I Z A Institute
of Labor Economics
Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 11091

Heterogeneity and the Public Sector Wage Policy

Pedro Gomes

OCTOBER 2017

I Z A Institute
of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 11091

Heterogeneity and the Public Sector Wage Policy

Pedro Gomes
Universidad Carlos III de Madrid,
Birkbeck, University of London and IZA

OCTOBER 2017

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Heterogeneity and the Public Sector Wage Policy*

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 UK 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.

JEL Classification: E24, E62, J45

Keywords: public sector employment, public sector wages, public sector wage premium, unemployment, skilled workers, worker heterogeneity

Corresponding author:
Pedro Gomes
Department of Economics
Universidad Carlos III de Madrid
Calle Madrid 126
28903 Getafe
Spain
E-mail: pgomes@eco.uc3m.es

* This paper is forthcoming in the *International Economic Review*. Please cite the published version.

Financial support was provided by Fundación Ramón Areces and from the Ministerio de Economia y Competitividad (ECO2014-56676-C2-1-P). An earlier version of the manuscript was prepared for the workshop *Government wage bill: determinants, interactions and effects*, organized by the European Commission (DG ECFIN). I would like to thank Luisa Fuster, Matthias Burgert, Andres Erosa, Iacopo Morchio, Gernot Müller, Matteo Salto and the participants of the European Commission workshop, the University of Kent Macroeconomics workshop and seminars at Toulouse School of Economics and Universidad Carlos III, for comments and suggestions.

1 Introduction

Two sets of stylized facts characterise 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 labour market or government budget. Governments of OECD countries account for 18 percent 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 percent of college graduates, but only 17 percent 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, while more educated individuals receive a lower premium.[1] 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.[2]

This paper builds a quantitative macro model with search and matching frictions that incorporates these stylized facts. With labour market frictions the loose relation between public and private sector pay creates distortions in the labour market. Higher public sector wages create queues for those jobs, while 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 strengthen the link with private sector wages across workers. I consider this reform because the equality of public sector wages with the private sector is the implicit wage policy in any model with a frictionless labour 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 labour 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), Burdett (2012) or more recently Michaillat (2014), Gomes (2015) and Afonso and Gomes (2014). Attempts to model heterogeneity include Bradley *et al.* (2016), Albrecht *et al.* (2016) and Domeij and Ljungqvist (2016). Bradley *et al.* (2016) consider a

[1]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).

[2]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.

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.* (2016) 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 US can explain the different evolutions of the skill premium in the two countries. Two reasons motivate me to introduce worker heterogeneity.

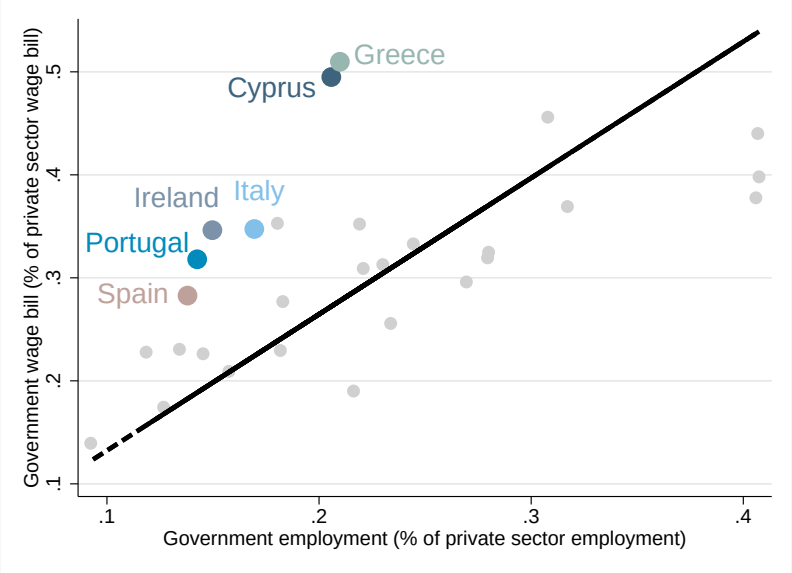
In a simple RBC model, as in Finn (1998), even if the productivity differs across sectors, identical workers receive the same wage due to arbitrage. With frictions, the labour market tolerates different wages. Gomes (2015) examines the optimal wage policy in the context of a stylized two-sector search 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 centre of the Euro area crisis due their poor public finances and sclerotic labour 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.[3] 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

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

Figure 1: Government wage bill and employment in 2008, OECD countries



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

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 paper 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 paper. 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, labour 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 towards unskilled workers. Cuts above 6 percent 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 seven percent cut reduces the unemployment rate by more that 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 favour 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 percent. 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 1970's and 1980's, 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.

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 the introduction. It features 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 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), whilst 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 prevent 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. While employers can easily observe potential employees' length of education from their CVs, 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 labour 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.[4]

[4]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

Section 2.4 explains why assuming observable types is not a problem.

I assume that the unemployed can direct their search to the private or public sectors. This assumption finds support in micro-econometric 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:

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

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 behaviour of those unemployed specifically searching for public sector jobs, defined as: $s_t^i \equiv \frac{u_t^{g,i}}{u_t^i}$. We 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:

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

This setting relies on two other assumptions. First, as in Albrecht *et al.* (2016), I abstract from on-the-job search and direct transitions between sectors. According to LFS data, in the UK in any given quarter, only 0.25 percent of workers in the private sector move to the public sector without a measured spell of unemployment. This represents less than 30 percent of all inflows into the public sector. Although these flows are not negligible, the large majority of public sector workers are hired directly from non-employment. See Bradley *et al.* (2016) for a model that incorporates explicitly transitions between sectors. Second, I assume that the labour 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 private consumption is equalised across members. This is a common assumption in the literature to maintain a representative agent framework in the presence of unemployment. Without this

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 it is required an entry exam to the public sector that can give information on the ability of the worker.

