

# How do bureaucratic budget competition and collective bargaining affect the share of temporary employment?

by

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This paper will present a two–period model in which two bureau–union units, due to the presence of a tenured labour constraint, negotiate sequentially over employment and wages, under the hypotheses that the bureaus maximise output and the sponsor can commit itself to an overall budget. The paper will show that, when both tenured and temporary workers are essential in production, the extent and strength of collective bargaining power of unionised permanent workers, jointly with bureaucratic strategic incentives in budget competition, will determine a sub–optimal allocation of inputs. As a result, strategic over–hiring of permanent workers may emerge in symmetric equilibrium.

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## *1 Introduction*

Which factors affect the choice of the labour input mix between permanent employment and temporary employment in the Public Administration (hereafter PA), namely in the public sector agencies producing non–marketable services?

An answer to this question cannot ignore two distinctive features of PA employment, which are observed particularly, but not exclusively, in many European countries. The first feature is the high degree of job security enjoyed by workers who are hired under tenured and open–ended labour contracts. These contracts have characterized historically employment relationships in the civil service. In many EU countries, the nature of these contracts limits greatly the ability of PA employers to dismiss workers, except for disciplinary reasons and for poor performance on the job.<sup>1</sup> In other words, once a PA appoints a worker under a permanent contract, it cannot dismiss her easily thereafter.

Trade unions are the second distinctive feature of labour market institutions in the European PA sector. Actually, trade union density (i.e., the ratio of union workers over total workers) is systematically higher in the PA than in the private sector (Visser, 2019a, series 172, 217).<sup>2</sup> Moreover, it is a well–known fact that temporary workers are less likely to be unionised than permanent workers (e.g. Salvatori, 2012; Visser, 2019b, p. 36).

This evidence has a two–fold implication. First, as Konrad and Kessing (2008) pointed out, tenured labour becomes a fixed factor of production. This fact also implies that, for the majority of PA services, tenured employment is a less flexible variable than wages, a characteristic already underscored by Babcock and Engberg (1997) and Falch (2001). Second, because of the high degree of job protection enjoyed by the typical worker, public sector employers may seek to achieve flexibility in the use of the labour force by other means. These include a more extensive adoption of temporary contracts than in other sectors (OECD, 2014, Fig. 4A.1.1), and the freezing of recruitment and turnover in times of public budget crisis (Bach and Bordogna, 2016).

Related to the diffusion of temporary contracts, in the past two decades a two–tier labour market has emerged in the European public sector. In this market, tenured workers operate alongside temporary workers in the same workplace (Checchi, Fenizia and Lucifora, 2020, section 1.4). Moreover, it is observed that temporary contracts are often used to hire peripheral workers (including workers who are unskilled or have limited skills) who are not perfect substitutes for core workers on permanent contracts (possessing unique skills for the organisation), who are younger and who are subject to higher labour turnover (e.g. Bosch, 2013, pp. 223–224, for Germany). These features are not limited to Europe. For example, Mastracci and Thompson (2009) documented the presence of a core/ring structure, associated to the permanent contracts–temporary contracts divide, in the U.S. federal government labour market.

Based on these features (i.e., the presence of a tenured labour constraint; the less flexible nature of tenured employment vs. the tenured wage; the higher unionisation rates for workers on permanent

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<sup>1</sup> For example, central PA workers cannot be dismissed for economic reasons in Austria, Belgium, Germany, Greece, Ireland, Italy, Portugal and Spain. Strong job protection is enjoyed in France, the Netherlands and the Nordic countries. Tenured contracts are often, but not exclusively, governed by public law, while temporary contracts tend to be governed by labour law, Demmke and Moilanen (2012, pp. 77–88).

<sup>2</sup> In the EU–22 countries, the unweighted average union density rate was equal to 52.4% in PA vs. 29.4% in the private sector in the 2010s.

contracts; the core/ring structure), this paper will present a theoretical model that mixes PA unionisation à la Falch (2001)– thus assuming that the tenured employment decision is made before the wage decision– with Konrad and Kessing (2008)’s two–period model of bureaucratic activity. The model will consider two output–maximising bureaus, competing over budget allocations made by a political sponsor before production occurs, and which supply non–marketable services by combining (unionised) permanent labour with (non–unionised) temporary labour. When collective bargaining occurs at the bureau–level, the model will generate a negative relation between the ratio of temporary workers to permanent workers (i.e., the temporary contract rate, henceforth TCR) and the union bargaining power over wages.

The key mechanism for this negative relation to emerge is the strategic incentive of PA employers to over–hire permanent workers so as to induce union wage moderation. Moreover, as Konrad and Kessing (2008) showed for complementary inputs, when labour types are not too close substitutes in the bureaucratic production function, PA employers will tend to over–hiring permanent workers in an attempt at obtaining larger budget appropriations. The interaction of union bargaining within agencies and bureaucratic budget competition between agencies will give each bureaucracy enhanced incentives to over–hiring permanent workers. Both the union wage moderation and the budget competition incentives will arise because the tenured labour constraint pre–commits PA employers and unions to choosing employment levels before wages.

The paper is organised as follows. Section 2 will present a review of the related literature. Section 3 will outline a model of the determinants of the share of temporary contracts. This section will assume bureau–level collective bargaining and a Cobb–Douglas bureaucratic production function, implying that both labour types are essential in production. Hence, Section 3 will focus on the bureaucratic choice of the labour input mix at the intensive margin. Section 4 will extend the model to the cases of multi–employer bargaining (Subsection 4.1), and of a V.E.S. technology (Subsection 4.2)–where permanent labour is the only essential input– under the hypothesis of wage negotiations only. The former extension will show that the sign of the relationship between the TCR and the union bargaining power may change when union power is high, given that the internalisation of wage externalities by the encompassing union raises the expected wage cost of tenured employment. The latter extension will allow us to consider the bureaucratic choice of temporary workers at the extensive margin. Section 5 will present an empirical test of the model’s main prediction based on a small dataset for a sample of European countries. Section 6 will conclude.

## 2 *Related Literature*

There is a renewed academic interest in economics for the workings of public sector labour markets (see Garibaldi, Gomes, and Sopraseuth, 2021, for a recent contribution). A large part of the literature assumes that governments/political sponsors choose public employment levels unilaterally, while wages can deviate from the competitive outcome because of either monopsony power or collective bargaining.<sup>3</sup> Public sector labour market outcomes emerge under the constraint of a public budget. The public budget introduces a trade–off between employment levels and the wage, by playing a role similar to that of market demand in the private sector (Freeman, 1986).

Regarding collective bargaining in the public sector, there are two different but complementary approaches. A first strand of the literature underscores the union’s political role as a pressure group.

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<sup>3</sup> The more recent literature adopting the search and matching framework typically considers public–private two sector models. This literature often assumes exogenous public wages, and sometimes exogenous employment levels, and analyses the labour market effects of changing these, e.g. Chassamboulli and Gomes (2021).

According to this approach (for example, Courant, Gramlich, and Rubinfeld, 1979), public sector unions can obtain larger budget allocations through the political process (for example, by mobilising voters for an expansion in public services). In this way, unions can increase labour demand and employment, relaxing the trade-off (see Garibaldi and Gomes, 2020, pp 87–89 for a survey of the empirical evidence).<sup>4</sup> A second strand of the literature analyses wage bargaining or efficient bargaining subject to a hard public budget constraint, which takes the form of exogenous cash limits (Leslie, 1985, Holmlund, 1997; but see Strøm, 1999, for softer endogenous budgets; Checchi, Fenizia, and Lucifora, 2020, pp. 34–38 survey the empirical evidence on collective bargaining).

However, albeit modelling the interaction between public employers and trade unions, none of these papers considered explicitly the tenured nature of public employment. A notable exception is Falch (2001), who captured this feature by assuming that employment is determined before wages in collective bargaining. His model allowed for a joint determination of contractual variables through agency-level negotiations between an output-maximising bureau and a trade union, with non-labour expenditures being determined residually from the public budget. Falch's key finding (see his Proposition 4) was that equilibrium employment was higher and output was lower when negotiators faced a soft budget constraint (i.e., a budget set after negotiations) rather than a hard budget constraint (i.e., a budget set before negotiations). The intuition for his result is that, when the bureau and the union can use employment as a strategic variable, the bureau can obtain a larger budget from its government sponsor. However, because of union pressures, the bureau ends up allocating this budget inefficiently towards labour rather than the complementary input.

At the basis of Konrad and Kessing (2008) model there was as well the idea that bureaus would use employment commitments as a strategic device in an attempt at tilting budget allocations in their favour, and that this situation would generate sub-optimal over-hiring of labour with complementary inputs. However, their framework was different. First, these authors assumed exogenous public sector wages. Second, they modelled tenured employment explicitly, by considering a dynamic model. Third, they assumed that the political sponsor could commit itself to a given budget. However, due to the presence of output-maximising bureaus competing over budget allocations, the strategic hiring incentives were still at work in their model.

To be sure, the effect of unions on the choice of the labour input mix is a relatively underdeveloped area of study. Contributions are mainly empirical. The scant evidence for Europe, which is based predominantly on private sector data, finds inconclusive results as regards the direction of the link between the TCR and unionisation.<sup>5</sup> This literature points to different mechanisms that may be at work. First, there is a direct effect of unionisation on the observed TCR at the workplace level. Union attitudes towards temporary contracts are mainly shaped by the high likelihood that a permanent worker is also a union member, which gives rise to a trade-off. On the one hand, unions may favour temporary contracts as a buffer, namely as a way of insulating core union workers on permanent contracts from fluctuations in labour demand. On the other hand, unions may oppose temporary contracts, because they fear that the presence of an exceedingly large fraction of non-unionised temporary workers might weaken their bargaining position. Second, there is an indirect effect, working through employer adoption of temporary contracts as a tool for pre-empting unionisation (Hatton, 2014).

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<sup>4</sup> This approach originates from Tullock (1974)'s public-sector factor-supplier pressure group hypothesis.

<sup>5</sup> Devicienti, Naticchioni, and Ricci (2018) and the references therein cited. The discussion of this section draws heavily on their paper.

However, the incentives to using temporary contracts do not fully align in the PA and private sectors. On the one hand, PA employers may be more willing to hire temporary workers than their private counterparts as they represent the only way to gain labour input flexibility in the face of budgetary restrictions. However, temporary contracts may be less attractive as cost-containing tools when temporary workers substitute for permanent workers. In fact, at least in the European Union, workers must receive equal pay for comparable jobs, irrespective of the length of contract.<sup>6</sup> Although reclassification of workers' tasks is possible to circumvent this limitation, this strategy is less likely to be pursued in the PA. Moreover, because PA workers on permanent contracts cannot be easily dismissed, PA employers may find it optimal to over-hire permanent workers when facing budgetary limits. In this way, they can induce unions to moderate their wage claims. Thus, using this strategy, PA employers may increase the level of bureaucratic activity for a given budget. This mechanism will be investigated below.

