Public Sector Employment in an Equilibrium Search and Matching Model*

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Abstract

In this paper, we extend the standard Diamond-Mortensen-Pissarides model of equilibrium unemployment to incorporate public-sector employment. We modify the model in three ways. First, we assume that workers are heterogeneous in terms of human capital. Second, we assume that productivity is match specific and that the distribution of match-specific productivity is more favorable in the sense of first-order stochastic dominance the higher is a worker’s human capital. Third, we allow for both private- and public-sector employment. We prove existence of equilibrium and numerically analyze the effects of public-sector employment policy on the distributions of wages, productivities and human capital levels in the two sectors and on overall employment and welfare using data from Colombia.

1 Introduction

The public sector accounts for a substantial fraction of employment in both developed and developing economies. Algan et al. (2002) estimates that the public sector accounted for slightly less than 19% of total employment across 17 OECD countries in 2000, and Mizala et al. (2011) estimates that 13% of total urban employment over the period 1996-2007 across eleven Latin American countries was in the public sector. The basic ordering between public- and private sector wages is similar in most developed and developing countries. On average, there is a public-sector wage premium (see, e.g., Gregory and Borland 1999 for a survey), both in the raw data and after controlling for observable worker characteristics and endogenous sector choice. Wages in the public sector tend to be more compressed than in the private sector. The public-sector premium is higher at lower quantiles and there is a negative public-sector premium at higher quantiles in some

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countries. See, e.g., Melly (2005) for Germany, Lucifora and Meurs (2006) for France, Britain and Italy and Mizala et al. (2011) for Latin America.

These stylized facts raise a number of obvious questions. In general, how do the private- and public-sector labor markets interact? What types of workers tend to work in the public sector? How does the size of the public sector affect the overall unemployment rate and the distributions of worker productivities and wages? What types tend to work in the private sector? How do the hiring and wage-setting rules used in the public sector affect the distribution of wages in the private sector? A natural approach to these questions is to incorporate public-sector employment into an equilibrium search and matching model. Surprisingly, there are very few papers that do this.

In this paper, we incorporate a public sector into an extended version of the canonical Diamond-Mortensen-Pissarides (Pissarides 2000) model of equilibrium unemployment. We extend this model in three directions. First, we allow for *ex ante* worker heterogeneity; that is, we assume an exogenous distribution, \( y \sim F(y), y \leq y \leq \overline{y} \), of human capital across workers. This makes it possible to address questions about which types of workers tend to work in the two sectors. This feature of our model is based on Albrecht, Navarro and Vroman (2009). Second, we allow for *ex post* idiosyncratic match productivity. When a worker of type \( y \) meets a prospective employer with a vacancy, she draws a match-specific productivity, \( x \sim G_s(x|y), \underline{x} \leq x \leq \overline{x} \), where the subscript \( s \in \{p,g\} \) indicates whether the job in question is in the private or public (government) sector. To give content to our notion of human capital, we assume first-order stochastic dominance, i.e., \( y' > y \Rightarrow G_s(x|y') < G_s(x|y) \). The higher is a worker’s level of human capital, the more favorable is that worker’s distribution of match-specific productivity, and this is the case in both sectors. The combination of idiosyncratic match productivity with a first-order stochastic dominance assumption is related to Dolado, Jansen and Jimeno (2009), who assume first-order stochastic dominance in conjunction with a two-point distribution for \( y \) – “low-skilled workers” and “high-skilled workers.” Finally, we take into account the fact that the rules governing public-sector employment and wage determination are in general not the same as those used in the private sector. We assume that the public sector posts an exogenous measure of vacancies, \( v_g \), and that a worker of type \( y \) who meets a public-sector vacancy and draws match-specific productivity \( x \) is offered the job iff an index that depends on both \( x \) and \( y \) is large enough, i.e., \( \text{h}_g(x,y) \geq 0 \). We assume the index is nondecreasing in both of its arguments, which implies that a worker of type \( y \) receives a public-sector offer iff \( x \geq \xi_g(y) \). We also assume that a worker’s wage in a public-sector job is determined by an exogenous rule, \( w_g(x, y) \), and without loss of generality, we set \( w_g(x, y) = 0 \) for \( x < \xi_g(y) \). We assume that \( w_g(x, y) \) is nondecreasing in its arguments so long as \( x \geq \xi_g(y) \). We experiment with a variety of functional forms for \( \xi_g(y) \) and \( w_g(x, y) \); for example, we allow for the possibility that the government may pay relatively more attention to formal

\[\footnote{A related idea can also be found in Coşar (2010). In his model, a worker’s productivity on a particular job is the product of his or her human capital and a match-specific draw. The two components of the product are independently distributed.} 1\]
qualifications, i.e., $y$, than a private-sector employer would in the same circumstances. As best we know, our combination of these three elements — *ex ante* worker heterogeneity, match-specific productivity with a first-order stochastic dominance assumption, and both private- and public-sector employment — is unique in the search/matching literature.

As noted above, there are relatively few papers that incorporate public-sector employment into an equilibrium search and matching model. Four exceptions are Burdett (2012), Bradley, Postel-Vinay and Turon (2012), Quadrini and Trigari (2007), and Gomes (2011). Burdett (2012) adds a public sector to the Burdett and Mortensen (1998) model of on-the-job search, extended to allow for free entry of private-sector vacancies along the lines of Mortensen (2000). In Burdett (2012), the public sector is characterized by a measure of job slots (filled jobs plus vacancies), $O_g$, and a wage, $w_g$. Given $(O_g, w_g)$ the measure of private-sector vacancies is determined by the free-entry condition, and the distribution of private-sector wage offers is determined by the usual Burdett and Mortensen (1998) equal-profit condition. Burdett (2012) thus captures the idea that public-sector employment policy, i.e., the choice of $(O_g, w_g)$, has spillover effects on the size of private-sector employment and the distribution of wages in the private sector. On the other hand, the equilibrium wage distribution in this paper has some decidedly unrealistic features — an upward-sloping density of private-sector wage offers (as in the standard homogeneous-firm version of Burdett and Mortensen 1998) and no wage dispersion in the public sector. The paper by Bradley et al. (2012) is also set in a two-sector Burdett-Mortensen framework. They allow for a non-degenerate distribution of wages in the public sector and estimate the model structurally. The paper by Quadrini and Trigari (2007) is closer to ours in the sense of taking the basic Pissarides (2000) model as its starting point. Their model is designed to analyze the effect of public-sector employment policy on the private-sector labor market over the business cycle. To do this, they consider a discrete-time version of Pissarides (2000) in which private-sector productivity varies stochastically over time. They assume sector-specific search in the sense that in each period each unemployed worker chooses whether to search for a private- or a public-sector job. In equilibrium, since workers are homogeneous, each worker has to be indifferent between searching in one sector versus the other. Quadrini and Trigari (2007) assume that the level of public-sector employment (or, equivalently, the measure of public-sector vacancies) depends on (i) a target steady-state level for public-sector employment and (ii) the difference between current private-sector employment and its steady-state value, and they make an analogous assumption for the public-sector wage. The model developed in Gomes (2011) is similar to that of Quadrini and Trigari (2007). However, rather than assuming exogenous public-sector employment and wage-setting rules, Gomes (2011) characterizes the optimal public-sector policies. He shows, in particular, that public-sector vacancy posting should be countercyclical but that public-sector wages should vary procyclically.

