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HETEROGENEITY AND THE PUBLIC SECTOR WAGE POLICY*

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A model with search and matching frictions and heterogeneous workers was established to evaluate a reform of the public sector wage policy in steady state. The model was calibrated to the U.K. economy based on Labour Force Survey data. A review of the pay received by all public sector workers to align the distribution of wages with the private sector reduces steady-state unemployment by 1.4 percentage points.

1. INTRODUCTION

Two sets of stylized facts characterize the public sector employment and wage policy regarding their size and heterogeneity across skills. First, public sector employment and wages always stand out as major components, whether one looks at the labor market or government budget. Governments of OECD countries account for 18% of total employment, and their wage bills represent more than half of their government consumption expenditures. Perhaps less known is the policy heterogeneity across the skill dimension. The public sector predominantly hires skilled workers. In the United Kingdom, for instance, the government employs 37% of college graduates, but only 17% of workers with lower qualifications. The pay rates also vary across workers. Researchers estimate that the public sector wage premium, although positive on average, differs across education groups. Less educated individuals are paid a high premium, whereas more educated individuals receive a lower premium.[2] Finally, adding to the wage compression observed across education levels, a wage compression also exists within education categories, with the bottom quantile having higher premium and the top quantile having lower or even negative premium.[3]

This article builds a quantitative macromodel with search and matching frictions that incorporates these stylized facts. With labor market frictions, the loose relation between public and private sector pay creates distortions in the labor market. Higher public sector wages create queues for those jobs, whereas lower wages generate recruitment problems. It also alters the incentives of the government on which type of workers to hire. These distortions affect the equilibrium unemployment rate. I use the model to evaluate a reform that strengthens the link with private sector wages across workers. I consider this reform because the equality of public

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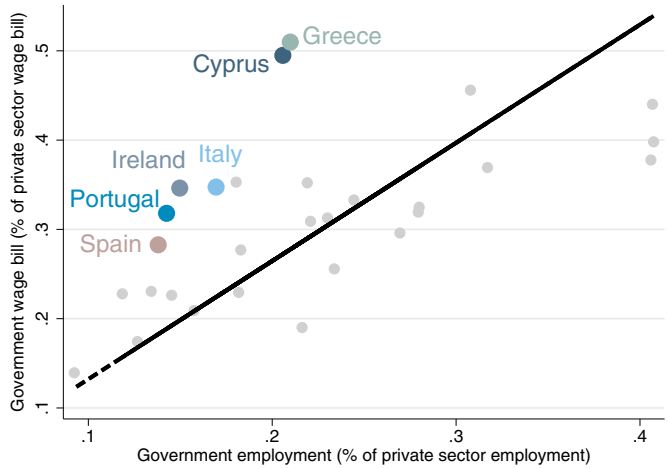
[2] This was found in the United States by Katz and Krueger (1991), in the United Kingdom by Postel-Vinay and Turon (2007) or Disney and Gosling (1998), and in several European countries by Christofides and Michael (2013), Castro et al. (2013), and Giordano et al. (2011).

[3] This was found in Poterba and Rueben (1994) for the United States, Postel-Vinay and Turon (2007) or Disney and Gosling (1998) for the United Kingdom, or Mueller (1998) for Canada.



Source: Data on government and private sector employment are from EUROSTAT and OECD. Data on government wage bill and private sector wage bill are from AMECO.

FIGURE 1

GOVERNMENT WAGE BILL AND EMPLOYMENT IN 2008, OECD COUNTRIES [COLOR FIGURE CAN BE VIEWED AT WILEYONLINELIBRARY.COM]

sector wages with the private sector is the implicit wage policy in any model with a frictionless labor market.

Given the heterogeneity across skills, it is surprising that most theoretical literature on public employment has ignored this dimension by assuming homogeneous workers. Examples that consider a labor market without frictions include Finn (1998), Algan et al. (2002), and Ardagna (2007). Papers that consider search and matching frictions include Quadrini and Trigari (2007), Hörner et al. (2007), and Burdett (2012) or, more recently, Michaillat (2014), Gomes (2015), and Afonso and Gomes (2014). Attempts to model heterogeneity include Bradley et al. (2017), Albrecht et al. (2017), and Domeij and Ljungqvist (2016). Bradley et al. (2017) consider a setting where homogeneous workers receive different wages ex post, due to search frictions, and examine how public policies affect the distribution of wages and employment in the private sector. Albrecht et al. (2017) consider heterogeneous human capital and match specific productivity in a Diamond–Mortensen–Pissarides model. Domeij and Ljungqvist (2016) study how the public employment hiring of skilled and unskilled workers in Sweden and the United States can explain the different evolutions of the skill premium in the two countries. Two reasons motivate me to introduce worker heterogeneity.

In a simple RBC model, as in Finn (1998), even if the productivity differs across sectors, identical workers receive the same wage due to arbitrage. With frictions, the labor market tolerates different wages. Gomes (2015) examines the optimal wage policy in the context of a stylized two-sector search and matching model. If the government sets a high wage, it induces too many unemployed to queue for public sector jobs, thus reducing private sector job creation and increasing unemployment. Conversely, if it sets a lower wage, few unemployed want a public sector job and the government faces recruitment problems. The heterogeneous public sector wage premium suggests that we may have the two inefficiencies operating simultaneously, with long queues and high unemployment for unskilled workers and recruitment problems for high-ability skilled workers.

The second reason stems from the recent experience of European countries subject to austerity packages. Figure 1 displays the government's wage bill as a fraction of the private sector wage bill and the size of government employment relative to private sector employment of OECD countries in 2008, calculated using aggregate data. Six countries stand out for having a high public sector wage bill relative to their level of public employment: Greece, Cyprus,

Ireland, Portugal, Italy, and Spain. These countries would end up in the center of the Euro area crisis due to their poor public finances and sclerotic labor markets. Regardless of whether public sector employment was part of the problem, it was certainly seen as part of the solution. The implemented austerity measures included public sector wage cuts. However, most governments opted for asymmetric cuts, centered on the highest earners, instead of reforms aligning the wage distribution with that of the private sector.[4] Although the cuts reduced spending, they did not correct inefficiencies at the bottom and probably exacerbated inefficiencies at the top.

I set up a two-sector search and matching model and introduce worker heterogeneity along two dimensions: education and ability. I consider heterogeneous ability for two reasons. First, as previously stated, the public sector wage premium also varies within education groups. Second, such inclusion acknowledges the common argument that public sector wage cuts limit the scope of governments to hire high-ability workers. Nickell and Quintini (2002) document the fall in relative pay of British public sector workers during the 1980s and find that men entering the public sector had significantly lower test score positions compared with public sector entrants in the previous decade.

Instead of deriving the optimal policy in a stylized setting, as in Gomes (2015), this article aims to quantitatively assess the gains of a reform that embodies the principle that public wage should be linked to the private sector. To do it, the model features several realistic elements. Instead of a social planner, the model features a government that provides an exogenous amount of services. Taking the wage schedule as given, the government decides the number and type of workers to hire to minimize the cost of providing those services. The endogenous choice of the number and type of government workers to hire plays an important role and is novel to this article. I also include capital stock, distortionary taxes, and an idiosyncratic preference for the public sector, all quantitatively relevant. The model is calibrated for the United Kingdom. I use the Labour Force Survey (LFS) from 1996 to 2006 to calibrate the parameters related to the worker heterogeneity, labor market, and wages.

I measure the steady-state effects of a pay review covering different types of public sector workers on the following variables: the equilibrium unemployment rate, the level and composition of the public sector worker pool, total government spending, and welfare. Wage cuts of skilled workers can reduce spending, but up to a limit. If the cuts are too severe, they actually increase government spending and reduce welfare. As the government lowers the pay of skilled workers too severely, it faces recruitment problems. To maintain its services, the government spends more to recruit a skilled worker and substitutes hiring toward unskilled workers. Cuts above 6% of skilled wages are welfare-reducing. On the other hand, wage cuts of unskilled government employees reduce both the unemployment rate and government spending. A 7% cut reduces the unemployment rate by more than 1.1 percentage points. A large wage premium at the bottom makes these workers expensive compared to their productivity. A government that minimizes costs neglects these workers in favor of more productive workers that are relatively cheaper. By decompressing the wages, the government hires more unskilled workers, reducing their unemployment rate. The overall reform that sets equal pay reduces the unemployment rate by 1.4 percentage points and raises welfare by 1%. If the government savings are used to reduce distortionary income taxes, the effects are even larger, with a reduction of the unemployment rate of 2.1 percentage points.

The proposed policy resembles the one followed by Nordic countries. During the 1970s and 1980s, these countries reformed the public sector, simultaneously reducing the wage premium, particularly of the unskilled, and employing more of these workers; see Domeij and Ljungqvist (2016) for Sweden and Pederson et al. (1990) for Denmark. The policy allowed these countries to have large public sectors without asphyxiating the private sector and to maintain low levels of unemployment.

[4] In Portugal, in 2012, the wage cuts were 22% on the highest earners and 0% on the lowest. In Spain, in 2010, they were 10% on top and zero at the bottom. In Ireland, in 2010, the cuts were 15% at the top and 5% at the bottom.

