a cost has on hiring. In a hypothetical experiment in which a firing tax is instituted equal to the average worker's monthly earnings, the model implies a large negative effect on unemployment incidence and a large positive effect on unemployment duration resulting in a small positive net increase in the unemployment rate. Because the creation of more productive jobs are adversely affected and because the continuation of relatively low productivity jobs is encouraged by the policy, annual aggregate net output falls by an amount equivalent to $48 billion in 1990. These results cause concern about the productivity consequences of the recent trend toward more job protection measures in the United States while at the same time provide support for reforms in Europe designed to reduce these kinds of restrictions on labor mobility.

Finally, an experimental subsidy paid to employers for each worker hired of the same magnitude, one month of average earnings, reduces the unemployment rate by **1.26** points and increases aggregate income by **$32** billion per year even though a hiring subsidy induces a higher layoff rate in the model. Furthermore, it is the workers who receive the bulk of the economic benefits of the subsidy as a consequence of both increased employment and wages. Because payroll taxes do not have big disincentive effects in the model, the results of the experiment suggest that the subsidy is productive even if fully financed with a tax on wages. Indeed, at baseline parameters, the estimated marginal net gain in aggregate income is sixty-five cents per dollar of subsidy financed with a payroll tax after account is taken of the dead weight loss of the latter. These results provide support for active labor market policies designed to encourage job creation.

Mathematical Appendix

The specific formulae underlying the calculations reported in the text are summarized here. The details of their derivations can be found in Millard and Mortensen ***(1994).***

The equilibrium relationship between reservation productivity and market tightness that characterizes the job creation condition, that labeled CC in Figure 1, follows:

$$\text{(A1)}\quad c\frac{\mathbf{0}}{m(\theta)} + k - \psi + f(w,\theta,\varphi,\varepsilon,\rho,\tau) = \frac{\tilde{}}{1+\beta\pi}\left\{\frac{1-R}{r+\delta+qm(\theta)+\lambda}\right\}.$$

The curve labeled DD in Figure *1* represents the following relationship between reservation productivity implied by the job destruction decision

$$\text{(A2)}\quad R + (r+\delta+qm(\theta))\,\varphi + \left(\frac{\lambda}{r+\delta+qm(\theta)+\lambda}\right)\left(\frac{1-\beta}{1+\beta\pi}\right)$$

$$\int_R^1 (x-R)\,dF(x) = (1+\pi)w$$

where w, the wage on a job of marginal productivity, solves

$$\text{(A3)}\quad w = \frac{\beta(R+(r+\delta+qm(\theta))\varphi) + (1-\beta)g(w,\theta,b,\rho,\tau)}{1+\beta\pi} +$$

$$\frac{(m(\theta)\,(1-q)}{r+\delta+qm(\theta)+\lambda}\;\frac{\beta\,(1+\beta)\,(1-R)}{1+\beta\pi)^2}$$

The function

$$\text{(A4)}\quad g(w,\theta,b,\rho,\tau) = b + \rho w(1-e^{-(r+m(\theta))\tau})$$

represent the value of leisure plus the UI benefit flow received when laid off appropriately adjusted for benefit period limitation, τ. Analogously, the function

$$\text{(A5)}\quad f(w, \theta, \varphi, \rho, \tau, \varepsilon) = \varphi + \frac{\varepsilon \rho w[1-e^{-(r+m(\theta))\tau}]}{r+m(\theta)}$$

represents the total cost of laying off a worker, the firing penalty ϕ plus the expected tax on the UI benefit stream received by the worker during the subsequent spell of unemployment. Finally, the particular forms of the unemployment hazard and the distribution of idiosyncratic productivity innovations functions used in the calculations are

$$\text{(A6)}\quad m(\theta) = \theta^{\eta}$$

and

$$\text{(A7)}\quad F(x) = \frac{x-\gamma}{1-\gamma}\ \forall\, x \varepsilon\, [\gamma, 1].$$

Given equations A1 through A7, one can compute the equilibrium reservation productivity and market tightness pair (R,θ) for any specification of the parameters, such as the baseline values in Table 1.