Finally, there are, of course, papers that model the interaction between the private- and public-sector labor markets without taking an explicitly search-theoretic approach. For example, Algan et al. (2002) present a static model in which workers choose whether
to look for work in the private or public sector. The private-sector wage and level of employment are then determined by union bargaining in a right-to-manage framework while the corresponding variables are set exogenously in the public sector. Worker sector choice is determined by an arbitrage condition.

Relative to these papers, our paper offers the following. First, so far as we know, ours is the only paper that allows for \textit{ex ante} worker heterogeneity in an equilibrium search and matching model with public-sector employment. That is, ours is the only paper that can address the question of which types of workers tend to work in the private sector and which types tend to work in the public sector. Second, we allow for match-specific productivity coupled with our first-order stochastic dominance assumption. This implies – as we see in reality – that there is not a perfect sorting of worker types between the two sectors. Finally, relative to earlier papers, we allow for a rich specification of public-sector employment policy.

In the next section, we set out the model and prove existence of equilibrium. In Section 3, we make specific functional form assumptions so that we can solve the model and analyze it numerically. We present a simple numerical example to show how the model works. In Section 4, we present a calibration of the model using data from Colombia. We are able to look at the effects of changes in public-sector employment policy. We look at the effect of changing the productivity cutoff for public employment and changing the public wage policy. We are able to see how these policy changes effect the distributions of wages, productivities and human capital levels in the two sectors and overall welfare. In Section 5, we conclude.

2 Model

We consider a model with search and matching frictions. Only the unemployed search, and their prospects depend on overall labor market tightness, $\theta = (v_p + v_g)/u$, where $v_p$ and $v_g$ are the measures of private- and public-sector vacancies posted at any instant, and $u$ is the fraction of the workforce that is unemployed. Search is random, so conditional on meeting a prospective employer, the probability that the job is in the private sector is $\phi = v_p/(v_p + v_g)$. Specifically, job seekers meet prospective employers at Poisson rate $m(\theta)$, and employers meet job seekers at rate $m(\theta)/\theta$. Not all meetings lead to matches. In the private sector, a match forms if and only if the realized value of $x$ is high enough so that the match is jointly worthwhile for the worker and firm. The threshold value of $x$ depends in general on the worker’s type. That is, a private-sector match forms if and only if $x \geq R_p(y)$, where $R_p(y)$ is a type-specific reservation productivity. In the public sector, a match forms

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2As will be seen when we lay out our model, an assumption of sector-specific search, as in Gomes (2011) and Quadrini and Trigari (2007), would give the unrealistic prediction of perfect sorting. That is, all workers above some type $y^*$ would search exclusively in one sector while all workers of type below $y^*$ would direct their search to the other sector.
if and only if \( x \geq \xi g(y) \). The key equilibrium objects are the reservation productivity schedule, \( R_p(y) \), overall labor market tightness, \( \theta \), and the fraction, \( \phi \), of vacancy postings that are accounted for by the private sector. These objects are determined in equilibrium by (i) the condition that private-sector matches form only when it is in the joint interest of the worker and firm, (ii) a free-entry condition for private-sector vacancies, and (iii) steady-state conditions for worker flows into and out of unemployment, private-sector employment and public-sector employment.

2.1 Value Functions, Wages, Reservation Values

We start with the optimization problem for a worker of type \( y \). Let \( U(y) \), \( N_p(x, y) \), and \( N_g(x, y) \) be the values (expected discounted lifetime utilities) associated with unemployment and employment in, respectively, a private-sector job and a public-sector job with match-specific productivity \( x \). The value of unemployment for worker \( y \) is defined by:

\[
rU(y) = z + \phi m(\theta) E \max[N_p(x, y) - U(y), 0] + (1 - \phi)m(\theta) E \max[N_g(x, y) - U(y), 0]
\] (1)

This expression reflects the following assumptions. Time is continuous, and the worker lives forever, discounting the future at rate \( r \). The worker receives a flow value \( z \) while unemployed. Private-sector vacancies are met at rate \( \phi m(\theta) \), and public-sector vacancies are met at rate \( (1 - \phi)m(\theta) \). When the worker meets a vacancy, a match-specific productivity is realized, and the worker realizes a capital gain, either \( N_p(x, y) - U(y) \) or \( N_g(x, y) - U(y) \) if the relevant difference is positive; zero otherwise.

The two employment values are defined by

\[
rN_p(x, y) = w_p(x, y) + \delta_p(U(y) - N_p(x, y))
\] (2)

\[
rN_g(x, y) = w_g(x, y) + \delta_g(U(y) - N_g(x, y)).
\] (3)

The private-sector wage is determined by Nash bargaining with an exogenous worker share parameter, as described below, while the public-sector wage schedule is exogenous. Job destruction is assumed to occur at exogenous Poisson rate \( \delta_s \), and we allow for the possibility that \( \delta_p \neq \delta_g \).

On the private-sector firm side, let \( J(x, y) \) be the value (expected discounted profit) associated with a job filled by a worker of type \( y \) whose match-specific productivity is \( x \), and let \( V \) be the value associated with posting a private-sector vacancy. These values are defined by

\[
rJ(x, y) = x - w_p(x, y) + \delta_p(V - J(x, y))
\] (4)

\[
rV = -c + \frac{m(\theta)}{\theta} E \max[J(x, y) - V, 0].
\] (5)

The expectation in equation (5) is taken with respect to the joint distribution of \((x, y)\) across the population of unemployed job seekers. A private-sector firm with a vacancy
Similarly, using equation (6), for any value of \( x \) is increasing in \( x \), and the flow value of the worker’s outside option, that is, the private-sector wage is a weighted average of the flow productivity of the match, \( \beta \). Imposing the free-entry condition for private-sector vacancy creation in advance, i.e., \( V = 0 \), the Nash bargaining solution implies

\[
wp(x, y) = \beta x + (1 - \beta)rU(y);
\]

that is, the private-sector wage is a weighted average of the flow productivity of the match, \( x \), and the flow value of the worker’s outside option, \( rU(y) \).