2. MODEL WITH SEARCH AND MATCHING FRICTIONS

The model extends Gomes (2015) in some realistic dimensions. It adds heterogeneous workers to capture the stylized facts on heterogeneity discussed in Section 1. It features the capital accumulation because capital–skill complementarity is an important determinant of productivity differences across workers.

Instead of following the optimal policy as in Gomes (2015), the government takes the wage schedule as given. It chooses how many workers of different types to hire to guarantee the provision of a certain level of services while minimizing the cost of providing those services. It finances its spending with a distortionary income tax. I set up the model in a dynamic setting, but the main exercise is steady-state comparative statics. The transition dynamics are shown in a Companion Appendix and discussed in Section 5.2.

2.1. *General Setting.* The economy has two sectors $j \in \{p, g\}$. Public sector variables are denoted by the superscript g and private sector variables by p. Time is discrete and denoted by t. There is no uncertainty. The economy is populated by a measure one of workers. Workers differ ex ante from each other, with all workers falling into one of four categories $i \in \{\bar{h}, \underline{h}, \bar{\mu}, \underline{\mu}\}$, with two dimensions of heterogeneity. The first dimension is education, with skilled workers (college degree) denoted by h and unskilled (below college degree) workers denoted by μ. Within each group, there are workers with higher ability, $(\bar{h}, \bar{\mu})$, and others with lower ability $(\underline{h}, \underline{\mu})$. The productivity of workers of type i is denoted by z^i, with $z^{\bar{h}} > z^{\underline{h}}$ and $z^{\bar{\mu}} > z^{\underline{\mu}}$. The mass of workers of type i is ϑ^i, with $\sum_i \vartheta^i = 1$.

For each type, a fraction of workers are unemployed (u_t^i), while the remaining are working either in the public $(l_t^{g,i})$ or private $(l_t^{p,i})$ sector:

$$1 = l_t^{p,i} + l_t^{g,i} + u_t^i, \quad \forall i. \tag{1}$$

Total unemployment is denoted by $u_t = \sum_i \vartheta^i u_t^i$. The presence of search and matching frictions prevents some unemployed individuals from finding jobs; see Pissarides (2000). The evolution of employment of type i in sector j depends on the number of new matches $m_t^{j,i}$ and on job separations. In each period, jobs are destroyed at rate $\lambda^{j,i}$, which potentially differs across sectors and types:

$$l_{t+1}^{j,i} = (1 - \lambda^{j,i}) l_t^{j,i} + m_t^{j,i}, \quad \forall ji. \tag{2}$$

I assume that the markets are segmented and independent across types. This assumption is worth discussing. Although employers can easily observe potential employees' length of education from their curriculum vitae, this is not necessarily the case with ability. We have to state whether it is observable ex ante by the employer or it is private information. If ability is unobservable, low-ability workers can apply to high-ability jobs, breaking down an equilibrium with segmented markets. I want to abstract from the complications arising from asymmetric information. I rely on previous papers on adverse selection with labor market frictions, such as Guerrieri et al. (2010) or Fernández-Blanco and Gomes (2017). These papers argue that firms can design mechanisms such that workers self-select into the correct segment.[5] Section 2.4 explains why assuming observable types is not a problem.

[5] In Guerrieri et al. (2010), this is done by contracts specifying the hours worked. Assuming that high-ability workers have lower disutility of work, firms post a contract specifying a higher wage and more hours, which excludes the low-ability type. I follow the setting of Fernández-Blanco and Gomes (2017). They assume that the output of a match depends on the capital supplied by firms and that firms and workers bargain over wages. Firms specify a capital plan ex ante. With capital-skill complementarity, the low-ability worker does not have an incentive to apply to high-ability jobs, as it implies too much capital and hence lower wages. These mechanisms would not apply to the public sector. However, in many countries, an entry exam is required for a job in the public sector that can give information on the ability of the worker.

I assume that the unemployed can direct their search to the private or public sectors. This assumption finds support in microeconometric evidence and was discussed in length in Gomes (2015). Together with the assumption of segmented markets, it allows new matches to be expressed with the following matching functions:

$$m_t^{j,i} = m^{j,i}\left(u_t^{j,i}, v_t^{j,i}\right), \quad \forall ji. \tag{3}$$

I assume that the unemployed choose the sector in which they concentrate their search; thus, $u_t^{j,i}$ represents the number of unemployed of type i searching in sector j. Vacancies in each segment are denoted by $v_t^{j,i}$. An important part of the analysis focuses on the behavior of those unemployed specifically searching for public sector jobs, defined as $s_t^i \equiv \frac{u_t^{g,i}}{u_t^i}$. I also define $q_t^{j,i}$ as the probability of filling a vacancy of type i in sector j and $f_t^{j,i}$ as the job-finding rate of an unemployed of type i conditional on searching in sector j:

$$q_t^{j,i} = \frac{m_t^{j,i}}{v_t^{j,i}}, \qquad f_t^{j,i} = \frac{m_t^{j,i}}{u_t^{j,i}}, \quad \forall ji.$$

This setting relies on two other assumptions. First, as in Albrecht et al. (2017), I abstract from on-the-job search and direct transitions between sectors. According to LFS data, in the United Kingdom in any given quarter, only 0.25% of workers in the private sector move to the public sector without a measured spell of unemployment. This represents less than 30% of all inflows into the public sector. Although these flows are not negligible, the large majority of public sector workers are hired directly from nonemployment. See Bradley et al. (2017) for a model that incorporates explicitly transitions between sectors. Second, I assume that the labor market friction parameters are exogenous. One could argue that some parameters, such as separation rates or matching elasticities, might respond to changes in the public sector wage, so that these indirect effects might mitigate or reinforce the outcome of the reform.

2.2. *Representative Household.* Following Merz (1995), I assume that household members pool their income so that private consumption is equalized across members. This is a common assumption in the literature to maintain a representative agent framework in the presence of unemployment. Without this risk-sharing assumption, risk-averse workers with different employment histories would accumulate different levels of wealth. As the wealth distribution is not relevant to our problem, I prefer to retain the representative agent framework. The household is infinitely lived and has the following preferences:

$$\sum_{t=0}^{\infty} \beta^t [u(c_t) + v(u_t)], \tag{4}$$

where c_t is the consumption good produced by the final good sector. The household also derives utility from members who are unemployed $v(u_t)$, which captures the value of leisure and home production. $\beta \in (0, 1)$ is the discount factor. The budget constraint in period t is given by

$$c_t + K_{t+1} = (1-\delta)K_t + (1-\tau_t)\left(r_t K_t + \sum_j \sum_i \vartheta^i w_t^{j,i} l_t^{j,i}\right) + \chi^g u_t + \Pi_t. \tag{5}$$

The household can save by accumulating capital stock K_t. The capital stock depreciates at a rate δ and can be rented to firms at a rental rate of r_t. The second source of income is labor income, with $w_t^{j,i}$ being the wage rate from the members of type i working in sector j. Unemployed members collect unemployment benefits χ^g. The household pays a tax τ_t on both its labor and

capital income. Finally, Π_t encompasses the lump-sum taxes or transfers from the government and possible net profits from the private sector firms.

The household chooses the sequence of $\{c_t, K_{t+1}\}_{t=0}^{\infty}$ to maximize the expected utility subject to the sequence of budget constraints, taking taxes and prices as given. The solution is the Euler equation:

$$u_c(c_t) = \beta(1 - \delta + r_{t+1}(1 - \tau_{t+1}))u_c(c_{t+1}). \tag{6}$$

The agents in this economy discount the future with $\beta_{t,t+T} = \beta^T[\frac{u_c(c_{t+T})}{u_c(c_t)}]$, equal to β^T in steady state.

