The impact of public employment on local labor markets

Jordi Jofre-Monseny
Universitat de Barcelona
Institut d’Economia de Barcelona

José I. Silva
Universitat de Girona

Javier Vázquez-Grenno
Universitat de Barcelona
Institut d’Economia de Barcelona

Preliminary Draft: July 21, 2015

Abstract
What are the local labor consequences of hosting public administration services on a large scale? In this paper, we develop a search and matching model with public, tradable and non tradable sectors, agglomeration economies, local land market and mobility to identify the channels through which public employment affects local private employment in the tradable and non tradable sectors so differently. We calibrate and simulate the model for a representative Spanish city and find that public employment increase the employment in the non tradable sector and reduce the employment in the tradable sector. Using city-level data from Spain and using the framework recently developed by Moretti (2010), we estimate the long-run multiplier effects of public administration employment. The main result of our estimations is that, for each additional job in the public administration in a given city, 1.17 jobs are created in the non tradable sector. This result is in line with the multiplier derived from the simulations of our model, that predicts 1.74 more non tradable jobs for each extra job in public administration in a given city.

JEL Classifications: J45, J64, H70, R12.

Keywords: public employment, search, local multipliers, industry mix.
1 Introduction

Public employment constitutes a significant fraction of employment in many countries around the world. In 2008, the employer of 15 percent of all US workers was the public sector. In Europe, Germany and Spain show a similar proportion, while public sector employment in France represents as much as 27 percent of total employment\(^1\).

Public employment is not evenly distributed across cities, with the public administration being typically clustered in a few (capital) cities. Brasilia and Ottawa, in Brazil and Canada respectively, are two very prominent examples of “government cities”. From the viewpoint of a city, what are the consequences of hosting public administration services on a large scale? And more specifically, what are the indirect employment effects of a local public sector expansion?

More public employees, will increase the demand for local services such as housing, restaurants, bars, lawyers or hair-dressers, expanding private employment (see Moretti (2010) and Moretti (2011) among others). This crowding-in effect is the focus of traditional Input-Output analysis. However, local wages and prices might respond to the positive labor demand shock. This price adjustment will tend to crowd-out private employment. Analyzing the equilibrium responses of private employment to public employment shocks is especially important for regional policy as public employment has been used to overcome spatial inequalities in different countries including Italy Alesina, Danninger, and Rostagno (2001), UK Faggio and Overman (2014) and Spain Marqués-Sevillano and Rosselló-Villallonga (2004). Some recent papers on local labor markets stand out that shocks in one sector can have effects on the employment in other sectors trough agglomeration economies (Glaeser and Gottlieb (2009) and Moretti (2011)). At the same time, the trade-off between agglomeration economies and urban costs could drive not only the size of the city but also the patterns of firm and worker location (Duranton and Puga (2014)). From this perspective, we believe that public sector employment can play an important role explaining the local labor market outcomes. Then,

\(^1\)International Labour Organization statistics - France’s figure corresponds to 2006.
our main objective in this paper is to analyze the effects of public employment policies on local labor markets under the presence of agglomeration economies, land costs and labor mobility from both, theoretical and empirical perspective.

Following the spirit of Beaudry, Green, and Sand (2012), we start the paper presenting a search and matching model with three sectors (public, tradable and non tradable), agglomeration economies and a local land market. In addition, as in Kline and Moretti (2013), we consider a small representative city with homogenous workers who can migrate to another city and search for a job.

In this context, the main implication of our theoretical model is that the effects of public employment on the local labor market outcomes and, in particular, on private employment are empirical questions. First, wages in public sector operates as a reservation wage in the local labor market, affecting positively the private wages in both sectors. Second, if the agglomeration (present in the tradable sector) and demand effects (because of increase in public employment) are higher than the wage effects, then the profits of the firms will increase and more vacancies will be created, increasing the private employment.

This theoretical model is linked to the models developed by Beaudry, Green, and Sand (2012) and Kline and Moretti (2013), however, we focus our analysis on the effects of the public employment on local labor markets outputs and land prices. We integrate their analysis in the sense that we develop a multi-sector model, with frictions, to study how a local increase in the public employment (probably policies carried-out to correct local labor market failures) affects the local labor market outcomes and, in particular, the industry composition of the city.

