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PUBLIC ENTERPRISES AND LABOR MARKET PERFORMANCE*

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This article shows that state control of some industries may have contributed to the increase in European unemployment from the 1970s to the early 1990s. We develop a simple two-sector model, one privately run and one publicly run, that has risk-averse workers directing their search into one of the sectors. Assuming that the privately run sector is less able to insure its employees against uncertainty, we show that aggregate unemployment in this economy increases in response to an increase in economic turbulence.

1. INTRODUCTION

In this article, we focus on the role of state control in the explanation of the rise of European unemployment since the late 1970s. We argue that state control of some sectors of the economy can contribute to the rise in aggregate unemployment in presence of an increase in economic turbulence. We follow Ljungqvist and Sargent (1998) in claiming that the world economy has been subjected to significant increases in turbulence since the late 1970s. We interpret the increase in turbulence as the increase in the instability of earnings over this time period.[2] In simple terms the mechanism we propose in the article is as follows. In an economy with two sectors, one privately run and one publicly run, the benevolent government must

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[2] This is consistence with evidence reported in Gottschalk and Moffit (1994, 1998). They show that a large component of the widening of the earnings distribution in the U.S. labor market during the 1980s was due to a sharp increase in the earnings instability for individual workers. A similar pattern has also been observed in other countries. See Dickens (2000) for the United Kingdom, Baker and Solon (2003) for Canada, and Cappellari (2002) for Italy.

choose how many vacancies to open in the public sector, and, in effect, in which sector each worker should search (of course, the search decision must be optimal from the individual's point of view). Therefore, the government faces a trade-off between discouraging vacancies in the private sector and a higher rate of unemployment in that sector. We show that this may, overall, lead to a higher unemployment rate than in an economy in which both sectors are privately run. Further, assuming that the privately run sector is less able to insure its employees against uncertainty, we show that increases in turbulence lead to a rise in aggregate unemployment in economies where one sector is publicly run.

The existing literature on the rise of European unemployment has focused mainly on the role of labor market institutions in explaining the European unemployment experience and its differences from that of the U.S. experience.[3] Our methodology is similar to that of the works cited, to the extent that we focus on the interaction between the turbulence shock and the institution of public ownership, but we do not model other labor market institutions.[4]

Our analysis is motivated by the fact that public employment is quantitatively important in many developed countries. Moreover, the extent of public ownership in the economy is of relevance especially in European countries, such as Italy, France, Portugal, Finland, and Greece. We consider a "complete" definition of the public sector that includes both publicly operated enterprises, and typical public sector activities, such as the provision of education, health services, public security, and administrative services. Public enterprises are government-owned or -controlled economic entities that generate most of their revenue by selling goods and services. In many European countries, the government has a presence in commercial, industrial, and financial sectors of the economies including banking, car manufacturing, airlines, telecommunications, postal services, oil extraction, refinement, and distribution. The government operates such enterprises either by controlling these firms directly or by holding a majority of their shares. Table 1 summarizes data on employment in the *limited* public sector and in public enterprises as a fraction of total employment.[5] The *limited* public sector includes ministries and other services of (central and local) government, education, health, and the army, as well as other activities that are financed primarily by the government's general revenue. The first column shows how the size of the *limited* public sector is quite relevant and how it varies across countries. The limited public sector accounts for around 20% of total employment in Italy and France. In the United States, government employment accounts for around 14% of total employment. Scandinavian countries have the largest governments, which account for more than 30% of total employment in both Sweden and Denmark. The role of the government in the production sector also differs quite substantially

[3] See Layard et al. (1991), Nickell (1997), and Blanchard and Wolfers (2000).

[4] For other models along these lines, see Bentolila and Bertola (1990), Bertola and Ichino (1995), Bertola and Rogerson (1997), and Mortenson and Pissarides (1999a, 1999b) for mechanisms emphasizing demand side factors, and Marimon and Zilibotti (1999) and Ljungqvist and Sargent (1998) for supply side mechanisms.

[5] As a consequence of this large and diverse set of public sector activities it is very difficult to find an inclusive and comparable cross-country measure of public employment. In Table 1 we report data from OECD (1997). To our knowledge this report provides the best available data on employment in the public sector.

TABLE 1
EMPLOYMENT IN THE "LIMITED" PUBLIC SECTOR AND IN PUBLIC ENTERPRISES (PERCENTAGE OF TOTAL EMPLOYMENT)

	Employment in Public Sector	Employment in Public Enterprises
Australia	14.6	4.1
Austria	15.8	6.7
Belgium	20	3.9
Canada	17.4	2.5
Denmark	35.4	3.9
Finland	25.1	2.1
France	20.2	6.8
Germany	14.1	1.3
Greece	9.6	3.3
Ireland	16.8	4.3
Italy	18.2	5
Japan	6.5	0.5
Netherlands	11.8	2.1
New Zealand	12.1	2.1
Portugal	14.8	2.7
Spain	15.1	2.9
Sweden	31.7	6.4
Turkey	9.4	2.7
United Kingdom	11.9	5
United States	14.2	0.7

DATA SOURCE: "Measuring Public Employment in OECD Countries: Sources, Methods, and Results," OECD, 1997.

across countries. Entries in the second column of Table 1 represent the share of employment in *public enterprises* relative to total employment. This share is almost negligible in the United States (0.7%) and Japan (0.5%), whereas it is a quantitatively relevant part of total employment (above 4%) for many European countries. When we consider both components of public employment, the share of total employment due to government employment ranges from 7% in Japan to more than 20% in many European countries, including Italy (23.2%), France (27%), and the Scandinavian countries, where the public sector constitutes 40% of total employment.

We develop a simple two-sector model that has risk-averse workers directing their search into one of the sectors. There is a fixed cost to creating a vacancy in each sector. In the benchmark economy, both sectors are private and firms are free to create vacancies. In the European economy, Sector 1 is a public sector and only the government can create vacancies. In each sector, workers and vacancies are matched randomly. The output of a match is subject to match-specific productivity shocks. Workers and firms share ex post the output in a private match, but the wage is set by the government in the public sector. The key results in our model hinge on the following mechanisms: (1) the worker's choice of the sector in which to search for a job depends on both the expected volatility of wages offered and the probability of getting a job; (2) the government can provide more insurance against match-specific shocks than private firms; and (3) the

government can influence the incentives that firms have to enter the private sector by influencing the number of job searchers who enter the public sector, for example, by opening up vacancies or increasing wages. We investigate the implication of a mean-preserving spread of the match-specific shock in our economy, that is, an increase in economic turbulence. We find that in equilibrium there will be higher unemployment in the European economy following this shock, because workers will be queueing for public sector jobs, which offer less risky wage profiles. However, the unemployment in the benchmark economy is not affected by the shock. Hence, the increase in turbulence induces higher unemployment in the European economy relative to the benchmark economy.