2.3. *Workers.* The unweighted value of each member of type i to the household depends on his or her current state. The values of being employed are

$$W_t^{j,i} = (1 - \tau_t)w_t^{j,i} + \beta_{t,t+1}\left[(1 - \lambda^{j,i})W_{t+1}^{j,i} + \lambda^{j,i}U_{t+1}^{i}\right], \quad \forall i, j. \tag{7}$$

The value of being employed in a specific sector depends on the current net wage, $(1 - \tau_t)w_t^{j,i}$, as well as the continuation value of the job, which depends on the separation probability. Under the assumption of direct search, those unemployed are searching for a job in either the private or public sector, with value functions given by

$$U_t^{j,i} = \frac{v_u(u_t)}{u_c(c_t)} + \chi^b + \beta_{t,t+1}\left[f_t^{j,i}W_{t+1}^{j,i} + \left(1 - f_t^{j,i}\right)U_{t+1}^{i}\right], \quad \forall i, j. \tag{8}$$

As in Hall and Milgrom (2008), the unemployed collect unemployment benefits χ^b and contribute to home production (marginal utility from unemployment relative to the marginal utility of consumption). The continuation value of being unemployed and searching in a particular sector depends on the probability of finding a job and the value of working in that sector. I assume that each unemployed member decides on which sector to search according to the following condition:

$$U_t^{p,i} = U_t^{g,i} + \gamma_t^i, \quad \forall i. \tag{9}$$

Optimality implies that movement between the two segments guarantees no additional gain for searching in one sector vis-à-vis the other. To this condition, I add, γ_t^i, a random variable with cumulative distribution Γ, which stands for an idiosyncratic relative preference (or distaste) for searching in the public sector. In each period all the unemployed draw γ_t^i and decide where to search. One can interpret this variable as incorporating all the extra factors that affect the decision of the unemployed of where to search for a job, including potential additional time costs of applying to the public sector, that is, preparing for an exam. This is a shortcut, but a quantitatively important one. Without it, as in Gomes (2015), small changes in relative wages generate implausibly large swings in the fraction of unemployed searching in the public sector. With this distribution of preferences, even if the government pays low wages, workers with strong preferences for the public sector would still apply for jobs there.[6] Γ puts discipline on the fluctuations on s_t^i, which are given in equilibrium by

$$s_t^i = 1 - \Gamma\left(\gamma_t^{i,*}\right), \quad \forall i, \tag{10}$$

[6] Artuç et al. (2010) argue that wage differentials alone cannot explain several facts about mobility. The idiosyncratic shock is crucial to a realistic treatment of worker mobility.

where $\gamma_t^{i,*}$ is the cutoff point of the distribution for type i at time t. All unemployed household members with preferences above the cutoff will search for jobs in the public sector, whereas the ones below search in the private sector. This threshold is given by

$$\gamma_t^{i,*} = f_t^{p,i}\beta_{t,t+1}\left[W_{t+1}^{p,i} - U_{t+1}^{i}\right] - f_t^{g,i}\beta_{t,t+1}\left[W_{t+1}^{g,i} - U_{t+1}^{i}\right], \quad \forall i. \tag{11}$$

An increase in the value of employment in the public sector, driven by either wage increase or decrease in the separation rate, raises s_t until no extra gain exists for searching in that sector. However, the marginal searcher has a lower preference for the public sector. In each period, there is a wedge between the two values of unemployment. The ex ante value of being unemployed is given by

$$U_t^i = \left(1 - s_t^i\right) U_t^{p,i} + s_t^i U_t^{g,i} + \int_{\gamma_t^{i,*}} \gamma_t^i \Gamma\left(\gamma_t^i\right) d\gamma_t^i, \quad \forall i. \tag{12}$$

2.4. *Intermediate Goods Producers.* There is a large continuum of firms that produce one of four types of intermediate goods x_t^i, which is sold at price $p_t^{x,i}$. Firms open vacancies in a given submarket i. If the vacancy is filled, the firm is matched to a type-i worker and produces $x(a, z^i, k_t^i)$, where a is an aggregate productivity and k_t^i is the capital used in the match, rented at rate r_t. The production technology $x(\cdot, \cdot, \cdot)$ is increasing and concave in all its arguments with a positive cross partial derivative of capital and skill. The value of a job is given by

$$J_t^i = \max_{k_t^i}\left[p_t^{x,i} x\left(a, z^i, k_t^i\right) - w_t^{p,i} - r_t^{p,i} k_t^i + \beta_{t,t+1}(1 - \lambda^{p,i}) J_{t+1}^i\right], \quad \forall i. \tag{13}$$

For each match, the firm chooses every period how much capital it rents. The optimal level of capital k_t^{*i} solves the first-order condition

$$p_t^{x,i} x_k\left(a, z^i, k_t^{*i}\right) = r_t, \quad \forall i. \tag{14}$$

Therefore, we can write the value of a job as

$$J_t^i = \left[p_t^{x,i} x\left(a, z^i, k_t^{*i}\right) - w_t^{p,i} - r_t^{p,i} k_t^{*i} + \beta_{t,t+1}\left[(1 - \lambda^{p,i}) J_{t+1}^i\right]\right], \quad \forall i. \tag{15}$$

The value of opening a vacancy for type i is given by

$$V_t^i = -\kappa^{p,i} + \beta_{t,t+1}\left[q_t^{p,i} J_{t+1}^i + \left(1 - q_t^{p,i}\right) V_{t+1}^i\right], \quad \forall i, \tag{16}$$

where $\kappa^{p,i}$ is the cost of posting a vacancy. The number of firms is determined in equilibrium by free entry:

$$V_t^i = 0, \quad \forall i. \tag{17}$$

The surplus from the match is shared by the firm and workers as wages are the outcome of Nash bargaining:

$$w_t^{p,i} = \arg\max_{w_t^{p,i}}\left(W_t^{p,i} - U^i{}_t\right)^b \left(J_t^i\right)^{1-b}, \quad \forall i. \tag{18}$$

where b denotes the worker's bargaining power. The solution is given by

$$\left(W_t^{p,i} - U_t^i\right) = \frac{b(1-\tau_t)}{1-b\tau_t}\left(W_t^{p,i} - U_t^i + J_t^i\right), \quad \forall i. \tag{19}$$

With distortionary taxes, the share of the surplus going to workers is lower than their bargaining power. For every unit that the firm gives up in favor of the worker, the pair lose a fraction τ_t to the government. Therefore, they economize on their tax payments by agreeing to a lower wage.[7]

Notice that, from Equation (14), one capital level maximizes the surplus of the match and hence wages. Given the capital–skill complementarity, the optimal level of capital increases with ability, provided that the price of the good is not decreasing in ability, which is guaranteed in the numerical exercise. This ensures that, even if ability were not observable, we could design a separating equilibrium. If firms commit to supplying a capital stock of the high type in every period, low-ability workers would not pretend to have high ability. Even if they were to have a higher job-finding rate, they would be paired with too much capital for the duration of the match, implying lower wages; see Fernández-Blanco and Gomes (2017).

2.5. *Final Goods Producer.* The representative final goods producer who buys intermediate inputs in a competitive market produces a final good. The objective is to choose inputs to maximize profits given by

$$\max_{\mathbf{x}_t}\left[F(\mathbf{x}_t) - \sum_i p_t^{x,i} x_t^i\right], \tag{20}$$

where bold denotes a vector, that is, $\mathbf{x}_t$ denotes a vector with all four intermediate inputs. The solution is given by the first-order conditions

$$F'_{x^i} = p_t^{x,i}, \quad \forall i. \tag{21}$$

2.6. *Government.* I assume that the government needs to produce a minimum number of services, $\bar{g}$. To produce these services, the government hires different types of workers. I consider public sector wages to be exogenous policy variables determined one period in advance when vacancies are posted. Given a wage schedule, the government chooses the number of vacancies for each type of worker to minimize the total cost of providing the government services. The total cost encompasses the cost of recruitment and the future wage bill:

$$\min_{v_t^{g,i}} \sum_i \vartheta^i \kappa^{g,i} v_t^{g,i} + \beta_{t,t+1}\left[\sum_i \vartheta^i w_{t+1}^{g,i} l_{t+1}^{g,i}\right]$$

s.t.

$$\bar{g} = g\left(\mathbf{l}_{t+1}^g\right)$$

$$l_{t+1}^{g,i} = (1-\lambda^{j,i}) l_t^{g,i} + q_t^{g,i} v_t^{g,i}, \quad \forall i,$$

where $g(\mathbf{l}_t^g)$ is the production function of government services that uses the four types of workers, $\mathbf{l}_t^g$. Given the level of public wages and vacancy-filling probability, the government has to guarantee that it posts sufficient vacancies to maintain an employment level capable of

[7] If firms also paid taxes on their profits, the total surplus of the match would be independent of the tax rate that would not affect the bargaining power of workers. In that scenario, the tax rate would not distort the wage setting process in the private sector and would only affect the accumulation of capital.

continuing to provide its services. I consider a relatively myopic government that does not care about the infinite sequence of government services and the present discounted value of the costs. In Section 5.2, I generalize this problem and discuss the scenarios where the government has a longer horizon (4, 8, and 16 quarters and ∞).

I assume that the government does not internalize the effect its policies have on tightness. By choosing a different composition of workers to hire, it could affect the filling probabilities and, therefore, the hiring cost. My argument is that the government does not hire in a centralized way. There are vacancies in different branches of government and in different regional offices. Each one has little control over the wages and can only decide which workers to hire to be able to provide its services. The first-order conditions of this problem are

$$\frac{\vartheta^i \kappa^{g,i}}{q_t^{g,i}} + \beta_{t,t+1}\left[\vartheta^i w_{t+1}^{g,i}\right] = \xi_t g'_{i,t+1}, \quad \forall i, \tag{22}$$

where ξ_t is the real multiplier of the constraint on government services and $g'_{i,t}$ is the partial derivative of the government services with respect to government's employment of type i workers. This problem incorporates the two opposite forces that are important for understanding the role of public sector wages. When wages of one employee type go down, the government would save on the wage bill if it hired more of them. However, simultaneously, it may be more expensive to recruit them. The overall effect depends on the tightness of the labor market.[8]

The government budget constraint is given by

$$\tau_t\left(\sum_j \sum_i \vartheta^i l_t^{j,i} w_t^{j,i} + r_t K_t\right) = \sum_i \vartheta^i l_t^{g,i} w_t^{g,i} + \sum_i \vartheta^i v_t^{g,i} \kappa^{g,i} + \chi^b u_t + T_t + \bar{g}^{int}, \tag{23}$$

where T_t are lump-sum transfers and $\bar{g}^{int}$ are exogenous purchases of intermediate goods. The costs of recruiting are external, meaning they come out of the budget constraint. Throughout the article, I consider two cases: one where any adjustment of the government budget is guaranteed by changes in lump-sum transfers and the other where distortionary income tax rate adjusts to balance the budget.