On the other hand, PA unions may trade-off employment and wages, and evaluate temporary contracts, differently from what private sector unions do. One may argue that PA unions are likely to put more weight on employment increments under permanent contracts, since each extra union job today will be (almost) forever. This should imply a lower degree of wage orientation of PA unions relatively to private sector unions.<sup>7</sup> This preference for permanent jobs can be associated to political and institutional goals, and to the union's belief that a stronger organisation will be able to securing higher wages for workers as well as to obtaining larger budget allocations. The model presented below, however, will abstract from these incentives.

### 3 The Model

This section presents a two-period model of the choice of the labour input mix in PA. To this purpose, the section introduces unionisation with sequential employment-wage negotiation at the bureau level as in Falch (2001) into Konrad and Kessing (2008)'s (KK) model of bureaucratic activity.

#### 3.1 The Model's Assumptions

There are two periods:  $t=1, 2$ . At the start of each period, a political sponsor allocates an exogenous budget  $B$  to non-market activities. These activities are produced by two bureaus, such that  $B=b_{xt}+b_{yt}>0$ , where  $b_{it}$  is the operating budget the sponsor allocates to each bureau  $i=x, y$  at time  $t=1, 2$ . In each period, the bureau services enter log-linearly into the sponsor's objective function:

$G_t = \ln X_t + \ln Y_t$ , where  $X$  and  $Y$  are the bureau's  $i=x, y$  services, respectively. After the budgetary allocation at  $t=1$  has been made, each bureau chooses simultaneously and independently the number of permanent workers  $\ell_{i1}$  who are hired for the two periods, and the number of temporary workers  $z_{i1}$  who are hired for the  $t=1$  single period to produce output. At the start of period  $t=2$ , after the sponsor has made a new budgetary allocation of  $B$ , each bureau hires simultaneously and independently temporary workers  $z_{i2}$  by combining them with the permanent workers hired at  $t=1$ . Then,  $t=2$  bureaucratic production occurs. In both periods, bureaus use a symmetric Cobb-Douglas production technology:

$$(1) \quad O_t = \ell_{i1} f\left(\frac{z_{it}}{\ell_{i1}}\right) = \ell_{i1} \left(\frac{z_{it}}{\ell_{i1}}\right)^{1-\alpha},$$

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<sup>6</sup> This is the no discrimination principle embedded in art 4(1) of the EU Directive 1990/70 on temporary contracts.

<sup>7</sup> The evidence on union preferences is scant and focuses on private sector's unions. For example, Dumont, Rayp, and Willemé (2006, 2012) found that most EU manufacturing unions were wage oriented over the 1990–2008 period, though union rent maximisation was present in several sectors.

$O=\{X, Y\}$ , and  $i=x, y$ ;  $\alpha \in (0,1)$  is the tenured labour input elasticity of output;<sup>8</sup>  $\frac{z_{it}}{\ell_{i1}}$  denotes the share

of temporary workers over permanent workers, or TCR, at time  $t$ . Workers under permanent contracts are interpreted as core or experienced workers. Workers under temporary contracts are interpreted as peripheral or less experienced workers. The key assumption of Eq. (1) is that both labour types are essential in production. (This assumption will be relaxed in Section 4.2 by considering a V.E.S. technology with substitutes.)

The sponsor has full knowledge of each bureau's production function. This assumption rules out the possibility of bureaucratic slack.

Turning to bureaucratic preferences, the two head of bureaus pursue the goal of output maximisation:

$$(2) \quad V_O = O_1 + O_2,$$

$O=\{X, Y\}$ . For simplicity, the discount factor is equal to one. Output maximisation is a standard assumption both in the literature of public sector collective bargaining (Holmlund, 1997; Falch, 2001) and in the economics of bureaucracy (Niskanen, 1971, KK).<sup>9</sup> The budget allocation  $b_{it}$  from the sponsor implies that each bureau in each period faces the following budget constraint:

$$(3) \quad b_{it} \leq w_i^\ell \ell_{i1} + w^z z_{it},$$

$i=x, y, t=1, 2$ .  $w_i^\ell$  is the tenured wage, while  $w^z$  is the temporary labour wage, with  $w^\ell \geq w^z$ . The temporary wage is an exogenous reservation wage. The permanent wage will be determined endogenously as a result of bureau-level collective bargaining. Given these assumptions, output maximisation can be interpreted as a proxy for a result-oriented bureaucracy, which is instructed by its political sponsor to achieve output or productivity targets in a context of cash limits for the overall PA sector.

The typical bureau-level union maximises

$$(4) \quad U_{it} = (w_i^\ell - w^z) \ell_{i1} \quad ,$$

$i=x, y, t=1, 2$ . Eq. (4) is interpreted as the union leadership's utility. The leadership cares equally about a union wage premium over the exogenous reservation wage, and the level of union membership. This assumption reflects a higher concern for membership employment by part of PA unions relatively to private sector unions (see Section 2 above for a rationale and footnote 7). It is important to notice that the baseline model's results would not change qualitatively if the union's utility function allowed for different weights for employment and the wage premium.<sup>10</sup> The rank- and file union members are the permanent workers, who are secure in their jobs once they are hired at  $t=1$ . They evaluate the union leadership's wage performance by comparing their wage  $w_i^\ell$  with the wage of temporary workers  $w^z$ .

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<sup>8</sup> KK (2008: 10) illustrated their results using a Cobb–Douglas technology, although they interpreted  $z_{it}$  as a non-labour input. Falch (2001) adopted the same assumption. Adding a non-labour input would not change qualitatively this model's results.

<sup>9</sup> Budget maximisation (Niskanen's original assumption) is equivalent to output maximisation under a binding bureau's budget (see Migué and Bélanger, 1974: 29).

<sup>10</sup> In this case, the equilibrium TCR would contain an extra-parameter (i.e., the "degree of wage orientation"). The higher the union's wage orientation, the higher the incentive of each head-of-bureau to use permanent employment as a union wage-moderation device.

Temporary workers are union non-members. This assumption reflects the fact that union membership is usually much lower for workers under temporary contracts than under open-ended contracts (Visser, 2019a, series 163, 164).<sup>11</sup> This holds true for public sector jobs as well. For example, Blanchflower and Bryson (2010) documented for the UK that non-unionised workers were more likely to be on temporary contracts than unionised workers in the public sector than they were in the private sector.

The hypothesis that PA union leadership tends to neglect the utility of temporary workers is consistent with Checchi, Fenizia and Lucifora (2020, p. 123)'s observation that public sector unions are inclined to protect the "insiders" rather than the workers in atypical jobs. These latter usually experience more precarious job guarantees than the former. This assumption is also consistent with the reality of a weak union's initiative in Europe to recruit workers in atypical jobs or contracts (Pedersini, 2010), at least until the more recent "union revitalisation strategy" targeting non-standard workers begins (Visser 2019b, pp. 34–38).<sup>12</sup> In other words, to the extent that the leadership cares about membership, it will try to secure more permanent jobs, rather than more employment in the bureau. One possible explanation for this behaviour is that the leadership finds it too costly to convince workers on temporary contracts to join the union (because, say, it is more likely that temporary workers will leave the workplace after one period).

Bureau-level collective bargaining is observed in several European countries. However, there remain national differences as regards the role played by decentralised bargaining vis-à-vis sectoral and national bargaining levels. Nomden, Farnham, and Onee-Abbruciati (2003, p. 413) argued that "collective bargaining in public services is neither completely centralised nor completely decentralised" in the EU. Considering the institutional features of public sector collective bargaining in the EU, Checchi, Fenizia, and Lucifora (2020, p. 3) concluded that "the wage rate tends to be centrally determined, but individual pay rise and working conditions tend to be negotiated at lower levels."

This section models the bargaining process at the bureau level (as observed, for example, in the UK civil service). This assumption will be relaxed in Section 4.1 below. At time  $t=1$ , for given allocated budget, a simultaneous and independent negotiation between each head of bureau and its bureau-level union determines both the number of tenured workers hired for both periods, and the number of temporary workers (who are hired for the current period only). Subsequently, each head-of-bureau-union bargaining unit negotiates simultaneously and independently the tenured worker's wage. The tenured wage holds for both periods. Temporary workers receive the reservation wage. At  $t=2$ , given the number of tenured workers and wages, each bureau determines the number of temporary workers as a residual from the new allocated budget. Figure 1 summarizes the model's timeline.

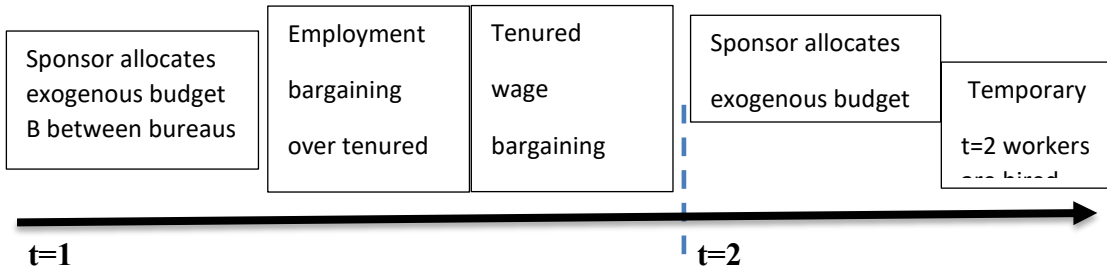
The assumption of a sequential negotiation first on employment then on wages follows Falch (2001)'s application of the Manning (1987) model to the public sector. It captures the idea that, in the public sector, the tenured workers wage is changed more frequently than their employment level.

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<sup>11</sup> Workers may want to join unions because they wish to obtain individual insurance against the risk of dismissal. This effect, though, should be stronger for private sector jobs. Indeed, Goerke and Pannenberg (2011) showed that in Germany job security is higher individually for union members than for non-members.

<sup>12</sup> Gumbrell-McCormick (2011, p. 300) documented an early extreme example of union leadership's neglect of temporary workers: "In Belgium, public sector unions often restricted recruitment to those with the official status of 'public servants' (*fonctionnaires* or *ambtenaren*), while excluding those on fixed-term contracts".