Substituting equation (6) into equation (6) and recalling our assumption that \( wp(x, y) \) is increasing in \( x \) for \( x \geq \xi_g(y) \), it is clear that \( N_p(x, y) \) and \( N_g(x, y) \) are nondecreasing in \( x \) for any value of \( y \). Accordingly, reservation productivities can be defined for the type-\( y \) worker. The private-sector reservation productivity for a type-\( y \) worker, \( R_p(y) \), is defined by \( N_p(R_p(y), y) = U(y) \). Using equations (6) and (7), \( N_p(R_p(y), y) = U(y) \) implies \( R_p(y) = rU(y) \). That is, at \( x = R_p(y) \) the net surplus associated with the match equals zero. The public-sector reservation productivity for a type-\( y \) worker is simply \( R_g(y) = \xi_g(y) \). This is equivalent to assuming that, given the public-sector wage schedule, \( N_p(\xi_g(y), y) \geq U(y) \). If \( N_g(\xi_g(y), y) > U(y) \), there is rationing of public-sector jobs for type-\( y \) workers as shown in Figure 1. If \( N_g(\xi_g(y), y) = U(y) \), then \( \xi_g(y) = rU(y) = R_p(y) \); that is, the public- and private-sector reservation productivities are equal for the type-\( y \) worker. Finally, we could in principle consider the case of \( N_g(\xi_g(y), y) < U(y) \). In this case, however, matches would not form for \( x \in [\xi_g(y), R_p(y)] \) because workers would reject them. In this sense, it is without loss of generality to assume \( N_g(\xi_g(y), y) \geq U(y) \).

To further characterize the private-sector reservation productivity, it is useful to rewrite our expression for \( rU(y) \). Using equations (6) and (7) and integrating by parts gives

\[
E \max[N_p(x, y) - U(y), 0] = \frac{\beta}{r + \delta_p} \int_{R_p(y)}^{x} (1 - G_p(x|y)) \, dx.
\]

Similarly, using equation (7) together with \( rU(y) = R_p(y) \) gives

\[
E \max[N_g(x, y) - U(y), 0] = \frac{1}{r + \delta_g} \int_{\xi_g(y)}^{x} (w_g(x, y) - R_p(y)) dG_g(x|y).
\]
Figure 1: Public Sector Job Rationing

Substituting into equation (??) then gives

\[
R_p(y) = z + \phi m(\theta) \frac{\beta}{r + \delta_p} \int_{R_p(y)}^{x} (1 - G_p(x | y)) dx + (1 - \phi) m(\theta) \frac{1}{r + \delta_p} \int_{\xi_p(y)}^{x} (w_p(x, y) - R_p(y)) dG_p(x | y).
\]

Given overall labor market conditions, i.e., \( \theta \) and \( \phi \), and the government’s employment and wage-setting policy, equation (??) gives a unique solution for \( R_p(y) \) since the RHS of equation (??) is positive at \( R_p(y) = 0 \), goes to \( z \) as \( R_p(y) \to \infty \), and the derivative of the RHS with respect to \( R_p(y) \) is negative.

2.2 Steady State and Free-Entry Conditions

The next step is to characterize optimal entry by private-sector firms. Imposing \( V = 0 \) in advance and using equation (??), we have

\[
J(x, y) = \frac{x - w_p(x, y)}{r + \delta_p} = \frac{(1 - \beta) x - ru(y)}{r + \delta_p} = \frac{(1 - \beta) x - R_p(y)}{r + \delta_p}.
\]
Letting \( f_u(y) \) denote the density of \( y \) among the unemployed, the free-entry condition, i.e., equation (??) with \( V = 0 \), can be written as

\[
c = \frac{m(\theta)}{\theta} \left( \frac{1 - \beta}{r + \delta_p} \right) \int \int \pi (x - R_p(y)) dG_p(x|y) f_u(y) dy \frac{r}{\theta}
\]

\[
= \frac{m(\theta)}{\theta} \left( \frac{1 - \beta}{r + \delta_p} \right) \int \int \pi (1 - G_p(x|y)) dx f_u(y) dy,
\]

where the final equality uses integration by parts.

The only unknown function in equation (??) is the contaminated density, \( f_u(y) \). Assuming that the exogenous distribution function, \( F(y) \), is continuous with corresponding density, \( f(y) \), one can use Bayes Law (as in Albrecht, Navarro and Vroman 2009) to write

\[
f_u(y) = \frac{u(y) f(y)}{u};\]

that is, the density of types among the unemployed, \( f_u(y) \), can be written as the type-specific unemployment rate, \( u(y) \), times the population density, \( f(y) \), normalized by the overall unemployment rate,

\[
u = \int_y u(y) f(y) dy.
\]

To derive the type-specific unemployment rates, \( u(y) \), let \( n_p(y) \) and \( n_g(y) \) be the fractions of time that a type-\( y \) worker spends in private-sector and public-sector employment, respectively. In steady state, the following two equations must hold:

\[
\delta_p n_p(y) = \phi m(\theta)(1 - G_p(R_p(y)|y)) u(y) \quad (9)
\]
\[
\delta_g n_g(y) = (1 - \phi) m(\theta)(1 - G_g(\xi_g(y)|y)) u(y). \quad (10)
\]

The first condition equates the flow from private-sector employment to unemployment and vice versa, and the second condition equates the flow from public-sector employment to unemployment and vice versa. Using

\[
u(y) + n_p(y) + n_g(y) = 1,
\]

8
equations (??) and (??) imply

\[
\begin{align*}
    u(y) &= \frac{\delta_g \delta_p}{\delta_g \delta_p + \delta_g \phi m(\theta)(1 - G_p(R_p(y)|y)) + \delta_p (1 - \phi) m(\theta)(1 - G_g(\xi_g(y)|y))} \\
    n_p(y) &= \frac{\delta_g \delta_p}{\delta_g \delta_p + \delta_g \phi m(\theta)(1 - G_p(R_p(y)|y))} \\
    n_g(y) &= \frac{\delta_p (1 - \phi) m(\theta)(1 - G_g(\xi_g(y)|y))}{\delta_g \delta_p + \delta_g \phi m(\theta)(1 - G_p(R_p(y)|y)) + \delta_p (1 - \phi) m(\theta)(1 - G_g(\xi_g(y)|y))}
\end{align*}
\]  

(11)

Substituting the expression for \(u(y)\) into equation (??) completes the characterization of the private-sector free-entry condition.

The final unknown that needs to be characterized is \(\phi\), the fraction of vacancies that are posted by private-sector firms. To do this, note that since \(v_p + v_g = \theta u\),

\[
\phi = \frac{v_p}{v_p + v_g}
\]

implies

\[
\phi = \frac{\theta u - v_g}{\theta u}.
\]

(12)

This closes the model.

2.3 Equilibrium

**Definition:** A steady-state equilibrium is a function, \(R_p(y)\), that satisfies equation (??) for all \(y \in [y, \bar{y}]\) together with scalars \(\theta\) and \(\phi\) that satisfy equations (??), (??) and (??).

