Università degli Studi di Genova
DISEFIN – Series of Economic Working Papers
16126 Genova – via vivaldi 5 – Fax +39 010 209 5223

Public Sector Wage Bargaining, Unemployment, and Inequality

Gabriele Cardullo

wp n. 2/2012
February 2012

"DISEFIN Working Papers on line"
series of economic working papers
published online by

Research Doctorate in
Economics and Finance of European Union
Ph.D School in New technologies and Social Sciences
University of Genoa

Web site:
http://www.disefin.unige.it

Public Sector Wage Bargaining, Unemployment, and Inequality[♣]

Gabriele Cardullo
University of Genoa

Abstract

In many countries, the government pays almost identical nominal wages to workers living in regions with notable economic disparities. In most cases this is the result of highly centralized pay systems. By developing a two-region general equilibrium model with unions and search frictions in the labour market, I study the differences in terms of unemployment, real wages, and inequality between a regional wage bargaining process and a national one in the public sector. Adopting the former lowers public sector real salaries but it also decreases unemployment and jacks up private sector real earnings. Simulations conducted on the basis of Italian data show that, compared to a national negotiation process, a regional one also increases inequality both within and between regions

Keywords: *public sector wages; unemployment; economic integration; local labour markets*
Jel Classification: *H53, J38, J64, R12, R13*

♣ The usual disclaimer applies. I thank Giorgio Brunello, Maurizio Conti, Bruno Decreuse, Thomas Gall, Andrea Ichino, Christian Holzner, Andrey Launov, Claudio Lucifora, Fabien Postel-Vinay, Bruno Van der Linden, Klaus Wälde, and the participants to the LAGV conference in Marseille, the Mainz Workshop in Labour Economics, the SAM conference in Bristol, the "Brucchi Luchino" conference in Rome for useful comments and suggestions.

1 Introduction

In many countries, public sector salaries are very similar in nominal terms for employees of regions with different private sector productivities and costs of living. The spatial distribution of public wages is very compressed in the five largest EU economies (Germany, France, UK, Italy, and Spain) (see Elliot et al., 2007)[1]. Albeit in a weaker form, even the US federal government regional pays are substantially unaffected by local market conditions, while different is the case for state and local public employees (Katz and Krueger, 1991).

The aim of this paper is to analyse the impact in terms of unemployment, real wages, and inequality of wage setting mechanisms that differ in their responsiveness to local market conditions. In particular, I investigate the effects of replacing the highly centralized wage negotiation process, that characterizes labour relations in most EU countries, with a more decentralized one.

Since Adam Smith (1776), economists know that, in a competitive framework in which the factors of production are mobile, nominal rates of pay vary across regions, and that such a divergence should compensate for the differences in terms of marginal

[1] In Italy, Spain, and Germany this is accompanied by a pronounced income disparity between regions (see, respectively, Dell'Arringa et al., 2007, Garcia-Perez and Jimeno, 2007, and Heitmueller and Mavromaras, 2007). For France, see Meurs and Edon (2007). Some of these papers look at real wage spatial distributions but, since they use a national price index, their results also apply to nominal pay variations.

product of labour, cost of living, and the amenity of the area. A reason why this fails to occur even in countries with notable regional discrepancies lies on the structure of the public pay setting system, more centralized than in the private sector and in which national unions aim to squeeze the spatial wage dispersion (Elliot et al., 2007)[2]. Another explanation emphasizes the role of the government. Paying civil servants in poorer areas the same nominal salary of their peers in the other parts of the country is viewed as a subsidy that the government decides to grant because internal migration is not regarded with favour or for a purely redistributive purpose[3]. In this sense, the hidden form of such a transfer makes it politically attractive (Coate and Morris, 1995; Alesina et al., 2000) and, in the case of EU countries, points to circumvent the competition rules that forbid direct subsidies to disadvantaged regions[4].

Making public wages more respondent to local market conditions has not obvious consequences not only on private sector employment but also on the cost of living, if it entails a shift in the supply of factors from nontradable sectors, as most of the public goods are, to the ones subject to international competition. By affecting the real values of earnings, a variation in the

[2]The role of unions in compressing wage inequality has been extensively studied (see Kahn, 2000 and Lemieux, 1998). However, this literature focuses on skill rather than locality wage differentials.

[3]On the consequences of a policy on the flows of internal migration in Italy see Caponi (2008).

[4] For Alesina et al. (2001), about half of the public wage bill in the South of Italy can be read as a transfer of resources from the North.

cost of living also has profound implications on inequality.

The main conclusions of this paper are that substituting a regional bargaining process for a national one lowers the real pays of civil servants in the poor regions of the country, but it also decreases unemployment and pushes private sector real wages up[5]. The same variables move in the opposite direction in the rich regions, but at smaller magnitude, so that the national unemployment rate and price level go down. The reason is that, under a national negotiation, public sector unions must account for the marginal productivities and fall-back positions of workers of all regions and so end up accepting a nominal wage that is lower (resp. higher) than the one that would accrue to employees in the richer (resp. poorer) regions under a regional bargaining scheme. This enhances the cost of producing the nontradable good - and, in turn, the cost of living - in the poor regions and lowers it in the rich ones. The real value of private sector wages move accordingly. Unemployment in the poor, less productive regions is higher under a centralized negotiation because more expensive wage costs entail a lower share of public jobs, that have a higher expected duration compared to the private ones. The fact that this mechanism - with opposite sign - leads to higher unemployment and a dearer cost of living in the richer regions may also offer an explanation for the reluctance by most governments to undertake such a change in the wage setting mechanism.

[5]In the model a region is poorer than the other because it has a lower private sector productivity.

These results are obtained by constructing a two-region general equilibrium model in which private tradable and public nontradable goods are produced, the labour market is unionized, it exhibits search and matching frictions, and there is an (exogenous) internal migration of unemployed workers. Regions differ ex ante only in terms of private sector productivity and the disparities in the cost of living stem from the Harrod-Balassa-Samuelson effect. The model is analytically tractable in steady-state and the main conclusions on wage and employment are obtained via comparative statics. The model is also calibrated and simulated on the basis of data from Italy, a country that epitomizes most of the characteristics analyzed in this paper. Despite the huge income divergence between the North-Center and the South - the income per capita and the price level being respectively 1.5 and 1.15 higher in the former than in the latter - data show no statistically significant difference in nominal rates of public service pay across regions[6]. The labour market is strongly unionized. In Italy, as in most European countries, the passage from national collective agreements to more decentralized systems has not involved the public sector. Economists (e.g. ?, 2002) have long called for a regional differentiation of public wages to tackle the high unemployment rate in Italian "Mezzogiorno"[7].

[6]Data refer to the $2006 - 2007$ period. For the price level differences between the North-Center and the South of Italy, see the accurate work of Cannari and Iuzzolino (2009).

[7]The idea has also entered the public debate (see Alesina and Giavazzi, 2001).

Simulations allow to examine the inequality issues that a change in the negotiation process may entail. A regional bargaining scheme has a negative impact on inequality both within and between regions. The Gini index for the entire country increases by 20%, while the ratio between the highest and the lowest earnings in the economy results 40% bigger. The wage variance within each region jumps even more. The reason of greater wage dispersion within the more productive regions lies in that the public service wage premium goes up once civil servants' pay becomes more respondent to local market conditions. In the less productive ones, real pays become lower in the public sector than in the private one, and to a such extent that the wage variance increases there too. As concerns the inequality in the entire country, two mechanisms are at work. On the one hand, under a national bargaining process civil servants earn the same nominal pay irrespective of the region they belong to. On the other hand, the same process jacks up the cost of living for people in the poorer areas and decreases it for those in the richer ones. Numerical simulations show that the former outweighs the latter.

The structure of public sector wages and their interplay with the earnings in the private sector is the subject of a vast theoretical and empirical literature (see Gregory and Borland, 1999). Most of the analysis dwells on the public sector pay gap, especially the unexplained portion of it[8]. As concerns the differences

[8]See Fogel and Lewin (1974) and Ehrenberg and Schwarz (1986). Bender (2002) provides a detailed survey.

between the public and the private sector earnings distributions, the focus is more on the wage differentials between workers of different skills (that, for Borjas, 2002, are narrower in the public sector) than on the disparities in the spatial variation. The empirical works I refer at the beginning of the paper constitute a notable exception.

In this paper, the interplay between the labour market and the composition between tradable and nontradable sectors is key. In this respect, it bears some similarities with two recent research areas. One analyses cross-regional unbalances in the labour market and how they influence the impact of a local policy or shock (see Moretti, 2001). The other focuses on the relationship between the structure of the city and labour market outcomes, examining the spatial mismatch between jobs and ethnic minorities's residence (see ?, 2009). In both strands of research the nontradable sector is constituted by the land/housing market, while in the present model it is the public one.

This is not the first work that nests the search and matching approach pioneered by Diamond, Mortensen, and Pissarides[9] into a two-region model. ?) combine the New Economic Geography and the search literature to understand the link between regional productivity differences and uneven distribution of unemployment within the same country. The mechanism hinges on transport costs and migration, while the nontradable characteristics of the public good are not investigated. Other papers (e.g. Davidson et al., 1999 and ?, 2010) are in the same vein, but

[9]See Pissarides (2000) for a theoretical presentation.

with a different objective, namely to study how cross-country differences in labour market frictions shape the terms of trade and the comparative advantage of a country. By contrasting two different levels of wage bargaining in the public sector, this work is also similar to Strom (1999), that argues a more decentralized pay system must be accompanied by a higher extent of fiscal federalism.

The paper is organized as follows. Section 2 and 3 present the basic model. Section 4 analyzes the effects of a regional bargaining scheme on real wages and unemployment. Section 5 studies the effects of a subsidy on public employment. Sections 6 and 7 respectively present the calibration procedure and the quantitative results. Section 8 concludes.

2 The Basic Model

2.1 Preferences and Technology

Time is continuous and the model is developed in steady-state. I consider a country composed by two regions, say a and b. Regions differ only in terms of private sector productivity, while all the other product and labour market parameters are assumed to be the same. Besides the gain in simplicity, this also allows to isolate more starkly the effects of different public wage policies on the regional disparities that will result from the model.

As regards the structure of the product market, I follow the standard approach of Obstfeld and Rogoff (1996, chapter

4, pages 204 - 228). In each region, two intermediate goods and one final consumption good are produced. One intermediate good is produced in the private sector and can be traded across the regions at a competitive price, the other one is public and not tradable[10]. The consumption good is also sold in a competitive market, but it is not tradable. Its production function takes a CES form:

$$Y_i = \left[Q_{p,i}^{\frac{s-1}{s}} + Q_{g,i}^{\frac{s-1}{s}} \right]^{\frac{s}{s-1}} \quad \text{with } i \in \{a, b\}, \tag{1}$$

in which $Q_{p,i}$ and $Q_{g,i}$ respectively denote the intermediate good produced in the private sector and the intermediate good produced in the public sector in region i. The elasticity of substitution s is greater than 1 to allow a situation in which some Q_i are equal to zero.

Let P_i and $P(Q_{p,i})$ be the prices of the consumption good and the private intermediate good in region i. I consider $Q_{p,i}$ as the numeraire for the economy of region i. So its price is normalized to 1 and it is equal across the regions. The final good firm in region i minimizes its cost by taking these prices and the amount of the public good provided by the government $Q_{g,i}$ as given. This leads to the following F.O.C.:

$$p_i \cdot \left(\frac{Q_{p,i}}{Y_i} \right)^{-\frac{1}{s}} = 1 \qquad \text{with } p_i \equiv \frac{P_i}{P(Q_{p,i})} \tag{2}$$

In the entire country there is a measure normalized to 1 of workers that are infinitely-lived and risk-neutral. Any private

[10] Police service, environmental protection, the administration of justice are all examples of goods that cannot be traded.

(resp. public) employed worker in region i produces y_i (resp. 1) units of the private (resp. public) intermediate good, with $i \in \{a, b\}$ and $y_a > y_b > 1$:

$$\begin{aligned} Q_{p,i} &= y_i \cdot E_{p,i} \\ Q_{g,i} &= E_{g,i} \qquad\qquad i \in \{a, b\}. \end{aligned} \tag{3}$$

$E_{p,i}$ and $E_{g,i}$ respectively define the level of employment in the private sector and in the public sector of region i.