2.7. *Market Clearing.* The market clearing conditions in the intermediate and final goods' markets are

$$x_t^i = \vartheta^i l_t^{p,i} x\left(a, z^i, k_t^i\right), \quad \forall i, \tag{24}$$

$$Y_t = F(\mathbf{x}_t) = c_t + \bar{g}^{int} + K_{t+1} - (1-\delta)K_t + \sum_i \sum_j \vartheta^i v_t^{j,i} \kappa^{j,i}. \tag{25}$$

In this economy, the measure of GDP in the national accounts would be $GDP_t = F(\mathbf{x}_t) + \sum_i \vartheta^i l_t^{g,i} w_t^{g,i}$. The market clearing in the capital market implies that all capital is rented to intermediate goods producers:

$$K_t = \sum_i \vartheta^i k_t^i l_t^{p,i}. \tag{26}$$

[8] I have also considered an alternative setting in which the government has a budget fixed and chooses the number and type of workers to maximize the production of the public good. The conclusions under this setting are similar, but the gains of reducing wages are measured in terms of public sector output instead of the reduction in the public sector wage bill and private consumption.

2.8. *Decentralized Equilibrium.*

DEFINITION 1. Given a sequence of policies of public wages $\{w_t^{g,i},\ \forall i\}_{t=o}^{\infty}$, unemployment benefits χ^b, government services $\bar{g}$, intermediate purchases $\bar{g}^{int}$, and income tax $\bar{\tau}$ and a set of initial conditions $\{K_0, l_0^{p,i}, l_0^{g,i},\ \forall i\}$, a decentralized equilibrium is a sequence of prices $\{r_t, w_t^{p,i}, p_t^{x,i},\ \forall i\}_{t=o}^{\infty}$ and allocations $\{K_{t+1}, C_t, k_t^i, v_t^{p,i}, v_t^{g,i}, s_t^i,\ \forall i\}_{t=o}^{\infty}$ such that (i) household satisfies the Euler equation (6), (ii) unemployed members of type i choose which sector to search (Equation (9)), (iii) matched intermediate goods' firms choose optimal capital for each type (Equation (14)), (iv) free entry of intermediates goods' firms (Equation (17)), (v) private sector wages are the outcome of Nash bargaining (Equation (19)), (vi) a final good representative firm maximizes profits (Equation (21)), (vii) government minimizes the cost of producing services (Equation (22)), (viii) lump-sum taxes balance the budget (Equation (23)), and (ix) intermediate goods, final good, and capital markets clear (Equations (24)–(26)).

3. CALIBRATION

To solve the model, I consider the following functional forms for the matching functions, production functions, and preferences:

$$u(c_t) + v(u_t) = \frac{c_t^{1-\sigma}}{1-\sigma} + \chi^u u_t,$$

$$m_t^{j,i} = \zeta^{j,i}\left(u_t^{j,i}\right)^{\eta^j}\left(v_t^{j,i}\right)^{1-\eta^j}, \quad \forall i, j,$$

$$x(a, z^i, k^i) = a z^i (k^i)^{\alpha} \quad \forall i,$$

$$F(\mathbf{x}_t) = \left(\Psi\left(\left(x_t^{\bar{h}}\right)^{\varrho} + \left(x_t^{\underline{h}}\right)^{\varrho}\right)^{\frac{\varsigma}{\varrho}} + (1-\Psi)\left(\left(x_t^{\bar{\mu}}\right)^{\varrho} + \left(x_t^{\underline{\mu}}\right)^{\varrho}\right)^{\frac{\varsigma}{\varrho}}\right)^{\frac{1}{\varsigma}},$$

$$g\left(\mathbf{l}_{t+1}^{g}\right) = \left(\Phi\left(\left(\vartheta^{\bar{h}} z^{\bar{h}} l_{t+1}^{g,\bar{h}}\right)^{\varrho^g} + \left(\vartheta^{\underline{h}} z^{\underline{h}} l_{t+1}^{g,\underline{h}}\right)^{\varrho^g}\right)^{\frac{\varsigma^g}{\varrho^g}} + (1-\Phi)\left(\left(\vartheta^{\bar{\mu}} z^{\bar{\mu}} l_{t+1}^{g,\bar{\mu}}\right)^{\varrho^g} + \left(\vartheta^{\underline{\mu}} z^{\underline{\mu}} l_{t+1}^{g,\underline{\mu}}\right)^{\varrho^g}\right)^{\frac{\varsigma^g}{\varrho^g}}\right)^{\frac{1}{\varsigma^g}}.$$

I assume a CRRA utility function with a coefficient of risk aversion σ and linear utility of unemployment. For the matching function, the matching elasticity with respect to unemployment, η^j, can be different across sectors, but not across types, whereas the matching efficiency, $\zeta^{j,i}$, differs across sectors and education, but not ability. For the production function of individual firms, I assume an elasticity of output with respect to capital per worker of α. The final output is produced by two nested constant elasticity of substitution (CES) functions. Both skilled and unskilled inputs are an aggregation of low- and high-ability workers, with the parameter ϱ determining the elasticity of substitution between types. The final good is then produced by a CES of the skilled and unskilled intermediate inputs with a parameter ς. Ψ governs the importance of the skilled input in the production. In the baseline calibration, the government's production function has the same elasticity of substitution between low- and high-ability workers ($\varrho^g = \varrho$) and between skilled and unskilled inputs ($\varsigma^g = \varsigma$) as the private sector.

The model is calibrated to match the U.K. economy on a quarterly frequency, drawing largely on the LFS microdata for the period 1996–2010. Table 1 lists all the parameters, their values, and the data sources. The educational attainment of the labor force has significantly improved over the past two decades, as documented in Gomes (2012). I take an average of the period 1996–2010, which places the share of university graduates at 32% of the population. I consider that high- and low-ability workers have the same mass, so $\vartheta^{\bar{h}} = \vartheta^{\underline{h}} = 0.16$ and $\vartheta^{\bar{\mu}} = \vartheta^{\underline{\mu}} = 0.34$. I also report the results assuming the share of college graduates is (i) the one at the beginning of the sample (25%) and (ii) the one at the end of the sample (40%).

TABLE 1
SUMMARY OF BASELINE CALIBRATION

Fixed Parameters Fixed	Source	Values
Public–private wage ratio	LFS	$\frac{\bar{w}^{g,\bar{h}}}{\bar{w}^{p,\bar{h}}} = 1.016$, $\frac{\bar{w}^{g,\underline{h}}}{\bar{w}^{p,\underline{h}}} = 1.039$, $\frac{\bar{w}^{g,\bar{\mu}}}{\bar{w}^{p,\bar{\mu}}} = 1.037$, $\frac{\bar{w}^{g,\underline{\mu}}}{\bar{w}^{p,\underline{\mu}}} = 1.071$.
Job-separation rates	LFS	$\lambda^{g,h} = 0.004$, $\lambda^{p,h} = 0.012$, $\lambda^{g,\mu} = 0.006$, $\lambda^{p,\mu} = 0.018$.
Weights of skilled	LFS	$\vartheta^{\underline{h}} = 0.16$, $\vartheta^{\bar{h}} = 0.16$, $\vartheta^{\underline{\mu}} = 0.34$, $\vartheta^{\bar{\mu}} = 0.34$.
Matching elasticities w.r.t. unemployment	Gomes (2014)	$\eta^g = 0.15$, $\eta^p = 0.40$.
CES elasticities	Set exogenously	$\varsigma = 0.0$, $\rho = 0.50$
Steady-state income tax	Standard	$\bar{\tau} = 0.2$
Depreciation rate	Standard	$\delta = 0.02$
Discount factor	Standard	$\beta = 0.99$
Coefficient of relative risk aversion	Standard	$\sigma = 2$
Productivity	Normalization	$a = z^{\underline{h}} = z^{\bar{\mu}} = 1$
Other Parameters	**Target (Source)**	**Values**
Matching efficiency	Vacancy duration (CIPD)	$\zeta^{g,h} = 0.677$, $\zeta^{p,h} = 0.588$, $\zeta^{g,u} = 1.011$, $\zeta^{p,u} = 0.956$
Cost of posting vacancies	Cost per hire (CIPD)	$\kappa^{g,h} = 6.376$, $\kappa^{p,h} = 9.534$, $\kappa^{g,u} = 0.907$, $\kappa^{p,u} = 0.959$
Unemployment benefits	Replacement rate (EC)	$\chi^g = 1.506$
Unemployment utility	Unemployment rate of unskilled (LFS)	$\chi^u = 0.063$
Bargaining power of workers	Unemployment rate (LFS)	$b = 0.288$
Weight of skilled in government production	Public employment of skilled (LFS)	$\Phi = 0.755$
Government services	Public employment of unskilled (LFS)	$\bar{g} = 0.266$
Weight of skilled in production	College premium (LFS)	$\Psi = 0.348$
Market ability	Residual wage dispersion (LFS)	$z^{\underline{\mu}} = 0.557$, $z^{\bar{h}} = 1.577$
Elasticity w.r.t private capital	Labor share (AMECO)	$\alpha = 0.459$
Government purchases	Government consumption (AMECO)	$\bar{g}^{int} = 0.218$
Distribution of preferences	Average search and ratio of job finding	$v_1 = -8.283$, $v_2 = 0.135$

NOTES: In Section 5, the parameters in the top panel remain fixed and the parameters in the bottom panel are recalibrated to match the new targets.