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 simplify and retain the representative agent framework. The household is infinitely lived and has the following preferences:

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

where c_t is the consumption good produced by the wholesale sector. The household also derives utility from members who are unemployed $\nu(u_t)$, 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 labour 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 labour 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 maximise 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 their current state. The values of being employed are:

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

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 sectors, with value functions given by

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

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, i.e. 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.[5] Γ puts discipline on the fluctuations on s_t^i, that are given in equilibrium by

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

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

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

[5] 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.

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:

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

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 sub-market 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

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

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:

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

Therefore, we can write the value of a job as

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

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

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

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:

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

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

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

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 favour of the worker, the pair lose a fraction τ_t to the government. Therefore, they economise on their tax payments by agreeing to a lower wage.[6]

Notice that, from Equation (14), one capital level maximises the surplus of the match, and hence wages. Given the capital-skill complementarity, the optimal level of capital increases with ability, provided the price of the good is not decreasing in ability, which is guaranteed in the numerical exercise. This ensures that, even if ability was 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 would 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 buys intermediate inputs in a competitive market, produces a final good. The objective is to choose inputs to maximise profits given by

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

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:

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

[6] 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.

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 minimise the total cost of providing the government services. The total cost encompasses the cost of recruitment and the future wage bill.

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

$$s.t.$$

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

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

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 continuing providing 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 ($4, 8, 16$ 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

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

where ζ_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 to understand 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 labour

market.[7]

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 paper, 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

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

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

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:

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

2.8 Decentralised 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 decentralised 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 (eq. 6); ii) unemployed members of type i choose which sector to search (eq. 9); iii) matched intermediate goods' firms choose optimal capital for each type (eq. 14); iv) free entry of intermediates goods' firms (eq. 17); v) private

[7] I have also consider 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 rather than the reduction in the public sector wage bill and private consumption.

sector wages are the outcome of Nash bargaining (eq. 19); vi) final good representative firm maximizes profits (eq. 21); vii) government minimizes the cost of producing services (eq. 27); viii) lump-sum taxes balance the budget (eq. 23); ix) intermediate goods, final good and capital markets clear (eq. 24-26).

3 Calibration

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

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

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

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

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

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

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, while 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 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 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 UK economy on a quarterly frequency, drawing largely on the Labour Force Survey (LFS) microdata for the period 1996-2010. Table 1 lists all the parameters, their values and the data sources. The educational attainment of the labour 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 percent 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 percent) and ii) the one at end of the sample (40 percent).

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 percent of university graduates and 16.7 percent 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 25 and 75 percentiles as the premium of the low- and high-ability skilled workers. I repeat the regressions for non-college 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 micro data 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 percent lower premium for all types; ii) a scenario without compression but a positive premium of 3 percent 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 £13000 for a skilled worker in the private sector and £8000 in the public sector, corresponding to 26 and 16 weeks of the UK median income. For a low-skilled worker, the costs are £3500 and £2000 for private and public sectors, respectively.

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 gov. 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	Labour share (AMECO)	$\alpha = 0.459$
Gov. purchases	Gov. consumption (AMECO)	$\bar{g}^{int} = 0.218$
Distribution of preferences	Average search and ratio of job-finding	$v_1 = -8.283$, $v_2 = 0.135$

Note: 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 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 reports 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 percent, which was found by regressing the log net wages on a dummy for college education, and average hours and its square. I normalise $a = z^{\underline{h}} = z^{\bar{\mu}} = 1$. 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 25-75 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, Kramarz, and Margolis (1999) find that search frictions can explain 7-25 percent of the French inter-industry differential. Tjaden and Wellschmied (2014) find that 13.7 percent of overall wage inequality is due to the presence of search frictions. I assume that 20 percent 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 percent 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 percent for low-educated workers and 49 percent 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 percent of the net wage. It implies a replacement rate of 30 percent for the high-ability skilled workers and of 45 percent for the remaining workers. I calibrate the utility value of unemployment ($\chi^u = 0.06$) and bargaining power of workers ($b = 0.29$) to target an average unemployment rate of six percent and of 7.4 percent 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 percent for a low-ability unskilled worker. The average is around 70 percent, 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 labour share of 60.8 percent, the UK'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 percent of GDP, the UK average from 1996 to 2010 ($\bar{g}^{int} = 0.22$). Lump-sum transfers balance the budget in 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 indexes of keyword searches reflecting the instances people have "Googled" a specific word or combination of words relative to overall traffic. These indexes are available on a *weekly* basis dating back to 2004.[8] 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 indexes 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 steady-state