We then conduct a simple calibration exercise that illustrates the quantitative relevance of our mechanism. We consider two European economies where the state has a strong control of the economy: Italy and France. Both countries experienced a large increase in unemployment and in public employment between the early 1970s and the mid-1990s. We calibrate the parameters in our model to match their employment structure in the 1970s and then measure the predicted increase in the unemployment rate when the economy is subject to a mean-preserving spread of the match-specific shock, which we identify with the increase in the *instability* of earnings documented by Gottschalk and Moffitt (1994, 1998). We find that our model can generate between 5% and 60% of the actual rise in unemployment between 1973 and 1994 for both Italy and France. The ability of the model to account for the rise in unemployment depends on how risk averse workers are. We interpret our quantitative exercise as suggestive evidence that our model, although parsimonious, captures a relevant aspect of the European labor market.

The prediction that overall unemployment and public employment increase simultaneously as the economy becomes more turbulent is consistent with the data. We observe a positive cross-country correlation between the growth in unemployment and the growth in public employment between the early 1970s and the mid-1990s—a period of growing economic instability. That is, countries that experienced the largest growth in unemployment over this period also had the largest increases in public sector employment.[6] Figure 1 plots the change in unemployment rate between 1970 and 1994 against the change in public sector employment (in the limited public sector) as a percentage of total employment for the subset of OECD countries for which comparable time series data are available.[7] The figure shows that there is a positive cross-country correlation between the two variables. The Spearman rank correlation between the two series is equal to 0.40 and is significant at the 5% level.[8]

[6] Assessing the causal link between the growth in public employment and unemployment empirically is outside the scope of this article.

[7] Data on public employment in 1970 and 1990 are from the OECD, Historical Statistics. Data on standardized unemployment rates are from the CEP Labor Market Institution Database available online.

[8] It might be thought that this positive cross-country correlation is simply due to the fact that in some of these countries, aggregate employment declined disproportionately more and not by a genuine (relative) increase in the number of public sector employees. However, we find similar results when we measure public employment as a fraction of the labor force.

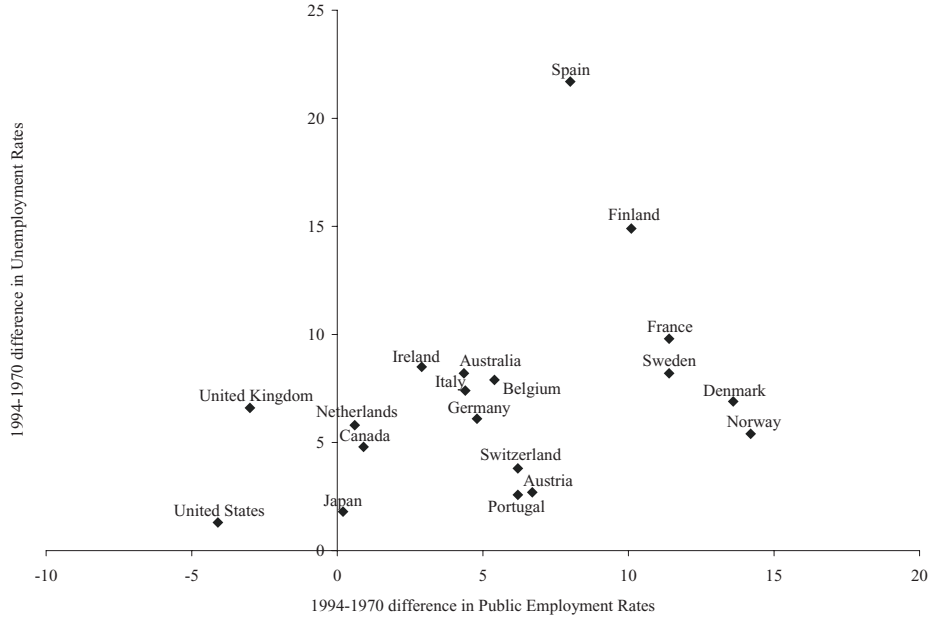

FIGURE 1

PERCENTAGE DIFFERENCES IN PUBLIC EMPLOYMENT AND IN UNEMPLOYMENT, 1970–1994

Additional evidence in favor of our hypothesis is discussed in recent empirical work that considers the importance of regulation in product markets and of public ownership in explaining cross-country differences in employment outcomes (Nicoletti et al., 2001), and in private investment and growth (Alesina et al., 2005). In particular, Nicoletti et al. (2001) show that there is a *negative* correlation between the degree of public ownership and *employment* across countries and that countries characterized by a larger share of state ownership also experienced the lowest employment growth between 1982 and 1995.[9]

Our results are related to an older literature that studies how the presence of a unionized sector in the economy, which offers "safer" jobs, may generate high and persistent unemployment, because workers queue for such "protected" jobs. In our model the government plays a similar role to that played by the union in this literature (see the discussion in Hall, 1975). More recently, Rodrik (2000) has emphasized the role of the public sector as an insurance mechanism against household income and consumption risk in countries that face a relatively large and undiversifiable external risk.

Our model is complementary to recent papers that study the interaction of state and private ownership. Blanchard and Giavazzi (2003) develop a model that

[9] In more details they find that the 1995 cross-country correlation between employment rate (in the nonagricultural business sector) and the index of public ownership is equal to −0.71 and significant at the 10% level. The correlation of the index with employment *growth* is −0.44. Such a negative relationship is robust to the inclusion of other factors in the regression analysis.

studies the interconnection between labor market institutions and the state's regulatory intervention on the production side of the economy. Our article contributes to this literature by providing insights into one possible mechanism through which the presence of an active government in an economy may affect its labor market performance. Finally, our article is related to Algan et al. (2002). They show that public employment crowds out total employment in those countries where goods produced in the public sector are substitutes for goods produced in the private sector.

The rest of the article is organized as follows. Section 2 describes the model. Section 3 discusses its main implications. Finally, Section 4 presents the results of our calibration exercise.

2. MODEL

We consider a two-sector economy with three types of agents: workers, firms, and capitalists. In each sector ($i = 1, 2$), firms produce exclusively one good ($i = 1, 2$). Goods are used exclusively for consumption.