The contribution of skilled workers to the provision of government services, Φ, and their steady-state level $\bar{g}$ are such that the government hires 37.3% of university graduates and 16.7% of workers without a university degree. These numbers, taken from the LFS, reflect the fact that the government predominantly hires skilled workers. Following Gomes (2012), I construct data on worker flows to calibrate the separation rates, which I assume are equal for workers of different abilities, but differ by education and sector. The numbers are $\lambda^{p,h} = 0.012$, $\lambda^{p,\mu} = 0.018$, $\lambda^{g,h} = 0.004$, and $\lambda^{p,\mu} = 0.006$. The private sector has two to three times more separations than the public sector. Unskilled workers are more likely to lose their jobs than skilled workers.

To calibrate the public sector wage premium for skilled workers, I run quantile regressions of the log of net wages of college graduates on a dummy for the public sector. I control for sex, industry and occupation, status in previous quarter, tenure, age and its square, marital status, time and region, and average hours worked and its square. The sample runs from 1996 to 2006. I take the coefficients of the public sector dummy of the 25th and 75th percentiles as the premium of the low- and high-ability skilled workers. I repeat the regressions for noncollege

graduates. The steady-state public sector wages of the four types are set such that $\frac{\bar{w}^{g,\bar{h}}}{\bar{w}^{p,\bar{h}}} = 1.016$, $\frac{\bar{w}^{g,\underline{h}}}{\bar{w}^{p,\underline{h}}} = 1.039$, $\frac{\bar{w}^{g,\bar{\mu}}}{\bar{w}^{p,\bar{\mu}}} = 1.037$, and $\frac{\bar{w}^{g,\underline{\mu}}}{\bar{w}^{p,\underline{\mu}}} = 1.071$. These numbers are consistent with studies using microdata from the United Kingdom, such as Disney and Gosling (1998), which document a wage compression within and across education groups. Recent papers by Postel-Vinay and Turon (2007) and Dickson et al. (2014) argue that the lifetime premium in the public sector is lower than the one measured in static regressions and that, when controlling for selection, job losses in the two sectors are very similar. As robustness, I consider (i) a 3% lower premium for all types, (ii) a scenario without compression but a positive premium of 3% for all types, and (iii) equal job-separation rates across sectors.

The United Kingdom has a unique source of data on recruitment costs by sector. Every year, the Chartered Institute of Personal Development conducts a recruitment practice survey covering 800 organizations ranging from manufacturing to private and public sectors services (CIPD, 2009). The costs of recruiting a worker, which encompass advertising and agency costs, are approximately £13,000 for a skilled worker in the private sector and £8,000 in the public sector, corresponding to 26 and 16 weeks of the U.K. median income. For a low-skilled worker, the costs are £3,500 and £2,000 for private and public sectors, respectively. The costs of posting vacancies are set to target these numbers ($\kappa^{p,h} = 9.53, \kappa^{g,h} = 6.38, \kappa^{p,\mu} = 0.96$, and $\kappa^{g,\mu} = 0.91$). The CIPD data also report vacancy durations. It takes 14.5 weeks to hire a skilled worker in the private sector and 16 weeks in the public sector. For unskilled workers, it takes 5.5 weeks in the private sector, compared with 9.1 weeks in the public sector. The matching elasticities are set to match these moments ($\zeta^{g,h} = 0.68$, $\zeta^{p,h} = 0.59$, $\zeta^{g,\mu} = 1.01$, and $\zeta^{p,\mu} = 0.96$). The matching elasticities with respect to unemployment are set to $\eta^p = 0.4$ and $\eta^g = 0.15$, estimated by Gomes (2015).

The parameter of the private production function Ψ is set to 0.35 to target a college premium of 40%, which was found by regressing the log net wages on a dummy for college education, and average hours and its square. I normalize $a = z^{\underline{h}} = z^{\bar{\mu}} = 1$. I link the productivity differences within skilled and unskilled workers to a measure of within-group wage dispersion. I run a mincer regression of log net wages on several controls and retrieve the 25th–75th percentile difference of the wage residuals. The difference is 0.461 for skilled and 0.416 for unskilled workers. It is a strong assumption to consider that all the wage dispersion is due to productivity differences. Other factors, namely, search frictions, may also contribute. Abowd et al. (1999) find that search frictions can explain 7%–25% of the French inter-industry differential. Tjaden and Wellschmied (2014) find that 13.7% of overall wage inequality is due to the presence of search frictions. I assume that 20% of the wage dispersion is due to other factors and set $z^{\bar{h}} = 1.58$ and $z^{\underline{\mu}} = 0.56$ to target a wage gap between high and low ability of 0.368 for skilled and 0.332 for unskilled workers. I also report the results assuming (i) all wage dispersion is due to productivity differences and (ii) only 20% of wage dispersion is due to productivity differences across workers.

To accurately predict the welfare and budgetary effects of public sector pay, we have to distinguish the flow value of unemployment due to home production versus unemployment benefits. Salomäki and Munzi (1999) find that the net replacement rate is 61% for low-educated workers and 49% for highly educated workers in the United Kingdom. I set $\chi^b = 1.51$ such that the replacement rate for a low-ability unskilled worker is 60% of the net wage. It implies a replacement rate of 30% for the high-ability skilled workers and of 45% for the remaining workers. I calibrate the utility value of unemployment ($\chi^\mu = 0.06$) and bargaining power of workers ($b = 0.29$) to target an average unemployment rate of 6% and of 7.4% for unskilled workers, values extracted from the LFS. The joint flow value of unemployment varies from 50% of the net private sector wage for a high-ability skilled worker to 96% for a low-ability unskilled worker. The average is around 70%, suggested by Hall and Milgrom (2008).

Regarding technology, the elasticity of output with respect to capital α is set to 0.46 to target a labor share of 60.8%, the United Kingdom's average between 1996 and 2010. As a benchmark, I consider an elasticity of substitution of 1 across skills ($\varsigma^g = \varsigma = 0$) and of 2 across abilities ($\varrho^g = \varrho = 0.5$). I perform several robustness exercises varying the elasticities of substitution,

both economy wide or specific to the public sector technology (i) where skills are substitutes ($\varsigma = 0.4$, as in Krusell et al., 2000); (ii) where skills are complements ($\varsigma = -0.4$); and (iii) where abilities are more or less substitutes ($\varrho = 0.8$ and $\varrho = 0.3$). I also consider a case where the four types of workers in the public sector are close to perfect complements ($\varsigma^g = -10$ and $\varrho^g = -10$). In this scenario, changes in public sector wages do not affect the type of workers hired by the government that are kept in fixed proportions.

The rest of the parameters are standard: β is set to 0.99, σ to 2, and the depreciation rate δ to 0.02. I set the steady-state income tax equal to 0.2 and the purchase of intermediate inputs such that total government consumption is 20% of GDP, the U.K. average from 1996 to 2010 ($\bar{g}^{int} = 0.22$). Lump-sum transfers balance the budget in the steady state.

I assume a uniform distribution of sector preference Γ, with parameters $[\nu_1, \nu_2]$. Given that the search patterns of the unemployed are unobservable, there are no obvious data sources to use. I exploit data from *Google Trends* as a proxy. *Google Trends* provides indices of keyword searches reflecting the instances people have "Googled" a specific word or combination of words relative to overall traffic. These indices are available on a *weekly* basis dating back to 2004.[9] I retrieved the index of keyword searches of "jobs" and one that includes several keywords related to the public sector such as "government jobs," "council jobs" "nhs jobs," or "army jobs." The average ratio of the two indices is 0.14. I calibrate the two parameters of the distribution, ν_1 and ν_2, to match an average search of 0.14 and such that the dispersion is equal to twice the average wage in the economy $\nu_2 - \nu_1 = 2 \times \bar{w}$. This implies a ratio of private to public job-finding rate equal to 7.4, found in the data. I also report the results with (i) a higher and lower level of search ($\bar{s} = 0.2$ and $\bar{s} = 0.07$) and (ii) high and low dispersion ($\nu_2 - \nu_1 = 3 \times \bar{w}$ and $\nu_2 - \nu_1 = 1 \times \bar{w}$).