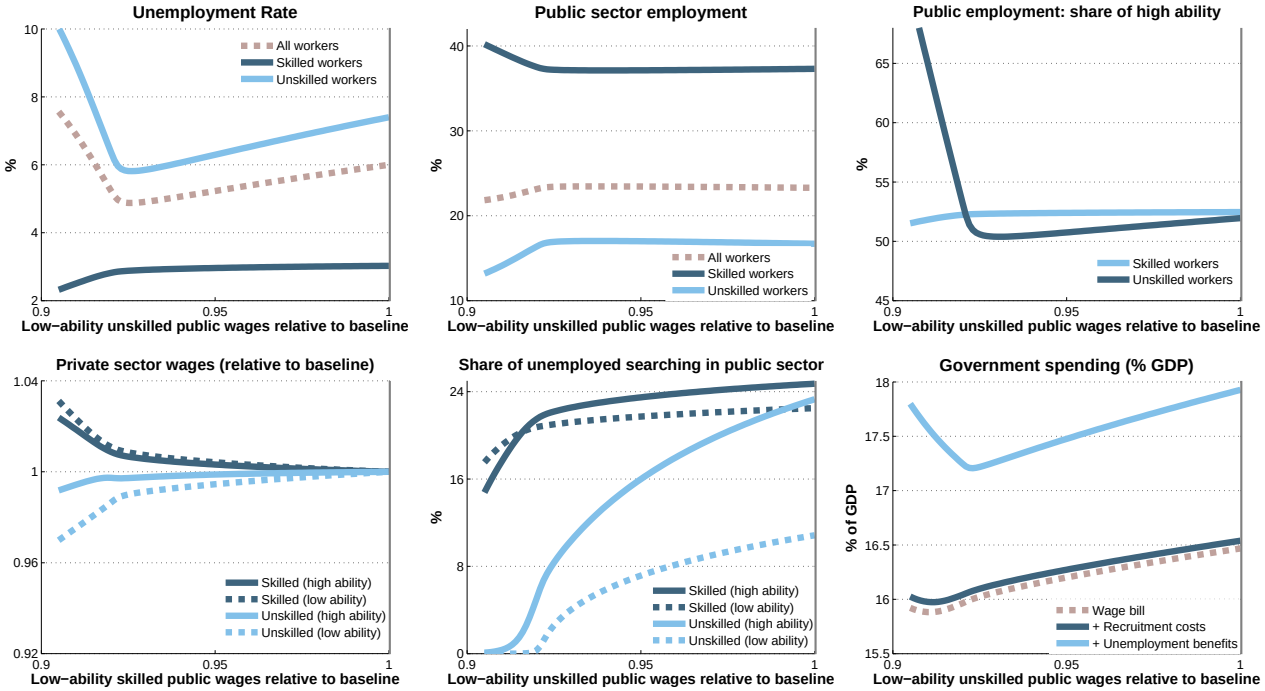
I start by examining the effects of progressive and regressive wage cuts. The progressive wage cuts target skilled workers. I assume that, for each one percent cut of high-ability wages, the wages of the low-ability are cut by 0.5 percent. Unskilled wages remain constant. The regressive wage cuts target only unskilled workers. For each one percent cut of low-ability wages, the wages of the high-ability are cut by 0.5 percent. 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

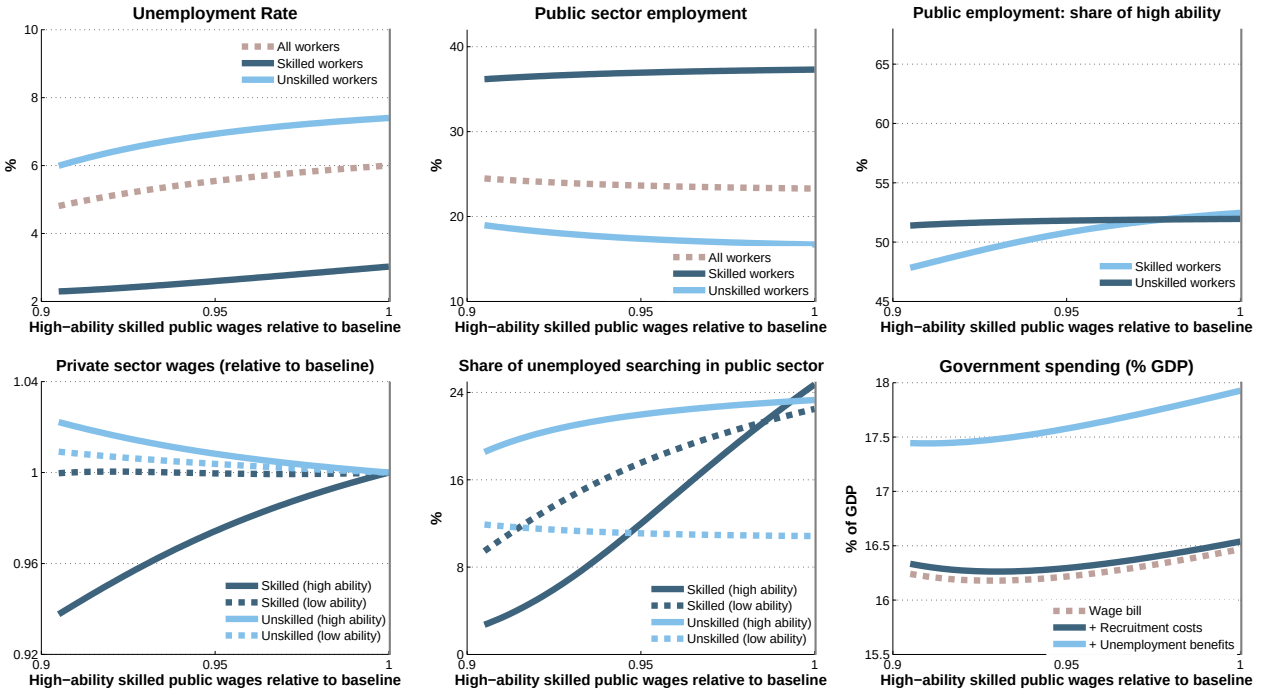
[8] Researchers have used these data to forecast: financial markets, labour and housing markets, automobile sector, inflation expectations or private consumption. See the review in Gomes and Taamouti (2016).

Figure 2: Steady-state effects of public sector wages adjustments

Regressive public sector wage cuts: unskilled wages only



Progressive public sector wage cuts: skilled wages only



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

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.