Firms have identical production technologies, independent of the sector. Namely, production requires precisely one worker and one unit of capital. The output of each firm is random, and is independently and identically distributed across firms. Each firm operates in exactly one of the two sectors.

In our economy, which we term *Europe*, the two sectors differ with respect to their ownership: the first sector is *public*, whereas the second is *private*. The structure of ownership has two consequences. First, the number (more precisely, the measure) of public firms is set by the government, whereas the number of private firms, each of which maximizes expected profits, is determined by free entry. Second, the wage paid to workers employed by public firms is set by the government, whereas it is equal to an exogenous fraction of the output's value for a private firm.

There is a unit mass of workers in the economy. Search is directed. In each sector, firms in that sector that have acquired one unit of capital and workers who directed their search toward this sector meet according to a matching technology that is homogeneous of degree one. There is no disutility or cost from being matched. We assume that the productivity of a match is not observed until output is realized. Hence, production will always take place once a firm and a worker are matched.

To close the economy, there are also capitalists who provide a perfectly elastic supply of capital at a fixed, exogenous price to firms in both sectors.

Both (matched and unmatched) workers and capitalists are also *consumers*, with identical preferences. In particular, they display risk aversion. Consumers spend all their (capital and labor) net income on the consumption of the two goods.

In this *European* economy, the government seeks to maximize the expected utility of workers. The government controls (i) the unemployment benefits, which are the sole income of unmatched workers and must be the same for all unmatched workers, independent of their search behavior, (ii) the tax rate on labor income, which applies to all workers, (iii) the price at which it sells the publicly produced good, and, as mentioned, (iv) the number of firms in the public sectors and wages

paid to workers in that sector. The government must balance its budget. Revenues include both the tax revenues and the sales revenues from the public good, and expenditures consist of the wages paid and the cost of capital in the public sector and of the unemployment benefits.

In our model, capitalists provide a convenient way of modeling the vacancy cost in a two-sector economy. In order for the vacancy cost to represent a real cost to the economy, we make two assumptions: (1) the government cannot tax capital income and (2) the capitalists' indirect utility does not enter the government's welfare consideration.

We contrast our findings with the outcome of a *Benchmark* economy in which firms' ownership is private in both sectors. In this economy, the government only controls the tax rate on labor income and the unemployment benefits. As in the European economy, the government maximizes the expected utility of workers, subject to budget balance. Trivially, this expected utility is lower in the benchmark economy. Our focus, however, is on the labor market performance. Observe that we compare two economies that share the same fundamentals and only differ in their ownership structure.

An *equilibrium* is a specification of firms' measure in each sector, of workers' measure searching in each sector, of consumption bundles for consumers, of a relative price for the consumption goods, of a tax rate, public wages, and unemployment benefits such that (i) consumers maximize their expected utility given prices and income, (ii) private firms' expected profit is zero (*free entry*), (iii) workers' search decision is optimal, (iv) goods markets clear (*market clearing*), and (v) the government balances its budget (*budget balance*). We restrict attention to the case in which the measure of firms is positive in both sectors (as will be true in the optimum, given the postulated preferences), and in which workers weakly prefer to be matched than remain unmatched, so that all workers search. In particular, (iii) requires that workers be indifferent searching in either sector (*labor indifference*). An *optimum* is an equilibrium that maximizes the worker's expected utility across all equilibria. As mentioned, our objective is to determine and compare the labor market performance in the optimum of each economy.

In any optimum, we show that the government fully insures the workers in the European economy. That is, the government chooses the unemployment benefits and the wage in the public sector to be equal to the certainty equivalent of the random wage in the private sector.[10] This implies that, for some realizations of the match, a worker is worse off ex post in the private sector as in the public sector or as an unemployed worker. Although unintuitive, recall that we implicitly assume that

[10] The theoretical finding that public sector workers are offered the certainty equivalent of the distribution of output is clearly an extreme case. The way to interpret this result is in terms of a relative larger volatility of the private sector wage distribution. Empirical studies show how the distribution of wages in the public sector is more compressed than in the private sector in many countries. These studies also show that whereas wage inequality in the private sector widened substantially during the 1980s and early 1990s, the distribution in the public sector has remained relatively more stable. See Borjas (2002) for the United States, Disney and Gosling (1998) for the United Kingdom, and Cappellari (2002) for Italy.

working is costless. In a more realistic setting with costly effort, labor indifference would require that the worker be compensated for his effort by a wage premium.

To summarize, the main simplifications of our model are (i) the wage paid by a private firm is a fixed (but arbitrary) fraction of the output's value, (ii) the price of capital is fixed, and (iii) costs of effort are ignored.

2.1. *The Setup.* Subscripts $i = 1, 2$ refer either to the good or the sector, depending on the context. We sometimes add a superscript E (respectively B) to emphasize that a particular condition or specification is valid for the European (respectively the Benchmark) economy.

Let u_i be the measure of workers searching in sector i, and v_i denotes the measure of vacancies posted in sector i. Since there is a unit mass of workers, it follows that $u_1 + u_2 = 1$ will hold throughout the analysis, as workers weakly prefer to search. The measure of matches in sector i is determined by a matching function $M_i = M(u_i, v_i)$ that is identical across sectors. Following the literature, we use a Cobb–Douglas specification, that is, $M_i = A u_i^{\gamma} v_i^{1-\gamma}$, where $\gamma \in (0, 1)$ and $A > 0$ is a scale parameter small enough to guarantee that all relevant probabilities are smaller than one. The probability that a worker searching in sector i gets a job is $\phi(\theta_i) := M(u_i, v_i)/u_i = A\theta_i^{1-\gamma}$, where $\theta_i := v_i/u_i$ is the market tightness in sector i. The total mass of employed workers in the economy is $E := M_1 + M_2$.

The output of a match is independently and identically distributed across sectors. More specifically, the random output Y of a match is distributed according to the lognormal distribution, that is, $Y = e^Z$, where $Z \sim N(\lambda, \sigma)$. Hence, the total output in a sector i is given by $M_i y$, where $y := \mathbb{E}\{e^Z\} = \exp[\lambda + \sigma^2/2]$ is the expected output of the firm.

The worker's gross wage is denoted by w_j, where the subscript $j = 0, 1, 2$ refers to the worker's employment status. That is, w_0 is the (gross) unemployment benefit, and w_1 and w_2 are the wages obtained in the first and second sector, respectively. In any optimum, the public wage is constant, as shown in the next subsection. In the private sector, however, workers are paid a share $\alpha \in (0, 1)$ of the realized output's value. That is, w_2 is randomly distributed. All gross wages are taxed at the common rate τ, so that net wages are given by $(1 - \tau)w_j$.