As concerns the labour market flows, I make two important assumptions. First, in each region search is undirected; this means that unemployed workers do not direct job search towards a particular sector and both private and public job vacancies have the same probability of meeting a worker. I believe it is reasonable to assume that the average (and not only the marginal) unemployed worker does not have a preference for a public occupation compared to a private one (and vice-versa) and so he does not apply for jobs in one sector only. The flow of hires, M_i, is a function of the number of vacancies, V_i and the number of unemployed people, the only job-seekers in the economy (there is no on-the-job search), U_i, with $i \in \{a, b\}$. The matching function is written $M_i = m\,(U_i, V_i)$. Labour market tightness is denoted by $\theta_i \equiv V_i/U_i$. The rate at which vacant jobs become filled is $q(\theta_i) \equiv m\,(U_i, V_i)\,/V_i$, with $q'(\theta_i) < 0$. A job-seeker moves into employment at a rate $f(\theta_i) \equiv m\,(U_i, V_i)\,/U_i = \theta_i\, q(\theta_i)$ with $f'(\theta_i) > 0$. At an exogenous rate δ_g (resp. δ_p) a public (private) job is destroyed. Working in the public sector has a longer duration: $\delta_p > \delta_g$.

The second important assumption concerns migration from one region to the other. At an exogenous rate λ_i, an unemployed worker in region i migrates to region j and starts searching for a job there. The choice of a constant rate of migration is done for simplicity reasons. If the decision to move were endogenous, one would expect that better economic conditions in one region would ensue a large inflow of immigrants, so partially offsetting the employment or wage gains there (see Moretti, 2011)[11]. Notice however that such a mitigating effect of migration is also present in this model via the assumption that only the unemployed workers move between regions. The lower the unemployment rate in a region is, the larger the net flow of people moving there.

Let ϕ_i ($i \in \{a, b\}$) designate the share of public job vacancies among all vacancies in region i. The equality between flows in and out each workers' status leads to the following equations:

$$\begin{aligned} E_{p,i}\,\delta_p &= U_i\,(1-\phi_i)\,f(\theta_i) \\ E_{g,i}\,\delta_g &= U_i\,\phi_i\,f(\theta_i) \qquad \text{with } i \in \{a, b\}, \\ \lambda_a U_a &= \lambda_b U_b \end{aligned} \tag{4}$$

where U_i is the level of unemployment in region i. Since $1 = \sum_{n,i} E_{n,i} + \sum_{n,i} U_{n,i}$ with $n \in \{p, g\}$ and $i \in \{a, b\}$, the equa-

[11] For instance, an increase in the number of people queuing for a job in one region would raise the expected duration of unemployment. In turn, this would exert a downward pressure on wages via a reduction in workers' fall-back position. The price of the land would also go up.

tions that determine the level of employment in each region are:

$$E_a = \frac{f(\theta_a)\cdot\left(\frac{\phi_a}{\delta_g}+\frac{1-\phi_a}{\delta_p}\right)}{1+\frac{\lambda_a}{\lambda_b}\left[1+f(\theta_b)\cdot\left(\frac{\phi_b}{\delta_g}+\frac{1-\phi_b}{\delta_p}\right)\right]+f(\theta_a)\cdot\left(\frac{\phi_a}{\delta_g}+\frac{1-\phi_a}{\delta_p}\right)}$$

$$E_b = \frac{\frac{\lambda_a}{\lambda_b}f(\theta_b)\cdot\left(\frac{\phi_b}{\delta_g}+\frac{1-\phi_b}{\delta_p}\right)}{1+\frac{\lambda_a}{\lambda_b}\left[1+f(\theta_b)\cdot\left(\frac{\phi_b}{\delta_g}+\frac{1-\phi_b}{\delta_p}\right)\right]+f(\theta_a)\cdot\left(\frac{\phi_a}{\delta_g}+\frac{1-\phi_a}{\delta_p}\right)} \tag{5}$$

Using equations (4) and (5), it possible to determine the fraction of public jobs out of total for each region:

$$\frac{E_{g,i}}{E_i} = \frac{\frac{\phi_i}{\delta_g}}{\frac{\phi_i}{\delta_g}+\frac{1-\phi_i}{\delta_p}}, \qquad \text{with } i \in \{a, b\} \tag{6}$$

Moreover, substituting equations (3) and (6) in the demand function (2), p_i can be written as:

$$p_i = \left[1+\left(\frac{\phi_i}{y_i(1-\phi_i)}\cdot\frac{\delta_p}{\delta_g}\right)^{\frac{s-1}{s}}\right]^{\frac{1}{1-s}} \qquad \text{with } i \in \{a, b\}. \tag{7}$$

The price of the consumption good is increasing in y_i and decreasing in ϕ_i. As I proceed I will investigate the general implications of this equation.

Let r be the discount rate common to all agents. As usual in the standard search and matching literature (Pissarides, 2000, chapter 1), I impose the one firm - one job assumption in the private sector. The expected discounted utility of an unemployed worker searching for a job of type $n \in \{g, p\}$ in region $i \in \{a, b\}$,

W_i^U verifies the following Bellman equation:

$$rW_i^U \;=\; f(\theta_i)\,\left[\,\phi_i W_{g,i}^E \,+\, (1-\phi_i)W_{p,i}^E \,-\, W_i^U\,\right] \qquad (8)$$

The instantaneous utility in unemployment is assumed equal to zero for simplicity, and $W_{g,i}^E$ (resp. $W_{p,i}^E$) is the discounted present value of being employed in the public (resp. private) sector in region i.

The Bellman equation for a worker of region $i \in \{a,\, b\}$ employed in sector $n \in \{g,\, p\}$ is:

$$rW_{n,i}^E \;=\; \frac{w_{n,i}}{p_i} + \delta_n \cdot \left(\, W_i^U \,-\, W_{n,i}^E \,\right), \qquad (9)$$

where $w_{n,i}/p_i$ is the real wage in sector n of region i.

On the other side of the market, the Bellman equation for an active private firm is:

$$rJ_{p,i}^E \;=\; \frac{y_i}{p_i} - \frac{w_{p,i}}{p_i} + \delta_p\,\left(J_{p,i}^V \,-\, J_{p,i}^E\right), \qquad \text{with } i \in \{a,\, b\} \quad (10)$$

To post a vacancy, intermediate firms need to import an input good, whose price k is determined in the international market by an infinitely elastic supply[12]. For a convenient normalization, I impose that firms buy 1 unit of an input good per unit of time[13].

[12] Advertising costs via internet may be an example.

[13] In a standard search and matching model the flow cost of a vacancy are units of the final consumption good. My assumption that firms need to buy a different input with a fixed price is done for simplicity reasons. If private firms needed the consumption good to hire a worker, their behaviour would differ across regions not only for the productivity gap but also because vacancy costs would increase with the cost of living. This further complication would jeopardize the analytical tractability of the model.

So, as long as the job position remains idle, the flow cost for the firm is equal to k/p_i. The expected value of vacancy, $J^V_{p,i}$, is given by the sum of such a cost and the capital gain that accrues from the match, multiplied by the job filling rate:

$$rJ^V_{p,i} = -\frac{k}{p_i} + q(\theta_i)\left(J^E_{p,i} - J^V_{p,i}\right), \quad \text{with } i \in \{a, b\}. \tag{11}$$

2.2 Tightness and wage determination in the private sectors

As common in search and matching models, a free entry zero-profit condition and a rent sharing rule determine the equilibrium values of tightness and nominal wage in sector i, θ_i and $w_{p,i}$. Free entry of vacancies and zero-profit imply that $J^V_{p,i} = 0$. Substituting this into (10) and (11), one gets the usual vacancy-supply curve:

$$\frac{y_i - w_{p,i}}{r + \delta_p} = \frac{k}{q(\theta_i)} \quad \text{with } i \in \{a, b\}.$$

The expected discounted revenues are equal to the expected cost of posting a vacancy.

In each region, the private sector wage is negotiated via collective bargaining between unions of firms and unions of workers. Such an assumption seems plausible for many countries in Continental Europe, where individual bargaining is rare and the sectoral level of negotiation often plays a major role. The expected discounted utility of the unions of private sector workers

and firms in region i are respectively:

$$rT^W_{p,i} = \frac{w_{p,i}}{p_i} \cdot E_{p,i} \tag{12}$$

$$rT^F_{p,i} = \left(\frac{y_i}{p_i} - \frac{w_{p,i}}{p_i}\right) \cdot E_{p,i} \tag{13}$$

The underlying assumption is that the trade union behaves in a utilitarian way, caring about the sum of its members' incomes[14]. I consider an axiomatic Nash solution. The nominal wage received by private employees in region i solves the problem:

$$\begin{aligned} w_{p,i} &= \text{argmax } \left[T^W_{p,i} - \bar{T}^W_{p,i}\right]^{\beta} \left[T^F_{p,i} - \bar{T}^F_{p,i}\right]^{1-\beta} \\ \text{s.t.} \quad & T^W_{p,i} > \bar{T}^W_{p,i} \\ & T^F_{p,i} > \bar{T}^F_{p,i} \quad \text{with } i \in \{a, b\}. \end{aligned} \tag{14}$$

The terms $\bar{T}^W_{p,i}$ and $\bar{T}^F_{p,i}$ denote respectively the threat points for the unions of workers and firms. For simplicity I impose both threats points equal to zero. If no agreement is concluded, the employees in that sector do not work and do not earn any salary. The firm does not produce and does not pay any wage[15]. The constraints imposed in the maximization mean that both parties have always the possibility to abandon the negotiation

[14] Recall that the instantaneous utility of unemployed workers is equal to zero

[15] Such threats points are similar to those introduced by Rosen (1997) and Hall and Milgrom (2008). The idea is that a disagreement in the negotiation between unions usually implies a delay in the production, strikes, not massive lay-offs or quits. Actually, in the paper of Hall and Milgrom, the delay in the production involves a flow cost for the firm. For simplicity, I impose it equal to zero.

if this choice makes them better off. As in Rosen (1997) and Hall and Milgrom (2008), they are not binding: no player has an incentive to quit the negotiation. Parameter β denotes the exogenous bargaining power of the unions of workers ($0 < \beta < 1$). Computing the F.O.C. and the conditions on the threats points yields to

$$w_{p,\,i} \;=\; \beta \cdot y_i \qquad \text{with } i \in \{a,\, b\}. \tag{15}$$

Substituting this value of the nominal wage in the vacancy-supply equation, I get:

$$\mathbb{ZP}(\theta_i) \;\equiv\; (1 \,-\, \beta)\, y_i \,-\, k \cdot \frac{r \,+\, \delta_p}{q(\theta_i)} \;=\; 0 \qquad \text{with } i \in \{a,\, b\}. \tag{16}$$

This implicit function is denoted $\mathbb{ZP}(\theta_i) = 0$ because of the the zero-profit condition that determines the vacancy/unemployment ratio in the private sector. Notice that $\theta_a > \theta_b$ because $y_a > y_b$.