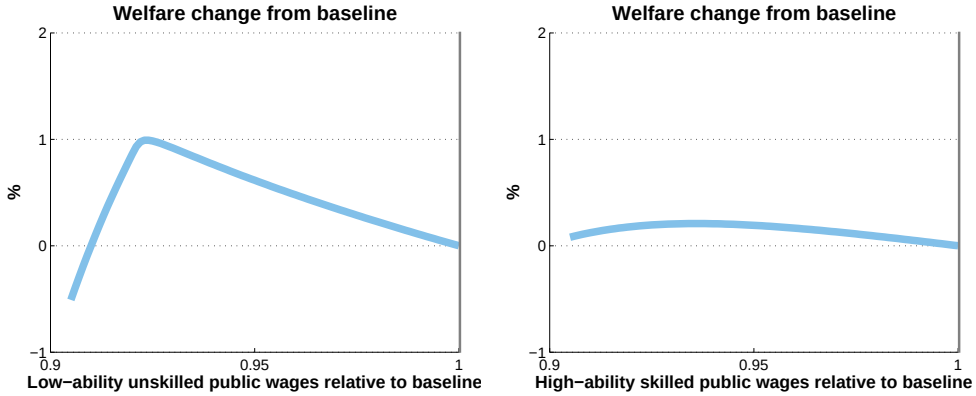
The consequences in the labour market are dramatic. With an seven percent wage cut, the unemployment rate of unskilled workers falls from 7.4 percent to 5.8 percent. Lowering wages shifts the job searches to private sector firms, that post more vacancies. But the improvement in the labour market cannot 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 percent of these workers, but when paying lower wages it hires as much as 16.9 percent. This is the group with the highest unemployment rate, that 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 favour of more productive workers that are relatively cheaper.

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 percent (4 percent 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.

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 have perverse effects. With wage cuts of more than 7 percent 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 percent of GDP. By cutting unskilled wages, the government can reduce it by 0.6 percent of GDP. The response of private sector wages are also heterogeneous. Skilled wage cuts, reduce private sector wages of the skilled but increase those of the unskilled. Unskilled wage cuts, reduce

Figure 3: Welfare effects of public sector wages adjustments



(a) Regressive (b) Progressive

private sector wages of the unskill, 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 percent. Cuts above 6 percent do not raise welfare. On the other hand, the regressive cuts can raise welfare by 1 percent.

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 points decrease in the unemployment rate for unskilled workers (low-ability).

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

Table 2: Steady-state effects of a reform of public sector wages

		Lump-Sum Taxes	*Distortionary Taxes*
Public-private wage premium	Baseline	0%	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%]

*Note: model simulations under the baseline calibration. * given in percent of GDP.*

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 percent 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 percent of steady-state consumption. A large fraction of the gains from the reform comes from the labour market effect, but are 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 labour 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 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 percent below baseline for all types of workers and one with no wage compression in the public sector. For most of the alternative calibrations, the steady-state reform that equates the public sector wages to their private sector counterparts, reduces 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 percent 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 percent, 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 percent 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 percent of the unemployed are searching in the public sector prior to the reform, than the gains are lower but still positive (a reduction of 0.2 to 0.6 percentage points of the unemployment rate).

5.2 Transition and extensions

I further analyse the robustness of the results by carrying out three other exercises, that are shown in 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 percent of steady-state consumption, compared to the 1.05 percent if we only compare steady-state utilities.

Table 3: Effects of the reform in 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						
$\lambda^{g,h} = 0.012$, $\lambda^{g,\mu} = 0.017$	-1.1pp	1.2%	0.9%	-1.8pp	2.8%	2.3%

Note: model simulations under alternative calibrations. For each scenario the model was re-calibrated 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).

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 1.3pp instead of 1.4pp) but there are lower welfare gains (0.57 instead of 1.05 percent). 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. 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 analyse the role of the government horizon by generalizing the government problem to:

$$\min_{\mathbf{v}_t^{g,i}} \sum_i \vartheta^i \kappa^{g,i} v_t^{g,i} + \sum_{l=1}^{T} \beta_{t,t+l} \left[\sum_i \vartheta^i (1-\lambda^{j,i})^{(l-1)} w_{t+l}^{g,i} l_{t+l}^{g,i} \right]$$

$$s.t.$$

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

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

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:

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

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 re-calibrated as discussed in Section 3. The effects of the reform under different horizons are shown in Table A5. 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 dies matter for the consumption and welfare gains. When the government has an horizon of 4 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 labour 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 show the effects of implementing the reform under the different financing scenarios, in which the government sets different labour

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%
Labour 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%

Note: model simulations under the baseline calibration, under alternative tax scenarios.

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 labour market value of all workers, including the low-ability unskilled workers.

In Column (2), I maintain the capital tax constant and only reduce the labour 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 labour market value increase by close to 10 percent. The welfare gains of 3.1 percent 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 labour income tax rate for a worker type, such that its labour 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 to 2.8 percentage points. The efficiency gains of this reform are large enough to, by using the income tax rate, 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 paper 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 paper 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 towards 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 increase the unemployment of workers with the lowest skills, and that under several financing scenarios their labour 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 oppositive. 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 distort the labour 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 rises in federal agencies are two to three percent higher in election years. Matschke (2003) also finds a systematic public wage increase of two to three percent 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.

References

Abowd, J. M., F. Kramarz, and D. N. Margolis (1999): "High Wage Workers and High Wage Firms," *Econometrica*, 67(2), 251–334.

Afonso, A., and P. Gomes (2014): "Interactions between private and public wages," *Journal of Macroeconomics*, 39(PA), 97–112.

Albrecht, J., M. Robayo-Abril, and S. Vroman (2017): "Public-Sector Employment in an Equilibrium Search and Matching Model," *Economic Journal*, Forthcoming.

Alesina, A., R. Baqir, and W. Easterly (2000): "Redistributive Public Employment," *Journal of Urban Economics*, 48(2), 219–241.

Algan, Y., P. Cahuc, and A. Zylberberg (2002): "Public employment and labour market performance," *Economic Policy*, 17(34), 7–66.

Ardagna, S. (2007): "Fiscal policy in unionized labor markets," *Journal of Economic Dynamics and Control*, 31(5), 1498–1534.