**Figure 1. Timeline**



Note: Sequence of events with bureau-level union bargaining

The observation that different contractual items are negotiated separately (e.g., at different bargaining levels and/or timing) is at the basis of Manning’s (1987) model. Manning argues that trade unions may exert a differential control over wage and employment negotiations. This insight is modelled by assuming different union’s bargaining power parameters for wages and employment, and/or different fall-backs in the sequential Nash bargaining solution representing the outcome of collective bargaining. Whether PA unions are able to influence the level of employment through collective bargaining (either directly or indirectly by imposing work rules and by protecting jobs), as it is assumed here, rather than through politics (i.e., by exerting political pressure to expand budgets) remains an open issue (Kaufman, 2002, p. 132). However, there is institutional evidence that PA unions can negotiate explicitly the labour input mix.<sup>13</sup>

The assumption that wages are set for two periods, after budget allocations at  $t=1$ , but before local budget allocations at  $t=2$ , captures the idea that wage contracts last often for more than one year, whereas local budgets are changed typically on a yearly basis. The model will be solved by backward induction, determining the sub-game perfect Nash equilibrium in pure strategies.

### 3.2 The Model’s Solution

Solving backwards, provided the predetermined budget covers the wage bill of the permanent workers who were hired at  $t=1$ , at the end of  $t=2$  each bureau chooses residually from its budget the number of temporary workers to be hired. This implies:

$$(5) \quad z_{i2} = \frac{b_{i2} - w_i^{\ell} \ell_{i1}}{w^z} ,$$

$i=x, y$ . Previously, the sponsor allocates the total exogenous budget  $B = b_{x2} + b_{y2}$  between bureaus, anticipating Eq. (5), by solving:

$$(6) \quad \begin{aligned} & b_{x2} \operatorname{argmax} G_2 = \ln X_2 + \ln Y_2 \\ \text{s. t. } & X_2 = \ell_{x1} \left( \frac{b_{x2} - w_x^{\ell} \ell_{x1}}{w^z \ell_{x1}} \right)^{1-\alpha} \\ & Y_2 = \ell_{y1} \left( \frac{B - b_{x2} - w_y^{\ell} \ell_{y1}}{w^z \ell_{y1}} \right)^{1-\alpha} , \end{aligned}$$

The sponsor takes as given the predetermined wages and number of tenured workers. The solution is

<sup>13</sup> For example, in Italy the 2016–2018 national contract for the PA set an explicit 20% upper limit to the share of temporary workers that could be employed in normal times within an agency in a given year (art. 50,3). The contract listed various contingencies allowing to waive the 20% limit as a result of local bargaining (art. 50,4), A.Ra.N (2016). Although the constraint was non-binding, these contractual provisions suggest the potential for collective bargaining on the labour input mix at the agency level. More generally, information and consultation rights included in the national collective contract allow local unions to monitor the number of temporary workers employed.



$$(7) \quad b_{i2} = \frac{[B - w_j^\ell \ell_{j1}] + w_i^\ell \ell_{i1}}{2},$$

$i, j=1, 2, i \neq j$ . Each rational bureau, by anticipating Eq. (7) at  $t=1$ , has a strategic incentive to over-hire tenured labour in order to obtain a larger share of budget  $B$  from the sponsor at  $t=2$  (Moene, 1986, Falch, 2001, p. 87, KK, 2008, p. 10). For given tenured wages and rival's tenured employment level, this budget competition strategic incentive is:  $\frac{db_{i2}}{d\ell_{i1}} = \frac{w_i^\ell}{2} > 0$ .<sup>14</sup>

At  $t=1$ , in the wage negotiation stage and for given  $t=1$  employment, each head-of-bureau/union pair chooses simultaneously and independently the tenured wage  $w_i^\ell$  for both periods. The bargaining unit takes as given the wage in the other bureau, by anticipating Eq. (5) and Eq. (7). The outcome of this negotiation is the solution to:

$$(8) \quad w_i^\ell \operatorname{argmax} Nw_i =$$

$$\left\{ (\ell_{i1})^\alpha [(z_{i1})^{1-\alpha} + (z_{i2})^{1-\alpha}] - (\ell_{i1})^\alpha (z_{i1})^{1-\alpha} \right\}^{1-\gamma} \{ 2(w_i^\ell - w^z) \ell_{i1} \}^\gamma$$

$$\text{s.t. } z_{i2} = \frac{B - w_i^\ell \ell_{i1} - w_j^\ell \ell_{j1}}{2w^z},$$

$$w_i^\ell \geq w^z.$$

$0 \leq \gamma < 1$  is the union's bargaining power over wages. This is taken as a parameter common to both unions. Eq. (8) interprets the fall-backs in the Nash bargaining solution as inside options, namely as the payoff each agent receives in the event of a momentary breakdown in the wage negotiation. Inside options are assumed to be equal to  $t=1$  output for the head-of-bureau, and to be equal to zero for the union's leadership. The idea is that PA tenured workers cannot stop completely the bureau's production during a wage dispute. In some countries (e.g., civil servants in Germany and Poland) and for some PA sectors (e.g., the armed forces, the police) there is no legal right to strike for pay conditions. In such cases, tenured employees would continue to work at the reservation wage. In other countries and for other sectors (e.g., general or local government), the right to strike for pay issues is often limited by law, implying that the bureaus must satisfy minimum-service requirements (Boehmer, Biletta, Aumayr-Pintar, Wohlgemuth, and Bremermann, 2015). In such circumstances, the head-of-bureau's fall-back would be given by the level of essential services prescribed by the law. However, Eq. (8) abstracts from this latter feature. As a consequence of the former assumption, the union's fall-back is normalised to zero: if the rank-and-file union members receive the reservation wage during a wage dispute, from Eq. (4) the union's utility is zero. Eq. (8) assumes no discounting of future utility. Finally, although the first period budget and employment levels are given, notice that there is still room for manoeuvre for setting the same wage rates in both periods. On the one hand, resources from the  $t=2$  budget have not been allocated fully yet when the wage negotiation occurs. On the other hand, the satisfaction of the budget constraint at  $t=1$  will occur thanks to the anticipation of the wage negotiation outcome in the previous employment negotiation stage.

Substituting the constraints and log differentiating Eq. (8) with respect to  $w_i^\ell$ , taking  $j$  variables,  $B$  and  $w^z$  as given, the FOCs are:

$$(9) \quad - \left[ (1 - \gamma)(1 - \alpha) \frac{\ell_{i1}}{2w^z z_{i2}} \right] + \frac{\gamma}{w_i^\ell - w^z} = 0,$$

$i=x, y; i \neq j$ . In Eq. (9), the LHS first term gives the reduction in the head-of-bureau's utility from agreeing on a higher tenured wage, given the number of tenured workers. In fact, the corresponding

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<sup>14</sup> In general, the budget competition strategic incentive operates if permanent and temporary workers are not too close substitutes.

increase in the tenured wage bill lowers the residual budget available to hire temporary workers at  $t=2$ , hence lowering output correspondingly. This effect is balanced partly by the bureau's perception that an increase in the wage bill of permanent workers may induce the sponsor to tilt the  $t=2$  budget allocation in its favour. The LHS second term of Eq. (9) represents the increase in union's utility that is related to the existence of a union wage premium. Using the bureau's budget at  $t=2$ , yields:

$$(10.1) \quad w_i^\ell = (1 - \lambda)w^z + \lambda \left[ \frac{B - w_j^\ell \ell_{j1}}{\ell_{i1}} \right]$$

$$(10.2) \quad \lambda \equiv \left[ \frac{\gamma}{(1-\gamma)(1-\alpha)+\gamma} \right] < 1$$

Eq. (10.1) shows that the union wage is equal to the temporary wage for  $\gamma=0$  (i.e., for  $\lambda=0$ ), as expected. Moreover, it shows that there is a trade-off between the union wage and the number of union tenured workers, as long as  $\frac{\partial w_i^\ell}{\partial \ell_{i1}} < 0$  other things being equal. This trade-off arises for standard reasons, namely the presence of a binding overall public budget  $B$ . Eq. (10.1) can be interpreted as the bureau-union  $i$ 's wage best reply function. It shows that wages are strategic substitutes here. For a given level of tenured employment in both bureaus, an increase in the  $j$ 's wage raises the wage bill of  $j$ 's permanent workers, which lowers the budget available for wage settlements in the bureau  $i$ . This induces  $i$ -bureau's negotiators to agree on a lower wage.

Moving backwards, each bargaining unit negotiates simultaneously and independently the levels of permanent and temporary employment, taking the employment levels chosen by the other bureau as given, and anticipating subsequent outcomes. Since temporary employment is related to permanent employment through the bureau's budget constraint, each bureau-union bargaining unit solves:

$$(11) \quad \ell_{i1} \operatorname{argmax} NL_i =$$

$$\{(\ell_{i1})^\alpha [(z_{i1})^{1-\alpha} + (z_{i2})^{1-\alpha}]\}^{1-\beta} \{2(w_i^\ell - w^z) \ell_{i1}\}^\beta$$

s.t Eq. (5), Eq. (7), Eq. (10.1)

$$b_{i1} = w_i^\ell \ell_{i1} + w^z z_{i1}.$$

$0 \leq \beta < 1$  is the union's bargaining power over employment. This is interpreted as a parameter that, in Manning's (1987) spirit, may differ from  $\gamma$ . In this negotiation, inside options are normalised to zero. The assumption is that, during a momentary dispute on the number of workers to be hired, no bureaucratic production will occur, since tenured workers are essential in production.