2.3 The governments' objective function and the budget constraint

The value function of each local government solves the following Bellman equation:

$$\begin{aligned} r\Pi(E_{g,i}) \;&=\; \max_{V_{g,i}} \left[\left(Y_i \,-\, \frac{w_{g,i}}{p_i}\, E_{g,i,t} \,-\, \frac{k}{p_i}\, V_{g,i} \right) \,+\, \frac{d\,\Pi(E_{g,i})}{d\,t} \right] \\ s.t. \quad \frac{d\,E_{g,i}}{d\,t} \;&=\; V_{g,i} \cdot q(\theta_i) \;-\delta_g \cdot E_{g,i} \qquad \text{with } \; i \in \{a,\, b\}\,. \end{aligned} \tag{17}$$

When deciding how many public vacancies must be posted, the public authority of region i maximizes total output net of the wage bill and the vacancy costs. Labour market tightness is taken as given[16]. Notice that at this stage there is no link between regions, so we would get the same results if we considered a central government that maximizes a value function equal to the sum $\Pi(E_{g,\,a}) + \Pi(E_{g,\,b})$. The F.O.C. condition that satisfies (17) is:

$$\frac{d\,\Pi(E_{g,\,i})}{d\,E_{g,\,i}} \;=\; \frac{k}{p_i \cdot q(\theta_i)}, \qquad i \in \{a,\, b\}$$

The marginal value of one additional job must be equal to the expected cost of filling a vacancy. In steady-state, $\frac{d\,E_{g,\,i}}{d\,t} = 0$. Applying the envelope theorem to (17) yields:

$$\frac{d\,\Pi(E_{g,\,i})}{d\,E_{g,\,i}} \;=\; \frac{1}{p_i} \cdot \frac{p_i \cdot (d\,Y/d\,Q_{g,\,i}) \;-\; w_{g,\,i}}{r \;+\; \delta_g}, \qquad i \in \{a,\, b\}$$

Using equations (2), (3), and (6) one gets that $p_i \cdot (d\,Y/d\,Q_{g,\,i}) = y_i^{1/s} \cdot \left(\frac{\phi_i}{1-\phi_i} \cdot \frac{\delta_p}{\delta_g}\right)^{-1/s}$. Putting together the RHS of the two preceding equations, one gets:

$$\mathbb{G}\,(\phi_i,\, \theta_i,\, w_{g,\,i}) \;\equiv\; \frac{y_i^{\frac{1}{s}} \cdot \left(\frac{\phi_i}{1-\phi_i} \cdot \frac{\delta_p}{\delta_g}\right)^{-\frac{1}{s}} - w_{g,\,i}}{r \;+\; \delta_g} - \frac{k}{q(\theta_i)} \;=\; 0 \qquad i \in \{a,\, b\} \tag{18}$$

[16] Of course, many other utility functions can be thought, namely the maximization of the primary surplus or of the welfare of civil servants. Here the idea is to imagine a government guided by a simple policy rule and whose behaviour does not conflict with the one would be adopted by an an utilitarian social planner. Again, this would allow to single out more starkly the effects of different public wage bargaining regimes.

For each region, the implicit function $\mathbb{G}(\phi_i, \theta_i w_{g,i}) = 0$ determines the fraction of public vacancies ϕ_i conditional on the level of tightness θ_i and on the value of $w_{g,i}$. Since the public good is not sold in a competitive market but freely provided by the government, its production costs are financed via a tax T_i (expressed in terms of the numeraire) levied on the final good firms and equal to their profits.

$$T_i \;=\; p_i{\cdot}Y_i - Q_{p,i} \;=\; p_i{\cdot}E_{g,i}{\cdot}(dY/dQ_{g,i}) \;=\; E_{g,i}{\cdot}\, y_i^{\frac{1}{s}}{\cdot}\left(\frac{\phi_i}{1-\phi_i}\right)^{-\frac{1}{s}} \qquad i \in \{a,\, b\} \tag{19}$$

The second equality comes from the constant returns to scale property of the final good production functions. The amount of tax per public worker is equal to the marginal value of public employment. By substituting this value to equation (18), governments' expected profits are equal to zero. By the same token, the free entry condition and equation (19) respectively ensure that neither the intermediate private firms nor the final good sector get positive expected profits or losses in steady-state.

A corollary of the budget balanced condition (19) is the absence of fiscal redistribution among regions: in each one taxes must be equal to fiscal revenues. This condition will be relaxed in the third scenario I present in section 5.

3 Two Public Wage Scenarios

To close the model, an assumption on how public wages are determined is needed. In this section, I consider two mutually

exclusive scenarios:

1. Regional Public Wage Bargaining. The nominal public wage is negotiated at regional level by local public authorities and unions.

2. Centralized Public Wage Bargaining. The public wage negotiation takes place at the central level by national unions and the central government.

In both scenarios, the local authorities benefit from a relative autonomy with respect to the central government, since they are free to choose the optimal level of public job vacancies.

3.1 Regional Bargaining

As in the private sector, the rent sharing rule has the following form:

$$w_{g,i} = \text{argmax} \left[\frac{w_{g,i}}{p_i} \cdot E_{g,i} \right]^{\beta} \left[E_{g,i} \left(F'(Q_{g,i}) - \frac{w_{g,i}}{p_i} \right) - \frac{k}{p_i} V_{g,i} \right]^{1-\beta}$$

with $i \in \{a, b\}$. The public union's utility is equal to the sum of the instantaneous utilities of its members. The local government considers the revenues obtained by employing $E_{g,i}$ civil servants, net of the wage bill and the vacancy costs. The fall-back position of both parts is assumed equal to zero[17].

[17] I am also assuming that public and private sector unions have the same bargaining power. I will relax this assumption in the quantitative section.

I proceed as in section 2.2, using the steady-state equation $V_{g,i}q(\theta_i) = E_{g,i}\delta_g$, $\mathbb{G}(\phi_i, \theta_i w_{g,i}) = 0$, and $\mathbb{ZP}(\theta_i) = 0$ to get an equation for the nominal public wage:

$$w_{g,i} = \beta \cdot \frac{r}{r + \delta_p} \cdot y_i \tag{20}$$

with $i \in \{a, b\}$. Substituting (20) into (18) yields:

$$\begin{aligned}(1 - \beta)\, y_i^{\frac{1}{s}} \cdot \left(\frac{\phi_i^*}{1-\phi_i^*} \cdot \frac{\delta_p}{\delta_g}\right)^{-\frac{1}{s}} &= k \cdot \frac{r + (1-\beta)\delta_g}{q(\theta_i)} \\ &= (r + (1-\beta)\delta_g) \cdot \frac{(1-\beta)y_a}{r + \delta_p},\end{aligned} \tag{21}$$

with $i \in \{a, b\}$. Henceforth the superscript * denotes the values of the endogenous variables under this regional scenario[18]. The second equality is obtained by using the zero-profit condition $\mathbb{ZP}_i(\theta_i) = 0$. Under regional wage bargaining in the public sector, the fraction of public vacancies out of total ϕ_i is uniquely determined by equation (21).

Differences between regions

1. $\phi_a < \phi_b$. From (21), it is easy to see that $\phi_a < \phi_b$ because $y_a > y_b$. In region a, the private sector is more productive, firms post more vacancies and crowd out more public jobs. From equation (6), $\phi_a < \phi_b$ implies that the fraction of public employment out of total is lower in region a than in region b.

[18] As we will see in the next sections, there is no need to add it for θ_i since tightness does not change with the different scenarios.

2. $p_a^* > p_b^*$. Combining (7) and (21), one gets:

$$p_i^* = \left[1 + \left(\frac{r + (1-\beta)\delta_g}{r + \delta_p}\, y_i\right)^{1-s}\right]^{\frac{1}{1-s}} \quad \text{with } i \in \{a, b\}.$$

Region a exhibits a higher cost of living because $y_a > y_b$. This is the well-known Harrod-Balassa-Samuelson effect, that predicts that countries with a higher productivity in tradables compared to nontradables have higher price levels (see Obstfeld and Rogoff, 1996, chapter 4, for a detailed exposition). Because of decreasing marginal returns to labour in the final good production function, a lower share of public jobs raises the marginal value of employment in the public sector, namely 1 multiplied by the tax per unit of public good levied on the final firm, $y_i^{\frac{1}{s}} \cdot \left(\frac{\phi_i^*}{1-\phi_i^*} \cdot \frac{\delta_p}{\delta_g}\right)^{-\frac{1}{s}}$ from equation (19). So, the higher the marginal productivity of labour y_i in the private tradable sector, the higher will be the relative cost - paid via taxes - of the public nontradable good. In turn, this translates into a higher price of the composite consumption good, p_i^*[19].

3. It is not possible to ascertain analytically whether employment in region a, E_a, is higher than employment in region b, E_b. In the region with a greater private sector produc-

[19] Actually, the Harrod-Balassa-Samuelson effect hinges on the assumption of perfect labour mobility across tradable and nontradable sectors, that equalizes wages and the correspondent values of the marginal product. Here the mechanism is different, as undirected search prevents workers from choosing in which sector they want to apply.

tivity, vacancy creation and labour market tightness are higher, but there is also a lower share of public jobs, that enjoy a longer expected duration (since $\delta_g < \delta_p$).

4. $\frac{w^*_{p,\,a}}{p^*_a} > \frac{w^*_{p,\,b}}{p^*_b}$ and $\frac{w^*_{g,\,a}}{p^*_a} > \frac{w^*_{g,\,b}}{p^*_b}$. These inequalities are obtained by expressing real wages in terms of the exogenous variables and noting that they positively depend on the private sector productivity of their region, y_i. Computations are in Appendix 1. Moreover, in each region public sector wages are lower than private ones.

3.2 Centralized Bargaining in the Public Sector

In this second scenario, I assume that the nominal public sector wage is bargained over at the national level. A national union representing all the civil servants in the economy negotiates with the central government. The Nash bargaining problem is:

$$w_g = \text{argmax} \left[\frac{w_g}{p_a} \cdot E_{g,\,a} + \frac{w_g}{p_b} \cdot E_{g,\,b} \right]^{\beta} \left[\sum_{i\,=\,a,b} E_{g,\,i} \left(F'(Q_{g,\,i}) - \frac{w_g}{p_i} \right) - \frac{k}{p_i} V_{g,\,i} \right]^{1-\beta}$$

The resulting F.O.C. is equal to:

$$w_g \left(\frac{E_{g,\,a}}{p_a} + \frac{E_{g,\,b}}{p_b} \right) = \beta \left[\sum_{i\,=\,a,b} \frac{E_{g,\,i}}{p_i} \cdot \left(y_i^{\frac{1}{s}} \cdot \left(\frac{\phi_i}{1-\phi_i} \cdot \frac{\delta_p}{\delta_g} \right)^{-\frac{1}{s}} - \frac{k \cdot \delta_g}{q(\theta_i)} \right) \right]$$

Using the steady state equations in (4) and the implicit function $\mathbb{G}_i(\phi_i,\, \theta_i,\, w_g) = 0$, the above equation simplifies to:

$$\begin{aligned} w_g &= \gamma \cdot w_{g,\,a} + (1-\gamma) \cdot w_{g,\,b} \\ &= \beta \cdot \frac{r}{r + \delta_p} \left[\gamma \cdot y_a + (1-\gamma) \cdot y_b \right] \end{aligned} \tag{22}$$

in which

$$\gamma \;=\; \gamma(\theta_a,\, \theta_b,\, \phi_a,\, \phi_b\,) \;\equiv\; \frac{\frac{f(\theta_a)\phi_a}{p_a}}{\frac{f(\theta_a)\phi_a}{p_a} \;+\; \frac{\lambda_a}{\lambda_b}\frac{f(\theta_b)\phi_b}{p_b}}$$

and $w_{g,\,a}$ and $w_{g,\,b}$ have the same functional form of the nominal public wages in the first scenario (see equation 20). Under national bargaining, the nominal public sector wage is a weighted average of the wages obtained via regional negotiation. The endogenous weight are γ and $1-\gamma$. Notice that γ positively depends on ϕ_a and θ_a and it is negatively affected by ϕ_b and θ_b. The larger the fraction of public sector vacancies (in turn, the fraction of public sector jobs) and the labour market tightness in region i, the larger the share of civil servants in i belonging to the union, the closer the identical nominal wage w_g is to productivity and tightness of that region. Apart from the exogenous migration flows, w_g is the only link between region a and b, since it depends on $\theta_{g,\,a}$, $\theta_{g,\,b}$, ϕ_a, and ϕ_b.

As in the first scenario, θ_i is uniquely determined by the zero-profit equation $\mathbb{ZP}(\theta_i) = 0$, with $i \in \{a,\, b\}$, while the equilibrium conditions in the public sector $\mathbb{G}(\phi_i,\, \theta_i,\, w_g) = 0$ with $i \in \{a,\, b\}$ form a system of two equations in the two unknowns, ϕ_a and ϕ_b. Lemma 1 presents the result:

Lemma 1 If $y_b > y_a \cdot \frac{s\beta r}{s\beta r + r + \delta_g(1-\beta)}$, the system of equations $\mathbb{G}(\phi_i,\, \theta_i,\, w_g) = 0$ with $i \in \{a,\, b\}$ admits a unique solution in ϕ_a and ϕ_b.