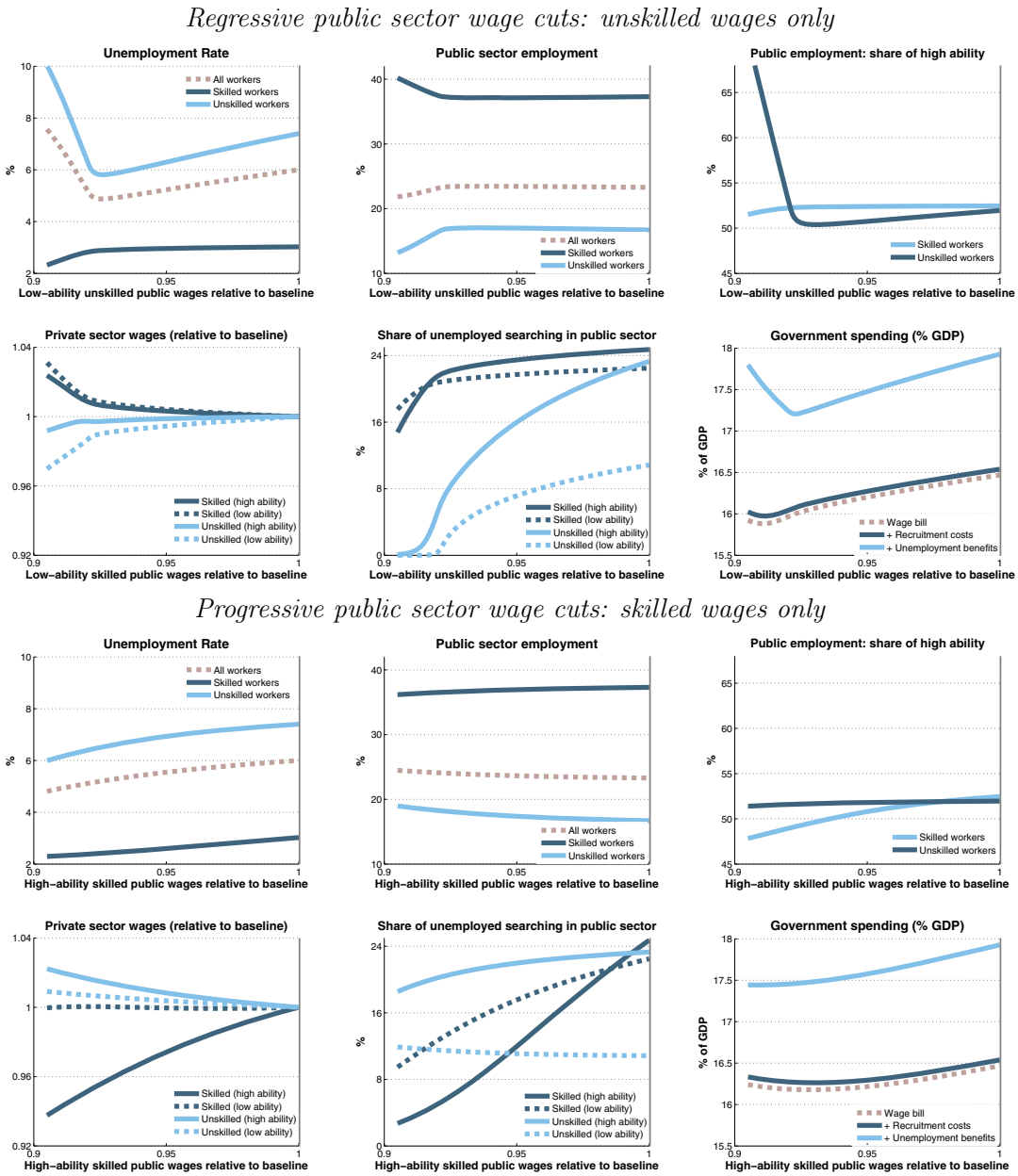
4. REFORMING THE PUBLIC SECTOR'S WAGE POLICY

4.1. *The Effects of Heterogeneous Pay in the Steady State.* I start by examining the effects of progressive and regressive wage cuts. The progressive wage cuts target skilled workers. I assume that, for each 1% cut of high-ability wages, the wages of the low ability are cut by 0.5%. Unskilled wages remain constant. The regressive wage cuts target only unskilled workers. For each 1% cut of low-ability wages, the wages of the high ability are cut by 0.5%. Lump-sum taxes adjust to balance the budget. Figure 2 shows the outcomes.

As the government reduces the unskilled workers' wages (top panel), the composition of public employment shifts from skilled to unskilled workers. Lowering wages has two opposite effects: a wage bill effect and a recruitment effect. As workers become cheaper, the government wants to employ more to save on the wage bill. However, offering lower wages makes the public sector less attractive, implying that fewer unemployed search for jobs there, making the recruitment more costly. When the government reduces unskilled workers' wages, the first effect dominates because unemployed workers are still queuing for jobs in the public sector. To maintain the same level of services, the government hires more workers, but reduces spending on the total wage bill plus recruitment costs.

The consequences in the labor market are dramatic. With a 7% wage cut, the unemployment rate of unskilled workers falls from 7.4% to 5.8%. Lowering wages shifts the job searches to private sector firms that post more vacancies. But the improvement in the labor market cannot explain the magnitude of the unemployment reduction. The other reason is that the unskilled wage cuts encourage the government to hire more unskilled workers, particularly with low ability. In the baseline case, the government hires 16% of these workers, but when paying lower wages, it hires as much as 16.9%. This is the group with the highest unemployment rate, which is reduced with the increase in hiring. A large wage premium at the bottom, makes these workers expensive compared to their productivity. A government that minimizes costs neglects them in favor of more productive workers that are relatively cheaper.

[9] Researchers have used these data to forecast financial markets, labor and housing markets, the automobile sector, inflation expectations, or private consumption. See the review in Gomes and Taamouti (2016).

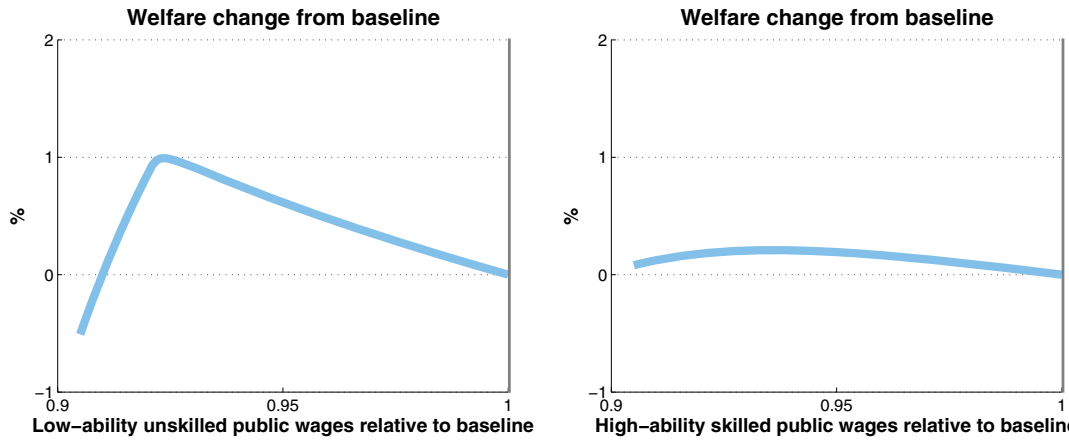


NOTES: Model simulations under the baseline calibration. Regressive public sector wage cuts: for each 1% cut in low-ability unskilled wages, the wages of the high-ability unskilled are cut by 0.5%. Skilled wages are constant. Progressive public sector wage cuts: for each 1% cut in high-ability skilled wages, the wages of the low-ability skilled are cut by 0.5%. Unskilled wages are constant.

FIGURE 2

STEADY-STATE EFFECTS OF PUBLIC SECTOR WAGES ADJUSTMENTS [COLOR FIGURE CAN BE VIEWED AT WILEYONLINELIBRARY.COM]

The government faces a constraint when reducing wages: They have to guarantee that some unemployed search for public sector jobs. For the baseline calibration, if cuts of low-ability unskilled wages are above 8% (4% for the high ability), few unskilled workers search in the public sector. This forces the government to turn to skilled workers to produce its services. By hiring many skilled workers, there are fewer left for the private sector, which reduces the demand for unskilled workers in the private sector and generates a strong increase in their unemployment rate.



(a) Regressive (b) Progressive

FIGURE 3

WELFARE EFFECTS OF PUBLIC SECTOR WAGES ADJUSTMENTS [COLOR FIGURE CAN BE VIEWED AT WILEYONLINELIBRARY.COM]

The bottom panel of Figure 2 shows the consequences of reducing skilled workers' wages. First, it shifts the composition of public employment to unskilled workers. In the case of skilled workers wage cuts, the recruitment effect dominates the wage bill effect. By offering too low wages, only a few devoted skilled unemployed will look for public sector jobs. The government faces recruitment problems, making it costly to hire a skilled worker. To maintain its services, the government hires more unskilled workers, increasing the size of the public sector. This is a case where lowering wages has perverse effects. With wage cuts of more than 7% on top earners, the total wage bill plus recruitment cost increases (bottom right graph). They do, however, reduce the unemployment for unskilled workers.