An equilibrium always exists. First, as noted above, for given values of \(\theta\) and \(\phi\), the reservation productivity, \(R_p(y)\), is uniquely determined. Second, given any value of \(\phi\), equation (??) has at least one solution for \(\theta\). The argument is standard. The RHS of equation (??) is continuous in \(\theta\), it converges to infinity as \(\theta \to 0\), and it goes to zero as \(\theta \to \infty\). Finally, once \(R_p(y)\) and \(\theta\) are determined as functions of \(\phi\), equation (??) has at least one solution in \(\phi\). (The complication, of course, is that \(u\) depends on \(\phi\).) Note that we do not claim uniqueness. In equation (??), \(f_u(y)\) need not be monotonically decreasing in \(\theta\) nor is it obvious that equation (??) has a unique solution. Uniqueness depends on the form of \(F(y)\), \(G_p(x|y)\), \(G_g(x|y)\) and public-sector employment policy and needs to be investigated numerically.\(^3\)

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\(^3\)The possibility of non-uniqueness of equilibrium is a common feature of models with worker heterogeneity. See, e.g., Albrecht, Navarro and Vroman (2009) and Chéron, Hairault and Langot (2011).
2.4 Wage Distributions

Let \( H_s(w) \) denote the distribution function of wages paid in sector \( s \). We can develop expressions for \( H_p(w) \) and \( H_g(w) \) as follows. Consider first the distribution of private-sector wages across workers of type \( y \), say \( H_p(w|y) \). Of course,

\[
H_p(w|y) = 0 \text{ for } w < w_p(R_p(y), y).
\]

That is, no wages are paid to a type-\( y \) worker below the wage that makes that worker indifferent between accepting and rejecting a private-sector match. The conditional distribution function of \( w \) in private-sector jobs given \( y \) for \( w \geq R_p(y) \) then follows from

\[
H_p(w|y) = P[w_p(R_p(y), y) \leq w(X, y) \leq w|y].
\]

Since \( w_p(R_p(y), y) = \beta R_p(y) + (1 - \beta) R_p(y) = R_p(y) \), we have

\[
H_p(w|y) = P[R_p(y) \leq \beta X + (1 - \beta) R_p(y) \leq w|y]
\]

\[
= P[R_p(y) \leq X \leq w - \frac{(1 - \beta) R_p(y)}{\beta}|y]
\]

\[
= G_p \left( \left( \frac{w - (1 - \beta) R_p(y)}{\beta} \right)|y \right) - G_p \left( R_p(y)|y \right).
\]

Summarizing, we have

\[
H_p(w|y) = \begin{cases} 
0 & \text{for } w < R_p(y) \\
G_p \left( \left( \frac{w - (1 - \beta) R_p(y)}{\beta} \right)|y \right) - G_p \left( R_p(y)|y \right) & \text{for } w \geq R_p(y)
\end{cases}
\] (13)

The unconditional distribution of private-sector wages is then found by integrating the conditional distribution function against the density of \( Y \) among private-sector employees. That is,

\[
H_p(w) = \int_{y} H_p(w|y)f_p(y)dy,
\] (14)

where

\[
f_p(y) = \frac{n_p(y)f(y)}{n_p}.
\]
The same approach can be used to find the distribution of public-sector wages, namely,\[
H_g(w|y) = \begin{cases} 
0 & \text{for } w < w_g(\xi_g(y), y) \\
P[w_g(\xi_g(y), y) \leq w(X, y) \leq w|y] & \text{for } w \geq w_g(\xi_g(y), y)
\end{cases}
\] (15)
and\[
H_g(w) = \int_{y}^{\infty} H_g(w|y)f_g(y)dy.
\] (16)
To go further requires specifying the functional form of \(w_g(x, y)\) in order to invert the inequality in (??). We do this below.

3 Solving the Model

To solve the model, we make functional form assumptions for \(F(y)\), \(G_p(x|y)\), \(G_g(x|y)\), \(\xi_g(y)\) and \(w_g(x, y)\). Specifically, we assume

(i) \(F(y) = \Phi\left(\frac{\ln y - \mu_y}{\sigma_y}\right)\) for \(y > 0\)

(ii) \(G_s(x|y) = \Phi\left(\frac{\ln x - \ln y}{\sigma_s}\right)\) for \(x > 0\) and \(s = p, g\)

(iii) \(\xi_g(y) = \alpha + R_p(y)\)

(iv) \(w_g(x, y) = \psi + \gamma x + (1 - \gamma)rU(y) = \psi + \gamma x + (1 - \gamma)R_p(y)\).

How can we understand these assumptions? Assumption (i), namely, that \(Y\) follows a lognormal distribution, can be viewed as a normalization. The effect on model outcomes of changing this assumption, e.g., to assuming that \(Y\) follows a more general Beta distribution, can equally well be achieved by changing the assumed distributions of match-specific productivities conditional on \(y\). Assumption (ii) states that, conditional on \(y\), match-specific productivity in sector \(s\) follows a log-normal distribution. This functional form clearly satisfies first-order stochastic dominance; i.e., \(G_s(x|y') < G_s(x|y)\) for \(y' > y\). The particular parameterization we are using also implies that, conditional on \(y\), the expected value of match-specific productivity in sector \(s\) is \(\exp\{y + \sigma^2_s / 2\}\). If \(\sigma^2_g < \sigma^2_p\), then the conditional distribution of private-sector match productivity first-order stochastically dominates the corresponding distribution of public-sector match productivity and, of course, vice versa if \(\sigma^2_g > \sigma^2_p\). Our log normality assumption is parsimonious, but we also expect it to do a good job of matching the data.

Our specifications for the public-sector hiring rule and wage schedule are expressed as “deviations from” the corresponding private-sector rules. Our specification for \(\xi_g(y)\) requires \(\alpha \geq 0\). At \(\alpha = 0\), there is no rationing of public-sector jobs; a worker of type \(y\) who
draws \( x = rU(y) = R_p(y) \) is just indifferent between accepting the job and continuing to search. When \( \alpha > 0 \), some public-sector jobs are rationed. A worker of type \( y \) who draws \( x = \xi_g(y) \) receives a wage above the level needed to get her to accept the job. Specifically, at \( x = \xi_g(y) \), the gap between the wage the worker receives and her reservation wages is \( \alpha \gamma \). See Figure 2.

These functional form assumptions simplify the equations that define equilibrium. Equation (??) becomes

\[
R_p(y) = z + \phi m(\theta) \frac{\beta}{r + \delta_p} \int_{R_p(y)}^{\infty} \left( 1 - \Phi \left( \frac{\ln x - \ln y}{\sigma_p} \right) \right) dx + \left( 1 - \phi \right) m(\theta) \frac{1}{r + \delta_g} \left( (\alpha + \psi) \gamma \left( 1 - \Phi \left( \frac{\ln (\alpha + R_p(y)) - \ln y}{\sigma_g} \right) \right) + \gamma \int_{\alpha + R_p(y)}^{\infty} \left( 1 - \Phi \left( \frac{\ln x - \ln y}{\sigma_g} \right) \right) dx \right)
\]