Capitalists receive R per unit of capital. That is, their total revenue is $R(v_1 + v_2)$, which is both their gross and net revenue, since their income is not taxable.[11]

Consumers consist of capitalists and workers. Consumers have identical preferences, with constant relative risk aversion. Namely, consumers maximize

$$u(c_1, c_2) := \frac{\left(c_1^{\beta} c_2^{1-\beta}\right)^{1-r} - 1}{1 - r},$$

where c_i is good i's consumption, and $r \neq 1$ is the coefficient of risk aversion. We focus on the case of risk-averse workers: $r > 0$. Workers' budget constraint is

$$pc_1 + c_2 \leq w, \tag{1}$$

[11] Since their demand functions are linear in income, the number or mass of capitalists is irrelevant.

where p is the price of good one (relative to good two), and w is the worker's net wage. This implies that the worker's demand function and indirect utility function are

$$(2) \quad x_1(p, w) = \beta w, \quad x_2(p, w) = \frac{(1-\beta)w}{p}, \quad V(p, w) = \frac{(wp^{-\beta})^{1-r} - 1}{1-r}.$$

Observe that the certainty equivalent of the gross wage earned in the private sector is equal to $\exp[\lambda + (1-r)\sigma^2/2]$.

We now discuss the equilibrium conditions. First, in any equilibrium, goods' markets must clear, which means that

$$(3)\ M_i y = M_1 \mathbb{E}\{x_i(p, (1-\tau)w_1)\} + M_2 \mathbb{E}\{x_i(p, (1-\tau)w_2)\} + (1 - M_1 - M_2)\mathbb{E}\{x_i(p, (1-\tau)w)\} + x_i(p, R(v_1 + v_2)), \quad i = 1, 2.$$

Second, workers are indifferent between searching in either sector, and weakly prefer to search. This means that

$$(4) \quad \begin{aligned} &\phi(\theta_1)\mathbb{E}\{V(p, (1-\tau)w_1)\} + (1 - \phi(\theta_1))\mathbb{E}\{V(p, (1-\tau)w_0)\} \\ &= \phi(\theta_2)\mathbb{E}\{V(p, (1-\tau)w_2)\} + (1 - \phi(\theta_2))\mathbb{E}\{V(p, (1-\tau)w_0)\} \\ &\geq \mathbb{E}\{V(p, (1-\tau)w_0)\}. \end{aligned}$$

Third, in any sector in which firms' ownership is private, firms must earn zero-expected profits. Since the probability that a firm in sectors i finds a match is given by $\phi(\theta_i)/\theta_i$, this requires that

$$(5) \quad (\phi(\theta_i)/\theta_i)(1-\alpha)p_i y = R,$$

with $p_1 = p$, $p_2 = 1$. Indeed, conditional on a match, a firm's expected revenue, net of labor cost, is $(1-\alpha)p_i y$, whereas a firm must incur a cost of R whether it is matched or not. This condition must hold in sector 2 in the European economy and in both sectors in the Benchmark economy.

Fourth, the government must balance its budget. In the European economy, this means that

$$(6) \quad \tau M_2 \alpha y + M_1 p y = (1-\tau)(M_1 w_1 + (1 - M_1 - M_2)w_0) + R v_1,$$

whenever the public wage and unemployment benefits are constant, as will be the case at the optimum. Revenues are on the left-hand side: They include the tax revenues on workers' income and sales revenues from good 1. Expenditures are on the right-hand side, and include net public wages and unemployment benefits, as well as vacancy cost in sector 1. In the Benchmark economy, budget balances require that

$$(7) \quad \tau(pM_1 + M_2)\alpha y = (1-\tau)(1 - M_1 - M_2)w_0,$$

since labor income is taxed now in both sectors. The government no longer has sales revenue in sector 1, but wages and vacancy costs in that sector are no longer incurred.

Although the specifications above are particularly convenient to get closed forms, let us emphasize the key assumptions. First, the matching technology is homogeneous of degree one. Second, both the matching and production technologies are the same across *sectors*. As we shall see, it follows that comparing unemployment levels across economies reduces to comparing market tightnesses between sectors within the European economy.

2.2. *Solving the Model.*

2.2.1. *Equilibrium.* We start our analysis with the Benchmark economy. As the next lemma establishes, the relative price of good 1 must be equal to one, and market tightnesses are the same in both sectors. This follows from the fact that both firms and workers are indifferent across sectors. Formally, define $\theta^B := (A(1-\alpha)y/R)^{1/\gamma}$.

LEMMA 1. *In any equilibrium of the Benchmark economy*, $\theta_1^B = \theta_2^B = \theta^B$, and $p^B = 1$. *Further,* $u_1^B = \beta$, $u_2^B = 1-\beta$.

PROOF. Free entry in both sectors implies that

$$p\phi(\theta_1)/\theta_1 = \phi(\theta_2)/\theta_2. \tag{8}$$

Since workers are indifferent across sectors, we must have

$$\begin{aligned}\phi(\theta_1)(\mathbb{E}\{V(p,(1-\tau)\alpha pY)\} - \mathbb{E}\{V(p,(1-\tau)w_0)\}) \\ = \phi(\theta_2)(\mathbb{E}\{V(p,(1-\tau)\alpha Y)\} - \mathbb{E}\{V(p,(1-\tau)w_0)\}) \geq 0.\end{aligned} \tag{9}$$

We claim that $p = 1$, which is equivalent to $\theta_1 = \theta_2$, from the first condition. Suppose otherwise. Without loss of generality, suppose that $\theta_2 > \theta_1$, that is, $p < 1$, since $\phi(\theta)/\theta$ is strictly decreasing in θ. It follows that

$$\begin{aligned}\mathbb{E}\{V(p,(1-\tau)\alpha pY)\} - \mathbb{E}\{V(p,(1-\tau)w_0)\} < \mathbb{E}\{V(p,(1-\tau)\alpha Y)\} \\ - \mathbb{E}\{V(p,(1-\tau)w_0)\},\end{aligned} \tag{10}$$

which contradicts the indifference condition, since $\phi(\theta)$ is strictly increasing in θ. Thus, $\theta_1 = \theta_2$ and $p = 1$. From free entry, we get that indeed $\theta_1 = \theta_2 = \theta^B$.