The progressive and regressive wage cuts affect the government budget differently. Cutting skilled wages allows the government to reduce its wage bill by, at most, 0.3% of GDP. By cutting unskilled wages, the government can reduce it by 0.6% of GDP. The response of private sector wages is also heterogeneous. Skilled wage cuts reduce private sector wages of the skilled but increase those of the unskilled. Unskilled wage cuts reduce private sector wages of the unskilled but increase those of the skilled. However, the effects are not linear. They are stronger when the unemployment rate is lower. The demonstration effect of the public sector as a wage leader depends on how tight the market is.

Figure 3 shows the welfare effects of public sector wage cuts in terms of steady-state consumption-equivalent variations. High-ability skilled wage cuts can increase welfare, at most, by 0.2%. Cuts above 6% do not raise welfare. On the other hand, the regressive cuts can raise welfare by 1%.

4.2. *Equal Pay in the Public Sector.* Let us now consider a policy reform consisting of a review of public sector wages to have a parity with those in the private sector across workers in the steady state. The results are shown in Table 2. This reform significantly lowers the unemployment rate. If the government equates wages to those in the private sector, the aggregate unemployment rate falls by 1.4 percentage points, driven by the 1.9 (3.0) percentage point decrease in the unemployment rate for unskilled workers (low ability).

This reform generates savings of 0.6% of GDP on the government wage bill and of 0.9% of GDP if we consider further savings in unemployment benefits. Private consumption increases by 1.4%, and the welfare gains amount to 1.05% of steady-state consumption.

Decompressing the public wages alters the composition of public employment. The government is able to hire more high-ability skilled workers (by 0.3 percentage points), but it also

TABLE 2
STEADY-STATE EFFECTS OF A REFORM OF PUBLIC SECTOR WAGES

Public–Private Wage Premium	Baseline	*Lump-Sum Taxes* 0%	*Distortionary Taxes* 0%
Variables			
Unemployment rate	0.060	0.046	0.039
Skilled	0.030	0.026	0.025
High-ability	0.022	0.019	0.018
Low-ability	0.039	0.033	0.031
Unskilled	0.074	0.055	0.046
High-ability	0.016	0.009	0.009
Low-ability	0.132	0.102	0.083
Public employment	0.233	0.236	0.236
Skilled	0.373	0.368	0.369
High-ability	0.391	0.394	0.394
Low-ability	0.355	0.343	0.343
Unskilled	0.167	0.173	0.173
High-ability	0.174	0.175	0.174
Low-ability	0.160	0.171	0.173
Consumption	–	+1.40%	+3.02%
Welfare gains	–	1.05%	2.48%
Government*			
Wage bill	0.165	0.159	0.158
+ recruitment costs	0.165	0.160	0.159
+ unemployment benefits	0.179	0.170	0.168
Income taxes	0.2	0.2	0.188
Implied public [private] sector wage change			
Skilled (high-ability)	–	−0.7% [0.8%]	1.2% [2.8%]
Skilled (low-ability)	–	−5.0% [−1.3%]	−3.2% [0.5%]
Unskilled (high-ability)	–	−3.4% [0.2%]	−1.9% [1.7%]
Unskilled (low-ability)	–	−7.5% [−0.9%]	−7.4% [−0.9%]

NOTES: Model simulations under the baseline calibration. * given in percent of GDP.

hires more low-ability unskilled workers. The public employment of this group increases by 1.1 percentage points, which accounts for one-third of the fall in the unemployment rate of these workers. The last rows of the table show the effects of the reform on wages in the two sectors. This reform implies a slight increase in the private sector wage of high-ability workers and a decline of around 1% of low-ability wages (skilled and unskilled).

If income taxes adjust instead of lump-sum taxes, the effects are even larger. This reform generates sufficient savings to cut the income tax by 1.2 percentage points. The unemployment rate falls by 2.1 percentage points, and welfare increases by almost 2.5% of steady-state consumption. A large fraction of the gains from the reform comes from the labor market effect, but is further amplified by the consequent tax reduction.

In Gomes (2015), I discussed the optimal public sector wage policy in a simple setting. I showed that wages should be lower than in the private sector to compensate for job security and the differences in the labor market frictions. The optimal policy problem in this setting is complicated, with tax distortions and externalities across different workers and sectors adding to the congestion and thick market externalities. Hence, I evaluate the welfare gains of this simple reform that can be realistically implemented and moves in the direction of optimality. I could have examined the welfare gains from other policies with distinct premia for different types of workers, but type-contingent reforms are difficult to justify without computing the optimal policy.

5. FURTHER RESULTS

5.1. *Robustness.* Table 3 shows that the previous quantitative results are robust to different calibrations. I consider scenarios with a wide range of technological parameters, different levels

TABLE 3
EFFECTS OF THE REFORM IN THE STEADY STATE, ROBUSTNESS

	Lump-Sum Taxes			Distortionary Taxes		
Scenario	Unemployment Rate	Consumption	Welfare	Unemployment Rate	Consumption	Welfare
Elasticity of substitution between skills (both sectors)						
$\varsigma = 0.4$	−1.5pp	1.4%	1.0%	−2.2pp	3.0%	2.5%
$\varsigma = -0.4$	−1.3pp	1.4%	1.1%	−2.0pp	3.0%	2.5%
Elasticity of substitution between skills (only public sector)						
$\varsigma^g = 0.4$	−1.5pp	1.4%	1.0%	−2.2pp	3.0%	2.4%
$\varsigma^g = -0.4$	−1.4pp	1.4%	1.1%	−2.0pp	3.0%	2.5%
Elasticity of substitution between abilities (both sectors)						
$\varrho = 0.8$	−1.6pp	1.6%	1.2%	−2.5pp	3.6%	2.9%
$\varrho = 0.3$	−1.3pp	1.3%	1.0%	−1.9pp	2.8%	2.3%
Elasticity of substitution between abilities (only public sector)						
$\varrho^g = 0.8$	−1.6pp	1.6%	1.2%	−2.3pp	3.2%	2.6%
$\varrho^g = 0.3$	−1.4pp	1.4%	1.0%	−2.1pp	3.0%	2.5%
Perfect complements (only public sector)						
$\varsigma^g = -10, \varrho^g = -10$	−1.1pp	1.3%	1.0%	−1.8pp	3.1%	2.6%
Search in the public sector						
$\bar{s} = 0.07$	−0.2pp	0.2%	0.1%	−0.6pp	1.1%	1.0%
$\bar{s} = 0.21$	−2.0pp	2.0%	1.5%	−2.8pp	4.0%	3.3%
Dispersion in preferences for public sector						
$\nu_2 - \nu_1 = 3 \times \bar{w}$	−1.7pp	1.7%	1.3%	−2.5pp	3.4%	2.8%
$\nu_2 - \nu_1 = 1 \times \bar{w}$	−0.6pp	0.6%	0.5%	−1.2pp	1.9%	1.6%
Share of skilled workers						
$\vartheta^{\bar{h}} = \vartheta^{\underline{h}} = 0.125$	−1.9pp	1.7%	1.2%	−2.8pp	3.7%	3.0%
$\vartheta^{\bar{h}} = \vartheta^{\underline{h}} = 0.20$	−1.1pp	1.2%	0.9%	−1.7pp	2.5%	2.1%
Heterogeneity in ability						
$\frac{\bar{w}^{p,\bar{i}}}{\bar{w}^{p,\underline{i}}} = 1.09 - 1.08$	−1.5pp	1.8%	1.3%	−2.4pp	3.9%	3.2%
$\frac{\bar{w}^{p,\bar{i}}}{\bar{w}^{p,\underline{i}}} = 1.46 - 1.42$	−1.4pp	1.4%	1.0%	−2.1pp	2.9%	2.4%
Lower average premium						
Baseline-3%	−0.7pp	0.7%	0.6%	−0.9pp	1.2%	1.0%
No dispersion in premium						
Premium = 3%	−1.1pp	1.1%	0.8%	−1.7pp	2.5%	2.1%
Equal job-separation rates across sectors						
$\lambda^{g,h} = 0.012, \lambda^{g,u} = 0.017$	−1.1pp	1.2%	0.9%	−1.8pp	2.8%	2.3%

NOTES: Model simulations under alternative calibrations. For each scenario, the model was recalibrated according to Section 3. The table reports the steady-state change of implementing a zero public sector wage premium for all workers relative to baseline of unemployment rate (percentage points), consumption (percent), and welfare (percent of consumption equivalent variation).

and dispersion of preferences for public sector jobs, different magnitudes of heterogeneity in ability, and different shares of college graduates. I also consider a scenario with equal job-separation rates across sectors, a premium 3% below baseline for all types of workers, and one with no wage compression in the public sector. For each scenario, the model was recalibrated according to Section 3. For most of the alternative calibrations, the steady-state reform, which equates the public sector wages to their private sector counterparts, reduces the unemployment rate between 0.6 and 1.9 percentage points if taxes are lump-sum and between 1 and 2.5 percentage points if taxes are distortionary. The welfare gains are, in all cases, positive and can be as high as 3% of steady-state consumption.