The dynamic laws of motion for the associated equilibrium level of market employment, represented by N, and the employment density over match productivity, denoted as $n(x)$, are represented by the differential equations

$$\text{(A8)}\quad N = m(\theta)\,(I-N) - (\delta+\lambda F(R))\,N$$

and

$$\text{(A9)}\quad \dot{n}(x) = \lambda F'(x)N - (\delta+qm(\theta)+\lambda)n(x)\ \ \forall\, x < 1$$

Of course, the unemployment rate denoted as Un in the text equals I-N* where N* is the steady state solution to equation ***A8.*** At any date *t*, aggregate output net of recruiting and training costs is

(A10)

$$Y(t) = N(t) + \int_R^1 ((x-1)n(x,t)dx + b(1-N(t)) - [c\theta + km(\theta)]\,(1-N(t))$$

where *N(t)* and *n(x,t)* represent the solutions to equations **A8** and **A9** respectively. Finally, permanent aggregate net output (which includes the value of leisure of the unemployed) is defined as follows:

$$\text{(A11)} \qquad Y = r\int_0^\infty Y(t)e^{-rt}dt$$

Note that a change in any policy parameter instantly changes the equilibrium reservation productivity, R, and market tightness, 8, in equation A10, but does not affect the initial distribution of employment. Because this distribution will evolve over time to its new steady state, the marginal effect of a parameter change on permanent net output, Y, is a weighted average of the varying marginal effects on the stream of future values $Y(t)$, $t \in (0,\infty)$.

The net government transfer per labor force participant at time *t*, total taxes less UI benefit payments and hiring subsidies, is defined by

$$\text{(A12)} \quad G(t) = \pi B(t) + \varphi\lambda F(R)N(t) - (1-\varepsilon)\rho\left(\frac{1-e^{-r+m(\theta))\tau}}{r+m(\theta)}\right)B(t)\lambda F(R) - \varphi m(\theta)\,(1-N(t))$$

where

$$\text{(A13)} \quad B(t) = \omega(1)N(t) + \int_R^1 (\omega(x) - \omega(1))n(x,t)\,dx$$

is the total wage bill at time *t* and where in turn

$$\text{(A14)}\quad \omega(x) = \frac{B\,(x+(r+\delta=qm(\theta))\varphi) + (1-\beta)g(w,\theta,b,\rho,\tau)}{1=\beta\pi} + \frac{m(\theta)\,(1-q)}{r+\delta+qm(\theta)+\lambda}\,\frac{B(1-\beta)\,(1-R)}{(1+\beta\pi)^2}$$

is the wage paid to a worker employed in a job with productivity x. Finally, total earnings (including the value of leisure enjoyed when not employed) and UI benefit payments plus other per capita government transfers received by working participants at date t equal

$$\text{(A15)}\quad W(t) = B(t) + b(1-N(t)) + \rho\left(\frac{1-e^{-(r+m(\theta))\tau}}{r+m(\theta)}\right)B(t)\lambda F(R) + G(t).$$

Finally, the permanent measure of this stream of labor income and of the stream of government transfers per participant are respectively

$$\text{(A16)}\quad W = r\int_0^\infty W(t)e^{-rt}dt$$

and

$$\text{(A17)}\quad G = \int_0^\infty G(t)e^{-rt}dt.$$

The reform induced changes in welfare measures reported in Table 2 are the changes induced in Y and W as defined by equations A11 and A16 under the assumption that the system is in the old steady state when the reform takes place at time $t = 0$ and that the reform is permanent. A marginal gain or loss reported in Table 3 is the ratio of the change in Y divided by the change in G induced by a small change in the relevant policy parameter:

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Endnotes

[1]See Kydland and Prescott (1994) for a discussion of the role of the computational experiment in economic policy analysis.

[2]Because the only investment in the model is in the form of recruiting and training costs incurred by employers which are expenditures regarded as current expenses for income tax purposes, ordinary income taxes are neutral in this model provided that profits, wages, and UI benefits are all taxed at the same marginal rates.

[3]In the model, bargaining adjusts the wage so that who actually pays the tax is irrelevant

[4]Permanent income is defined as the imputed Interest income on the expected present value of a future stream, that is, an exponentially weighted average of the future stream where the weights reflect time preference. Hence, in each case account is taken of the dynamic paths of future income adjustment to each policy reform.

[5]These calculations account for the'pnvate income effects of the benefit reduction. In particular, the government saving attributable to the UI benefit decrease is assumed to be redistributed equally among all working households as a lump sum transfer. (See equations A12 and A15.)

[6]In light of the fact that the cost of employment protection in the United Kingdom is estimated to be as high as three months' average earnings, the size of this hypothetical tax is not particularly large.

[7]In particular, experiments reported in Millard and Mortensen (1994) suggest sharply diminishing returns to the subsidy which explain its relatively small impact on aggregate output in Table 2.

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