The proof is in Appendix 2. The condition imposed in Lemma 1 ensures the uniqueness of the equilibrium. To have a unique

equilibrium, it is sufficient that the expected revenues of a public job in region b decrease with ϕ_b.[20] However, ϕ_b has a twofold effect on the expected revenues of a public job in region b. On the one hand, a larger number of public job vacancies and, in turn, public employment lowers the marginal productivity in the public sector. On the other hand, a higher ϕ_b increases the weight of public employees working in region b in the bargaining process. This exerts a downward pressure on the nominal wage w_g, for it gets closer to the lower productivity value of the public sector in that region. Because of the Inada properties of the CES final good production function, the first effect approaches infinity as ϕ_b is close to zero. However, if y_b is too small compared to y_a, the advantage of paying lower wages by raising ϕ_b could make the second effect prevail for some intermediate values of ϕ_b, implying a non monotone effect of ϕ_b on the expected revenues.

As a comparison between (20) and the second line of (22) makes clear, passing to a national public wage bargaining regime entails a redistribution in nominal terms from the rich to the poor region. Civil servants in region a get a lower nominal wage than it would be implied under the regional bargaining scenario. The opposite occurs to public employees in region b. This chimes well with the conclusions of most empirical literature, according to which a fraction of the identical public wage can be viewed as a subsidy towards the employees of the poorer regions (e.g. see Borjas, 1986; Alesina et al., 2001).

[20] Formally, this implies that the derivative of $\mathbb{G}(\phi_b, \theta_b, w_g)$ with respect to ϕ_b is negative.

A comparison between region a and b broadly delivers the same results illustrated in the previous scenario. Notice first that θ_i and $w_{p,\,i}$ take the same value obtained under regional public wage bargaining, as the zero-profit condition $\mathbb{ZP}(\theta_i) = 0$ and the private sector wage negotiation do not change. So we still have $\theta_a > \theta_b$ and $w_{p,\,a} > w_{p,\,b}$. The price of the consumption good in the second scenario is

$$p_i^{**} = \left[1 + \left(\frac{k(r + \delta_g)}{q(\theta_i)} + w_g\right)^{1-s}\right]^{\frac{1}{1-s}} \qquad i \in \{a,\, b\},$$

with the superscript ** denoting the value of a variable under this second scenario. Since $\theta_a > \theta_b$, we have $p_a^{**} > p_b^{**}$ and the Harrod-Balassa-Samuelson effect applies even in this framework. As in the first scenario, it is not possible to check at the analytical level which region exhibits the higher employment level. As concerns the real wages, in region a workers are paid more in the private sector than in the public one[21]. In region b, simple computations (available on request) show that $w_{p,\,b} > w_g$ if $y_b \geq y_a \frac{r}{r+\delta_p}$. Contrarily to the regional bargaining scenario, civil servants in region b are better paid than their colleagues in region a, since they receive the same nominal salary while enjoying a lower cost of living[22].

[21] Compare the expression for w_g in (22) with $w_{p,\,a} = \beta y_a$

[22] The comparison between $w_{p,\,a}/p_a^{**}$ and $w_{p,\,b}/p_b^{**}$ will be made in the next section.

4 Regional vs. National Public Wage Bargaining

The two scenarios presented so far differ only in terms of the wage determination in the public sector. In this section, I wonder what are the consequences on employment, prices, and real wages of applying either regime. Proposition 1 summarizes the results.

Proposition 1 The shift from a national wage negotiation in the public sector to a regional one delivers the following results:

1. In the less productive region, the price of the consumption good and the public sector real wage decrease. Private sector real earnings, the employment level, and the share of public employment go up.

2. In the more productive region, the same variables move in the opposite direction.

Computations are in Appendix 3. Let focus on the effects that a change in the level of negotiation implies in region b. Passing from a national wage negotiation to a regional one lowers the cost of a public job in region b, as civil servants are paid less (from eqs. 20 and 22 we have $w_{g,b} < w_g$) while the job filling rate $q(\theta_a)$ is unchanged. Because of decreasing returns to labour, the share of public employment out of total must be higher to equalize expected marginal costs and revenues (obtained via taxes) in the the public sector. As the equations for p_i^{**} and p_i^* make clear, the price of the consumption good increases with the cost

of producing the nontradable good. So, a regional bargaining process in the public sector also lowers the cost of living in region b. A higher proportion of public workers has a positive impact on employment, since there are more jobs with a higher expected duration: $E_b^* > E_b^{**}$.[23] As concerns the real pays, a regional bargaining scheme jacks up private sector earnings in the less productive region because the consumption good is cheaper. However, real wages go down in the public sector. This because the uniform nominal retribution w_g also takes into account the higher productivity of civil servants in region a. So, the nominal loss resulting from a regional negotiation outweighs the fall in the cost of living.

It is easy to see that the same chain of events - with opposite sign - occurs in region a. Again, the starting point is the higher nominal wage that civil servants in the more productive region receive when the bargaining process takes place at regional level. This raises the costs in the nontradable sector and, in turn, the price of the consumption good, thereby depressing public jobs creation and private sector real earnings.

[23] Actually, there is another effect at work. E_i is negatively affected by ϕ_j, with $i, j \in \{a, b\}$, $i \neq j$ because the higher the fraction of public, more secure, jobs in region i, the lower the level of unemployment there and, in turn, the smaller the fraction of them that will move to region j. So, region b (resp. a) benefits (suffers) from a lower (higher) fraction of civil servants in a (b).

4.1 A Remark on the Price-Taking Behaviour of the Agents

In both scenarios, unions (both in the private and in the public sector) and the governments take the price of the consumption good as given. It is natural to wonder whether the results in Proposition 1 hold true if such "big agents" internalized the effects of their decisions on the cost of living. The question might appear particularly appropriate in the light of a well-known literature (e.g. Calmfors and Driffil, 1988 and Alesina and Perotti, 1997) that stresses the advantages of a national negotiation compared to a more decentralized one in that, under the former, unions are more conscious of the impact of their wage demands on inflation. However, this line of reasoning does not apply to the framework considered in the present paper. Since the price of the consumption good is determined at regional level, even under a regional bargaining scheme unions' and governments' choices could have an impact on its value. So, abandoning the price-taking assumption does not add a further distinction between the two scenarios and does not change the results of Proposition 1.[24]

[24] In a separate extension, available on request, I consider the case in which each local government considers p_i as a function of $E_{g,i}$ in the maximization problem (17). Computations are more cumbersome but the results of Proposition 1 do not change.

5 Third Scenario: Fiscal Integration

So far, I have assumed that each local government autonomously decides how many public vacancies must be opened, provided that the public budget of any region is balanced. It is a condition that may be realistic in a country with a higher extent of fiscal federalism, but that it is difficult to conceive in more integrated states, where some forms of compensation at the central level exist. In this section, I examine a third scenario, in which the central government favours the creation of public jobs in the poorer region by taking resources from the public sector of the richer one. Of course, one could imagine other forms of redistribution. For instance, the central government could tax the private sector in both regions. Here I consider a more hidden approach, in which the central government does not levy any new taxes to the workers, but it simply uses some of the taxes collected in region a to subsidize public employment in region b. The public budget of the country remains in balance. Then I evaluate the effects of this policy under both public wage regimes.

To convey this idea, consider a value function for the government of region i that is identical to the one in (17) apart from the term $\tau_i E_{g,i,t}$:

$$r\Pi(E_{g,i}) \;=\; \max_{V_{g,i}} \left\{ \left[Y_i \;-\; [w_{g,i} \;+\; \tau_i \cdot (\mathbf{1}_a(i) - \mathbf{1}_b(i))] \; \frac{E_{g,i,t}}{p_i} \;-\; \frac{k}{p_i} V_{g,i} \right] \;+\; \frac{d\,\Pi(E_{g,i})}{d\,t} \right\}$$

$$s.t. \quad \frac{d\,E_{g,i}}{d\,t} \;=\; V_{g,i} \cdot q(\theta_i) \;-\delta_g \cdot E_{g,i} \qquad \text{with } \; i \in \{a,\, b\}\,.$$

The indicator function $\mathbf{1}_a(i)$ (respectively $\mathbf{1}_b(i)$) has the value 1

if $i = a$ and 0 if $i \neq a$ (resp. 1 if $i = b$ and 0 if $i \neq b$). In words, the central government affects the choice of the local authority in region b by giving a transfer equal to τ_b (expressed in terms of the numeraire) for each public job created. To finance this policy, it takes a fraction τ_a of the taxes per public job raised in sector a. The private intermediate sector is not directly involved in this mechanism.

Proceeding as in section 2.3, I compute the F.O.C of the above problem, apply the envelope theorem, and put the resulting equations together to obtain:

$$\begin{aligned}
\mathbb{GI}(\phi_a,\, \theta_a,\, w_{g,\,a}) \;&\equiv\; y_a^{\frac{1}{s}} \cdot \left(\frac{\phi_a}{1-\phi_a} \cdot \frac{\delta_p}{\delta_g} \right)^{-\frac{1}{s}} - \tau_a - \frac{k}{q(\theta_a)} \, (\, r \,+\, \delta_g \,) \,-\, w_{g,\,a} \;=\; 0 \\
\mathbb{GI}(\phi_b,\, \theta_b,\, w_{g,\,b}) \;&\equiv\; y_b^{\frac{1}{s}} \cdot \left(\frac{\phi_b}{1-\phi_b} \cdot \frac{\delta_p}{\delta_g} \right)^{-\frac{1}{s}} + \tau_b - \frac{k}{q(\theta_b)} \, (\, r \,+\, \delta_g \,) \,-\, w_{g,\,b} \;=\; 0
\end{aligned} \tag{23}$$

I keep the assumption that the final good firms' profits are totally soaked up by taxes: equation (19) still holds. So, combining (19) and (23), one gets the following equations:

$$\begin{aligned}
\frac{1}{p_a} \left[T_a \,-\, \left(w_{g,\,a} \,+ \frac{k \cdot (r + \delta_g)}{q(\theta_a)} \right) E_{g,\,a} \right] \;&=\; \frac{\tau_a}{p_a} \cdot E_{g,\,a} \\
\frac{1}{p_b} \left[T_b \,-\, \left(w_{g,\,b} \,+ \frac{k \cdot (r + \delta_g)}{q(\theta_b)} \right) E_{g,\,b} \right] \;&=\; -\frac{\tau_b}{p_b} \cdot E_{g,\,b}
\end{aligned}$$

At the RHS of the first equation there is the amount of resources (expressed in terms of the consumption good) that region a transfers to region b. To make the country's budget balanced, it must be equal to the resources that region b needs to finance

this policy, the RHS of the second equation:

$$\frac{\tau_a}{p_a} \cdot E_{g,\,a} \;=\; \frac{\tau_b}{p_b} \cdot E_{g,\,b}$$

Using the steady state equations in (4):

$$\tau_a \;=\; \frac{p_a}{E_{g,\,a}} \cdot \frac{E_{g,\,b}}{p_b} \cdot \tau_b \;\;=\;\; \frac{\phi_b\, f(\theta_b)}{p_b} \cdot \frac{p_a}{\phi_a\, f(\theta_a)} \cdot \tau_b \cdot \frac{\lambda_a}{\lambda_b}, \qquad (24)$$

Notice that when deciding how many vacancies must be opened, the regional authority in a does not consider equation (24) and take τ_a as given. The rationale of this assumption is that, in this scenario, local institutions do not care about the budget, that becomes a constraint at the country level; so they ignore which values the central government assigns to τ_i to avoid a deficit or a surplus in steady-state.

Proving the existence and uniqueness of a steady-state equilibrium in $[\theta_i,\, \phi_i]$ for $i \in \{a,\, b\}$ involves the same procedure followed in sections 3.1 and 3.2. Under regional bargaining, each implicit equation $\mathbb{GI}(\phi_i,\, \theta_i,\, w_{g,\,i}) = 0$ uniquely determines the equilibrium value of ϕ_i, with $i \in \{a,\, b\}$. Under national bargaining, the existence and uniqueness can be proved by the same steps of Lemma 1[25].

Proposition 2 describes the effects of this policy.

Proposition 2 Consider a central government that uses taxes collected in the richer region to create public jobs in the poorer one. In the former, unemployment and the cost of living increase. In the latter, they decrease.

[25] An additional condition is required on the magnitude of τ_b. See Appendix 4 for details.