The results are more sensitive if we consider different baseline public sector wage premia. If the baseline premium is scaled down by 3%, the reform still reduces the unemployment rate by 0.7 or 0.9 percentage points, depending on the financing. Without wage compression and a 3% premium for all workers, the reform achieves an unemployment reduction of 1.1 or 1.7

percentage points. When the model is calibrated to match that only 7% of the unemployed are searching in the public sector prior to the reform, then the gains are lower but still positive (a reduction of 0.2–0.6 percentage points of the unemployment rate).

5.2. *Transition and Extensions.* I further analyze the robustness of the results by carrying out three other exercises, which are shown in a Companion Appendix. First, I compute the transition dynamics after the reform. Most of the effect on unemployment occurs within two years. The savings on the government wage bill occur in the first periods. Along the transition, all wages in the private sector fall, but after three years, the high skill wages are already above the initial steady state. Considering the transition, the welfare gains of the reform are 0.66% of steady-state consumption, compared to the 1.05% if we only compare steady-state utilities.

Second, I redo the exercise but fixing the aggregate stock of capital. With lump-sum taxes, the effects on the unemployment rate are only marginally lower than in the benchmark case (a fall of 1.3 percentage points instead of 1.4 percentage points) but there are lower welfare gains (0.57% instead of 1.05%). A large part of the gains from reducing distortionary taxation comes from capital accumulation. When we shut down this channel, the gains of a tax cut only work through the wage bargaining. The unemployment rate only falls by 1.6 percentage points instead of 2.1 in the benchmark case, and the wages in the two sectors fall by more.

Finally, I analyze the role of the government horizon by generalizing the government problem to

$$\begin{aligned}
\min_{\mathbf{v}_t^{g,i}} & \sum_i \vartheta^i \kappa^{g,i} v_t^{g,i} + \sum_{l=1}^{T} \beta_{t,t+l} \left[\sum_i \vartheta^i (1-\lambda^{j,i})^{(l-1)} w_{t+l}^{g,i} l_{t+l}^{g,i} \right] \\
& \text{s.t.} \\
\bar{g} &= g\left(\mathbf{l}_{t+1}^{g}\right) \\
l_{t+1}^{g,i} &= \left(1-\lambda^{j,i}\right) l_t^{g,i} + q_t^{g,i} v_t^{g,i}, \quad \forall i, \quad t = 1, \ldots T,
\end{aligned}$$

where T represents the time horizon of the government that considers the cost of recruitment and the future wage bills. The first-order conditions are

$$\frac{\vartheta^i \kappa^{g,i}}{q_t^{g,i}} + \sum_{l=1}^{T} \beta_{t,t+l} (1-\lambda^{j,i})^{(l-1)} \left[\vartheta^i w_{t+l}^{g,i} \right] = \xi_t g'_{i,t+1}, \quad \forall i. \tag{27}$$

In the benchmark case, I considered the government to be myopic with an horizon of $T = 1$. I have also considered with $T = 4$, $T = 8$, $T = 16$, and $T = \infty$. In all cases, the model is recalibrated as discussed in Section 3. The different horizons do not affect the average public sector employment and unemployment rate of skilled and unskilled workers that are targets in the calibration, but marginally affect them for high and low ability. The impact of the reform on unemployment is essentially unchanged with the horizon. However, the horizon does matter for the consumption and welfare gains. When the government has a horizon of four years, the welfare gains of the reform are 1.32 compared to 1.05 in the benchmark case.

5.3. *Reform of Public Sector Wages and Inequality.* One valid concern about this reform is its impact on inequality. Although the representative agent framework is not the most suitable for this type of analysis, it can provide some insights. I compute the labor market value of each type of worker as the weighted average of the value of being in each of the three states:

$$\Omega_t^i = l_t^{p,i} W_t^{p,i} + l_t^{g,i} W_t^{g,i} + u_t^i U_t^i, \quad \forall i. \tag{28}$$

This equation gives the contribution to the household of each type of worker and it would be the welfare measure under linear utility. Table 4 shows the effects of implementing the reform

TABLE 4
EFFECTS OF REFORM ON INEQUALITY UNDER DIFFERENT TAX SCENARIOS

		Alternative Tax Scenarios						
Public–Private Wage Premium	Baseline	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables								
Taxation								
Capital tax rate	0.200	0.188	0.200	0.200	0.200	0.200	0.200	0.200
Income tax rate								
Skilled (high-ability)	0.200	0.188	0.181	0.200	0.215	0.182	0.162	0.180
Skilled (low-ability)	0.200	0.188	0.181	0.200	0.166	0.177	0.162	0.180
Unskilled (high-ability)	0.200	0.188	0.181	0.200	0.166	0.182	0.204	0.180
Unskilled (low-ability)	0.200	0.188	0.181	0.079	0.166	0.182	0.162	0.195
Unemployment rate	0.060	0.039	0.038	0.020	0.033	0.038	0.032	0.044
Consumption	3.857	+3.0%	+2.3%	+4.2%	+2.8%	+2.2%	+2.9%	+1.6%
Welfare gains	–	2.5%	1.7%	3.1%	0.6%	0.2%	0.8%	−0.3%
Labor market value of type								
Skilled (high-ability)	642	+4.2%	+3.8%	+3.1%	+0.0%	+3.6%	+6.6%	+3.3%
Skilled (low-ability)	457	+0.1%	−0.3%	−0.8%	+1.7%	+0.0%	+2.2%	−0.8%
Unskilled (high-ability)	410	+2.9%	+2.6%	+0.9%	+4.6%	+2.5%	+0.0%	+2.5%
Unskilled (low-ability)	303	+1.4%	+0.9%	+9.7%	+1.9%	+0.9%	+2.2%	+0.0%

NOTES: Model simulations under the baseline calibration, under alternative tax scenarios.

under the different financing scenarios in which the government sets different labor income tax rates to specific types of workers. Column 1 is the benchmark case of the reform financed with income taxes discussed in Section 4.2. Notice that, under this scenario, there is an increase in the labor market value of all workers, including the low-ability unskilled workers.

In column 2, I maintain the capital tax constant and only reduce the labor income tax proportionally to all worker types. In column 3, the savings are only used to finance a reduction of taxes for the low-ability unskilled workers. Under this scenario, their labor market value increases by close to 10%. The welfare gains of 3.1% are actually higher than in any of the reforms in Section 4.2, which shows that the efficiency gains of the reform are not inconsistent with a reduction of inequality.

In columns 4–7, I consider the change in the labor income tax rate for a worker type such that its labor market value is constant, and I pass on the proceedings to finance tax reductions to other workers. In all but one scenario, there is a welfare increase and a Pareto improvement. In all scenarios, the unemployment rate is reduced by 1.6–2.8 percentage points. The efficiency gains of this reform are large enough, by using the income tax rate, to make all types better off.

6. CONCLUSION

I construct a model of public sector employment with search and matching frictions and heterogeneous workers to evaluate a reform of public sector wages that links them to the private sector. In the model, calibrated to the United Kingdom, setting the wage of all workers equal to those offered in the private sector reduces the unemployment rate by 1.4 percentage points.

The article was motivated by the experience of several countries during the Eurozone crisis. The principle of equating the distribution to the private sector could guide governments facing budgetary pressures on how to proceed with wage cuts. Instead of progressive cuts along the distribution, a review of pay by occupation and education is preferable to make the whole distribution of wages closer to those in the private sector.

It was not the purpose of the article to explain why the wages in the public sector are higher or more compressed, but to show the implications of this policy. Given that the benefits of the

proposed reform are so high, understanding why governments do not implement it becomes a paramount question. Clearly, governments must be using public sector wages as instruments to attain other objectives.

Alesina et al. (2000) argue that politicians use public employment for redistributive policies, directing income toward disadvantaged groups. This might also justify why the distribution of wages in the public sector are so compressed and the wage premium at the bottom so high. This policy is self-defeating. On the one hand, I show that the wage compression increases the unemployment of workers with the lowest skills, and that under several financing scenarios, their labor market value increases with the reform. Furthermore, Wilson (1982) shows that, from a redistributive point of view, it is optimal for the government to increase the wage difference between skilled and unskilled worker in order to induce more individuals to obtain education. The wage compression does precisely the opposite. Mitigation of inequality is a valid policy objective. But if governments want to reduce inequality, they should use suitable instruments such as income tax or minimum wage. Trying to deal with the problem of inequality by only protecting an arbitrary group of workers does not solve it and further distorts the labor market.

On the other hand, the government might have more pervasive objectives. Public sector wages are vulnerable to manipulation for electoral reasons, in the spirit of Nordhaus (1975) political cycles. Borjas (1984) finds that, in the United States, pay raises in federal agencies are 2%–3% higher in election years. Matschke (2003) also finds a systematic public wage increase of 2%–3% prior to federal elections in Germany. One of the reasons is the presence of stronger unions in the public sector. If the distortions in the public sector wage are driven by political economy factors, given their cost, we should aim to design institutions that limit the scope of politicians to manipulate public sector wages.

Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Online Appendix

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