Artuç, E., S. Chaudhuri, and J. McLaren (2010): "Trade Shocks and Labor Adjustment: A Structural Empirical Approach," *American Economic Review*, 100(3), 1008–45.

Borjas, G. J. (1984): "Electoral Cycles and the Earnings of Federal Bureaucrats," *Economic Inquiry*, 22(4), 447–59.

Bradley, J., F. Postel-Vinay, and H. Turon (2017): "Public sector wage policy and labour market equilibrium: a structural model," *Journal of the European Economic Association*, Forthcoming.

Burdett, K. (2012): "Towards a theory of the labor market with a public sector," *Labour Economics*, 19(1), 68–75.

Castro, F., M. Salto, and H. Steiner (2013): "The gap between public and private wages: new evidence for the EU," European Commission Economic Papers 508.

Christofides, L., and M. Michael (2013): "Exploring the public-private sector wage gap in European countries," *IZA Journal of European Labor Studies*, 2(15).

CIPD (2009): "Recruitment, retention and turnover survey report," Available at http://www.cipd.co.uk/subjects/recruitmen/general/.

Dickson, M., F. Postel-Vinay, and H. Turon (2014): "The lifetime earnings premium in the public sector: The view from Europe," *Labour Economics*, 31(C), 141–161.

Disney, R., and A. Gosling (1998): "Does it pay to work in the public sector?," *Fiscal Studies*, 19(4), 347–374.

Domeij, D., and L. Ljungqvist (2016): "Wage Structure and Public Sector Employment: Sweden versus the United States 1970-2002," *Scandinavian Journal of Economics*, Forthcoming.

Fernández-Blanco, J., and P. Gomes (2017): "Unobserved Heterogeneity, Exit Rates and Re-employment Wages," *Scandinavian Journal of Economics*, 119(2), 375–404.

Finn, M. G. (1998): "Cyclical Effects of Government's Employment and Goods Purchases," *International Economic Review*, 39(3), 635–57.

Giordano, R., D. Depalo, M. Coutinho Pereira, B. Eugéne, E. Papapetrou, J. J. Pèrez, L. Reiss, and M. Roter (2011): "The public sector pay gap in a selection of Euro area countries," European Central Bank Working Paper 1406.

Gomes, P. (2012): "Labour market flows: Facts from the United Kingdom," *Labour Economics*, 19(2), 165–175.

——— (2015): "Optimal public sector wages," *Economic Journal*, 125(587), 1425–1451.

Gomes, P., and A. Taamouti (2016): "In search of the determinants of international stock and bond commovement," *International Review of Economics and Finance*.

Guerrieri, V., R. Shimer, and R. Wright (2010): "Adverse selection in competitive search equilibrium," *Econometrica*, 78(6), 1823–1862.

Hall, R., and P. Milgrom (2008): "The Limited Influence of Unemployment on the Wage Bargain," *American Economic Review*, 98(4), 1653–1674.

Katz, L. F., and A. B. Krueger (1991): "Changes in the Structure of Wages in the Public and Private Sectors," NBER Working Papers 3667.

Krusell, P., L. Ohanian, J. Rìos-Rull, and G. Violante (2000): "Capital-Skill Complementarity and Inequality: A Macroeconomic Analysis," *Econometrica*, 68(5), 1029–1054.

Matschke, X. (2003): "Are There Election Cycles in Wage Agreements? An Analysis of German Public Employees," *Public Choice*, 114(1-2), 103–35.

Merz, M. (1995): "Search in the labor market and the real business cycle," *Journal of Monetary Economics*, 36(2), 269–300.

Michaillat, P. (2014): "A theory of countercyclical government multiplier," *American Economic Journal: Macroeconomics*, 6(1).

Mueller, R. E. (1998): "Public-private sector wage differentials in Canada: evidence from quantile regressions," *Economics Letters*, 60(2), 229–235.

Nickell, S., and G. Quintini (2002): "The consequences of the decline in public sector pay in Britain: a little bit of evidence," *Economic Journal*, 112(477), F107–F118.

Nordhaus, W. D. (1975): "The Political Business Cycle," *Review of Economic Studies*, 42(2), 169–90.

Pederson, P. J., J. B. Schmidt-Sorensen, N. Smith, and N. Westergard-Nielsen (1990): "Wage differentials between the public and private sectors," *Journal of Public Economics*, 41(1), 125–145.

Pissarides, C. A. (2000): *Equilibrium unemployment*. MIT press.

Postel-Vinay, F., and H. Turon (2007): "The Public Pay Gap in Britain: Small Differences That (Don't?) Matter," *Economic Journal*, 117(523), 1460–1503.

Poterba, J. M., and K. S. Rueben (1994): "The Distribution of Public Sector Wage Premia: New Evidence Using Quantile Regression Methods," NBER Working Papers 4734.

Quadrini, V., and A. Trigari (2007): "Public Employment and the Business Cycle," *Scandinavian Journal of Economics*, 109(4), 723–742.

Salomäki, A., and T. Munzi (1999): "Net Replacement Rates of the Unemployed. Comparison of various approaches," European Commission Economic Papers 133.

Tjaden, V., and F. Wellschmied (2014): "Quantifying the Contribution of Search to Wage Inequality," *American Economic Journal: Macroeconomics*, 6(1), 134–61.

Wilson, J. (1982): "The optimal public employment policy," *Journal of Public Economics*, 17(2), 241–258.