Computations are in Appendix 4. The results of Proposition 2 are verified regardless of the level of the public wage negotiation. Opening a public vacancy in region a is more expensive, because there is an additional cost τ_a for any job created. This raises the cost of producing the nontradable public good $Q_{g,a}$ and, for decreasing returns to labour, shrinks the share of public jobs ϕ_a. The price of the consumption good p_a goes up accordingly. A lower fractions of public vacancies reduces employment, as it is less likely that public jobs with higher expected duration will be created. Wages decrease because of the higher price of the consumption good.

The opposite occurs in region b, where a subsidy equal to $\tau_b E_{g,b}$ lowers the cost of posting public vacancies and, in turn, the cost of the nontradable good and the price of the consumption good. Unemployment goes down because there is a larger fraction of public jobs, with a longer expected duration. Private sector earnings are pushed upward, for the consumption good has become cheaper. The only ambiguity rests on the public sector real wages under national bargaining. For the price effect, they should be higher in the third scenario. Yet, the increase in ϕ_b and the decrease in ϕ_a put a downward pressure on their nominal value. A higher share of the members of the public sector trade union comes from region b, and the resulting wage will be closer to the marginal productivity y_b (see equation 22). The net effect cannot be ascertained analytically.

6 Calibration

I take the month as unit of time. Data refer to the period 2006-2007 in Italy. Italy is a country that suits the purpose of this paper particularly well. It exhibits huge economic disparities between the North-Center regions and the South ones, the former being 50% richer in terms of average disposable income per capita (ISTAT, 2011). Moreover, no statistically significant difference emerges in nominal public wages paid in the areas of the country (Alesina et al., 2001; Dell'Arringa et al., 2007). So the second scenario is the baseline framework that I will consider for the parametrization, to which I add only some changes to increase the realism of the model: (i) workers' bargaining power in the private sector is assumed to differ between regions ($\beta_{p,a} \neq \beta_{p,b}$) and it is different from the one in the public sector, β_g[26]; (ii) the private sector separation rate differ across regions, $\delta_{p,a} \neq \delta_{p,b}$.

Results are summarized in Table 1. The discount rate is fixed at 0.00083 (1 % on an annual basis). Elasticity s is set equal to 3, implying a low level of substitution between public and private goods[27]. The Italian Institute of Statistics (ISTAT, 2008; 2010) provides data on the labour force and the unemployment rate

[26] Assuming different bargaining powers across sectors allows to obtain a public sector wage premium even in the more productive region, in line with the empirical literature (Alesina et al., 2001; Dell'Arringa et al., 2007). From equations (15) and (22) it is easy to see that in the baseline model with a common β the ratio $w_g/w_{p,b} > 1$ but $w_g/w_{p,a} < 1$.

[27] If it is not unrealistic to suppose a low degree of substitutability between private and public goods, the case is even stronger for that subset of public goods that are nontradable: police services, justice administration, etc...

for each Italian region.[28]. It also provides some estimates of the average Italian separation rate that is not so far from the results obtained by Jolivet et al. (2006) and Hobijn and Sahin (2007): its monthly value ranges from 0.4% to 0.6%. Knowing from the Finance Ministry (MEF, 2010) both the public sector separation rate δ_g and the share of civil servants out of total employment (that is 11% in the North-Center compared to 18% in the South), I am able to find $\delta_{p,a}$, $\delta_{p,b}$, ϕ_a, and ϕ_b. Mocetti and Porello (2010) provide useful information on Italian internal migration: 0.6% is the annual rate at which people from the South went to the North-Center in 2009 and 20 % of the migrants were unemployed. Therefore, $\lambda_b = 0.0001$. Parameter λ_a is then obtained using equation (4). For the matching function, I consider a Cobb-Douglas form: $M_i = m \cdot U_i^{\eta} \cdot V_i^{1-\eta}$. Matching parameter η and the coefficient in the matching function m are set respectively to 0.35 and 0.2.

Knowing the unemployment rate in region a and b (3.5% and 11%, respectively) and the values for $\delta_{p,i}$, ϕ_i, λ_i, m, and η, the steady-state equations (5) for E_a and E_b form a system with two unknowns, θ_a and θ_b.

Once these labour market variables are known, I set the bar-

[28]I split the Italian regions as follows. In region a I include the North (Piedmont, Valle d'Aosta, Lombardy, Trentino, Alto Adige - South Tyrol, Veneto, Fiuli-Venezia Giulia, and Liguria) and the Center (Tuscany, Umbria, and Marche). In region b there are Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicily, and Sardinia. I decided to exclude Lazio from the computations because its high share of public employment is due to the presence of Rome, the capital, in its territory.

gaining power in the private sector equal to 0.4 and I express the flow cost of a vacancy k as a function of y_a, via the zero-profit condition $\mathbb{ZP}(\theta_a) = 0$. Then, to find y_a, y_b, and $\beta_{p,b}$, I solve a system with the following three equations: the other zero-profit condition $\mathbb{ZP}(\theta_b) = 0$, the relationship $\mathbb{G}(\phi_a, \theta_a) - \mathbb{G}(\phi_b, \theta_b) = 0$, and the fact that the ratio between private sector wages $w_{p,a}/w_{p,b}$ is about 1.1 (see Dell'Arringa et al., 2007). Finally, the public unions' bargaining power is obtained by exploiting the implicit function $\mathbb{G}(\phi_a, \theta_a) = 0$. I get $\beta_g = 0.84$, higher than the value of the correspondent parameters the private sector. This does not appear an unrealistic scenario in Italy, where public unions are particularly powerful (see Dell'Arringa et al., 2007).

To check the validity of my procedure, I look at some numerical values that result from the calibration and compare them with the corresponding empirical estimates. The model predicts an average expected duration of unemployment of about 22 months. This is in accordance with most of the empirical literature, that, for the period considered, obtains a value close to one year and an half in Italy. According to ISTAT (2011), the ratio of disposable income per capita between North-Center and South of Italy in 2006 was about 1.5 and this is exactly the result obtained by the model. Another piece of evidence that is well captured by the calibration is the private vacancy rate, equal to 1.2%, very close to the 1.1% found by ISTAT (2009) in 2007. The public sector wage premium in region a and region b is about 10% and 21% respectively, in line with the findings of

Alesina et al. (2001) and Dell'Arringa et al. (2007)[29]. The model performs less well in terms of different costs of living across regions. According to Cannari and Iuzzolino (2009), the price level in the South is 16% lower than in the North-Center if housing expenses are taken into account, and 10% lower if they are ignored. My calibrated model predicts a much smaller difference, about 5%. This is due to the fact that in the model the discrepancy in the cost of living between regions uniquely stems from the differences in the cost of the nontradable good, whereas the private tradable good is assumed to have the same price in the entire country. Thus the cost divergence in the nontradable good sector, that makes up for 17% of the labour force at most, is not able to produce a 16% gap in the price of the consumption good between regions. However, as we will see in the next section, different bargaining schemes in the public sector will deliver significant results in terms of unemployment, real wage changes, and inequality even when the disparities in the cost of living are not huge.

7 Numerical Results

I compare the second scenario calibrated in the previous section with the first scenario in which the regional level of negotiation

[29]For the former, the public sector wage premium is 26% in the South and 12.5% in the North-Center. The latter obtain a public-private wage gap lower than 10% in the richer regions and between 15 and 25% in the poorer ones.

implies that $w_{g,a} \neq w_{g,b}$. Numerical results are summarized in Table 2. A richer model in which some parameters differ by region or by sector confirms the conclusions of Propositions 1. If nominal public wages were negotiated at regional level, the poorer region would experience a reduction in the public sector wage premium by almost 40%, as the earnings in the public sector would be no longer dependent on the labour market conditions and productivity parameters of the richer region. This fosters the creation of public vacancies; in turn, the cost of living goes down by about 6%, for the already cited Harrod-Balassa-Samuelson effect. The 2% decrease in the unemployment rate is due to the fact that there are more public jobs with a higher expected duration. The opposite occurs in the other region. A regional bargaining process would raise the public sector wage premium by 19%. This would put only a slight pressure on the price level, that would increase by less than 1%. The unemployment rate would barely change.

Table 2 also presents some aggregate results. As expected, unemployment and the real wage go down, albeit by a small margin. The fall in average real earnings is the consequence of a small increase in the private sector pay and a substantial fall in public wages.

7.1 Inequality

Opting for a centralized wage bargaining process may harbour a redistributive purpose. Still, its general equilibrium effects are not as obvious, since a common w_g affects both public vacancy

creation and the costs of living in different parts of the country.

Table 2 illustrates the effects of a regional bargaining system on three indices: the Gini coefficient, the wage variance, and the ratio between the highest and the lowest wage in the economy. In all cases, the passage to a more decentralized pay system significantly raises inequality. The Gini index increases by 21%, the aforementioned ratio by 40%, and the wage variance jumps by 300 percentage points. The fact that the variance increases both in region a and in region b implies that a regional wage negotiation enhances inequality both within and between regions.

The rational behind these results is the following. As concerns inequality within regions, in the North-Center of Italy public wages go up and private wages go down in real terms, augmenting the public wage premium. In the South, salaries move in the opposite direction, but the reduction in the public service pay is so pronounced that the private sector now ensures higher earnings. There is a change of sign in the public - private wage differential and of such a magnitude that inequality increases.

With respect to the overall level of inequality, two effects are at work. Under a decentralized bargaining process, civil servants no longer get the same nominal pay irrespective of the region they belong to. Of course, this increases earnings dispersion. On the other hand, as Table 2 illustrates, such a system also raises the cost of living in the richer region and lowers it in the poorer one. Since private wage do not change in nominal terms, the gap between private sector real wages across regions becomes shorter.

The results summarized in Table 2 clearly show that this effect on private earnings is outweighed by the one on public pays.

The huge increase in the wage variance compared to the more moderate change in the Gini index can be explained by the fact the the former fails to consider the effects on inequality coming from a reduction in the unemployment rate. By lowering the unemployment rate, a decentralized public sector negotiation also decreases the number of the poorest people in the economy, so squeezing inequality. This channel is captured by the Gini index but not by the wage variance.

7.2 Subsidizing public employment

Table 3 illustrates the effects of a subsidy on public employment in region b financed by a fraction of the taxes collected in region a. The exercise is performed under both public wage policies. I consider a subsidy τ_b equal to 10% of the cost of producing the public good in region b. Results are in line with the conclusions of Proposition 2. The second column of Table 2 shows the case of a government that introduces a regional wage negotiation in the public sector and, in addition, subsidies public employment in the poorer region. In the third column, I look at the effects of the subsidy when there is no change in the bargaining scheme, that remains at national level. In both cases, this policy boosts vacancy creation in the public sector of region b and it dampens that in region a. More (less) public jobs in region b (in a) reduce (increase) unemployment for their higher expected duration. At the end, the negative variation in the national unemployment

rate is tiny (about 0.2%). Although this result holds for both bargaining schemes, a closer look at Table 3 allows to make an interesting distinction. Under regional bargaining, the unemployment rate in region b decreases by a significant 2.4%; the fact that the national unemployment rate remains virtually unchanged is due to the negative effect that less resources in region a have on unemployment there. On the contrary, under a national bargaining, even the unemployment rate in region b barely changes, meaning that subsidizing public jobs in the poorer region crowds out almost completely private employment there. In short, the crowding out effect of public employment is much stronger when wages are negotiated at a central level. This is because under regional bargaining salaries in the poorer region plummet by almost 33% and this adds a stronger incentive to public jobs creation there.

As concerns the price of the consumption good, diminishing returns to labour in the nontradable sector make living cheaper in region b (a decrease between 2% and 9%) and more expensive in a (an increase between 0.4% and 2%). This explains the effects on real wages in the private sector, that go down in the rich region and go up in the poor one.

The other notable difference between the two negotiation processes concerns inequality. A subsidy on public employment in region b raises the overall level of inequality when a regional bargaining scheme is applied also in the public sector (for example, the Gini coefficient goes up by 21%). On the contrary, the same policy reduces inequality in presence of national negotiation: the

wage variance falls by almost 50%, the Gini index by 9%. To understand why, recall that passing from a national bargaining scheme to a regional one raises earnings dispersion in the country. So the results of the last lines of Table 3 must be interpreted as follows. Subsidizing public employment in the poor region via taxes in the rich region is a policy that redistributes income, so that inequality falls under a national bargaining process. This makes sense, as the consumption good becomes cheaper (dearer) in the poor (rich) region. However, such an effect is not sufficiently great in magnitude to offset the increase in wage dispersion ensued from the adoption of a regional negotiation process.