Using city-level data from Spain and the framework recently developed by Moretti (2010), in our empirical work, we estimate the long-run multiplier effects of public administration employment. Specifically, we regress 1980-1990 and 1990-2001 city-level changes in private jobs (in the tradable or the non tradable sector) on contemporaneous changes in public administrative jobs. Besides trying to control for changes in private employment determinants,
we also resort to an instrumental variables strategy that exploits path-dependency in the location of public administration jobs. The results indicate that adding public administrative jobs in a city increases employment in the non tradable sector and has no effects on employment in the tradable sector. Concretely, we find that for each additional job in the public administration in a given city, 1.17 jobs are created in the non tradable sector. Hence, hosting a large public administration changes a city’s industry mix favoring non tradable over tradable activities. The estimates also imply that, at the aggregate level, public sector jobs crowd-in private jobs. This empirical analysis, is closely related to Faggio and Overman (2014) that estimates multiplier effects of public sector job relocations away from London. Their results, based on 2004-2008 employment changes at the British Local Authority level, indicate that overall private employment does not change with public employment although the industry mix is changed in favor of the non tradable sector. Our paper also relates to an empirical (macroeconomics) literature studying the labor market effects of public employment at the national level. Edin and Holmlund (1997), using data for 22 OECD countries from the 1960s to 1990s, find that public sector employment reduces unemployment in the short-run (by 0.3 percent) and has no significant effect in the long-run. When focusing on the Swedish case, these authors conclude that the public sector growth over the 1960s and 1970s contributed to the low Swedish unemployment rate during those years. Using a longer OECD panel, Algan, Cahuc, and Zylberberg (2002) find different conclusions, namely that 100 new public jobs crowd-out 150 private sector jobs and increase unemployment by 30 workers. Our estimates are not directly comparable to these results since labor demand and supply elasticities at the local and national level are likely to differ. In a more recent study, Afonso and Gomes (2014) examine the interactions between public and private sector wages per employee and find that the growth of public sector wages and of public sector employment positively affects the growth of private sector wages.

Our paper, improve and complement the previous literature in several ways. First, we develop a multi-sector search model with agglomeration economies and labor mobility that
can rationalize our empirical results and helps to clarify the channels through which local public employment affects labor market outcomes and, in particular, private employment in the tradable and non tradable sectors so differently. The model brings together two different branches of the literature, on one side, the analysis of labor markets through search and matching models and, on the other side, the papers that study the effects of local policies on the local labor markets. Second in the econometric analysis, we focus on employment changes in the very long-run, allowing for possible sluggish price adjustments. More specifically, the period we study is characterized by a very large increase in the Spanish public sector that followed the advent of democracy after Franco’s death in 1975. Specifically, between 1980 and 2001, the employment in the public administration increased from 523,434 to 1,258,512 (from 4.4 to 7.8 percent of total employment). This late development of the Spanish public sector enables us to use the geographical distribution of the pre-democratic and immature public administration in 1970 (with only 296,207 employees) to predict city-level changes in public administration jobs in the 1980-2001 period.

The remainder of this paper is organized as follows. In Section 2 we develop the theoretical model, we also calibrate and simulate it. Section 3 presents and describes the data and variables used in the empirical analysis and considers the historical circumstances around the expansion of the Spanish public sector. Section 4 describes and justifies the econometric specifications and methods used. Then, section 5 presents and discusses the empirical results while Section 6 concludes.

2 The Model

In this section we present a search and matching model with three sectors (public, tradable and non tradable), agglomeration economies and a local land market. Our main objective is to understand the effects of public sector employment on local labor market outcomes.

Following Kline and Moretti (2013), we introduce a theoretical model that considers a
small representative city with homogenous workers who can migrate to another city and search for a job. Workers can be employed or unemployed. Employees can be either in the public sector \((g)\), in the tradable sector \((t)\) or in the non tradable sector \((n)\).

### 2.1 Employment and Unemployment

Unemployed workers search for jobs in the three sectors simultaneously and enjoy the non-labor income \(b\). The job creation rate, \(f_g\), and separation rate, \(s_g\), in the public sector are exogenous. In turn, jobs are filled in both the tradable and non tradable sectors via a constant return to scale (CRS) matching function, \(m(uL, vL) = m_0 u^{\chi} v^{(1-\chi)} L\), where \(u\) is the unemployment rate, \(v\) the vacancy rate and \(L\) is the labor force of each city and \(\chi\) and \(m_0\) are the matching function parameters. Unemployed workers find jobs in the tradable and non tradable sectors at the endogenous rates \(f_i(\theta) = \frac{m(uL, vL)}{uL} \Omega_i\), where \(\Omega_i\) represents the fraction of vacant jobs in each sector with \(i = t, n\), \(\Omega_i = \frac{v_i}{v_t + v_n}\). In turn, vacancies in the private sector are filled at rates \(q(\theta)\), where \(\theta\) represents the tightness of the private labor market in the city (vacancies-unemployment ratio), \(\theta \equiv \frac{v_t + v_n}{u} \equiv \frac{v}{u}^2\). According to the properties of the matching function, the higher the number of vacancies with respect to the number of unemployed workers, the easier it is to find a job, \(f'(){\theta} > 0\), and the more difficult it is to fill vacancies in each sector, \(q'(){\theta} < 0\).