As long as the choice of permanent employment occurs before the determination of wages, each union-bargaining unit anticipates the total effect of its own tenured employment choice on future wage negotiations. This means that a stronger commitment to tenured employment now, for a given rival's level of tenured employment, is anticipated to cause not only an own wage moderation later on (as long as there is a trade-off between wages and employment from Eq. (10.1)), but also a strategic change in the rival's wage. Substituting the constraints into Eq. (11), log-differentiating with respect to  $\ell_{i1}$  and taking  $\ell_{j1}$  as given, the FOCs are:

$$(12.1) \quad \left( \frac{(1 - \beta) \left\{ \alpha (\ell_{i1})^{\alpha-1} [(z_{i1})^{1-\alpha} + (z_{i2})^{1-\alpha}] - (1 - \alpha) (\ell_{i1})^\alpha \left\{ (z_{i1})^{-\alpha} \left[ \frac{w_i^\ell + \frac{dw_i^\ell}{d\ell_{i1}} \ell_{i1}}{w^z} \right] + (z_{i2})^{-\alpha} \left[ \frac{w_i^\ell + \frac{dw_i^\ell}{d\ell_{i1}} \ell_{i1} + \frac{dw_j^\ell}{d\ell_{i1}} \ell_{j1}}{2w^z} \right] \right\} \right\}}{o_{i1} + o_{i2}} \right)$$

$$+\beta \left[ \frac{\frac{dw_i^\ell}{d\ell_{i1}} \ell_{i1} + (w_i^\ell - w^z)}{U_i} \right] = 0,$$

$i, j=x, y, i \neq j$ . The anticipation effects of higher tenured employment on wages can be determined by totally differentiating the system of Eq. (12.1) with respect to  $w_i^\ell, w_j^\ell$  and  $\ell_{i1}$ , for given  $\ell_{j1}$ , and by applying Cramer's rule:

$$(12.2) \quad \frac{dw_i^\ell}{d\ell_{i1}} = \frac{-w_i^\ell(1+\lambda)+w^z}{\ell_{i1}(1+\lambda)} < 0,$$

$$(12.3) \quad \frac{dw_j^\ell}{d\ell_{i1}} = -\frac{\lambda}{1+\lambda} \frac{w^z}{\ell_{j1}} < 0,$$

The parameter  $0 \leq \lambda < 1$  has been defined in Eq. (10.2) above. Eq. (12.1) shows that the head-of-bureau perceives a stronger strategic incentive to over-hire permanent workers than when it treats the tenured wage as given. In this latter case, over-hiring is driven only by the budget competition strategic effect highlighted by KK (and derived from Eq. (7) above). This stronger incentive is due to the fact that higher tenured employment is anticipated to lower the negotiated wage ( $\frac{\partial w_i^\ell}{\partial \ell_{i1}} < 0$  from Eq. (12.2)), although this effect is somehow diluted by the rival's wage response ( $\frac{dw_j^\ell}{d\ell_{i1}} < 0$  from Eq. (12.3)), which boosts output in both periods. Moreover, a stronger union influence over wages will strengthen the size of this effect ( $\frac{\partial^2 w_i^\ell}{\partial \ell_{i1} \partial \gamma} < 0$ ). Turning to the union, the anticipation that higher tenured employment will put downward pressures on tenured wages induces the leadership to moderate its employment claims. Moreover, the higher the union power over wages, the bigger the union's perceived wage loss from hiring an additional tenured worker, other things being equal (see below). These offsetting effects on the choice of tenured employment are weighted by the relative bargaining power over employment  $1-\beta$  and  $\beta$ .

The symmetric Nash-in-Nash bargaining solution (Collard-Wexler, Gowrisankaran, and Lee, 2019) is adopted to solve the model. Each bargaining unit selects at each stage of the sequential negotiation its Nash equilibrium, under the assumption that a symmetric Nash equilibrium will occur in the other bargaining unit. Substituting Eq. (12.2) and Eq. (12.3) into Eq. (12.1), imposing symmetry by setting  $b_{x1}=b_{y1}=B/2, \ell_{x1} = \ell_{y1}=\ell, z_{i1} = z_{i2} = z, w_x^\ell = w_y^\ell = w^\ell$ , using  $B/2 = w^z z + w^\ell \ell$  in Eq.(10.1) and rearranging, yields (where the superscript D stands for decentralised bargaining):

$$(13) \quad \left(\frac{z}{\ell}\right)^D = \frac{3}{4} \left(\frac{1-\alpha}{\alpha}\right) \left[1 - \frac{2\lambda(2-\Delta)}{3(1+\lambda)}\right]$$

$\lambda \equiv \left[\frac{\gamma}{(1-\gamma)(1-\alpha)+\gamma}\right] < 1. \Delta \equiv \left(\frac{\beta}{1-\beta}\right) \left(\frac{1-\gamma}{\gamma}\right)$  is the index of union differential control. When  $\Delta=0$ , the union has no power over employment determination. When  $\Delta=1$ , it has the same degree of control over employment and wage determination. For  $\gamma=\beta=\lambda=0$ , the relative wage is equal to unity, and Eq. (13) replicates KK (p.10)'s result with Cobb-Douglas technology, as expected.

Direct inspection of Eq. (13) shows that the optimal TCR with decentralised bargaining is increasing in the  $\Delta$  index. Hence, the TCR is an increasing function of union power over employment  $\partial \left(\frac{z}{\ell}\right)^D / \partial \beta > 0$ . Moreover, the TCR is a decreasing function of union power over wages,  $\partial \left(\frac{z}{\ell}\right)^D / \partial \gamma < 0$ . If the union bargaining power over employment is sufficiently small relatively to its power over wages, i.e. if  $\Delta < 2$  or  $0 < \beta < 2\gamma/(1+\gamma) < 1$ , unionisation raises the bureau's incentives to over-hire

permanent workers than in the no-union regime. Notice that this condition is satisfied for  $\gamma = \beta$ , i.e. equal union strength.

The economic intuition is that each bureau-union pair perceives the wage moderation effect of higher tenured employment. When union power over wages is sufficiently high, on the one hand head-of-bureaus have a stronger strategic incentive to increase tenured employment to induce union wage moderation. On the other hand, unions are more willing to trade off higher tenured employment for lower wages, since wages are expected to be high.

As regards union power over employment  $\beta$ , the positive impact on equilibrium  $z/\ell$  depends on the sign of the union's contribution to the Nash product in Eq. (12.1) (see the LHS second term). This sign is negative. In fact, the union perceives a wage cost of employing an additional permanent worker in the bureau larger than the union's direct increase in utility from appointing this worker at a given wage premium. Using Eq. (4), Eq. (12.2) (the wage effect) and Eq. (9) (by the envelope theorem), the

LHS second term of Eq. (12.1) is: 
$$\beta \left[ \frac{\frac{dw_i^\ell}{d\ell_{i1}} \ell_{i1} + (w_i^\ell - w^z)}{U_i} \right] = -\beta \left[ \frac{\lambda w^z}{(1+\lambda)(w_i^\ell - w^z)\ell_{i1}} \right] =$$

$$-\beta \left[ \frac{\lambda}{(1+\lambda)} \frac{(1-\gamma)(1-\alpha)}{\gamma} \right] \frac{1}{2z_{i2}} < 0.$$

The higher  $\beta$ , the higher the weight of this incentive in the bureau's choice of the optimal input mix, and the larger  $z/\ell$ .

Notice that, had the wage moderation effect been absent, because, say, wages are set by law, bureau-level unions would perceive no employment-wage trade off. Hence, an increase in union power over employment would lead to an increase in the number of permanent workers, other things being equal. (Appendix 1 discusses this case.) Moreover, because employment bargaining lowers the negotiated wage, it is possible that a bureau-level union will prefer to leave employers the "right-to-manage" employment levels. This possibility may also reflect a potential alignment of interests between the union and the bureaucracy, i.e. in order to win a higher budget share at  $t=2$ .

Finally, notice that an increase in the reservation wage  $w^z$  has no effect on the equilibrium choice of input mix. This is because the permanent wage rate is a constant mark-up over the temporary wage in symmetric equilibrium. Using Eq. (10.1), yields:  $w_i^\ell = w^z \left[ 1 + \left( \frac{2\lambda}{1-\lambda} \right) \frac{z}{\ell} \right]$ , where the employment ratio is given by Eq. (13) above. Hence, a change in  $w^z$  neither changes the relative wage, nor it changes the bureaucratic choice of the input mix. The results of this section are summarised in

**PROPOSITION 1** Unionisation and the equilibrium labour input ratio

*Consider the symmetric equilibrium of a PA sector with Cobb-Douglas production technology and bureau-level collective bargaining.*

*i) Sovereign employer (no union) case. Suppose there are no unions and that all workers are paid the exogenous reservation wage. Each head of bureau has a budget competition strategic incentive to over-hire tenured workers than in the absence of a tenured labour constraint (KK, 2008, Proposition 1).*

*ii) Union influence over wages. If the union has no influence over employment determination  $\beta=0$ , but it exerts some influence over tenured wage determination  $0 < \gamma < 1$ , unionisation raises the*

incentives to over-hiring permanent workers  $\partial\left(\frac{z}{\ell}\right)^D / \partial\gamma < 0$  relatively to the sovereign employer case. The higher the union's bargaining power over wages, the higher over-hiring of permanent workers.

iii) *Union influence over both wages and employment.* If the union exerts some influence over both wage and employment determination,  $0 < \gamma < 1$  and  $0 < \beta < 1$ , an increase in union power over employment lowers the incentives to over-hiring permanent workers  $\partial\left(\frac{z}{\ell}\right)^D / \partial\beta > 0$ , other things being equal. The higher the union's bargaining power over employment, the lower over-hiring of permanent workers.

iv) *Union differential control.* For given union bargaining power parameters, over-hiring occurs if union power over employment is sufficiently small relatively to union power over wages, i.e. if  $0 < \beta < 2\gamma/(1+\gamma) < 1$ . In case of equal bargaining strength (i.e. no differential control, or  $\gamma = \beta$ ), unionisation leads to over-hiring of permanent workers than in the no-union case.

Proposition 1i) reproduces KK (Proposition 1, which assumes complementary inputs). Without unions and in the absence of a tenured labour constraint, both  $\ell$  and  $z$  are fully flexible inputs that the bureau can freely hire in both periods. In this case, there is no strategic incentive to manipulate  $\frac{z}{\ell}$  (i.e. the common wage is given, and  $\frac{db_{i2}}{d\ell_{i1}} = 0$ ), and each head-of-bureau chooses the output maximising input mix,  $\left(\frac{z}{\ell}\right)^* = \left(\frac{1-\alpha}{\alpha}\right)$ , yielding allocative efficiency. Without unions, but with a tenured labour constraint, each bureau perceives a strategic incentive to over-hire permanent workers at  $t=1$  to obtain a larger share of budget allocation at  $t=2$ , as long as  $\frac{db_{x2}}{d\ell_{x1}} = \frac{w^\ell}{2} > 0$ . Eq. (14) below shows the equilibrium input mix in the no-union regime. This will be distorted (as KK pointed out first), provided relative wages are not too high

$$(14) \quad \left(\frac{z}{\ell}\right)^N = \frac{3}{4} \left(\frac{1-\alpha}{\alpha}\right) \left(\frac{w^\ell}{w^z}\right) < \left(\frac{z}{\ell}\right)^*$$

where the superscript N stands for no union. Proposition 1ii)–iv) highlights the effects of unionisation on the choice of the labour input mix. These effects depend crucially on the assumed sequence of collective bargaining, implying that tenured employment is determined before tenured wages at  $t=1$ . This sequence is motivated by the tenured features of union employment in PA (see Falch, 2001 and the discussion in Section 3.1 above). When the union negotiates over tenured wages only (see Proposition 1ii), each head-of-bureau, by setting employment unilaterally, has a strategic incentive to over-employ tenured employment at  $t=1$ , other things being equal. This is because PA employers anticipate that the union will moderate its wage claims, as a result, in the presence of a binding overall public budget  $B$  (i.e.,  $\frac{\partial w_i^\ell}{\partial \ell_{i1}} < 0$  for given  $B$  from Eq. (10.1)), and other things being equal. The higher the union's influence on wage determination, the stronger the wage moderation effect, and the higher each head-of-bureau's incentive to over-hire tenured workers over and above the level induced by the budget competition strategic effect. In fact, higher tenured employment and lower tenured wages allow bureaus to produce more output for a given tenured wage bill, other things being equal.