COMPANION APPENDIX

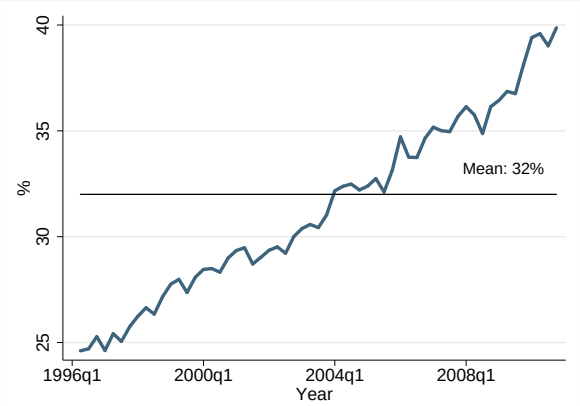
Heterogeneity and the public sector wage policy

Pedro Gomes

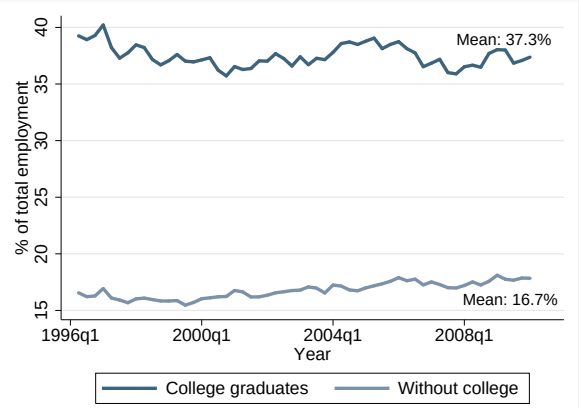
International Economic Review

Appendix A: Data used in calibration

Figure A1: Share of skills in labour force and in the public sector



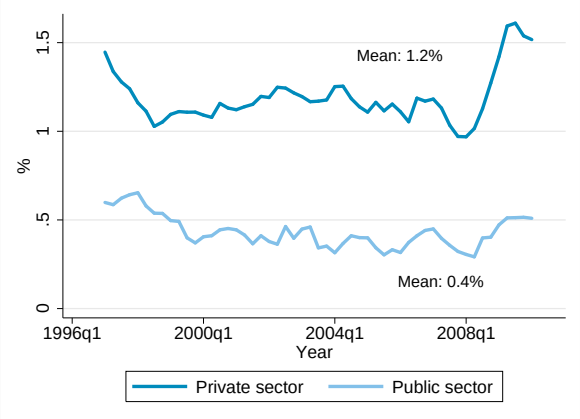
(a) Share of college graduates in labour force



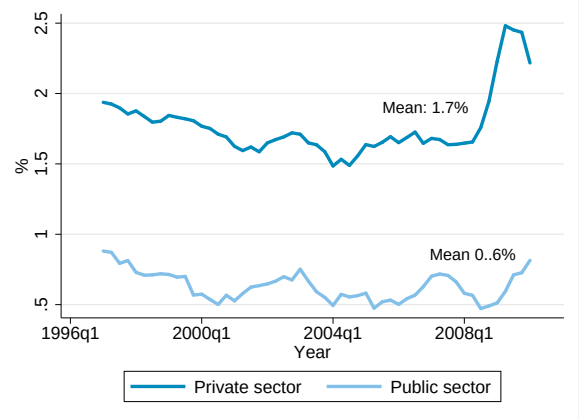
(b) Public sector employment by skill

Source: Labour Force Survey.

Figure A2: Job separation rates



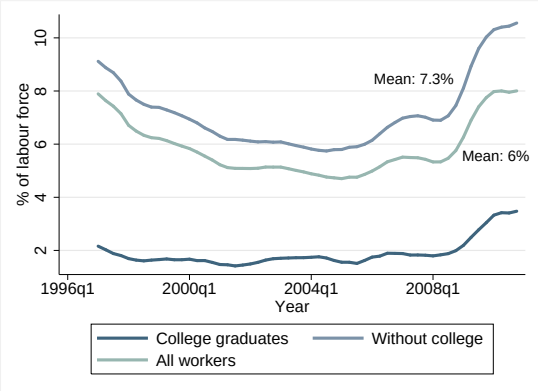
(a) College degree



(b) Without college

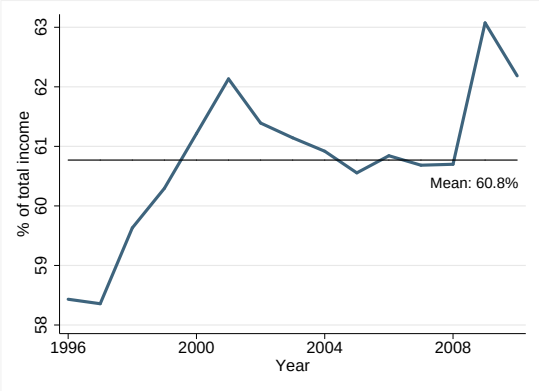
Source: Labour Force Survey.

Figure A3: Unemployment rate

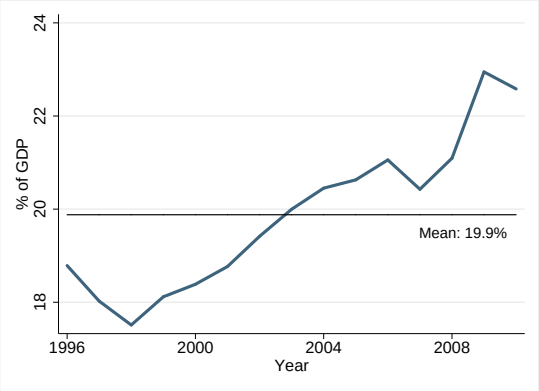


Source: Labour Force Survey.