Each city has a public sector that pays the exogenous wage \(w_g\). The jobs in the tradable and non tradable sectors can be either filled or vacant. Before a position is filled, the firm has to open a job vacancy with a flow cost \(k_i\). Private firms have a technology with labor as the only input. Each filled job in the tradable sector yields instantaneous profit equal to the difference between the marginal productivity of labor, \(A_t(L)\), and the wage, \(w_t\). We assume that the marginal productivity of labor is given by \(A_t(L) = A_{t0} L^\zeta\), where \(0 < \zeta < 1\) and \(A_{t0}\) captures the exogenous technological level in the tradable sector. The size of the labor force has a positive impact on \(A_t(L)\) because it generates positive agglomeration effects. In turn,

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\(^2\)By the homogeneity of the matching function this rate is not a function of \(L\).
the instantaneous profit of the non tradable sector is equal to $p_n A_n - w_n$, which increases with both the relative price of non tradable goods, $p_n$, and the constant specific technological level in that sector, $A_n$. All employed workers in the tradable and non tradable sectors separate from their firm at the constant rate $s_i$.

Thus, the value of vacancies $V_t$ and $V_n$, and the value of a job in the tradable and non tradable sectors, $J_t$ and $J_n$, are represented by the following Bellman equations

$$
 rV_t = -k_t + q(\theta)(J_t - V_t),
$$

(1)

$$
 rV_n = -k_n + q(\theta)(J_n - V_n),
$$

(2)

$$
 rJ_t = A_t(L) - w_t + s_t(V_t - J_t),
$$

(3)

$$
 rJ_n = p_n A_n - w_n + s_n(V_n - J_n).
$$

(4)

Firms in the tradable and non tradable sectors will open vacancies until the expected value of vacancies becomes zero. Thus, the free entry condition in these two sectors are:

$$
 rV_t = 0,
$$

(5)
\[ rV_n = 0. \] (6)

### 2.2 Households

Each worker consumes tradable and non tradable goods and land. Hence, a worker’s utility depends on income, \( y = \{ b, w_t, w_n \} \), the price of the tradable good (\( p_t \)), the price of the non tradable good (\( p_n \)), and the land price (\( p_c \)) in the city. We assume that workers have a Cobb-Douglas utility function which delivers the indirect utility 

\[ V(y, p_t, p_n, p_c) = y \left( \frac{1-\delta-\phi}{\phi} \right)^{(1-\delta-\phi)} \left( \frac{p_t}{p_n} \right)^{\phi} \left( \frac{p_n}{\phi} \right)^{\delta} = \frac{y}{PI}, \]  

defining \( PI \) as the price index.

\[ PI = \left( \frac{p_t}{1-\delta-\phi} \right)^{(1-\delta-\phi)} \left( \frac{p_n}{\phi} \right)^{\phi} \left( \frac{p_c}{\delta} \right)^{\delta}, \]  

(7)

Parameters \( \delta \) and \( \phi \) reflect the preferences for the land and non tradable goods, respectively. The values for the unemployment \( U \), employment in the tradable \( W_t \), non tradable \( W_n \) and public \( W_g \) sectors are given by the following expressions:

\[ rU = \frac{b}{PI} + f_g(W_g - U) + f_t(\theta)(W_t - U) + f_n(\theta)(W_n - U). \]  

(8)
\[ rW_g = \frac{w_g}{P_I} + s_g(U - W_g), \]  
(9)

\[ rW_t = \frac{w_t}{P_I} + s_t(U - W_t), \]  
(10)

\[ rW_n = \frac{w_n}{P_I} + s_n(U - W_n), \]  
(11)

Unemployed individuals have the option of changing cities. We assume that mobility across cities is sufficiently high and, therefore, the free-mobility condition requires that unemployed individuals everywhere have equal utility \( z \):

\[ rU = z, \]  
(12)

Notice that although individuals have equal values of search across cities, the value of being employed can be different. It is offset, however, by the differences in the local cost of living or by different labor market tightness in each city.

The next assumption is that wages in the tradable and and non tradable sectors are set through Nash bargaining. The Nash solution is the wage that maximizes the weighted product of the worker’s and firm’s net return from the job match. The first-order condition from this maximization problem is:
\[ \frac{1}{P_t} \beta J_t = (1 - \beta)(W_t - U), \]  
(13)

\[ \frac{1}{P_t} \beta J_n = (1 - \beta)(W_n - U), \]  
(14)

where the parameter \( \beta \) represents the worker’s bargaining power.