Given that $p = 1$, observe that market clearing implies that $M_1/M_2 = \beta/(1-\beta)$. Since $v_i/u_i = \theta^B$, it follows that $u_1 = \beta$ and $u_2 = 1-\beta$. ∎

Observe that the market tightness in sector 2 must also equal θ^B in the European economy. The price, however, need not be one, and equilibrium considerations per se do not allow us to further narrow down the set of possible outcomes. The government has three more instruments in the European than in the Benchmark

economy: the price of its output, p, the wage it pays its workers, w_1, and the number of firms, m_1. It is useful to examine the impact of these three instruments on the unemployment level $E = M_1 + M_2$, as well as on two measures of the relative size of the public sector, $M_1/(M_1 + M_2)$ and $v_1/(v_1 + v_2)$.

LEMMA 2. *In any equilibrium of the European economy,*

1. *Holding w_1 and p fixed, the employment level E, the size of the private sector, v_2, and the relative size of sector 1, $v_1/(v_1 + v_2)$, are increasing in v_1, whereas $M_1/(M_1 + M_2)$ is independent of v_1.*
2. *Holding v_1 and p fixed, E, v_2, $v_1/(v_1 + v_2)$, and $M_1/(M_1 + M_2)$ are independent of w_1.*
3. *Holding w_1 and v_1 fixed, E is decreasing in p if and only if A is small enough; v_2 is increasing in p; both $v_1/(v_1 + v_2)$ and $M_1/(M_1 + M_2)$ are decreasing in p.*

PROOF. Since $u_1 + u_2 = 1$ and $\theta_2 = \theta^B$, it follows from market clearing that

$$p = \frac{\beta}{1-\beta}\frac{\phi(\theta^B)}{\phi(\theta_1)}\frac{1-u_1}{u_1}. \tag{11}$$

Employment is given by

$$E = (1-u_1)\phi(\theta^B) + u_1\phi(\theta_1) = (1-u_1)\phi(\theta^B)\left(1 + \frac{\beta}{1-\beta}p^{-1}\right). \tag{12}$$

The same substitution gives

$$\frac{M_1}{M_1+M_2} = \frac{1}{1+\frac{1-\beta}{\beta}p} \qquad \frac{v_1}{v_1+v_2} = \frac{1}{1+\phi(\theta^B)\frac{1-u_1}{u_1}}. \tag{13}$$

All results follow immediately from one or another of these expressions (to study the effect of p on E, and of v_1 on $v_1/(v_1 + v_2)$, use implicit differentiation). ■

To sum up, increasing the number of public vacancies increases employment, for a fixed price. Indeed, the relative price pins down the relative output levels across sectors. Therefore, the number of private vacancies also increases, and so does employment. Similarly, the public wage has no impact on employment, for a fixed price; instead, it must lead to an adjustment in unemployment benefits to preserve the worker's indifference across sectors.

2.2.2. *Optimum.* Since workers are risk averse, it is rather intuitive that, at the optimum, the government provides full insurance against unemployment risk in both the Benchmark and the European economies. Similarly, in the European economy, the public wage is constant. Therefore, it must be that this public wage is equal to the unemployment benefits; in turn, their common value must be equal

to the certainty equivalent of the random wage in the private sector. We show in the Appendix that there is no loss of generality in doing so.

LEMMA 3. *In the European economy*,

$$w_0^E = w_1^E = w := \alpha \exp[\lambda + (1-r)\sigma^2/2]. \tag{14}$$

That is, the gross public wage is equal to the gross unemployment benefits and to the certainty equivalent of the gross wage in the private sector.

In the Benchmark economy,

$$w_0^B = w = \alpha \exp[\lambda + (1-r)\sigma^2/2]. \tag{15}$$

That is, the gross unemployment benefits are equal to the certainty equivalent of the gross wage in either sector (recall that $p^B = 1$).

Lemma 3 does not imply that the expected utility is the same in both economies, as the tax rates differ, in general. It is now straightforward to solve for the optimum in the Benchmark economy, since all there is left determining is the tax rate.

LEMMA 4. *The optimal tax rate in the Benchmark economy is given by*

$$1 - \tau^B = \frac{\phi(\theta^B)\alpha y}{(1-\phi(\theta^B))w + \phi(\theta^B)\alpha y}. \tag{16}$$

PROOF. Budget balance states that

$$\tau(pM_1 + M_2)\alpha y = (1-\tau)(1 - M_1 - M_2)w_0, \tag{17}$$

The result is then immediate, given Lemma 1, and $w_0 = w$.

The analysis of the European economy is also straightforward, although the algebra is more tedious. ■

LEMMA 5. *The optimum of the European economy is characterized by*

$$1 - \tau^E = \xi(1-\tau^B), \quad \theta_1^E = (1-\tau^E)\frac{1-\gamma}{\gamma}\frac{w}{R}, \tag{18}$$

where

$$\xi := \frac{1-\beta\gamma}{1+\beta(1-\gamma)}\left(1 + \frac{\beta}{\alpha(1-\beta)}\right). \tag{19}$$

PROOF. We solve for u_2 from budget balance:

$$\tau M_2 \alpha y + p M_1 y = (1-\tau)(1-M_2)w + R v_1 \tag{20}$$
$$\Leftrightarrow u_2 = \frac{1}{\phi(\theta^B)} \frac{(1-\tau)w + R v_1}{\tau \alpha y + \frac{\beta}{1-\beta} y + (1-\tau)w},$$

where we use that $p = (M_2/M_1)\beta/(1-\beta)$ and $M_2 = u_2\phi(\theta^B)$. Taking v_1 and τ as given, we obtain

$$u_1 = 1 - u_2, \quad v_2 = \theta^B u_2, \quad p = \frac{\beta}{1-\beta}\frac{M_2}{M_1} = \frac{\beta}{1-\beta}\frac{u_2\phi(\theta^B)}{A(1-u_2)^\gamma v_1^{1-\gamma}}. \tag{21}$$

As we can see, p depends both on τ and v_1. To characterize the optimum, we now maximize the indirect utility, or its logarithm:

$$\max_{\tau, v_1} \ln(1-\tau) - \beta \ln p(\tau, v_1).$$

The result follows immediately from the first-order conditions. ■

We conclude this section by describing the social planner's problem and solution. The social planner controls vacancies in both sectors, but he is still subject to the constraint that capitalists spread their consumption across goods in the same proportions as workers, since their preferences are the same. That is, the consumption bundle (c_1, c_2) chosen by the social planner must satisfy

$$u_i \phi(\theta_i) y = c_i + \frac{c_i}{c_1 + c_2} R(u_1\theta_1 + u_2\theta_2), \quad i = 1, 2, \tag{22}$$

which means that, by taking ratios and sums

$$\frac{c_2}{c_1} = \frac{1-u_1}{u_1}\frac{\phi(\theta_2)}{\phi(\theta_1)}, \quad \text{and} \tag{23}$$
$$c_1 + c_2 = (u_1\phi(\theta_1) + (1-u_1)\phi(\theta_2)) - R(u_1\theta_1 + (1-u_1)\theta_2).$$