An extreme special case of equation (??) holds when \( \alpha = 0 \) (no rationing of public-sector jobs) and \( \gamma = 0 \) (conditional on meeting the type-specific productivity hurdle for the job, workers are paid solely based on their credentials). In this case, the private-sector reservation productivity for a worker of type \( y \) only depends on the distribution of private-
sector opportunities, and the public-sector wage schedule is

\[ w_g(x, y) = \begin{cases} 
0 & \text{for } x < R_p(y) \\
\psi + R_p(y) & \text{for } x \geq R_p(y) 
\end{cases} . \]

Similarly, equation (??) becomes

\[ c = \frac{m(\theta)}{\theta} \left( \frac{1 - \beta}{r + \delta_p} \right) \int_0^1 \int_{R_p(y)}^{\infty} \left( 1 - \Phi\left( \frac{\ln x - \ln y}{\sigma_p} \right) \right) dx \frac{u(y)}{u} dy, \tag{18} \]

where

\[ u(y) = \frac{\delta_g \delta_p}{\delta_g \delta_p + \delta_g \phi m(\theta) (1 - \Phi(\ln R_p(y)/\ln y)) + \delta_p (1 - \phi) m(\theta) (1 - \Phi(\ln(\alpha + R_p(y))/\ln y))} \cdot \tag{19} \]

Finally, we have equation (??),

\[ \phi = \frac{\theta u - v_g}{\theta u} . \]
4 Empirical Strategy: Colombia

4.1 Stylized Facts

While the public sector size ranges between 15 percent and 19 percent of total urban employment across several Latin American economies in the period 1999-2007, the public sector size ranged between 7 percent and 12 percent of urban employment in Colombia.

On average, there is a public-sector wage premium in Colombia both in the raw data and after controlling for observable worker characteristics and endogenous sector choice.

Public-private log wage differentials in the raw data increased substantially after the mid 1990’s, starting from 0.492 in 1984 and reaching 0.86 in 2003. These differentials are very large compared with other Latin America countries.

![Figure 3: Evolution of Differences in mean log hourly wages, public-sector relative to private](source: Colombian National Household Surveys)

Workers in the public-sector are on average more educated than those in the private sector, and predominantly formal. This may suggest that a sizable part of the wage premium should be explained by differences in education and by the low wages paid in the informal private sector. However, when we exclude self-employment and unpaid family workers, and restrict the sample to workers with tertiary education, the wage premium is still quite sizable, even when controlling for standard observables. See Table 1.

---

4See Algan et al. (2002) and Mizala et al. (2010).
5In December 2010, while 70.37 percent of workers in the public sector have tertiary education, this fraction is only 38.13 percent among private sector workers. Also, only 2.18 percent of public sector workers do not have access to social security.
Table 1: Public Sector Log Wage-Premium: With and Without Controls

<table>
<thead>
<tr>
<th>Specifications</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>8.53***</td>
<td>4.76***</td>
<td>4.68***</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.110)</td>
<td>(0.107)</td>
</tr>
<tr>
<td>Public Sector Dummy</td>
<td>0.72***</td>
<td>0.32***</td>
<td>0.22***</td>
</tr>
<tr>
<td></td>
<td>(0.046)</td>
<td>(0.039)</td>
<td>(0.039)</td>
</tr>
<tr>
<td>Education</td>
<td>0.20***</td>
<td>0.199***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.005)</td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td></td>
<td>0.023***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.003)</td>
<td></td>
</tr>
<tr>
<td>Experience square</td>
<td>-0.00023***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.000)</td>
<td></td>
</tr>
</tbody>
</table>

Dependent Variable: Log Hourly Wage Rate. Author’s calculations based on GEIH, December 2010, 13 Metropolitan Areas. Sample includes salaried workers with tertiary education and excludes self-employed and unpaid family workers. All statistics weighted using sampling weights. Standard errors in parenthesis.

4.2 Descriptive Statistics

To calibrate the model, we use data from the Colombian Household Surveys\(^6\) repeated cross-sections carried out by the Colombian Statistics Department (DANE) on employed and unemployed individuals in thirteen metropolitan areas, for December of 2010.

In the calibration, we restrict the sample to salaried workers with tertiary education working in the private or public sector and exclude self-employed, domestic employees and unpaid family workers\(^7\).

The sample size is 3,165 observations, which represents 2.36 million people.

In addition to standard demographic and socio-economic variables (age, gender, marital status, educational attainment, etc), the sample is described by the following labor market variables:

\[
\left(\{W_s\}_{s \in E_j};\{t_{us}\}_{s \in E_j};\{t_{nes}\}_{s \in E_j};\{t_{us}\}_{s \in U};\{h_s\}_{s \in E_j}\right)_{j=F,I}
\]

\(W_s\): Accepted wages for individual \(s\), where \(s \in E_j\), so each individual can be employed in sector \(j\) (public or private).

\(^6\)These surveys include: Encuesta Nacional de Hogares (ENH) for the period 1984 q1 to 2000 q2, Encuesta Continua de Hogares (ECH) for the period 2000 q2 to 2003 q2, and Gran Encuesta Integrada de Hogares (GEIH) for the period 2007m1-2010m12

\(^7\)By restricting the sample to only workers with tertiary education the informality rate (based on the Social Protection definition) among private sector workers drops from 0.38 to 0.156.
**t_{es}**: Employment duration for individual s, where s ∈ E_j (incomplete spells -right censored)

**t_{nes}**: Non-Employment duration of previous employment for individual s, where s ∈ E_j.

**t_{us}**: Unemployment duration for individual s, where s ∈ U (incomplete spells -right censored)

**h_s**: Weekly hours of work for individual s

Although the data are not longitudinal, retrospective questions about previous unemployment and employment status for both employed and unemployed individuals are available, allowing us to construct transition flows across the different states.

The following table shows the descriptive statistics for the sample of employed population, by sector. The estimated size of the public sector is close to 17.1 percent.

<table>
<thead>
<tr>
<th></th>
<th>Employed</th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>2,517</td>
<td>449</td>
<td>2,068</td>
</tr>
<tr>
<td>Population</td>
<td>1,961</td>
<td>258</td>
<td>1,703</td>
</tr>
<tr>
<td>E(lnW_s)</td>
<td>8.62</td>
<td>9.26</td>
<td>8.53</td>
</tr>
<tr>
<td>SD(lnW)</td>
<td>0.78</td>
<td>0.64</td>
<td>0.75</td>
</tr>
<tr>
<td>E(t_{es})</td>
<td>63.29</td>
<td>144.38</td>
<td>48.49</td>
</tr>
<tr>
<td>SD(t_{es})</td>
<td>82.08</td>
<td>118.26</td>
<td>65.37</td>
</tr>
<tr>
<td>E(t_{nes})</td>
<td>3.28</td>
<td>3.51</td>
<td>3.24</td>
</tr>
<tr>
<td>SD(t_{nes})</td>
<td>7.95</td>
<td>9.71</td>
<td>7.67</td>
</tr>
<tr>
<td>E(h_s)</td>
<td>46.22</td>
<td>44.16</td>
<td>47.60</td>
</tr>
<tr>
<td>SD(h_s)</td>
<td>14.77</td>
<td>12.38</td>
<td>10.43</td>
</tr>
</tbody>
</table>

Table 2: Descriptive Statistics for Employed Population with Tertiary Education

Author’s calculations based on GEIH, December 2010, 13 Metropolitan Areas. Employed Population (in Thousands) excludes self-employment and unpaid family workers. All statistics weighted using sampling weights. Nominal wages in hourly rates, employment and non-employment duration in months.