When  $\beta > 0$ , there is a negotiation over tenured employment as well. Because in this case the union anticipates the wage moderation effect of higher tenured employment, it will partly offset the head-of-bureau incentives to over-hiring tenured workers. The higher the union power over employment determination, the stronger this counterbalancing effect (see Proposition 1iii). Finally, for given union power parameters, if union bargaining power over employment is sufficiently small relatively to its power over wages, including the case of equal bargaining strength, the wage moderation effect will

be present, and one will observe over-hiring of permanent workers above the no-union level (see Proposition 1iv).

#### 4 Extensions

This section considers two extensions of the model of Section 3, under the maintained hypothesis that the union has no direct influence over employment determination (i.e., for  $\beta=0$ ).

##### 4.1 Multi-Employer Bargaining

As Nomden, Farnham and Onnee-Abbruciati (2003) pointed out, public sector wage determination occurs at different levels across Europe. This subsection studies sector-level negotiations by assuming an encompassing union, which maximises the sum of utilities of each bureau-level union. The encompassing union is assumed to face uncoordinated head-of-bureaus and to bargain over a common wage in parallel negotiations. Wage negotiations occur after each head of bureau has set independently permanent employment at  $t=1$ . Solving backwards, the typical wage negotiation is the solution to:

$$(15) \quad w^\ell \operatorname{argmax} Nw = \left\{ (\ell_{i1})^\alpha [(z_{i1})^{1-\alpha} + (z_{i2})^{1-\alpha}] - (\ell_{i1})^\alpha (z_{i1})^{1-\alpha} \right\}^{1-\gamma} \left\{ 2(w^\ell - w^z)(\ell_{x1} + \ell_{y1}) \right\}^\gamma$$

s.t.  $z_{i2} = \frac{B - w^\ell(\ell_{x1} + \ell_{y1})}{2w^z}$   
 $w^\ell \geq w^z,$

$i=x, y, i \neq j; 0 \leq \gamma < 1$ . In Eq. (15), the encompassing union's utility is the last term in curly brackets. Notice that both the typical head-of-bureau and the union (and the sponsor) anticipate that a unique wage will be set, which explains the constraint of Eq. (15) (incorporating the sponsor's budget allocation choice at  $t=2$ , i.e., Eq. (7)). The solution to the FOC yields:

$$(16) \quad w^\ell = (1 - \lambda)w^z + \lambda \left[ \frac{B}{\ell_{x1} + \ell_{y1}} \right],$$

$\lambda \equiv \gamma / [(1-\gamma)(1-\alpha) + \gamma] < 1$  from Eq. (10.2). Eq. (16) shows that, for given budget  $B$ , each bargaining unit, thus the encompassing union, perceives a trade-off between the union wage and the *total* level of permanent employment in the two bureaus. Solving backwards, each bureau's simultaneous and independent choice of employment yields the symmetric equilibrium input ratio (where the superscript E stands for encompassing union):

$$(17) \quad \left( \frac{z}{\ell} \right)^E = \left[ \frac{3-2\lambda}{\frac{4\alpha}{1-\alpha} - \frac{\lambda}{1-\lambda}} \right].$$

For the bureau to choose a positive input ratio, Eq. (17) requires that union power over wages is not excessively high, namely  $0 < \lambda < 4\alpha / (1+3\alpha) < 1$ , or, using Eq. (10.1),  $0 < \gamma < 4\alpha / (1+4\alpha) < 1$ , with  $0 < \alpha < 1$ . Eq. (17) corresponds to the sovereign employer-no union case when  $\lambda = 0 = \gamma$ , as expected.

How does the degree of centralisation affect the choice of the labour input mix under wage bargaining? If one compares Eq. (17) with Eq. (13) for  $\Delta=0$ , it turns out that the symmetric equilibrium TCR is larger with an encompassing union than with a bureau level union (see Appendix 2). The intuition is that each head-of-bureau has fewer strategic incentives to over-hiring permanent workers, since it perceives a lower wage moderation effect from employing an extra tenured worker. Actually, each head-of-bureau anticipates at the employment determination stage that the encompassing union will push for higher wages at the bargaining table, as long as the union will internalize the externalities in wage setting. This implies a higher expected cost of tenured

employment. Hence, one should expect a higher TCR in PA labour markets with multi–employer bargaining than bureau–level bargaining, other things being equal.

An interesting issue is whether the presence of an encompassing union may induce bureaus to choose in equilibrium a TCR that is higher than in the absence of collective bargaining. In other words, can the anticipation of higher tenured wages partly or fully offset the budget competition strategic effect? Is it possible that the distortion of the factor input ratio provoked by the presence of a tenured labour constraint will be reduced or eliminated in the encompassing union regime?<sup>15</sup>

This comparison is not straightforward, as long as, in the encompassing union regime, from Eq. (17) the TCR is a non–linear function of both the union power over wages  $\gamma$  and the tenured employment elasticity of output  $\alpha$ . It turns out that, when  $\alpha$  is not “too small”,  $(\frac{z}{\ell})^E < (\frac{z}{\ell})^N$  if the union power over wages is sufficiently small, whereas  $(\frac{z}{\ell})^E > (\frac{z}{\ell})^N$  if the union power is sufficiently high. This result implies that, in the encompassing union regime, the relationship between union bargaining power over wages and the TCR is non–monotonic. (Figure 2 in Appendix 2 illustrates with an example, for given value of  $\alpha$ ).

The intuition for this result is that, when the union bargaining power over wages is low, the wage moderation strategic effect is reduced, but it is still at work. Hence, the head–of–bureaus have an incentive to push the TCR further below the level they would choose in the absence of collective bargaining, namely  $(\frac{z}{\ell})^D < (\frac{z}{\ell})^E < (\frac{z}{\ell})^N$ . However, when the union bargaining power is high, the head–of–bureaus expect that tenured wage costs will be high as well, which partly offsets (or fully offsets for very high union power) the budget competition strategic effect. In this latter case, a more powerful union would induce the head–of bureaus to choose a higher TCR than in the absence of collective bargaining, namely  $(\frac{z}{\ell})^D < (\frac{z}{\ell})^N < (\frac{z}{\ell})^E$ .

#### 4.2 Variable Elasticity of Substitution Production Function

This subsection assumes that the typical bureau  $i$  at time  $t$  produces output using a Variable Elasticity of Substitution (V.E.S.) technology, which is adapted from Karagiannis, Palivos and Papageorgiou (2005):

$$(18) \quad O_t = (\ell_{i1})^\alpha (z_{it} + \alpha e \ell_{i1})^{1-\alpha} = \ell_{i1} \left[ \frac{z_{it}}{\ell_{i1}} + \alpha e \right]^{1-\alpha}$$

$0 \leq e < 1/\alpha$ ,  $\alpha \in (0,1)$ ,  $O = \{X, Y\}$ ,  $i = x, y$ ,  $t = 1, 2$ . Eq. (18) exhibits constant returns to scale. For  $e = 0$ , it corresponds to the Cobb–Douglas technology of Eq. (1). In this case, both labour types are essential in production, and the choice of the labour input mix occurs at the intensive margin. This means that the equilibrium ratio  $z/\ell$  will always be positive. For  $e > 0$ , Eq. (18) shows that inputs are gross substitutes, and that temporary labour  $z_{it}$  is not an essential factor of production. In fact, the marginal product of permanent labour does not go to zero when no temporary worker is hired (i.e., when  $z_{it} = 0$ ). In this latter case, the bureaus can produce output by using permanent labour only.<sup>16</sup> This feature

<sup>15</sup> I thank one anonymous referee for suggesting me this analysis.

<sup>16</sup> From Eq. (18), the marginal product of permanent labour is:

$$\partial O_t / \partial \ell_{i1} = \left[ \frac{z_{it}}{\ell_{i1}} + \alpha e \right]^{1-\alpha} \left[ 1 - (1 - \alpha) \frac{\frac{z_{it}}{\ell_{i1}}}{\frac{z_{it}}{\ell_{i1}} + \alpha e} \right].$$

Hence,  $\lim_{\ell_{i1} \rightarrow \infty} \partial O_t / \partial \ell_{i1} = [\alpha e]^{1-\alpha} > 0$ , for  $e > 0$  and  $0 < \alpha < 1$ , in which case bureaus would use a linear technology. Notice that, when  $-1 < e < 0$ , the V.E.S. function allows for complements. However, one cannot have both cases simultaneously (i.e., the elasticity of substitution is either less or greater than unity).

seems desirable in the present context, as long as it allows us to consider the bureau's option of not hiring tem

porary workers, and/or the implications of strong legal or contractual limits to the use of temporary contracts. In other words, Eq. (18) assumes implicitly that permanent contracts are the normal form of bureaucratic employment. This assumption allows us to consider the choice of temporary labour at the extensive margin as well. This implies finding the condition for the equilibrium optimal  $z/\ell$  to be equal to zero. Notice that the restriction  $e < 1/\alpha$  is needed to avoid that the two worker types become too close substitutes. In this case, the budget competition strategic effect would be muted.

The elasticity of substitution between permanent and temporary workers is:  $\sigma_t^V = 1 + e/(z_{it}/\ell_{i1}) \geq 1$ . This expression confirms that temporary and permanent workers are gross substitutes when  $e > 0$ . It also shows that  $\sigma_t^V \rightarrow 1$  as the TCR falls towards zero. Finally, notice that an increase in  $e > 0$  raises both the elasticity of substitution  $\sigma_t^V$  for given  $z_{it}/\ell_{i1}$ , and the marginal physical product of permanent workers  $\partial^2 O_t / \partial \ell_{i1} \partial e > 0$ , while lowering the marginal physical product of temporary workers  $\partial^2 O_t / \partial z_{it} \partial e < 0$  at the same time.