Since ϕ is concave, it follows from the second equation that it is best to set $\theta_1 = \theta_2$, and choose this value to maximize

$$\phi(\theta) y - \theta R, \tag{24}$$

that is, set θ such that

$$(1-\gamma) q(\theta) y = R, \tag{25}$$

which is the same as the free entry condition when $\alpha = \gamma$. The labor market tightness is the same across sectors and is equal to the corresponding value in

the all-private economy. Moreover, the optimal fraction of job searchers in sector 1, $u_1^* = \beta$, which is also the same as in the all-private economy. Therefore, the Hosios condition (Hosios, 1990) holds in the two-sector model as well. Note that the equilibrium for the partially public (European) economy is different from the planner's solution, because the government controls only one sector of the economy.

3. DISCUSSION

Our model yields two important implications. First, we show that the comparison of unemployment rates in the European economy and in the Benchmark economy may go either way, depending on the parameters. Second, our model predicts higher unemployment in the European economy following a mean-preserving spread in the distribution of idiosyncratic shock.

With respect to the first point, consider the effect of ownership structure on the aggregate employment rate. The aggregate employment rate in our model is a weighted average of the probabilities of finding a job in the two sectors, $E = u_1\phi(\theta_1) + (1 - u_1)\phi(\theta_2)$. One nice feature of the model is that the comparison of aggregate employment rates between the Benchmark economy and the European economy reduces to comparing the labor market tightness in the public sector relative to the corresponding object in the private sector. In fact, the results obtained in Lemma 1 imply that the labor market tightness in the Benchmark economy is the same across sectors and it is also equal to the private sector labor market tightness in the European economy. As a consequence, the difference between the aggregate employment rate in the Benchmark economy relative to the European economy reduces to

$$E^B - E^E = u_1^E\left(\phi(\theta^B) - \phi\left(\theta_1^E\right)\right). \tag{26}$$

Moreover, given the closed-form solution for our model described in Lemmas 4 and 5, we find that the difference between the private and the public labor market tightness is

$$R\left(\theta^B - \theta_1^E\right) = \left[\frac{1-\alpha}{\alpha} - \left(\frac{1-\gamma}{\gamma}\right)\xi\frac{w}{\phi_B\alpha y + (1-\phi_B)w}\right]\phi_B\alpha y, \tag{27}$$

where $\phi_B \equiv \phi(\theta^B) < 1$ is the probability that a worker finds a job in the private sector, which is also the aggregate employment rate in the Benchmark economy. A simple way to look at this expression is to consider the case in which the workers' share in the private sector is equal to their share in the matching function, that is, $\alpha = \gamma$ (the Hosios condition). In this case, $\xi > 1$, so $\theta^B < \theta_1^E$ if $w = \alpha y$. In other words, the Benchmark economy has a higher unemployment rate than the European economy if workers are risk neutral. However, if workers are sufficiently risk averse, that is if w is small enough, this inequality is reversed. This is due to the fact that risk-averse workers are more willing to search in the public sector, which offers insurance against wage risk.

The second important prediction of our model relates to the effect of an increase in economic turbulence on unemployment in the European economy. We model the increase in turbulence as a mean-preserving spread of the distribution of output. The mean-preserving spread decreases the certainty equivalent w of the private wage while leaving the expected output y unchanged. European employment can be expressed as $E^E = \phi_B + u_1^E[\phi(\theta_1^E) - \phi_B]$. Since the mean-preserving spread does not affect expected output, the private sector tightness remains unchanged. By contrast, the public sector tightness decreases as $(1 - \tau^E)\, w$ decreases following the mean-preserving spread. The equilibrium u_1^E is

$$u_1^E = \frac{\beta\gamma}{1-\beta}\phi_B y \left[(1-\tau^E)w + \frac{\beta\gamma}{1-\beta}\phi_B y\right]^{-1} \tag{28}$$

and

$$Rv_1^E = \frac{\beta(1-\gamma)}{1-\beta}\phi_B y \left[1 + \left(\frac{\beta\gamma}{1-\beta}\right)\frac{\phi_B y}{(1-\tau^E)w}\right]^{-1}. \tag{29}$$

Lower $(1 - \tau^E)\, w$ implies higher u_1^E and lower v_1^E. Therefore, European unemployment increases due to two effects of the turbulence: (i) more workers are induced to search for a job in the public sector, which offers security by providing a constant wage profile, and (ii) fewer jobs are available in the public sector, because the government chooses to create fewer vacancies. The intuition for this result is as follows. The government needs to minimize the cost of creating matches in the public sector to maximize welfare. Since higher turbulence lowers the marginal cost of u (given by $(1 - \tau^E)w$) while leaving the marginal cost of v (given by R) unchanged, it is optimal for the European government to choose a higher level of unemployment as economic turbulence increases. Our model also has a unique prediction on the relative size of the public sector. The employment in the public sector relative to the private sector is

$$\frac{M_1}{M_2} = A\left(\frac{1-\gamma}{\gamma R}\right)^{1-\gamma}\left[(1-\tau_1^E)w\right]^{-\gamma}\frac{\beta\gamma}{1-\beta}y, \tag{30}$$

which increases as $(1 - \tau^E)\, w$ increases. Hence, our model predicts an increase in both overall unemployment and public employment following a mean-preserving spread of the distribution of output. This is consistent with the data reported in Figure 1.

It is also interesting to note that following the mean-preserving spread, employment remains the same in the Benchmark economy. Hence, even if initially the unemployment rate in the European economy is lower than in the Benchmark economy, a large increase in turbulence may reverse the ranking of unemployment rates.

4. CALIBRATION

In this section, we show that the mechanism highlighted in our model can contribute to the explanation of the rise in European unemployment from the 1970s to the 1990s. Following Ljungqvist and Sargent (1998), we interpret this as a period of increasing "turbulence" in the economic environment.[12] In the context of our model this phenomenon is captured by a mean-preserving spread of the distribution of the productivity shock. As we have shown analytically, our model predicts that both the unemployment rate and the public employment rate will increase *simultaneously* in response to such change. In this section, we assess the quantitative importance of this channel by conducting a simple calibration exercise.