In comparison with the private sector, the public sector is characterized by:

---

8This variable measures months without employment between the current job and the previous job (retrospective question), so we cannot identify whether it refers to unemployment or inactivity duration. Unemployment duration can be obtained from the unemployed population, however, this variable is right censored, while for the employed population we don’t have the same problem.

9Standard error of .006

16
Figure 4: Kernel Density Estimation of Log Nominal Hourly Wages, By Sector

- **Higher and less Dispersed Wages**: Log hourly wages are on average, higher, and less disperse than in the private sector. Difference in mean log wages is 0.72 and the standard deviation of public log-wages relative to private is 0.85. See Figure 4.

- **More Job Stability**: average employment duration in the public sector is 144.3 months (12.03 years) while in the private sector is 48.4 months (4.04 years)

- **Higher Non-Employment Duration**: if unemployed/inactive before the current state, public sector workers faced higher unemployment/inactivity duration on average than their private sector counterparts (3.51 vs. 3.24 months)

- **Less hours of work**: public sector workers work, on average, 44.1 hours per week, slightly lower while their private sector counterparts (47.6 hours per week).

When looking at the earnings distribution we see that most variance in log wages is due to within sector variability and not to between-sector variability.

---

10. The lower tail of the hourly wage distribution is excluded (wages below 1 peso) to minimize the effects of measurement error. This measure of wages includes tips, commissions but excludes non-monetary payments.
Table 1 contains information of the first two moments of the nominal earning distributions in the overall economy and in the two sectors (in particular, sectoral and economy-wide means and variances of log wages) for December 2010. The log wage variance is broken down into two components: a) Variability within sectors; b) Variability between sectors.\footnote{The proportion of population employed in sector does not correspond to public and private sector employment rates since the ratio is computed as a proportion of employed population who report wages (there is no wage information for all Employed). Total variance is computed by adding within-sector variance and between-sector variance.}

Table 3: Decomposition of Variance in Log Nominal Hourly Wages

<table>
<thead>
<tr>
<th></th>
<th>December 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Public Sector</strong></td>
<td></td>
</tr>
<tr>
<td>Mean of Log Wages ($M_1$)</td>
<td>9.25</td>
</tr>
<tr>
<td>Variance of Log Wages ($\sigma_1$)</td>
<td>0.417</td>
</tr>
<tr>
<td>Proportion of Employed in Sector ($P_1$)</td>
<td>0.128</td>
</tr>
<tr>
<td><strong>Private Sector</strong></td>
<td></td>
</tr>
<tr>
<td>Mean of Log Wages ($M_2$)</td>
<td>8.53</td>
</tr>
<tr>
<td>Variance of Log Wages ($\sigma_2$)</td>
<td>0.57</td>
</tr>
<tr>
<td>Proportion of Employed in Sector ($P_2$)</td>
<td>0.87</td>
</tr>
<tr>
<td><strong>Economywide</strong></td>
<td></td>
</tr>
<tr>
<td>Mean of Log Wages ($\frac{P_1 M_1 + P_2 M_2}{P_1 + P_2}$)</td>
<td>8.62</td>
</tr>
<tr>
<td>Sum of Within-Sector Variance ($\frac{P_1 \sigma_1^2 + P_2 \sigma_2^2}{P_1 + P_2}$)</td>
<td>0.55</td>
</tr>
<tr>
<td>Between-Sector-Variance [$\frac{P_1 P_2 (M_1 - M_2)^2}{(P_1 + P_2)^2}$]</td>
<td>0.057</td>
</tr>
<tr>
<td>Total Variance</td>
<td>0.608</td>
</tr>
</tbody>
</table>

Author’s calculations based on GEIH, December 2010, 13 Metropolitan Areas. All statistics weighted using sampling weights. Sample includes salaried workers with tertiary education and excludes self-employed and unpaid family workers.

Table 4 shows the descriptive statistics for the unemployed population. The estimated unemployment rate for December 2010 is 17.11% (s.e. of .0066).

Average unemployment duration is quite high (20.74 weeks or 4.78 months), and slightly higher than the mean non-employment duration for the employed population (3.28 months),
Table 4: Descriptive Statistics for Unemployed

<table>
<thead>
<tr>
<th></th>
<th>Unemployed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>648</td>
</tr>
<tr>
<td>Population</td>
<td>409.9</td>
</tr>
<tr>
<td>(P(s \in U))</td>
<td>17.11</td>
</tr>
<tr>
<td>(E(t_{us} \mid s \in U))</td>
<td>20.74</td>
</tr>
<tr>
<td>(SD(t_{us} \mid s \in U))</td>
<td>30.31</td>
</tr>
</tbody>
</table>

Author’s calculations based on ECH, June 2003, 13 Metropolitan Areas. Unemployment duration in weeks. Population in Thousands. Sample includes only unemployed with tertiary education.

even if the estimate is downward biased due to the right-censoring.

4.3 Simulated Method of Moments

We want to match aggregate unemployment and employment rate figures, and selected moments of the wage distribution in both sectors. We also want to get reasonable labor market tightness parameters by international standards\(^\text{12}\).

We partition the parameter space of the benchmark model in two groups.

In the first group, parameters are calibrated based on previous results from micro studies or data. This group of variables includes \(\delta_p, \delta_g, \beta\), the parameters of the matching function, the parameters of the distribution \(f(y)\), and the location parameters of the distributions \(g_s(x \mid y)\), for \(s=G,P\).

In the second group, parameters are chosen to match the division of the labor force among unemployment, public and private-sector employment, difference in mean log wages and the ratio between the log wage variance in the public relative to the private sector. This includes \(c, z\), and the scale parameters of the distributions \(g_s(x \mid y)\).

We construct our simulation-based estimator by simulating the model at the given parameter vector and calculate the moments of interest from the simulated data, and compare it to the empirical moments observed in the actual data. The parameters of the model are then chosen so as to minimize the weighted sum of squared deviations between model and data moments.

The parameter values are chosen with a quarter as the implicit unit of time.