Under the assumption of bureau-level permanent wage bargaining, the model is solved following the same steps that were made in Section 3.2 above. Appendix 3 presents the derivation. This yields the symmetric equilibrium TCR (where the superscript V denotes decentralised wage bargaining with V.E.S. technology)

$$(19) \quad \left(\frac{z}{\ell}\right)^V = \frac{3}{4} \left(\frac{1-\alpha}{\alpha}\right) \left[1 - \frac{4\lambda}{3(1+\lambda)}\right] - \left(\frac{3-\lambda+\alpha(1+5\lambda)}{4(1+\lambda)}\right) e$$

$\lambda \equiv \gamma / [(1-\gamma)(1-\alpha) + \gamma] < 1$ ;  $0 < \gamma < 1$  is the union bargaining power over wages, and  $0 \leq e < 1/\alpha$ . Eq. (19) corresponds to Eq. (13) for  $e=0$  (i.e., Cobb–Douglas technology) and  $\beta=0=\Delta$  (i.e., no union influence over employment determination), as expected. Eq. (19) includes the anticipated wage moderation effect of higher permanent employment when  $\gamma > 0$ .

The assumption of V.E.S. technology allows us to consider the impact of unionisation on the optimal input mix both at the intensive margin and at the extensive margin for temporary labour. Using Eq. (19), the threshold value of  $e > 0$  such that the head-of-bureau chooses not to hire temporary workers, i.e. the extensive margin  $(z/\ell)^V = 0$ , is:  $e^* = \left(\frac{(1-\alpha)(3-\lambda)}{\alpha[3-\lambda+\alpha(1+5\lambda)]}\right) > 0$ , with  $e^* < 1/\alpha$ . It follows that  $\partial e^* / \partial \lambda < 0$ . The former condition implies that the higher the union wage bargaining power  $\gamma$ , the lower the threshold value of  $e^*$  inducing the head-of-bureaus to hire permanent workers only. This result suggests that, when labour inputs are moderate substitutes in a V.E.S. technology, unionisation lowers the likelihood of observing temporary workers in the bureau at the extensive margin.

The effects of unionisation at the intensive margin, i.e. when optimal  $(z/\ell)^V > 0$ , can be assessed by direct inspection of Eq. (19). It follows that the higher the union power over wages, the lower the equilibrium share of temporary workers,  $\partial(z/\ell)^V / \partial \gamma < 0$ , other things being equal. This condition arises from the interaction of two oppositely signed effects of union power on bureaucratic hiring incentives. First, as in Section 3.2 above, the higher the union power over wages, the stronger the head-of-bureaus' strategic incentives to use permanent labour to induce wage moderation. The wage moderation strategic effect is given by the second term in square brackets of Eq. (19). Second, the higher the union power over wages, the lower the head-of-bureaus' gain from hiring an extra permanent worker who is relatively more productive. In fact, the higher  $e > 0$ , the larger the gap between permanent and temporary wages, since permanent union wages reflect now relative productivities. The productivity effect is given by the third term in round brackets of Eq. (19). The trade-off tilts in favour of hiring more permanent workers at the intensive margin as union power increases, in so far as the two inputs are not too close substitutes, or  $0 < e < 1/\alpha$ .



Finally, if one compares Eq. (13) under decentralised wage bargaining (i.e., for  $\Delta=0$ ) and Eq. (19), it follows that, other things being equal, the equilibrium share of temporary workers is lower under V.E.S. and  $e>0$  than under Cobb–Douglas technology (or  $e=0$ ). This result suggests that, for given union’s influence over wages  $\gamma$ , a union leadership who is insider–dominated may be willing to encourage the introduction of technologies or organisational changes that increase the productivity of permanent workers  $e>0$  at the intensive margin. These changes would both raise the share of permanent union workers and boost union wages.

##### 5 *Does Unionization Lower the TCR in PA?*

The model has shown that PA unionisation in the presence of a tenured labour constraint affects the TCR depending on both the union bargaining power and the degree of centralisation in wage setting. More specifically, one would expect that, with decentralised collective bargaining, increasing the union power in wage bargaining should lower the TCR. Moreover, PAs characterized by decentralised negotiations should have a lower TCR than PAs with more centralised wage setting, other things being equal. Finally, with more centralised collective bargaining, the relationship between union bargaining power over wages and the TCR should be non–linear. Are these predictions consistent with the observed data for the European Union?

To test these hypotheses, this section uses publicly available data for the years 2014–2018. To measure the TCR, the average 2014–2018 share of workers under temporary contracts over *total* workers is computed for the PA sector of 20 EU countries (i.e., Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden and the UK). The TCR is drawn from publicly available Eurostat (2020) LFS series. PA is defined according to the NACE084 code, which includes government non–market activities with the exception of education and health care.

The proxy measure for the union bargaining power is the union density rate in PA (UDPA), namely the percentage share of unionised workers over total workers in PA. This series is taken from the ICTWSS\_6.1 dataset (Visser, 2019a, series 217). The UDPA data refer to different years between 2008 and 2016, depending on availability.<sup>17</sup>

The degree of centralisation is identified using Eurostat (2010, Tables 5 and 6)’s taxonomy for civil servants collective bargaining in the EU. This taxonomy distinguishes between decentralised systems (i.e., France, Hungary, Ireland, the Netherlands, and the UK), mixed systems (i.e., Belgium, Denmark, Finland, Germany, the Slovak Republic, Italy, and Sweden), and centralised systems (i.e., Austria, Bulgaria, Czech Republic, Greece, Poland, Portugal, Slovenia and Spain). This taxonomy is compared with Nomden, Farnham and Onnee–Abbruciati (2003)’s classification of bargaining levels for public services, who considered a different set of countries.<sup>18</sup>

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<sup>17</sup> UD rates in PA from Visser (2019a) refer to 2008 (Bulgaria: 60%, Greece: 51%), 2011 (Germany: 31%, the Netherlands: 34%), 2012 (Poland: 16%, Portugal: 31%, Slovak Republic: 19.3%, Spain: 34.5%), 2013 (Austria: 59.5%, Belgium: 69%, Czech Republic: 22%, Denmark: 82%, Finland: 83%, France: 24.1%, Ireland: 58%, Slovenia: 49%, UK: 50.3%), 2014 (Italy: 56%), 2015 (Hungary: 11%), and 2016 (Sweden: 76%). According to Eurostat (2010, Table 5), Bulgaria’s UDPA was in the range 25–40%, while Belgium’s and Germany’s in the 40–55% range in 2010.

<sup>18</sup> Nomden, Farnham and Onnee–Abbruciati (2003) distinguished between career civil service systems, where wages are set mainly by national law or by central negotiation (Austria, France, Germany, Greece, Portugal Spain; central negotiations also occurring in the UK local government and for basic and general agreements in Sweden); and non–career systems, where wages are set by collective bargaining at lower levels (Belgium, Denmark, Finland, Ireland, the Netherlands). In their taxonomy by bargaining levels, they identified

Then, the N=20 countries are divided into nine categories based on the UDPA and Degree of Centralisation dimensions. Table 1 below illustrates. Numbers in square brackets are the average 2014–2018 TCRs in each country.

Table 1 is constructed as follows. Based on the UDPA sample mean of 45.835 (standard deviation: 22.22), countries are classified into three groups, according to their observed UDPA rates. The first group comprises low UDPA countries, such that their observed UDPA is within the 0–35% range. The upper bound of this range is determined by the sample mean minus half sample standard deviation. This group includes  $n_1=9$  countries (i.e., the Czech Republic, France, Germany, Hungary, the Netherlands, Poland, Portugal, Slovakia and Spain), with a group median TCR of 12.66%. The second group includes  $n_2=4$  countries with intermediate UDPA within the 36–56% range (i.e., Greece, Italy, Slovenia, and the UK, with a group average median TCR equal to 5.79%). The third group includes the remaining  $n_3=7$  high UDPA countries, with UDPA higher than 56% (i.e., the sample mean plus one half sample s.d.: Austria, Belgium, Bulgaria, Denmark, Finland, the Republic Ireland, and Sweden; group average median TCR=7.52%). According to Eurostat (2010: Table 5) three countries should be reclassified in the intermediate UDPA group (i.e. Belgium, Bulgaria and France). Table 1 does not reflect this. As regards the degree of centralisation in collective bargaining, Table 1 reflects Eurostat (2010)’s taxonomy. Table 1 signals with asterisks the cases clashing with Nomden, Farnham and Onnee–Abbruciati (2010)’s classification.

Controlling for the degree of centralisation in Table 1, there seems to emerge a negative relationship between the reported TCRs (i.e. the numbers in square brackets) and the UDPA when collective bargaining is decentralised (see column 1, and Figure 3.1 in Appendix 4).

*Table 1*  
Union Density Rates and Collective Bargaining Levels  
in the EU Public Administration

Union Density UDPA	Decentralised Collective Bargaining (1)	Mixed Collective Bargaining (2)	Centralised Collective Bargaining (3)
Low UDPA (0%–35%)	Hungary [33] France* [14.5] Netherlands**[8.9]	Slovakia [23.6] Germany*[12.4]	Czech Rep [9.6] Poland [12.6] Portugal [12.4] Spain [17.3]
Intermediate UDPA (36%–56%)	UK [4.1]	Italy [5.45]	Greece [6.12] Slovenia [12]
High UDPA (>56%)	Ireland** [4.2]	Belgium [5.73] Sweden [10.5] Denmark [7.7] Finland [13.9]	Austria [7.52] Bulgaria[1.29]

Note: average 2014–2018 TCR per cent in square brackets, NACE084 code (Source: Eurostat). UDPA various years 2008–2016 (Source: Visser, 2019a, series 2017). Collective Bargaining levels years 2000–2010 (Source: Eurostat, 2010). \* According to Nomden et al. (2003), Germany and France should be classified as centralised systems. \*\* According to Nomden, Farnham and Onnee–Abbruciati (2003), Ireland and the Netherlands should be classified as mixed systems.

three groups of countries: with centralised collective bargaining (France, Germany, Greece, Austria and Portugal); with decentralised collective bargaining (Sweden and the UK civil service); and with partially centralised/decentralised collective bargaining (Belgium, Denmark, Ireland, Finland, Italy, the Netherlands).

When considering countries with higher centralisation degree (i.e. mixed and centralised collective bargaining), there is some suggestion of a non-linear relation between TCR and UDPA (see columns 2 and 3, and Figure 3.2 in Appendix 4).

Because of the limited number of observations, this section develops a simple non-parametric test to check whether TCRs differ significantly across the three UDPA groups of Table 1 (low, intermediate and high UDPA countries: see the countries in the three rows of Table 1). This classification does not control for the degree of centralisation in collective bargaining, nor for the union's differential control over wage and employment determination.

To this purpose, a Kruskal-Wallis one-way analysis of variance by ranks was run by considering the three UDPA groups as independent samples. The test rejected the null hypothesis that the median TCRs were equal in the three UDPA groups at less than the 1% significance level (chi square (2) =9.588, p-value<0.01).