8 Conclusions

This paper tries to assess the economic implications of the poor responsiveness of public sector nominal wages to local market conditions. A national collective agreement under which civil servants' nominal pays are the same irrespective of the region they belong to has negative effects on the poorer, less productive, regions of the state. Unemployment soars and private sector earnings are squeezed. While choosing a more decentralized wage setting mechanism delivers employment gains at the country level, the inequality results obtained in the paper may offer an explanation why such a change is so difficult to embrace, especially for trade unions.

This does not mean that only trade unions may benefit from national collective agreements in the public sector. One of the

results of the paper is that a regional bargaining scheme raises unemployment and the cost of living in the more productive region, via an increase in the wage costs. So, private sector workers and firms in the rich area of country may see a national negotiation process in the public sector as a tool to contain inflation and unemployment. The work of ?) goes in this direction, arguing that a technologically advanced region may benefit from transfer resources to a backward one through an improvement in its terms of trade. This leaves room for both normative and political economy reflections that the paper has not addressed. They are left for future research.

Appendix 1: Regional Bargaining

Using $\mathbb{ZP}_i(\theta_i) = 0$, equation (21), and the one determining p_i^*, one gets:

$$\begin{aligned}
\frac{w_{p,\,i}^*}{p_i^*} &= \beta \left[y_i^{s-1} + \left(\frac{r + (1-\beta)\delta_g}{r + \delta_p} \right)^{1-s} \right]^{\frac{1}{s-1}} \\
\frac{w_{g,\,i}^*}{p_i^*} &= \beta \frac{r}{r + \delta_p} \left[y_i^{s-1} + \left(\frac{r + (1-\beta)\delta_g}{r + \delta_p} \right)^{1-s} \right]^{\frac{1}{s-1}} \qquad \text{with } i \in \{a,\, b\}.
\end{aligned}$$

So we have $\frac{w_{p,\,a}^*}{p_a^*} > \frac{w_{p,\,b}^*}{p_b^*}$ and $\frac{w_{g,\,a}^*}{p_a^*} > \frac{w_{g,\,b}^*}{p_b^*}$. Moreover, in each region public sector wages are lower than private ones. It remains to check if $\frac{w_{g,\,a}^*}{p_a^*}$ is greater than $\frac{w_{p,\,b}^*}{p_b^*}$. After some algebra, one gets

that this is the case if:

$$\left(\frac{r+(1-\beta)\delta_g}{r+\delta_p}\right)^{1-s}\cdot\left[1-\left(\frac{r}{r+\delta_p}\right)^{s-1}\right] < y_a^{s-1}\cdot\left(\frac{r}{r+\delta_p}\right)^{s-1}-y_b^{s-1}$$

.

Appendix 2: Proof of Lemma 1

I proceed in two steps. First, I look at the existence and uniqueness of a ϕ_i that solves $\mathbb{G}(\phi_i, \theta_i, w_g) = 0$, conditional on ϕ_j, with $i = \{a, b\}$.
Notice that (i) $\lim_{\phi_a \to 0} \mathbb{G}(\phi_a, \theta_a, w_g) > 0$; (ii) $\lim_{\phi_a \to 1} \mathbb{G}(\phi_a, \theta_a, w_g) < 0$; (iii) $\frac{d\mathbb{G}_a}{d\phi_a} < 0$. For the intermediate value theorem, there exists a ϕ_a that solves $\mathbb{G}(\phi_a, \theta_a, w_g) = 0\ \forall \phi_b \in [0, 1]$.

As concerns the second equation, we have: (i) $\lim_{\phi_b \to 0} \mathbb{G}(\phi_b, \theta_b, w_g) > 0$; (ii) $\lim_{\phi_b \to 1} \mathbb{G}(\phi_b, \theta_b, w_g) < 0$. It remains to check the sign of $\frac{d\mathbb{G}_b}{d\phi_b}$. Replacing the RHS of (22) in $\mathbb{G}(\phi_b, \theta_b, w_g) = 0$ and differentiating with respect to ϕ_b, one gets:

$$\frac{d\,\mathbb{G}_b}{d\,\phi_b} = \frac{1}{d\,\phi_b}\cdot d\left[y_b^{\frac{1}{s}}\cdot\left(\frac{\phi_b}{1-\phi_b}\cdot\frac{\delta_p}{\delta_g}\right)^{-\frac{1}{s}}\right]-\frac{\beta\cdot r}{r+\delta_p}\left(y_a-y_b\right)\frac{d\,\gamma}{d\,\phi_b}. \tag{25}$$

After some algebra, it becomes:

$$\frac{d\,\mathbb{G}_b}{d\,\phi_b} = \frac{1}{s}\frac{1}{1-\phi_b}\frac{1}{\phi_b}\cdot\left\{-\frac{r+\delta_g(1-\beta)}{r+\delta_p}y_b - \left[1-(1-\gamma)F'(Q_{g,b})^{1-s}\right]\frac{\beta r}{r+\delta_p}(y_a-y_b)\gamma\right\}+$$
$$+\frac{\beta r}{\phi_b(r+\delta_p)}(y_a-y_b)\gamma(1-\gamma)$$

Notice that $0 < F'(Q_{g,b})^{1-s} = \left[1 + \left(\frac{Q_{p,b}}{Q_{g,b}}\right)^{\frac{s-1}{s}}\right]^{-1} < 1$. Therefore, a sufficient condition for a negative derivative is:

$$\frac{1}{s} \cdot \frac{r + \delta_g(1-\beta)}{r + \delta_p} \cdot y_b > \frac{\beta \cdot r}{r + \delta_p}(y_a - y_b),$$

or, equivalently, $y_b > y_a \cdot \frac{s\beta r}{s\beta r + r + \delta_g(1-\beta)}$. If this inequality holds, I can use the intermediate value theorem and conclude that there exists a ϕ_b that solves $\mathbb{G}(\phi_b, \theta_b, w_g) = 0 \; \forall \phi_a \in [0, 1]$.

In the second step I examine $\mathbb{G}(\phi_a, \theta_a, w_g) = 0$ and $\mathbb{G}(\phi_b, \theta_b, w_g) = 0$ together. From the first step, we know that there exists a ϕ_a that solves $\mathbb{G}(\phi_a, \theta_a, w_g) = 0$ when $\phi_b = 0$. This means that the implicit function $\mathbb{G}(\phi_a, \theta_a, w_g) = 0$ has a positive intercept in the vertical axis in (ϕ_b, ϕ_a) space. Similarly, there exists a ϕ_a that solves $\mathbb{G}(\phi_a, \theta_a, w_g) = 0$ when $\phi_b = 1$. This means that the implicit function $\mathbb{G}(\phi_a, \theta_a, w_g) = 0$ intersects the $\phi_b = 1$ line in (ϕ_b, ϕ_a) space. Moreover, since $\frac{d\,\mathbb{G}_a}{d\,\phi_a} < 0$ and $\frac{d\,\mathbb{G}_a}{d\,\phi_b} > 0$, $\mathbb{G}(\phi_a, \theta_a, w_g) = 0$ describes an increasing relationship in in (ϕ_b, ϕ_a) space.

The same reasoning applied to $\mathbb{G}(\phi_b, \theta_b, w_g) = 0$ implies that this implicit function has a positive intercept in the horizontal axis and intersects the $\phi_a = 1$ line in (ϕ_b, ϕ_a) space. Notice that $\frac{d\,\mathbb{G}_b}{d\,\phi_a} < 0$. From the previous step $\frac{d\,\mathbb{G}_b}{d\,\phi_b} < 0$ if $y_b > y_a \cdot \frac{s\beta r}{s\beta r + r + \delta_g(1-\beta)}$. So $\mathbb{G}(\phi_b, \theta_b, w_g) = 0$ describes a decreasing relationship in (ϕ_b, ϕ_a) space.

Then, $\mathbb{G}(\phi_b, \theta_b, w_g) = 0$ and $\mathbb{G}(\phi_a, \theta_a, w_g) = 0$ intersects once in (ϕ_b, ϕ_a) space. The equilibrium solutions of the system $(\phi_b^{**}, \phi_a^{**})$ together with θ_a and θ_b obtained via the zero-profit

conditions, uniquely determine all the endogenous variables of the model.

Appendix 3: Comparing the first two scenarios

I first compare ϕ_i^* with ϕ_i^{**} for $i \in \{a, b\}$. Looking at the equilibrium equations in the public sector $\mathbb{G}(\phi_i, \theta_i, w_{g,i}) = 0$ in both scenarios, we have that

$$w_g + \frac{k(r + \delta_g)}{q(\theta_i)} > y_i \frac{r + \delta_g(1 - \beta)}{r + \delta_p} \quad \Leftrightarrow \quad \phi_i^* > \phi_i^{**}$$

Using $\mathbb{ZP}(\theta_i) = 0$, the first inequality above becomes:

$$w_g > y_i \frac{\beta \cdot r}{r + \delta_p}$$

From equation (22), this inequality never holds (resp. is always respected) when $i = a$ (resp. $i = b$). Therefore, $\phi_a^{**} > \phi_a^*$ and $\phi_b^{**} < \phi_b^*$. In turn, from equation (7), one gets $p_b^{**} > p_b^*$ and $p_a^{**} < p_a^*$.

Now let consider E_i^{**} and E_i^* for $i \in \{a, b\}$. Since θ_i takes the same value in both scenarios, to see if $E_i^{**} > E_i^*$ it is sufficient to look at the derivatives of employment with respect to ϕ_a and ϕ_b. From equation (5) we have:

$$\frac{d\,E_a}{d\,\phi_b} < 0 \quad \text{and} \quad \frac{d\,E_a}{d\,\phi_a} > 0$$

Since $\phi_a^{**} > \phi_a^*$ and $\phi_b^{**} < \phi_b^*$, we have $E_a^{**} > E_a^*$. Similarly:

$$\frac{d\,E_b}{d\,\phi_b} > 0 \quad \text{and} \quad \frac{d\,E_b}{d\,\phi_a} < 0$$

So one gets $E_b^{**} < E_b^*$.
It remains to compare $\frac{w_g}{p_i^{**}}$ with $\frac{w_{g,\,i}}{p_i^*}$:

$$w_g \left\{ 1 + \left[\frac{k}{q(\theta_i)} \left(r + \delta_g \right) + w_g \right]^{1-s} \right\}^{\frac{1}{s-1}} > w_{g,\,i} \left\{ 1 + \left[\frac{k}{q(\theta_i)} \left(r + \delta_g \right) + w_{g,\,i} \right]^{1-s} \right\}^{\frac{1}{s-1}} \Leftrightarrow$$

$$w_g^{s-1} + \left[\frac{k}{w_g \cdot q(\theta_i)} \left(r + \delta_g \right) + 1 \right]^{1-s} > w_{g,\,i}^{s-1} + \left[\frac{k}{w_{g,\,i} \cdot q(\theta_i)} \left(r + \delta_g \right) + 1 \right]^{1-s}$$

When $i = b$, this inequality is always verified, as $w_g > w_{g,\,b}$. On the contrary, when $i = a$, the LHS is always lower than the RHS because $w_g < w_{g,\,a}$. So, $\frac{w_g}{p_a^{**}} < \frac{w_{g,\,a}}{p_a^*}$ and $\frac{w_g}{p_b^{**}} > \frac{w_{g,\,b}}{p_b^*}$.

Appendix 4: Fiscal Integration

Existence under Regional Bargaining

Under regional bargaining, $\mathbb{GI}(\phi_i,\, \theta_i,\, w_{g,\,i}) = 0$ uniquely determines ϕ_i, for $i \in \{a,\, b\}$, because θ_i is found via the zero-profit condition $\mathbb{ZP}(\theta_i) = 0$ and $w_{g,\,i}$ is a function of ϕ_i only.

Existence under National Bargaining

By differentiating the implicit function $\mathbb{GI}(\phi_b,\, \theta_b,\, w_g) = 0$ and applying the implicit function theorem, it is easy to see that, as under the second scenario, $\left.\frac{d\phi_b}{d\phi_a}\right|_{\mathbb{GI}_b=0} < 0$ if $y_b > y_a \cdot \frac{s\beta r}{s\beta r + r + \delta_g(1-\beta)}$. So $\mathbb{GI}(\phi_b,\, \theta_b,\, w_g) = 0$ describes a decreasing relationship in the $(\phi_b,\, \phi_a)$ space.