Figure A4: Labour share and government consumption



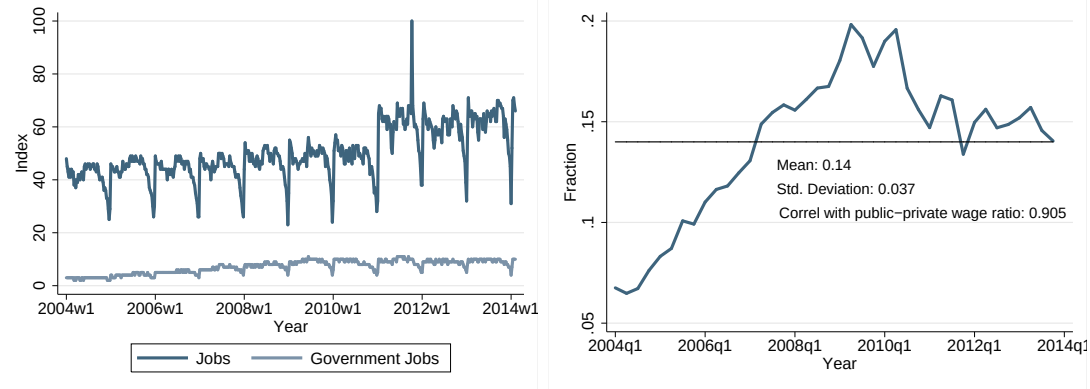
(a) Labour share



(b) Government consumption

Source: AMECO.

Figure A5: Google indexes



(a) Original indexes (b) Search in public sector

Source: Google. The index of search in the public sector includes the following keywords with their relative importance in brackets: 'nhs jobs' (46%), 'council jobs' (32%), 'jobs in nhs' (5%), 'gov jobs' (4%), 'public jobs' (4%), 'direct gov jobs' (2%), 'government jobs' (2%), 'army jobs' (2%), 'local government jobs' (1%), 'raf jobs' (1%).

Table A1: Estimation of public sector wage premium

Education	Percentile	R-squared	Estimated Premium
College educated	75	0.375	0.016
Obs: 84236	25	0.456	0.039
Without college degree	75	0.488	0.037
Obs: 209740	25	0.595	0.071

Note: quantile regression of log net wages on several control variables and a dummy for public sector. Controls include: sex, industry and occupation dummies, status in previous quarter, tenure, age and its square, marital status, time and region dummies, average hours worked and its square. Labour Force Survey: sample from 1996 to 2006.

Table A2: Cost per hire and vacancy duration by sector and worker type

	Cost per hire (£)			Vacancy duration (weeks)		
Type of worker	Manufacturing	Services	Public	Manufacturing	Services	Public
Senior Managers - Directors	13396	18963	10451	16.8	16.5	18
Managers and professionals	8049	12392	6066	12.1	11.8	14.3
Administrative, Secretarial and Technical	3680	5628	1934	6	5.2	9.1
Services (costumer, personal and sales)	4564	1398	2326	6.7	5.6	9.9
Manual, craft workers	2498	2978	1898	5.2	4.5	8.3

Source: Chartered Institute of Personal Development*, "Recruitment, retention and turnover survey", 2008 (Survey of 800 organizations: Manufacturing, Services and Public sector). Vacancy duration in weeks.*

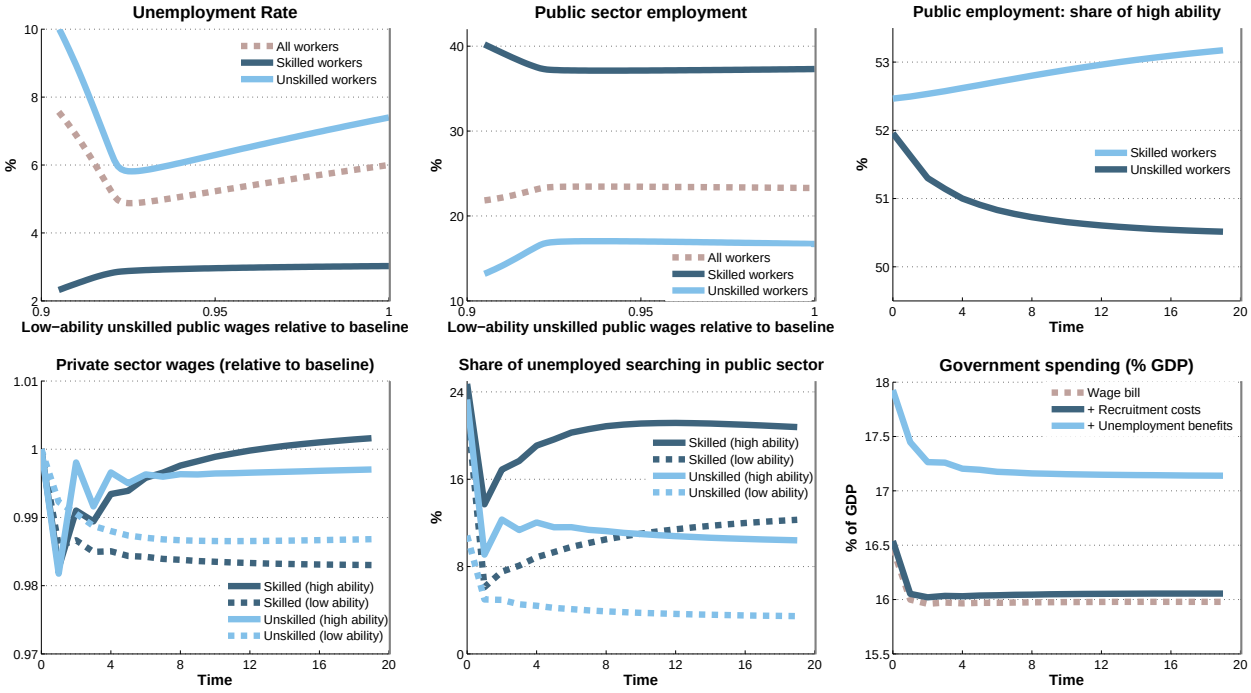
Table A3: Estimation of inter-quantile wage residual

Education	R-squared	Obs.	25-75 percentile residual difference		
			Total (100%)	Adjusted (80%)	Adjusted (20%)
College educated	0.600	44133	0.461	0.368	0.092
Without college degree	0.595	209740	0.416	0.332	0.083

Note: regression of the log of net wages on several control variables: sex, industry and occupation dummies, status in previous quarter, tenure, age and its square, marital status, time and region dummies, average hours worked and its square. Labour fource survey: sample from 1996 to 2006. The fourth column reports the 25-75 percentile difference of wage residuals.