To further investigate the source of this difference, Dunn tests were computed by making pairwise comparisons of groups, using the Bonferroni adjustment of p-values to correct for multiple testing. The Dunn test rejected the null hypothesis of equal median TCR between groups at less than the 5% significance level in two cases: when comparing the low UDPA group and the intermediate UDPA group ( $z= 2.4688$ , p-value<0.05); and when comparing the low UDPA group and the high UDPA group ( $z=2.593355$  p-value<0.05). However, the Dunn test was not statistically significant when comparing the intermediate and high UDPA groups ( $z=-0.3779$ , p-value<1). These results imply that the source of the difference in median TCRs detected by the Kruskal-Wallis test is due to differences in the TCRs of countries with less powerful unions (proxied by low UDPA) relatively to countries with more powerful unions. In other words, the median TCR of countries with low UDPA is significantly different from the median TCR of countries with intermediate and high UDPA: unionisation matters for the observed TCR in PA. Finally, as long as the median TCR is equal to 12.6% for low UDPA countries, while it is equal to 5.79% and 7.52% for intermediate and high UDPA countries, respectively, this suggests that PAs with weaker unions will be characterized by higher TCRs than PAs with stronger unions.<sup>19</sup> However, the relationship may be non-linear due to the effects of different degrees of centralisation in collective bargaining.

## 6 Conclusion

This paper has presented a model of the determinants of the equilibrium choice of the ratio of temporary workers to permanent workers, or TCR. The model has considered two output-maximising bureaucracies that compete over a fixed budget and that face employment-wage sequential negotiations with bureau-level unions. The model has shown that unionisation may lower the TCR in symmetric equilibrium, because head-of-bureaus, when employment is set before wages, have an incentive to increase permanent employment so as to moderate union wage claims. This way, they can boost output for given budget received from their political sponsor. The over-hiring incentive is reduced when wage negotiations are more centralised. Notice that, had the paper assumed simultaneous employment-wage bargaining, or bargaining about wages first, or exogenous tenured wages, tenured employment would cease to be a strategic labour market variable for PA employers. As a result, no wage moderation strategic effect would be present, and the negative correlation between union bargaining power over wages and the TCR would be absent. Of course, this would not rule out the existence of other mechanisms, thereby unionisation may affect the TCR in practice.

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<sup>19</sup> Note that a Jonckheere-Terpstra test for ordered alternatives rejects the null hypothesis of equal median TCRs across UDPA groups vs. the alternative of descending ordered alternatives (i.e. from higher median TCR for the low UDPA group to lower median TCR for the high UDPA group,  $z=-2.714$ , p-value<0.01).

The model has suggested that, apart from union bargaining power, other institutional features of the PA labour market, such as the degree of centralisation of collective bargaining, are likely to affect the observed TCR in manifold directions. In recent years, comparative industrial relations scholars have underscored the influence of institutions on the union attitudes towards temporary employment. These attitudes have changed over the last decade, by moving away from a predominantly insider-focused and exclusionary approach (which is still prevalent in Central Europe) towards a more inclusive and solidaristic approach, especially in Southern Europe and the Nordic countries (see Doellgast, Lillie, and Pulignano, 2018). Hence, further analysis may be needed to incorporate these features into a model of union influence on the bureaucratic choice of the labour input mix.

Finally, the empirical test presented in Section 5 focuses on a narrow definition of the PA, based on the NACE084 Eurostat code. This definition excludes publicly provided education and health care. Although the stylized assumptions of the model capture institutional features of relevance for public education and health care, it is likely that the choice of the labour input mix in these subsectors will depend as well on the complex interaction, in both the goods and labour markets, between bureaucratic agencies and private providers of services.

## Appendix

### A.1 Employment Bargaining with Cobb–Douglas Technology

To help understand the result that higher union power over employment lowers over-hiring of permanent workers, it is useful to assume that there is only the employment negotiation at the bureau level, e.g. by assuming that the union wage premium is exogenously determined by law or national negotiation. Clearly, exogenous wages eliminate strategic incentives to increase permanent employment to moderate wage claims, but they leave strategic incentives for budget appropriations. If the wage gap is not influenced by local bargaining, it seems reasonable to assume that the local union leadership will only care about permanent employment levels. Under these assumptions, the employment negotiation stage becomes:

$$(A1) \quad \ell_{i1} \operatorname{argmax} NL_i = \{(\ell_{i1})^\alpha [(z_{i1})^{1-\alpha} + (z_{i2})^{1-\alpha}]\}^{1-\beta} \{2 \ell_{i1}\}^\beta$$

s.t. Eq. (5), Eq. (7),  $b_{i1} = w_i^\ell \ell_{i1} + w^z z_{i1}$

The F.O.C.S. correspond to Eq. (12.1) in the main text, but with  $\frac{dw_i^\ell}{d\ell_{i1}} = \frac{dw_i^\ell}{d\ell_{i1}} = 0$ . Imposing symmetry by setting  $b_{x1} = b_{y1} = B/2$ ,  $\ell_{x1} = \ell_{y1} = \ell$ ,  $z_{i1} = z_{i2} = z$ ,  $w_x^\ell = w_y^\ell = w^\ell$ , yields:

$$(A2) \quad \left(\frac{z}{\ell}\right) \Big|_{\gamma=0}^D = \frac{3}{4} \left(\frac{1-\alpha}{\alpha}\right) \left[ \frac{\alpha}{\alpha + \frac{\beta}{1-\beta}} \right] \left(\frac{w^\ell}{w^z}\right)$$

where the superscript D denotes decentralized bargaining, while the subscript  $\gamma=0$  recalls that there is no wage negotiation. With employment negotiations and exogenous wages,  $\partial(z/\ell) / \partial\beta < 0$  from Eq. (A2): higher union power over employment  $\beta$  lowers the share of temporary contracts below the level a sovereign employer would choose (i.e., for  $\beta=0$ ) if facing the same exogenous wage premium. In fact, when wages are exogenous, the union perceives no trade-off from increasing permanent employment. The bureau–union unit chooses more permanent workers because of the direct union influence on employment determination, given that both the budgetary effects and the wage moderation effects are muted here.

### A.2 Comparing the Fully Decentralised Union, the Encompassing Union, and the Sovereign Employer (No Union) Regimes

By setting  $\beta=0$  in Eq. (13), the equilibrium input ratio with decentralised wage bargaining is:

$$(A3) \quad \left(\frac{z}{\ell}\right)^D = \frac{3}{4} \left(\frac{1-\alpha}{\alpha}\right) \left[ \frac{3-\lambda}{3(1+\lambda)} \right].$$

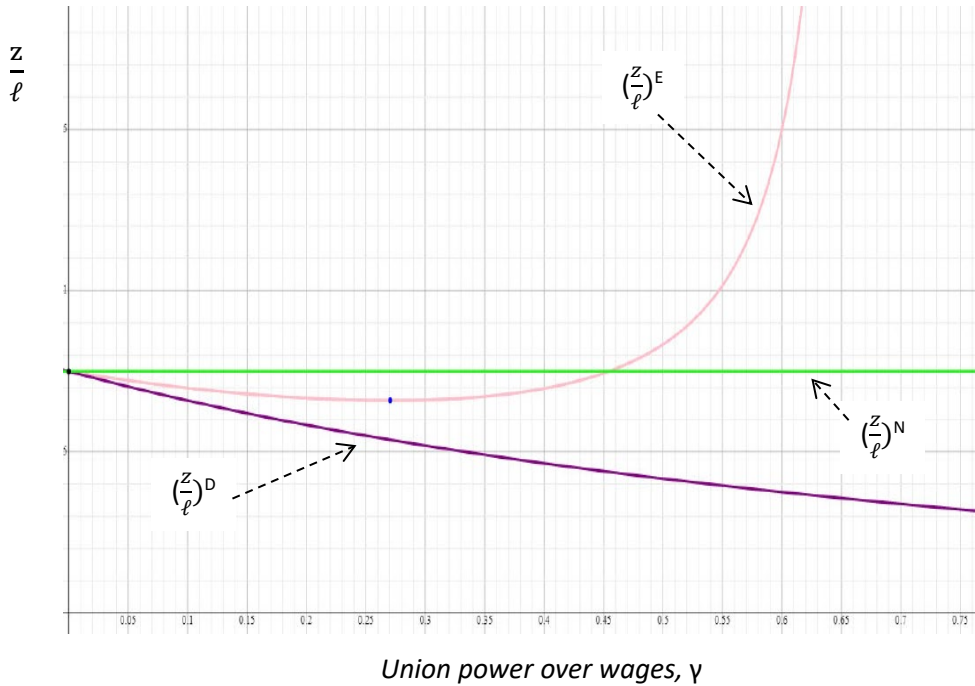
The equilibrium input ratio with an encompassing union is given by Eq. (17):

$\left(\frac{z}{\ell}\right)^E = \left[ \frac{3-2\lambda}{\frac{4\alpha}{1-\alpha} - \frac{\lambda}{1-\lambda}} \right]$ , where  $0 < \lambda < 4\alpha/(1+3\alpha) < 1$ , or  $0 < \gamma < 4\alpha/(1+4\alpha) < 1$  is imposed for  $\left(\frac{z}{\ell}\right)^E > 0$ . Direct comparison of Eq. (A3) with Eq. (17) shows that  $\left(\frac{z}{\ell}\right)^E > \left(\frac{z}{\ell}\right)^D$ , as long as  $(3-2\lambda)(1+\lambda) > (3-\lambda)$  for  $0 < \lambda < 1$ .