\(^{12}\)There are no reliable estimates for the Colombian case since there are no data on job vacancies.
<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PARAMETERS</strong></td>
<td></td>
</tr>
<tr>
<td>( r ) interest rate</td>
<td>0.023</td>
</tr>
<tr>
<td>( \delta_p ) job destruction rate, private sector</td>
<td>0.062</td>
</tr>
<tr>
<td>( \delta_g ) job destruction rate, public sector</td>
<td>0.021</td>
</tr>
<tr>
<td>( \beta ) worker’s Nash bargaining power</td>
<td>0.5</td>
</tr>
<tr>
<td>( A ) technological parameter, matching function</td>
<td>1.5</td>
</tr>
<tr>
<td>( \alpha_m ) elasticity matching function</td>
<td>0.5</td>
</tr>
<tr>
<td>( \mu_y ) mean, worker types</td>
<td>18.70</td>
</tr>
<tr>
<td>( \sigma^2_y ) variance, worker types</td>
<td>4.85</td>
</tr>
<tr>
<td>( \mu_{xP} ) private sector match-specific productivity, conditional mean</td>
<td>(log(y))</td>
</tr>
<tr>
<td>( \mu_{xG} ) public sector match-specific productivity, conditional mean</td>
<td>(log(y))</td>
</tr>
<tr>
<td><strong>PUBLIC POLICY</strong></td>
<td></td>
</tr>
<tr>
<td>( v_g ) vacancies, public sector</td>
<td>0.015</td>
</tr>
<tr>
<td>( \alpha ) differential productivity cutoff, public sector</td>
<td>1.0</td>
</tr>
<tr>
<td>( \gamma ) weight on productivity, public sector wage rule</td>
<td>0.3</td>
</tr>
</tbody>
</table>
Table 6: Calibrated Parameters (Moment Simulation)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARAMETERS</td>
<td></td>
</tr>
<tr>
<td>(c) cost of posting a vacancy</td>
<td>9.0</td>
</tr>
<tr>
<td>(z) opportunity cost of leisure</td>
<td>10.0</td>
</tr>
<tr>
<td>(\Psi) public sector constant term, wage setting</td>
<td>14</td>
</tr>
<tr>
<td>(\sigma^2_{x_P}) private-sector match-specific productivity, log variance</td>
<td>0.5</td>
</tr>
<tr>
<td>(\sigma^2_{x_G}) public-sector match-specific productivity, log variance</td>
<td>0.5</td>
</tr>
</tbody>
</table>

The real interest rate in Colombia in 2010 was approximately 9.8 percent\(^{13}\), so \(r\) is chosen to match the corresponding quarterly rate.

We chose the job destruction rate in the private and public sector, \(\delta_p\) and \(\delta_g\), respectively, as equal to 0.062 and 0.021. Assuming that unemployment duration follows an exponential distribution, we know that a private-sector job lasts on average 4.04 years (16.16 quarters) while a public-sector job lasts 12.03 years (48.12 quarters), which gives us estimated separation rates in the private and public sector of 0.062 and 0.021, respectively.

We set \(\beta = 0.5\), so shares are split equally between workers and firms.

The parameters of the matching function are set in the following way. We assume a standard Cobb-Douglas function given by \(m(\theta) = A\theta^{1-\alpha}\). We choose \(A = 1.5\) and \(\alpha_m = 0.5\). Since there is no data on vacancies for Colombia, we follow standard results for the U.S.

Following Mortensen and Nagypal (2007) and Brugemann (2008), the elasticity of the matching function for the U.S. ranges between 0.45 and 0.63. Also, job-finding rates in the U.S. are estimated to be 0.45 per month, or 1.8 per quarter, which gives us an upper bound for \(m(\theta)\). We assume job-finding rates in Colombia are closer to 1.5 per quarter. Assuming a reasonable labor market tightness, \(\theta\), ranging between 0.8 and 1.25, gives us a technological parameter \(A\) ranging between 1.34 and 1.67.

We assume the following functional forms for the distributions of types and productivity:

\[
f(y) = \log N(\mu_y, \sigma_y^2)
\]

\[
g_s(x \mid y) = \log N(\mu_{x_s}, \sigma_{x_s}^2), \text{ where } \mu_{x_s} = B_s \log(y), \text{ for } s=G,P.
\]

The parameters are chosen in the following way: \(\mu_y, \sigma_y^2\) are chosen to coincide with the corresponding empirical moments\(^{14}\). We assume \(B_P = 1.0\) and \(B_G = 1.0\), so the mean of \(x\) varies linearly with \(y\) in both sectors.

In the baseline case we assume \(\alpha = 1.0\), so the government uses a higher productivity hiring cutoff than in the private sector (\(\alpha > 0\)). We also assume \(\gamma = 0.3\), so the government

\(^{13}\)Source: IMF, International Financial Statistics

\(^{14}\)We use years of education as a proxy for worker types.
puts less weight on productivity than on education when setting wages ($\gamma < \beta$). We will change these assumptions in the policy experiments.

The rest of the parameters, \( c, z, \psi, \sigma^2_{x_G} \) and \( \sigma^2_{x_P} \) are chosen to match the selected empirical moments. The standard deviations of the conditional distribution of match specific productivity \( \sigma^2_{x_G} \), and \( \sigma^2_{x_P} \) are constrained to be equal among sectors. The optimal weighting matrix is the identity matrix.

The opportunity cost of leisure, \( z \), is chosen equal to 10.0. In Colombia unemployment benefits equal to one and a half times the monthly salary and are provided during six months if certain conditions are met\(^{15} \). This means the average ‘replacement rate’ is about 0.75 wages per month for this particular population group. According to Hornstein, Krusell, and Violante (2005), such rate is 0.7 for European countries where benefits are relatively high, and 0.2 for the U.S (at most). For the Colombian case, it may be reasonable to assume that this ratio is between 0.2 and 0.5. Considering that the average wage in the model is closed to 38.5, the chosen \( z \) gives us a replacement rate of 0.25.

The model match reasonably well the aggregate unemployment rate, private and public-sector employment rates and the mean employment durations in both sectors. The model is producing a smaller wage premium and longer unemployment durations. The model also produces less dispersion in public log-wages than in private log wages .

Table 7 summarizes the main results of the calibration.

Figure 6 to 15 contains the simulated distributions and equilibrium objects for the benchmark case.

4.4 Public-Sector Policy Analysis

4.4.1 Experiment 1: Change in public sector size

We increase the size of the public sector by increasing government vacancies from \( v_g = 0.015 \) to \( v_g = 0.020 \). This decreases decrease labor market tightness substantially from 1.90 to 1.83 and decreases slightly the fraction of jobs in the private sector, \( \phi \), from 0.95 to 0.93. The employment rate in the public sector increases from 0.102 to 0.137, but the reduction in the private sector employment is larger (from 0.733 to 0.69), causing an increase in unemployment from 0.162 to 0.17 . The public-sector wage premium decreases from 0.392 to 0.293. We also find a slightly higher dispersion in the public sector relative to the private.

4.4.2 Experiment 2: Changes in government productivity cut-off

Now let’s assume that the government uses the same productivity hiring cutoff as the private sector, so \( \alpha = 0 \). We find a decrease in private sector employment and and labor market tightness, and a switch in employment from the private to the public sector. This policy also decreases the wage premium from 0.392 to 0.283.