We consider two countries, Italy and France, that experienced a large increase in unemployment and in public employment between the early 1970s and the mid-1990s. These are also countries for which we were able to collect detailed information on public employment, including employment in public enterprises, for both decades. Our calibration strategy is as follows. For each country we calibrate our public/private economy to match the actual unemployment and public employment rates for the 1970s. We then increase the variance of the productivity shock to its 1990s value, everything else being equal, and compute the rate of unemployment and the share of public employment that would be predicted by our model. We then compare the model's predictions with the actual change in unemployment and public employment observed in the data. The predicted changes in both unemployment and public employment are increasing in the degree of risk aversion. We find that the model can generate between 5% and 60% of the actual rise in unemployment between 1973 and 1994 for both Italy and France. Not surprisingly the model can also explain from 10% to almost all of the increase in public employment. We interpret our quantitative exercise as suggestive evidence that our model, although parsimonious, captures a relevant aspect of the European labor market.

We next describe in detail our calibration strategy and report the results of the quantitative exercise.

Technology. We interpret our Benchmark economy as the United States, where the state control of the economy is very limited. Note that in our Benchmark economy a mean-preserving spread of the distribution of output translates into a higher variance of labor earnings while leaving unemployment unchanged. This is roughly consistent with the experience of the U.S. economy between the early 1970s and the mid-1990s.

We use standard estimates from the literature to calibrate the technology parameters of the Benchmark economy. As discussed in Petrongolo and Pissarides (2001) the estimates for γ, the elasticity of the matching function with respect to the number of unemployed individuals, ranges from 0.5 to 0.7. We set both γ

[12] Ljungqvist and Sargent (1998) show that unemployment insurance can have a perverse effect on unemployment when the economy is subject to an increase in turbulence. They model "turbulence" as an increase in the probability that a worker loses his or her job, and therefore the skills associated with that job.

and the labor share α to 0.7. This implies that we are operating under the Hosios efficiency condition, where the standard search externality is internalized. Hence our quantitative results stems from our mechanism of directed search given that workers are risk adverse. The parameter A is the scale parameter in the matching function and R is the vacancy cost. Both parameters determine the probability that a worker is matched, $\phi(\theta)$, and the probability that a vacancy is matched, $q(\theta)$. As it is common in this type of models, the individual values of A and R do not affect our results; what matters is the implied employment rate in the Benchmark economy, ϕ^B. We choose these parameters so that the unemployment rate in our Benchmark economy is equal to 5%—the average unemployment rate in the United States during the period of interest.

Finally, in our model we assume that output Y is stochastic and distributed according to a log normal distribution, that is, $Y = \exp(z)$, where the underlying productivity shock z is distributed according to $N(\lambda, \sigma^2)$. We normalize expected output to one and calibrate the variance of the underlying productivity shock, σ^2, to match the 1969 variance of the transitory component of log earnings for the United States. The increase in economic turbulence is then calibrated to match the increase in the transitory variance between 1969 and 1987. In order to calibrate the value for σ^2 we use the estimates from Gottschalk and Moffitt (1998). Their estimates are based on a formal model for earnings dynamics and they range, depending on the model specification and the age group, from 0.117 to 0.139 for 1969 and from 0.216 to 0.294 for 1987. In all specifications transitory movements in earnings double over this period. Moreover, they can explain half of the increase in the variance of earnings from 1969 to 1987. In our exercise we choose midrange estimates and set $\sigma^2 = 0.127$ in the baseline economy, the 1970s, and $\sigma^2 = 0.256$ for the 1990s.[13]

We assume that the calibrated technology parameters for the Benchmark economy are common to the European economies. Since at the optimum the employment rate for the private sector in our partially public (European) economy is equivalent to the total employment rate in the Benchmark economy, this seems a reasonable assumption within the context of our model.

Preferences. The parameter r measures the workers' degree of risk aversion. As discussed analytically, the degree of risk aversion (which, given the value for σ^2, determines the level of the certainty equivalent w) is crucial for the model's predictions. In our model risk-averse workers are more willing to search in the public sector, which offers insurance against wage risk. As the economy becomes more "turbulent" earnings in the private sector become more volatile thus making public sector employment even more attractive. Hence, the larger the r the stronger the increase in unemployment predicted by our model. We calibrate the economy for values of r between 1 and 7. This is a reasonable range given the estimates

[13] The calibrated values correspond to the estimates for 30–39-year-old male workers (see Table 7 in Gottschalk and Moffitt, 1998). The range of estimates reported in the text refer to different age groups (Table 7) as well as to the overall population (authors' calculations on the basis of the estimates reported in Table 1 in Gottschalk and Moffitt, 1998).

TABLE 2
EMPLOYMENT DATA FOR ITALY AND FRANCE (IN PERCENTAGES)

	Italy		France	
	Unemp. Rate	Extended Public Sector	Unemp. Rate	Extended Public Sector
1973	3.8	18	2.5	20
1994	9.4	23.2	9	27

NOTE: Data for the public sector as a percent of total employment.

typically used in the literature. The parameter β measures the share of the European economy that is controlled by the government. Given any level of our free parameter r and for a given β, we can compute θ_1, $(1-\tau)$ and u_1. For each value of r, we choose β to match the public employment rate in the European economy in the 1970s and then compute the resulting value for total (un)employment and the other variables.

Our statistics for public employment refer to an "extended" definition of the public sector that includes both publicly operated enterprises, and typical public sector activities, such as the provision of education, health services, public security, and administrative services. Data for employment in the extended public sector in 1994 are from Table 1. We use the following data sources to construct the corresponding 1970s statistics. For employment in state-owned enterprises we use entries from Table 6.2 in Keyser (1978) for Italy and data from Table 3.4 in Keyser and Windle (1978) for France. Data, in thousands, are available for 1973 for both countries. We use data from OECD Labor Statistics (available online) to compute the public enterprise share of total employment. For general government activities we use data on general government employment as a percentage of total employment from the OECD Historical Statistics. The 1973 statistics on "extended" public sector employment are then obtained by adding up these two components. The data for the standardized unemployment rates are taken from the CEP Labor Market Institution Database. Table 2 summarizes the employment data that we use in our calibration exercise.