The sovereign employer (no union) case (assuming equal wages) is given by Eq. (14):  $\left(\frac{z}{\ell}\right)^N = \frac{3}{4} \frac{(1-\alpha)}{\alpha}$ . Direct comparison of Eq. (A3) and Eq. (14) shows that  $\left(\frac{z}{\ell}\right)^N > \left(\frac{z}{\ell}\right)^D$ . The comparison between the equilibrium TCR of the encompassing union regime, given by Eq. (17), and that of the sovereign employer regime, given by Eq. (14), must deal with the non-linearity of the TCR both in the elasticity of output with respect to tenured employment  $\alpha$ , and in the union bargaining power over wages  $\gamma$ . (Recall that  $\lambda$  depends on both  $\alpha$  and  $\gamma$  from Eq. 10.2.) As long as Eq. (17) collapses to Eq. (14) for

$\lambda=0=\gamma$ , the first step is to find whether a unique positive value of  $\lambda$  (thus of  $\gamma$ ) exists such that  $\left(\frac{z}{\rho}\right)^E = \left(\frac{z}{\rho}\right)^N$ . Equating Eq. (17) to Eq. (14), solving for  $\lambda$ , and using Eq. (10.2) to substitute for  $\gamma$ , the equality above is satisfied for both  $\gamma=0$  and  $\gamma^*=1-3/11\alpha$ . If the output elasticity of tenured employment is not too small, namely if  $\alpha > \alpha^* = 3/11 \approx 0.28$ , one has  $\gamma^* > 0$ . Hence, the equilibrium choice of the input mix in the two regimes will be the same when both  $\gamma = \gamma^*$  and  $\gamma = 0$ . As long as Eq. (17) is continuous in  $\gamma$  in the relevant range such that  $\left(\frac{z}{\rho}\right)^E > 0$ , the second step is to establish whether  $\left(\frac{z}{\rho}\right)^E >$  or  $< \left(\frac{z}{\rho}\right)^N$ . As long as  $\left(\frac{z}{\rho}\right)^N$  does not depend on  $\gamma$ , one needs to establish whether  $\left(\frac{z}{\rho}\right)^E$  as a function of  $\gamma$  reaches a (local) maximum or a minimum in the range  $0 < \gamma < \gamma^*$ . In the latter case, it must be that  $\left(\frac{z}{\rho}\right)^E < \left(\frac{z}{\rho}\right)^N$ . Moreover, with a minimum, it must also be that  $\left(\frac{z}{\rho}\right)^E > \left(\frac{z}{\rho}\right)^N$  for  $\gamma^* < \gamma < 4\alpha/(1+4\alpha) < 1$ , with  $\alpha > \alpha^*$ . To proceed further with the analysis a numerical example is used, fixing the value of  $\alpha = 1/2 > \alpha^*$ . Figure 2 below illustrates. Figure 2 plots  $\left(\frac{z}{\rho}\right)^E$  (and  $\left(\frac{z}{\rho}\right)^D$ ) as a function of  $\gamma$ , together with  $\left(\frac{z}{\rho}\right)^N$  (which is independent of  $\gamma$ ).

Figure 2  
Simulating the TCR for  $\alpha = \frac{1}{2}$ .



Formally, if  $\alpha=1/2$ , Eq. (17), using Eq. (10.2), and Eq. (14) are:

$$(A4) \quad \left(\frac{z}{\rho}\right)^E = \left[ \frac{3-4\gamma/(1+\gamma)}{4 - \frac{2\gamma}{1-\gamma}} \right]$$

$$(A5) \quad \left(\frac{z}{\rho}\right)^N = 3/4$$

Differentiating Eq. (A4) with respect to  $\gamma$  and setting the result equal to zero yields:  $\frac{\partial \left(\frac{z}{\rho}\right)^E}{\partial \gamma} = \frac{-13\gamma^2 + 22\gamma - 5}{2(1+\gamma)^2(3\gamma-2)^2} = 0$ . Solving the quadratic equation at the numerator, yields:  $\gamma = \frac{11 \pm 2\sqrt{14}}{13}$ . The feasible negative root is  $\gamma = 0.2705$ . This value of  $\gamma$  is the turning point of the  $\left(\frac{z}{\rho}\right)^E$  function, which satisfies the condition  $0 < \gamma = 0.2705 < \gamma^* = 0.46$  given above. Evaluating the function's second derivative

at  $\gamma=0.2705$ , yields:  $\partial^2 \left(\frac{z}{\rho}\right)^E / (\partial\gamma)^2 = \frac{\gamma(39\gamma^2 - 99\gamma + 45) - 17}{(1+\gamma)^3(3\gamma-2)^3} = 3.28 > 0$ . Hence, for  $\alpha=1/2$ ,  $\gamma=0.2705$  is associated with a minimum. It follows that  $\left(\frac{z}{\rho}\right)^E < \left(\frac{z}{\rho}\right)^N$  for  $0 < \gamma < \gamma^* = 0.46$ . It also follows that  $\left(\frac{z}{\rho}\right)^E > \left(\frac{z}{\rho}\right)^N$  for  $\gamma^* = 0.46 < \gamma < 4\alpha/(1+4\alpha) = 0.67$ . This latter statement can be illustrated by means of a numerical example as well. If evaluating  $\left(\frac{z}{\rho}\right)^E$  at  $\gamma=0.47$ , say, when  $\alpha=1/2$ , it follows that:  $\left(\frac{z}{\rho}\right)^E = 0.773 > \left(\frac{z}{\rho}\right)^N = 0.75$ . Figure 2 above shows that, for sufficiently high union bargaining power over wages, i.e. for  $\gamma^* = 0.46 < \gamma < 4\alpha/(1+4\alpha) = 0.67$ , the head-of-bureaus would choose a TCR above the one they would choose in the no-union regime. In this case, the strategic budget competition effect will be more than compensated by the increase in the expected cost of permanent employment: the higher the union power over wages, the higher the TCR. If  $\gamma$  is high, i.e.  $0.55 < \gamma < 0.67$  for  $\alpha=0.28$ , then  $\left(\frac{z}{\rho}\right)^E > \frac{z^*}{\rho}$ , and there is over-hiring of temporary workers (see Figure 2). Finally, for  $\alpha < \alpha^*$  it can be shown that  $\left(\frac{z}{\rho}\right)^E > \left(\frac{z}{\rho}\right)^N$  for  $0 < \gamma < 4\alpha/(1+4\alpha) < 1$ .

### A.3 V.E.S. Production Function and Wage Bargaining

Solving backwards as usual, consider the typical bureau-level wage negotiation at  $t=1$ :

$$(A6) \quad w_i^\ell \argmax Nw_i$$

$$= \left\{ (\ell_{i1})^\alpha [(z_{i1} + \alpha e \ell_{i1})^{1-\alpha} + (z_{i2} + \alpha e \ell_{i1})^{1-\alpha}] - (\ell_{i1})^\alpha (z_{i2} + \alpha e \ell_{i1})^{1-\alpha} \right\}^{1-\gamma}$$

$$\left\{ 2(w_i^\ell - w^z) \ell_{i1} \right\}^\gamma$$

s.t.  $z_{i2} = \frac{B - w_i^\ell \ell_{i1} - w_j^\ell \ell_{j1}}{2w^z}$

$$w_i^\ell \geq w^z.$$

The choice of tenured wages in bureau  $i$  is made simultaneously and independently of the choice of tenured wages in bureau  $j$ , yielding

$$(A7) \quad w_i^\ell = (1 - \lambda + \lambda \alpha e) w^z + \lambda \left[ \frac{B - (w_j^\ell - \alpha e w^z) \ell_{j1}}{\ell_{i1}} \right],$$

$\lambda \equiv \left[ \frac{\gamma}{(1-\gamma)(1-\alpha)+\gamma} \right] < 1$ . Eq. (A7) shows that an increase in the permanent labour productivity parameter  $e > 0$  raises the union permanent wage, other things being equal.

In the employment determination stage, each head-of-bureau chooses simultaneously and independently  $\ell_{i1}$  to solve:

$$(A8) \quad \ell_{i1} \argmax (\ell_{i1})^\alpha [(z_{i1} + \alpha e \ell_{i1})^{1-\alpha} + (z_{i2} + \alpha e \ell_{i1})^{1-\alpha}]$$

s.t Eq. (5), Eq. (7), Eq. (A7)

$$b_{i1} = w_i^\ell \ell_{i1} + w^z z_{i1}.$$

Computing the F.O.C.S and imposing a symmetric equilibrium, yields Eq. (19) in the main text.

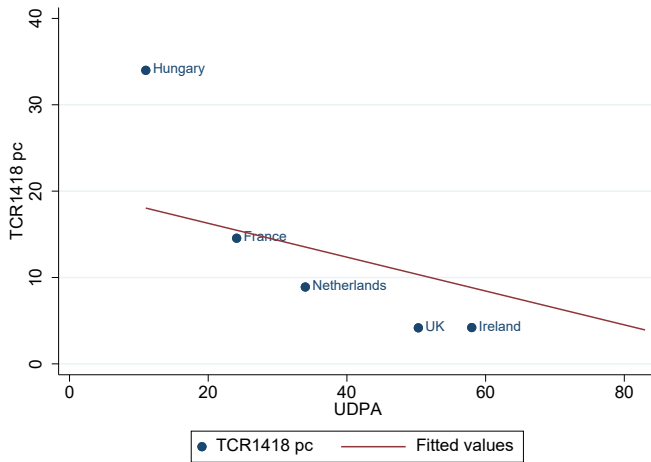
### A.4 The Relationship between TCR and UDPA

Two different relationships between the TCR and UDPA emerge from the data: one relationship pertains the five countries in the sample with low degrees of centralisation in collective bargaining according to Eurostat (2010) (i.e. Hungary, France, the Netherlands, Ireland, the UK), while the other pertains the remaining fifteen countries with intermediate and high degrees of centralisation. Figure 3.1 considers the former case, whereas Figure 3.2 the latter one. Figure 3.1 depicts a negative relationship between TCR and UDPA for countries with low degree of centralisation (corr:  $-0.9$ , significant at 5% level; the linear fit is also drawn). In Figure 3.2, considering the remaining countries,

the relationship appears non-linear (the quadratic fit is also drawn), with higher TCR for countries with both low UDPA and high UDPA relatively to countries with intermediate UDPA.

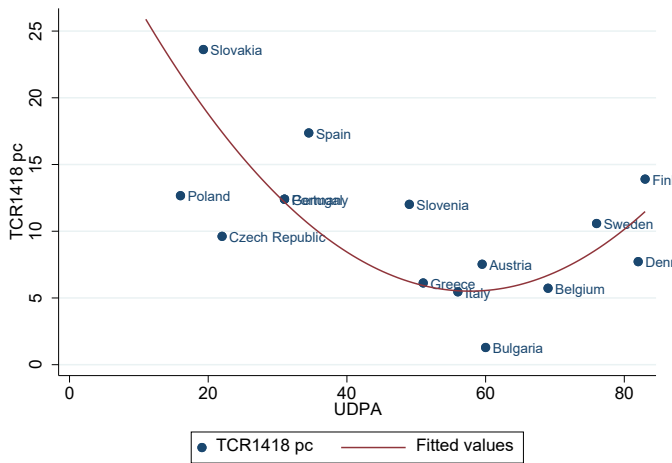
*Figure 3.1*

The Relationship between TCR and UDPA at Low Degrees of Centralisation in Collective Bargaining



*Figure 3.2*

The Relationship between TCR and UDPA at Intermediate and High Degrees of Centralisation in Collective Bargaining





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