Let consider $\mathbb{GI}(\phi_a,\, \theta_a,\, w_g) \,=\, 0$:

$$y_a^{\frac{1}{s}} \cdot \left(\frac{\phi_a}{1-\phi_a} \cdot \frac{\delta_p}{\delta_g} \right)^{-\frac{1}{s}} \,-\, \frac{\lambda_a}{\lambda_b} \frac{\Gamma_b}{\Gamma_a} \cdot \tau_b - \frac{k}{q(\theta_a)} \,(\, r \,+\, \delta_g \,) \,-\, w_g \;=\; 0$$

in which $\Gamma_i \,\equiv\, f(\theta_i) \frac{\phi_i}{p_i}$ Differentiating with respect to ϕ_a, one gets:

$$\frac{d\,\mathbb{GI}_a}{d\,\phi_a} \,=\, -\frac{1}{s(1-\phi_a)\phi_a} y_a^{\frac{1}{s}} \cdot \left(\frac{\phi_a}{1-\phi_a} \cdot \frac{\delta_p}{\delta_g} \right)^{-\frac{1}{s}} + \frac{\lambda_a}{\lambda_b} \Gamma_b \Gamma_a^{-2} \Gamma'_a \tau_b - \frac{d\,w_g}{d\,\phi_a},$$

in which $\Gamma'_i \,\equiv\, \frac{d\,\Gamma_i}{d\,\phi_i} \,>\, 0$. Notice that:

$$\frac{d\,w_g}{d\,\phi_a} \;=\; \frac{\beta r}{r \,+\, \delta_p} \frac{\Gamma_b \Gamma'_a (y_a \,-\, y_b)}{(\Gamma_a \,+\, \Gamma_b)^2}$$

So, $\frac{d\,\mathbb{GI}_a}{d\,\phi_a} \,<\, 0$ if:

$$\Gamma_b \Gamma'_a \left[\frac{\lambda_a}{\lambda_b} \Gamma_a^{-2} \tau_b \,-\, \frac{\beta r}{r \,+\, \delta_p} \frac{y_a \,-\, y_b}{(\Gamma_a \,+\, \Gamma_b)^2} \right] \,<\, 0 \;\Leftrightarrow\; \tau_b \,<\, \frac{\lambda_b}{\lambda_a} \frac{\beta r}{r \,+\, \delta_p} \gamma^2 (y_a - y_b), \tag{26}$$

since $\gamma \,=\, \frac{\Gamma_a}{\Gamma_a + \Gamma_b}$. Let the superscript *** denote the equilibrium

value of a variable under the third scenario. We have:

$$
\begin{aligned}
\gamma \equiv & \frac{\frac{f(\theta_a)\phi_a^{***}}{p_a^{***}}}{\frac{f(\theta_a)\phi_a^{***}}{p_a^{***}} + \frac{\lambda_a}{\lambda_b}\frac{f(\theta_b)\phi_b^{***}}{p_b^{***}}} \\
> & \frac{f(\theta_a)\phi_a^{***}}{f(\theta_a)\phi_a^{***} + \frac{\lambda_a}{\lambda_b}\frac{f(\theta_b)\phi_b^{***}}{p_b^{***}}} && \text{because } d\gamma/dp_a < 0 \text{ and } 0 < p_a < 1 \\
> & \frac{\phi_a^{***}}{\phi_a^{***} + \frac{\lambda_a}{\lambda_b}\frac{\phi_b^{***}}{p_b^{***}}} && \text{because } f(\theta_a) > f(\theta_b) \\
> & \frac{1}{1 + \frac{1}{p_b^{***}}\frac{\lambda_a}{\lambda_b}} = \frac{p_b^{***}}{p_b^{***} + \frac{\lambda_a}{\lambda_b}} && \text{because } d\gamma/d\phi_a > 0 \text{ and } d\gamma/d\phi_b < 0 \\
> & \frac{p_b^*}{p_b^* + \frac{\lambda_a}{\lambda_b}} && \text{if } p_b^{***} > p_b^*,
\end{aligned}
$$

To prove that $p_b^{***} > p_b^*$, rewrite the equilibrium equations $\mathbb{G}(\phi_b, \theta_b, w_g) = 0$ and $\mathbb{GI}(\phi_b, \theta_b, w_g) = 0$ as follows:

$$
\begin{aligned}
y_b^{\frac{1}{s}} \cdot \left(\frac{\phi_b^*}{1-\phi_b^*} \cdot \frac{\delta_p}{\delta_g}\right)^{-\frac{1}{s}} &= \frac{k}{q(\theta_b)}\,(r + \delta_g) + \frac{\beta r}{r + \delta_g} y_b \\
y_b^{\frac{1}{s}} \cdot \left(\frac{\phi_b^{***}}{1-\phi_b^{***}} \cdot \frac{\delta_p}{\delta_g}\right)^{-\frac{1}{s}} &= \frac{k}{q(\theta_b)}\,(r + \delta_g) + \frac{\beta r}{r + \delta_g} y_b + \gamma \frac{\beta r}{r + \delta_g}(y_a - y_b) - \tau_b
\end{aligned}
$$

Notice that $\phi_b^{***} < \phi_b^*$ if and only if inequality in (26) holds and $\lambda_b \leq \lambda_a$. In turn, for equation (7), $p_b^{***} > p_b^* \Leftrightarrow \phi_b^{***} < \phi_b^*$.

Since $p_b^* = \left\{1 + \left[\frac{y_b}{r+\delta_p}(r + (1-\beta)\delta_g)\right]^{1-s}\right\}^{\frac{1}{1-s}}$, a sufficient

condition for inequality in (26) to hold is

$$\tau_b < \frac{\lambda_b}{\lambda_a}\cdot\frac{\beta r}{r+\delta_p}(y_a-y_b)\cdot\left\{\frac{\left\{1+\left[\frac{y_b}{r+\delta_p}\left(r+(1-\beta)\delta_g\right)\right]^{1-s}\right\}^{\frac{1}{1-s}}}{\left\{1+\left[\frac{y_b}{r+\delta_p}\left(r+(1-\beta)\delta_g\right)\right]^{1-s}\right\}^{\frac{1}{1-s}}+\frac{\lambda_a}{\lambda_b}}\right\}^2 \tag{27}$$

If inequality in (27) holds, $\frac{d\,\mathbb{GI}_a}{d\,\phi_a} < 0$.
Similarly, we have:

$$\frac{d\,\mathbb{GI}_a}{d\,\phi_b} = \Gamma_b'\left[-\Gamma_a^{-1}\tau_b+\frac{\beta r}{r+\delta_p}\frac{\Gamma_a(y_a-y_b)}{(\Gamma_a+\Gamma_b)^2}\right] > 0 \Leftrightarrow \tau_b < \frac{\beta r}{r+\delta_p}\gamma^2(y_a-y_b)$$

Again, a sufficient condition for the last inequality is the one in (27).
To conclude, if the condition in (27) holds, $\frac{d\,\mathbb{GI}_a}{d\,\phi_a} < 0$ and $\frac{d\,\mathbb{GI}_a}{d\,\phi_b} > 0$, and the implicit function $\mathbb{GI}_a(\phi_a, \theta_a, w_g) = 0$ describes an increasing relationship in the (ϕ_b, ϕ_a) space. It is then easy to check that there exists a unique vector $(\phi_b^{***}, \phi_a^{***})$ that solves the system composed by $\mathbb{GI}_a(\phi_a, \theta_a, w_g) = 0$ and $\mathbb{GI}_b(\phi_b, \theta_b, w_g) = 0$.

Comparative statics

Under regional bargaining, the zero-profit condition $\mathbb{ZP}(\theta_i) = 0$ and $\mathbb{GI}_i(\phi_i, \theta_i, w_{g,b}) = 0$ respectively determine θ_i and ϕ_i, for $i \in \{a, b\}$. Both θ_a and θ_b do not change under this third scenario, since $\mathbb{ZP}(\theta_i) = 0$ is unaffected by τ_b, for $i \in \{a, b\}$. Inspecting $\mathbb{GI}_i(\phi_i, \theta_i, w_{g,i}) = 0$, one gets that τ_b lowers ϕ_a and raises ϕ_b. So we have $\phi_b^{***} > \phi_b^*$ and $\phi_a^{***} < \phi_a^*$. The remaining

algebra is straightforward. Since $\phi_b^{***} > \phi_b^*$, then $p_b^{***} < p_b^*$ for equation (7) and, consequently, $w_{p,b}/p_b^{***} > w_{p,b}/p_b^*$. Moreover, $E_b^{***} > E_b^*$ because θ_b takes the same value in both scenarios and E_b increases with ϕ_b.

By the same token, $\phi_a^{***} < \phi_a^*$ implies that $p_a^{***} > p_a^*$ and $w_{p,a}/p_a^{***} < w_{p,a}/p_a^*$. Moreover, $E_a^{***} < E_a^*$ because θ_a takes the same value in both scenarios and E_a increases with ϕ_a.

Even under national bargaining one has $\frac{d\,\mathbb{GI}_a}{d\,\tau_b} < 0$ and $\frac{d\,\mathbb{GI}_b}{d\,\tau_b} > 0$. Applying the implicit function theorem to the system composed by $\mathbb{GI}_a(\phi_a,\, \theta_a,\, w_g) = 0$ and $\mathbb{GI}_b(\phi_b,\, \theta_b,\, w_g) = 0$, I get:

$$\frac{d\,\phi_b}{d\,\tau_b} \;=\; -\frac{\frac{d\,\mathbb{GI}_a}{d\,\phi_a}\cdot\frac{d\,\mathbb{GI}_b}{d\,\tau_b} \;-\; \frac{d\,\mathbb{GI}_a}{d\,\tau_b}\cdot\frac{d\,\mathbb{GI}_b}{d\,\phi_a}}{\frac{d\,\mathbb{GI}_a}{d\,\phi_a}\cdot\frac{d\,\mathbb{GI}_b}{d\,\phi_b} \;-\; \frac{d\,\mathbb{GI}_a}{d\,\phi_b}\cdot\frac{d\,\mathbb{GI}_b}{d\,\phi_a}} \;>\; 0.$$

$$\frac{d\,\phi_a}{d\,\tau_b} \;=\; -\frac{\frac{d\,\mathbb{GI}_a}{d\,\tau_b}\cdot\frac{d\,\mathbb{GI}_b}{d\,\phi_b} \;-\; \frac{d\,\mathbb{GI}_a}{d\,\phi_b}\cdot\frac{d\,\mathbb{GI}_b}{d\,\tau_b}}{\frac{d\,\mathbb{GI}_a}{d\,\phi_a}\cdot\frac{d\,\mathbb{GI}_b}{d\,\phi_b} \;-\; \frac{d\,\mathbb{GI}_a}{d\,\phi_b}\cdot\frac{d\,\mathbb{GI}_b}{d\,\phi_a}}$$

Thus we have:

$$\text{sign}\left[\frac{d\,\phi_a}{d\,\tau_b}\right] \;=\; \text{sign}\left[-\frac{d\,\mathbb{GI}_a}{d\,\tau_b}\cdot\frac{d\,\mathbb{GI}_b}{d\,\phi_b} \;+\; \frac{d\,\mathbb{GI}_a}{d\,\phi_b}\cdot\frac{d\,\mathbb{GI}_b}{d\,\tau_b}\right] \qquad (28)$$

The RHS in (28) is equal to:

$$\left\{\frac{\Gamma_b}{\Gamma_a}\left[\frac{d\,F'(Q_{g,\,b})p_b}{d\,\phi_b} \;-\; \frac{\beta\,r}{r \;+\; \delta_p}(y_a \;-\; y_b)\frac{d\,\gamma}{d\,\phi_b}\right] \;-\; \frac{\beta\,r}{r \;+\; \delta_p}(y_a \;-\; y_b)\frac{d\,\gamma}{d\,\phi_b}\right\} \;=$$

$$=\; \frac{\Gamma_b}{\Gamma_a}\frac{d\,F'(Q_{g,\,b})p_b}{d\,\phi_b} \;-\; \frac{\Gamma_a \;+\; \Gamma_b}{\Gamma_a}\frac{\beta\,r}{r \;+\; \delta_p}(y_a \;-\; y_b)\frac{d\,\gamma}{d\,\phi_b} \;=$$

$$=\; \frac{1 \;-\; \gamma}{\gamma}\cdot\frac{1}{d\,\phi_b}\cdot d\left[y_b^{\frac{1}{s}}\cdot\left(\frac{\phi_b}{1-\phi_b}\cdot\frac{\delta_p}{\delta_g}\right)^{-\frac{1}{s}}\right] \;-\; \gamma\frac{\beta\,r}{r \;+\; \delta_p}(y_a \;-\; y_b)\frac{d\,\gamma}{d\,\phi_b}$$

Notice that the last term is negative if it is negative the derivative in (25). So the condition imposed in Lemma 1 to ensure the existence of a unique equilibrium, namely

$$y_b > s\frac{\beta r}{r + \delta_g(1-\beta)}(y_a - y_b),$$

also guarantees that $\frac{d\phi_a}{d\tau_b} < 0$.
To sum up the results of the comparative statics, we have that $\phi_b^{***} > \phi_b^{**}$ and $\phi_a^{***} < \phi_a^{**}$. This are exactly the same conclusions reached under regional bargaining. The effects of τ_b on the other variables of interest are therefore identical to that setting.