Appendix B: Further results

Figure A6: Transition dynamics after the reform



Note: model simulations under the baseline calibration. Adjustment of all public sector wages to the new steady-state occurs at period 1.

Table A4: Steady-state effects of a reform of public sector wages, no capital adjustment

		Lump-Sum Taxes	*Distortionary Taxes*
Public-private wage premium	Baseline	0%	0%
Variables			
Unemployment rate	0.060	0.047	0.044
Skilled	0.030	0.026	0.025
High-ability	0.022	0.019	0.019
Low-ability	0.039	0.033	0.032
Unskilled	0.074	0.057	0.053
High-ability	0.016	0.009	0.009
Low-ability	0.132	0.105	0.097
Public employment	0.233	0.236	0.235
Skilled	0.373	0.368	0.369
High-ability	0.391	0.394	0.395
Low-ability	0.355	0.342	0.343
Unskilled	0.167	0.173	0.172
High-ability	0.174	0.176	0.176
Low-ability	0.160	0.171	0.167
Consumption	-	+0.89%	+1.15%
Welfare Gains	-	0.57%	0.75%
Government*			
Wage bill	0.165	0.159	0.158
+ recruitment costs	0.165	0.160	0.159
+ unemployment benefits	0.179	0.171	0.169
Income taxes	0.2	0.2	0.19
Implied public [private] sector wage change			
Skilled (high-ability)	-	-1.6% [0.0%]	-1.6% [-0.1%]
Skilled (low-ability)	-	-5.8% [-2.1%]	-5.9% [-2.2%]
Unskilled (high-ability)	-	-4.0% [-0.4%]	-4.0% [-0.4%]
Unskilled (low-ability)	-	-7.9% [-1.3%]	-8.8% [-2.3%]

*Note: model simulations under the baseline calibration. * given in percent of GDP.*

Table A5: Steady-state effects of a reform of public sector wages, different government horizon

	Government forward-looking horizon									
Horizon	$T=1$		$T=4$		$T=8$		$T=16$		$T=\infty$	
Public-private wage premium	Baseline	0%	Baseline	0%	Baseline	0%	Baseline	0%	Baseline	0%
Variables										
Unemployment rate	0.060	0.046	0.060	0.046	0.060	0.046	0.060	0.046	0.060	0.046
Skilled	0.030	0.026	0.030	0.026	0.030	0.025	0.030	0.025	0.030	0.025
High-ability	0.022	0.019	0.022	0.019	0.022	0.020	0.022	0.020	0.022	0.020
Low-ability	0.039	0.033	0.039	0.032	0.039	0.031	0.039	0.031	0.039	0.031
Unskilled	0.074	0.055	0.074	0.055	0.074	0.055	0.074	0.056	0.074	0.056
High-ability	0.016	0.009	0.016	0.009	0.016	0.009	0.016	0.009	0.016	0.009
Low-ability	0.132	0.102	0.132	0.101	0.132	0.102	0.132	0.102	0.132	0.103
Public employment	0.233	0.236	0.233	0.235	0.233	0.235	0.233	0.235	0.233	0.235
Skilled	0.373	0.368	0.373	0.367	0.373	0.368	0.373	0.369	0.373	0.370
High-ability	0.391	0.394	0.378	0.373	0.373	0.366	0.370	0.362	0.367	0.358
Low-ability	0.355	0.343	0.368	0.362	0.373	0.370	0.376	0.376	0.379	0.382
Unskilled	0.167	0.173	0.167	0.173	0.167	0.172	0.167	0.171	0.167	0.171
High-ability	0.174	0.175	0.173	0.173	0.173	0.172	0.173	0.171	0.173	0.171
Low-ability	0.160	0.171	0.161	0.172	0.161	0.172	0.161	0.171	0.161	0.171
Consumption	-	+1.40%	-	+1.63%	-	+1.67%	-	+1.68%	-	+1.65%
Welfare Gains	-	1.05%	-	1.27%	-	1.31%	-	1.32%	-	1.31%
Government*										
Wage bill	0.165	0.159	0.164	0.157	0.164	0.157	0.164	0.157	0.164	0.157
+ recruitment costs	0.165	0.160	0.165	0.158	0.165	0.158	0.165	0.158	0.164	0.157
+ unemployment benefits	0.179	0.170	0.179	0.169	0.179	0.168	0.178	0.168	0.178	0.168
Income taxes	0.2		0.2			0.19				
Implied public [private] sector wage change										
Skilled (high-ability)	-	-0.7% [0.8%]	-	-1.5% [0.1%]	-	-1.6% [-0.1%]	-	-1.7% [-0.1%]	-	-1.7% [-0.2%]
Skilled (low-ability)	-	-5.0% [-1.3%]	-	-4.4% [-0.7%]	-	-4.1% [-0.3%]	-	-3.8% [-0.1%]	-	-3.6% [0.2%]
Unskilled (high-ability)	-	-3.4% [0.2%]	-	-3.3% [0.2%]	-	-3.4% [0.2%]	-	-3.5% [0.1%]	-	-3.5% [0.0%]
Unskilled (low-ability)	-	-7.5% [-0.9%]	-	-7.3% [-0.7%]	-	-7.3% [-0.7%]	-	-7.3% [-0.7%]	-	-7.3% [-0.7%]

*Note: For each scenario the model was re-calibrated 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, for the lump-sum taxation scenario. * given in percent of GDP.*