\(^{15} \) Only for unemployed household heads associated before to a Family Compensation Funds (CCF).
Table 7: Calibration: Data-based vs. Simulated Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v_g )</td>
<td>0.015</td>
<td></td>
</tr>
<tr>
<td>( \alpha )</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>( \gamma )</td>
<td>0.3</td>
<td></td>
</tr>
</tbody>
</table>

**POLICY PARAMETERS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>( u )</td>
<td>0.161</td>
<td>0.171</td>
</tr>
<tr>
<td>( n_P )</td>
<td>0.733</td>
<td>0.719</td>
</tr>
<tr>
<td>( n_G )</td>
<td>0.102</td>
<td>0.109</td>
</tr>
</tbody>
</table>

**AGGREGATE UNEMPLOYMENT AND EMPLOYMENT RATES\(^a\)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \theta )</td>
<td>1.9</td>
<td>n.a</td>
</tr>
<tr>
<td>( \phi )</td>
<td>0.95</td>
<td>n.a</td>
</tr>
</tbody>
</table>

**LM TIGHTNESS AND PUBLIC SECTOR SIZE**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_U )</td>
<td>44.33</td>
<td>20.73</td>
</tr>
<tr>
<td>( t_{e_P} )</td>
<td>4.04</td>
<td>4.04</td>
</tr>
<tr>
<td>( t_{e_G} )</td>
<td>12.03</td>
<td>12.03</td>
</tr>
</tbody>
</table>

**MEAN EMPLOYMENT AND UNEMPLOYMENT DURATIONS \(^b\)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \mu_{\ln(W_G)} - \mu_{\ln(W_P)} )</td>
<td>0.392</td>
<td>0.72</td>
</tr>
<tr>
<td>( \sigma_{\ln(W_G)}/\sigma_{\ln(W_P)} )</td>
<td>0.577</td>
<td>0.852</td>
</tr>
</tbody>
</table>

\(^a\) This unemployment rate represents the number of unemployed as a proportion of the adjusted labor force excluding self-employment, domestic employment and unpaid family workers.

\(^b\) Employment durations in months, unemployment duration in weeks.
4.4.3 Experiment 3: Change in government wage setting rule

We analyze an increase in $\gamma$, from 0.3 to 0.75. Since now $\gamma > \beta$, the government now puts more weight on productivity than the private sector when setting wages, and less weight on formal qualifications. Compositional changes are small. The wage gap is increased from 0.392 to 0.404 but there is more dispersion in the public sector relative to the private.

4.4.4 Experiment 4: Change in unemployment benefits

We analyze an increase in $z$ from 10 to 15. This policy will produce a substantial increase in unemployment and a substantial decrease in labor market tightness. Log wage inequality is worsened.

Table 8 summarizes the results of the simulations.

Figure 16-24 show the effects of the policy experiments on simulated distributions of productivities and wages.

5 Conclusions

To be done
Table 8: Compositional and Distributional Effects of Changes in Public Vacancy Creation, Wage Setting Rule and Unemployment Benefits

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Compositional Effects</th>
<th>Tightness &amp; Size</th>
<th>Distributional Effects</th>
<th>Durations b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$u$</td>
<td>$n_P$</td>
<td>$n_G$</td>
<td>$\theta$</td>
</tr>
<tr>
<td>Benchmark</td>
<td>0.162</td>
<td>0.733</td>
<td>0.102</td>
<td>1.90</td>
</tr>
<tr>
<td>$\Delta$ Public Sector Size</td>
<td>0.170</td>
<td>0.690</td>
<td>0.137</td>
<td>1.83</td>
</tr>
<tr>
<td>$v_g = 0.020$</td>
<td>0.162</td>
<td>0.724</td>
<td>0.110</td>
<td>1.92</td>
</tr>
<tr>
<td>$\Delta$ Public Wage Setting Rule</td>
<td>0.171</td>
<td>0.708</td>
<td>0.117</td>
<td>1.77</td>
</tr>
<tr>
<td>$\alpha = 0$</td>
<td>0.195</td>
<td>0.703</td>
<td>0.098</td>
<td>1.57</td>
</tr>
<tr>
<td>$\gamma = 0.75$</td>
<td>0.162</td>
<td>0.724</td>
<td>0.110</td>
<td>1.92</td>
</tr>
<tr>
<td>$\Delta$ Unemployment Benefits</td>
<td>0.171</td>
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<td>1.77</td>
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<td>$z = 15$</td>
<td>0.195</td>
<td>0.703</td>
<td>0.098</td>
<td>1.57</td>
</tr>
</tbody>
</table>

a Simulation results are robust to changes in initial conditions (guessed initial vectors for approximating ss equilibrium) and multiple repetitions of the sampling process.
b Employment Durations in years and unemployment durations in weeks.
Figure 5: Unemployment Rate

Figure 6: Employment Rate, Private Sector
Figure 7: Employment Rate, Public Sector

Figure 8: Analytical Densities of Worker Types, by Sector
Figure 9: Job creation Rate, Private Sector

Figure 10: Job creation Rate, Public Sector
Figure 11: Kernel Density Simulated Distribution of Types, by Sector

Figure 12: Kernel Density Simulated Distribution of Reservation Productivities, by Sector
Figure 13: Kernel Density Simulated Distribution of Idiosyncratic Productivities, by Sector

Figure 14: Kernel Density Simulated Distribution of Log Wages, by Sector
Figure 15: Kernel Density Simulated Distribution of Types, by Sector: Benchmark vs. Experiment 1 (vg=0.020)
Figure 16: Kernel Density Simulated Distribution of Idiosyncratic Productivities, by Sector: Benchmark vs. Experiment 1 (vg=0.020)

Figure 17: Kernel Density Simulated Distribution of Log Wages, by Sector: Benchmark vs. Experiment 1 (vg=0.020)
Figure 18: Kernel Density Simulated Distribution of Types, by Sector: Benchmark vs. Experiment 2 (α = 0)
Figure 19: Kernel Density Simulated Distribution of Idiosyncratic Productivities, by Sector: Benchmark vs. Experiment 2 ($\alpha = 0$)

Figure 20: Kernel Density Simulated Distribution of Log Wages, by Sector: Benchmark vs. Experiment 2 ($\alpha = 0$)
Figure 21: Kernel Density Simulated Distribution of Types, by Sector: Benchmark vs. Experiment 3 ($\gamma = 0.75$)
Figure 22: Kernel Density Simulated Distribution of Idiosyncratic Productivities, by Sector: Benchmark vs. Experiment 3 (γ = 0.75)

Figure 23: Kernel Density Simulated Distribution of Log Wages, by Sector: Benchmark vs. Experiment 3 (γ = 0.75)
Figure 24: Kernel Density Simulated Distribution of Types, by Sector: Benchmark vs. Experiment 4 ($z = 15$)
Figure 25: Kernel Density Simulated Distribution of Idiosyncratic Productivities, by Sector: Benchmark vs. Experiment 4 ($z = 15$)

Figure 26: Kernel Density Simulated Distribution of Log Wages, by Sector: Benchmark vs. Experiment 4 ($z = 15$)

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6 Conclusion

References