References

Alesina, A., R. Baqir, and W. Easterly (2000): "Redistributive Public Employment," Journal of Urban Economics, 48, 219 – 241.

Alesina, A., S. Danninger, and M. Rostagno (2001): "Redistribution Through Public Employment: The Case of Italy," IMF Staff Papers, 48, n.3.

Alesina, A., and F. Giavazzi (2011): "Dieci Proposte (a Costo Zero) per Dare una Scossa all'Italia," Corriere della Sera, 24 / 10 / 2011.

Alesina, A., and R. Perotti (1997): "The Welfare State and Competitiveness," The American Economic Review, 87, 921 – 939.

Bender, K. (2002): "The Central Government-Private Sector Wage Differential," Journal of Economic Surveys, 12, 177 – 220.

Borjas, G. (1986): "The Earnings of State Government Employees in the United States," Journal of Urban Economics, 19, 156 – 173.

——— (2002): "The Wage Structure and the Sorting of Workers into the Public Sector," NBER Working Paper No. 9313.

Calmfors, L., and J. Driffil (1988): "Bargaining Structure, Corporatism, and Macroeconomic Performance," Economic Policy, 6, 12 – 61.

Cannari, L., and G. Iuzzolino (2009): "Le Differenze nel Livello dei Prezzi al Consumo tra Nord e Sud," Banca d'Italia Occasional Papers N. 49.

Caponi, V. (2008): "Centralized Wage Determination and Regional Unemployment Differences: The Case of Italy," IZA DP N. 3592.

Coate, S., and S. Morris (1995): "On the Form of Transfers to Special Interests," Journal of Political Economy, 103, 1210 – 1235.

Dell'Arringa, C., C. Lucifora, and F. Origo (2007): "Public Sector Pay and Regional Competitiveness: A First Look at Regional Public-Private Wage Differentials in Italy," The Manchester School, 75, 445 – 478.

Ehrenberg, R. G., and J. L. Schwarz (1986): "Public Sector Labor Markets," in Handbook of Labor Economics, Volume 2. O. Ashenfelter and R. Layard, editors, Elsevier Science Publisher (North-Holland), Amsterdam.

Elliott, R., K. Mavromaras, and D. Meurs (2007): "Special Issue on Public Sector Pay Structures and Regional Competitiveness: Editors' Introduction," The Manchester School, 75, 373–385.

Fogel, W., and D. Lewin (1974): "Wage Determination in the Public Sector," Industral and Labor Relations Review, 5, 410 – 432.

Garcia-Perez, I., and J. Jimeno (2007): "Public Sector Wage Gaps in Spanish Regions," The Manchester School, 75, 501 – 531.

Gregory, R., and J. Borland (1999): "Recent Developments in Public Sector labor Markets," in Handbook of Labor Economics, Volume 3C. O. Ashenfelter and D. Card, editors, Elsevier Science Publisher (North-Holland), Amsterdam.

Hall, R., and P. Milgrom (2008): "The Limited Influence of Unemployment on the Wage Bargain," The American Economic Review, 98, 1653 – 74.

Heitmueller, A., and K. Mavromaras (2007): "On The Post-Unification Development of Public and Private Pay in Germany," The Manchester School, 75, 422 – 444.

Hobijn, B., and A. Sahin (2007): "Job-finding and Separation Rates in the OECD," Federal Reserve Bank of New York, Staff Report n. 298.

ISTAT (2008): "Rilevazione sulle Forze di Lavoro," Istituto Nazionale di Statistica.

——— (2009): "I Posti Vacanti presso le Imprese dell'Industria e dei Servizi," Istituto Nazionale di Statistica.

——— (2010): "La Mobilità nel Mercato del Lavoro," Istituto Nazionale di Statistica.

——— (2011): "Il Reddito Disponibile delle Famiglie nelle Regioni Italiane," Istituto Nazionale di Statistica.

Jolivet, G., F. Postel-Vinay, and J.Robin (2006): "The Empirical Content of the Job Search Model: Labor Mobility and Wage Distributions in Europe and the US," European Economic Review, 50, 877–907.

Kahn, L. (2000): "Wage Inequality, Collective Bargaining, and Relative Employment from 1985 to 1994: Evidence from Fifteen OECD Countries," Review of Economics and Statistics, 82, 564–579.

Katz, L., and A. Krueger (1991): "Changes in the Structure of Wages in the Public and Private Sector," NBER Workin Paper, 3667.

Lemieux, T. (1998): "Estimating the Effects of Unions on Wage Inequality in a Panel Data Model with Comparative Advantage and Nonrandom Selection," Journal of Labor Economics, 2, 261–291.

MEF (2010): "Conto Annuale 2007 -2008 -2009," Ministero dell'Economia e delle Finanze.

Meurs, D., and C. Edon (2007): "France: A Limited Effect Of Regions On Public Wage Differentials?," The Manchester School, 75, 479 – 500.

Mocetti, S., and C. Porello (2010): "La Mobilità del Lavoro in Italia: Nuove Evidenze sulle Dinamiche Migratorie," Banca d'Italia, Occasional Papers no. 61.

Moretti, E. (2011): "Local Labor Markets," in Handbook of Labor Economics, Volume 4B. O. Ashenfelter and D. Card, editors, Elsevier Science Publisher (North-Holland), Amsterdam.

Obstfeld, M., and K. Rogoff (1996): Foundations of International Macroeconomics. Cambridge, Mass: MIT Press.

Pissarides, C. (2000): Equilibrium Unemployment Theory. 2nd edition, Cambridge, Mass: MIT Press.

Rosen, A. (1997): "An Equilibrium Search-Matching Model of Discrimination," European Economic Review, 41, 1589–1613.

Smith, A. (1776): An Inquiry into the Nature and Causes of the Wealth of Nations. London: Methuen.

Strom, B. (1999): "Fiscal Institutions and Wage Bargaining in the Local Public Sector," Scandinavian Journal of Economics, 101, 67–82.

Calibration			
Variable	Value	Interpretation	Target
$\delta_{p,\,a}$	0.405%	private sector separation rate in a	Jolivet et al. (2006)
$\delta_{p,\,b}$	0.408%	private sector separation rate in b	Jolivet et al. (2006)
δ_g	0.36%	separation rate in the public sector	MEF (2010)
λ_a	0.01%	migration rate of the unemployed in a	Mocetti and Porello (2010)
λ_b	0.01%	migration rate of the unemployed in b	equation (4)
ϕ_a	0.1	share of public vacancies in a	MEF (2010); ISTAT (2008)
ϕ_b	0.16	share of public vacancies in b	MEF (2010); ISTAT (2008)
r	0.00083	discount rate	1% on annual basis.
θ_a	0.4	tightness in region a	equation (5)
θ_b	0.06	tightness in region b	equation (5)
$\beta_{p,\,a}$	0.40	bargaining power in the private sector in a	$w_{p,\,a}/w_{p,\,b}$ about 1.1
$\beta_{p,\,b}$	0.54	bargaining power in the private sector in b	$w_{p,\,a}/w_{p,\,b}$ about 1.1
y_a	2.9	private productivity in region a	$\mathbb{ZP}(\theta_b) = 0$
y_b	1.9	private productivity in region b	$\mathbb{G}(\phi_a,\,\theta_a) - \mathbb{G}(\phi_b,\,\theta_b) = 0$
k	98.1	flow cost of opening a vacancy	$\mathbb{ZP}(\theta_a) = 0$
β_g	0.84	bargaining power in the public sector	$\mathbb{G}(\phi_a,\,\theta_a) = 0$

Table 1. Calibration procedure

Comparison between the First and Second Scenario		
Variables	Region a	Region b
Cost of living	0.82%	−6.04%
Unemployment rate	0.24%	−1.7%
Real wage in the private sector	−0.82%	6.43%
Real wage in the public sector	17.8%	−34.7%
Public sector wage premium	18.8%	−38.6%
Wage variance	617%	137%
Aggregate Variables		
Unemployment rate		−0.43%
Average real wage		−1.43%
Average public sector real wage		−15.8%
Average private sector real wage		1.28%
Taxes per capita		−3.85%
Gini index		21.1%
Highest to lowest wage in the economy		41.8%
Wage variance		313.1%

Table 2. Simulation Results. Percentage changes when nominal public wages vary by region.

Third Scenario		
Variables (% change)	Regional bargaining	National bargaining
u_a	0.63	0.11
u_b	−2.4	−0.55
p_a	2.24	0.37
p_b	−8.6	−2.04
$w_{g,\,a}/p_a$	16.2	−5.3
$w_{p,\,a}/p_a$	−2.2	−0.37
$w_{g,\,b}/p_b$	−32.8	−2.96
$w_{p,\,b}/p_b$	9.4	2.08
wage variance in region a	347	−79
wage variance in region b	171	73.5
Aggregate Variables		
unemployment rate	−0.43	−0.12
Average real wage	−2.76	−0.10
Average public real wage	−21.2	−3.67
Average private real wage	0.88	0.41
Gini index	21.4	−9.4
Wage variance	231.5	−48.8
Highest to lowest wage	57.2	−4.9

Table 3. Third Scenario: Financing 10% of the cost of the public good in b through taxes in the public sector in a. Results under both public wage policies.

Working Papers recently published

(The complete list of working papers can be found at http.//www.disefin.unige.it)

n.1/2012 Amedeo Fossati, "The Italian Tradition in Public Finance: an Annotated Bibliografy of Mauro Fasiani", January 2012

n.7/2011 Amedeo Fossati, Marcello Montefiori, "Adverse Selection in Elderly Care", November 2011

n.6/2011 Paolo Cremonesi, Enrico di Bella, Marcello Montefiori, Luca Persico, "A self-reported work sampling to assess the Emergency Department's costs", October 2011

n.5/2011 Enrico di Bella, Luca Persico, Matteo Corsi, "A Multivari-ate Analysis Of The Space Syntax Output For The Definition Of Strata In Street Security Surveys", September 2011

n.4/2011 Elena Briata, "Marginal tax rates, tax revenues and inequal-ity. Reagan's fiscal policy", July 2011

n.3/2011 Francesco Copello, Cristiana Pellicanò, "Esemplificazione della Data Envelopment Analysis per la valutazione di effi-cienza in una grande azienda ospedaliera universitaria"

n.2/2011 Stefano Capri, Rosella Levaggi, "Shifting the risk in pricing and reimbursement schemes? A model of risk-sharing agree-ments for innovative drugs"

n.1/2011 Cinzia Di Novi, "The Indirect Effect of Fine Particulate Matter on Health through Individuals' Life-style"

n.4/2010 Angelo Baglioni, Andrea Monticini, "Why does the Interest Rate Decline Over the Day? Evidence from the Liquidity Cri-sis"

n.3/2010 Amedeo Fossati: "The double taxation of savings: the Ital-ian debate revisited"

n.2/2010 Andrea Monticini, David Peel, Giacomo Vaciago: "The im-pact of ECB and FED announcements on the Euro Interest Rates"

n.1/2010 Amedeo Fossati: "Vilfredo Pareto and the methodology of the Italian tradition in public finance"