For Italy, the unemployment rate increased by 5.6 percentage points between the two decades from 3.8% in 1973 to 9.4% in 1994. The public employment rate increased by 5.2 percentage points, from 18% to 23.2%. For France, the unemployment rate increased by 6.5 percentage points, from 2.5% to 9%, and the public employment rate increased by percentage points, from 20% to 27%.

The results of this experiment for Italy are reported in Table 3. Table 4 reports the results obtained for France. In both tables, entries in column 1 represent the actual difference between 1973 and 1994 (in percentage points) for both unemployment rates and public employment rates. The second column presents the same statistics as predicted by the model for different values of r. The third column reports information on the fraction of the actual change in unemployment and public employment that is predicted by our model.

As previously discussed, we find that as the workers' risk aversion increases the model can explain a larger fraction of the observed change in both unemployment

TABLE 3
ITALY

		Model			Percent Explained		
	Data	$r = 1$	$r = 4$	$r = 7$	$r = 1$	$r = 4$	$r = 7$
△ un.	5.6	0.3	1.6	3.6	5.6	29.3	64.3
△ public emp.	5.2	0.6	2.7	5.0	12.4	52.2	95.9

TABLE 4
FRANCE

		Model			Percent Explained		
	Data	$r = 1$	$r = 4$	$r = 7$	$r = 1$	$r = 4$	$r = 7$
△ un.	6.5	0.3	1.8	3.9	5.3	28	60
△ public emp.	7	0.7	2.9	5.4	10	42	77

and public employment rates. For the log utility case ($r = 1$), the model implies 12% of the change in public employment rate and 6% of the change in unemployment rate. When $r = 4$, the model implies about half of the change in the public employment rate and 30% of the change in the unemployment rate. For $r = 7$ the model can generate the entire increase in the public employment rate. In this extreme case, the model can explain 60% of the actual change in the unemployment rate.

We find similar results for France. For the log utility case, the model can explain 10% of the change in public employment rate and 6% of the actual change in unemployment rate. For $r = 4$, the model implies about 42% of the change in the public employment rate and 28% of the change in the unemployment rate. For $r = 7$ the model can account for 60% of the actual change in the unemployment rate and for around 80% of the increase in public employment. In this case, the model can account for all the change in public employment only if we set $r = 9$; this is because the size of the public sector in France is slightly larger than in Italy. For this relatively large value of r the model can also account for 88% of the actual change in the unemployment rate.

To conclude, our article contributes to the literature that tries to explain the large and persistent increase in European unemployment between the 1970s and the 1990s. In particular, we develop a model that provides insights into one possible mechanism through which the presence of a very active government in the economy may affect its labor market performance. We also present suggestive evidence that shows that such a mechanism may have contributed to the increase in European unemployment over this time period. In particular, we show that it can account for 5–60% of the actual increase in the unemployment rate in Italy and France.

APPENDIX

PROOF OF LEMMA 3. It is quite clear that using random wages is inefficient. We show here that it is optimal to provide full insurance against unemployment in the European economy. The argument is similar in the case of the Benchmark economy. Observe first that if $w_0 = w_1$, then this common value must be equal to the certainty equivalent in the private sector, for otherwise workers are not indifferent across sectors. Also, $w_1 \geq w_0$, since workers do not search otherwise. It then only remains to show that this constraint cannot be slack at the optimum.

Let ω_2 denote the certainty equivalent of the *net* wage in the private sector. Similarly, let $\omega_i := (1-\tau)w_i$, $i = 0, 1$ denote the net wage in the public sector and the net unemployment benefits. Consider changes $\triangle\omega_i/\omega_i$, $i = 0, 1, 2$ that leave workers indifferent between both sectors and preserves budget balance (observe that $\triangle\omega_2/\omega_2$ is not controlled directly by the government; but the government controls τ, and therefore ω_2, and since it controls w_0, w_1, it can set the three net wages independently; observe that this implies that τ is not constant when we differentiate the budget balance). Prices, numbers of searchers in each sector, and number of firms in each sector remain unchanged, so that all remaining conditions are satisfied. It is then clear that, with three instruments, and only two constraints to satisfy, we can find changes that do not decrease the objective and involve a smaller gap $w_1 - w_0$. One needs to make sure that the relevant coefficients are nonzero. To guarantee that workers are indifferent across sectors, pick $\triangle\omega_2/\omega_2$ so that

$$\frac{\triangle\omega_2}{\omega_2} = \frac{\phi(\theta_1)}{\phi(\theta_2)}\left(\frac{\omega_1}{\omega_2}\right)^{1-r}\frac{\triangle\omega_1}{\omega_1} + \left(1 - \frac{\phi(\theta_1)}{\phi(\theta_2)}\right)\left(\frac{\omega_0}{\omega_2}\right)^{1-r}\frac{\triangle\omega_0}{\omega_0}, \tag{A.1}$$

so that budget balance is guaranteed provided that

$$\left((1-\tau)\alpha M_2 y\frac{\phi(\theta_1)}{\phi(\theta_2)}\left(\frac{\omega_1}{\omega_2}\right)^{1-r} + M_1\omega_1\right)\frac{\triangle\omega_1}{\omega_1} + \left((1-M_1-M_2)\omega_0 + (1-\tau)\alpha M_2 y\frac{\phi(\theta_1)}{\phi(\theta_2)}\left(1-\frac{\phi(\theta_1)}{\phi(\theta_2)}\right)\left(\frac{\omega_0}{\omega_2}\right)^{1-r}\right)\frac{\triangle\omega_0}{\omega_0} \leq 0. \tag{A.2}$$

Since welfare increases provided

$$\phi(\theta_1)\omega_1^{1-r}\frac{\triangle\omega_1}{\omega_1} + (1-\phi(\theta_1))\omega_0^{1-r}\frac{\triangle\omega_0}{\omega_0} \geq 0, \tag{A.3}$$

it follows that if the coefficient of $\nabla\omega_0/\omega_0$ is nonpositive, welfare can be increased by simply choosing $\triangle\omega_0/\omega_0 \geq 0$, $\triangle\omega_1/\omega_1 = 0$ up to the point where $w_1 = w_0$, yielding the result; so we may assume that the coefficients of $\triangle\omega_i/\omega_i$ are positive,

and we can always values $\triangle\omega_0/\omega_0 > 0$, $\triangle\omega_1/\omega_1 < 0$ (and therefore, new values of w_1 and w_0 involving a smaller spread) for which the budget balance constraint binds with equality, and for which the objective function weakly increases. Therefore, we may assume that $w_1 = w_0$ at the optimum. ■

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