To fully characterize the dynamics of this economy, we need to define the law of motion for unemployment rate, \( u \), and for the employment rates in the tradable, \( e_t \), non tradable, \( e_n \) and public sector, \( e_g \). These evolve according to the following difference equations:

\[ \dot{u} = s_t e_t + s_n e_n + s_g e_g - f(\theta) u, \]  
(15)

\[ \dot{e}_g = f_g u - s_g e_g, \]  
(16)

\[ \dot{e}_t = f_t(\theta) u - s_t e_t, \]  
(17)

\[ \dot{e}_n = f_n(\theta) u - s_n e_n, \]  
(18)

\[ u + e_t + e_g + e_n = 1. \]  
(19)
Notice that the level unemployment, public and private employment are $uL$, $e_g L$, $e_n L$ and $e_t L$, respectively.

In order to close the model, we assume that land rents accrue to absentee land owners and following Combes, Duranton, and Gobillon (2012) land price is increasing in city size according to:

$$p_c = L^n. \quad (20)$$

### 2.3 Equilibrium

In equilibrium, the system of equations can be reduced to the following twelve key equations that characterize the behavior of the endogenous variables $q(\theta)$, $f_t(\theta)$, $f_n(\theta)$, $p_c$, $p_n$, $L$, $A_t$ $w_t$, $w_n$, $e_t$, $e_n$ and $u$:

$$\frac{k_t}{q(\theta)} = \frac{A_t(L) - w_t}{(r + s_t)}, \quad (21)$$

$$\frac{k_n}{q(\theta)} = \frac{p_n A_n - w_n}{(r + s_n)}, \quad (22)$$

$$w_t = \beta A_t(L) + ((1 - \beta)b + \beta \theta (\Omega_t k_t + \Omega_n k_n)) \frac{(r + s_g)}{(r + s_g + f_g)} + \frac{f_g (1 - \beta) w_g}{(r + s_g + f_g)} \quad (23)$$
\( w_{nt} = \beta p_n A_n + ((1 - \beta)b + \beta (\Omega_t k_t + \Omega_n k_n)) \frac{(r + s_g)}{(r + s_g + f_g)} + \frac{f_g (1 - \beta) w_g}{(r + s_g + f_g)}, \quad (24) \)

\[
\frac{1}{PT} \left[ b + \frac{f_g}{(r + s_g + f_g)} (w_g - b) + \frac{(r + s_g)\beta \theta (\Omega_t k_t + \Omega_n k_n)}}{(r + s_g + f_g)(1 - \beta)} \right] = z, \quad (25)
\]

\[ A_t(L) = A_{t_0} L^\quiren, \quad (26) \]

\[ u = \frac{s_t s_n s_g}{[s_t s_n s_g + s_g s_t f_n(\theta) + s_g s_n f_t(\theta) + f_g s_t s_n]}, \quad (27) \]

\[ e_t = \frac{f_t(\theta)}{s_t} u, \quad (28) \]

\[ e_g = \frac{f_g}{s_g} u, \quad (29) \]

\[ e_n + e_t + u + e_g = 1, \quad (30) \]

\[ \phi(w_t e_t + w_n e_n + w_g e_g + b u) = p_n A_n e_n, \quad (31) \]
\[ p_c = L^n, \] (32)

The public sector employment affects unemployment through two different channels that go in opposite directions. On the one hand, according to the wage equations (23) and (24), the wage of the public sector, \( w_g \), has a positive impact on \( w_t \) and on \( w_n \), reducing the firm’s profit. According to equations (21) and (22), firms react by posting fewer vacancies which in turn reduce the labor market tightness, \( \theta \). As a result, the job finding rate in the tradable and non-tradable sectors, \( f_i(\theta) \), decrease and the unemployment rate, \( u \), increases according to equation (27). On the other hand, the public wages increases the wage bill, which generates positive demand increasing \( L \) and also generating agglomeration effects that, at the end impact on the non-tradable and tradable sectors respectively. The agglomeration effect increases the labor productivity in the tradable sector, \( A_t(L) \), while, according to equation (31), the demand effect increases the relative price in the non-tradable sector, \( p_n \). As a result, net profit in both sectors increase and firms have more incentive to post vacancies, reducing the unemployment rate. In resume, our theoretical model tells us that the overall effect of \( w_g \) on unemployment is entirely an empirical question: If the agglomeration and labor demand effects are higher than the wage effects, then the profits of the firms will increase and more vacancies will be created, increasing the non-public employment. Similar results can be infer by modifying the employment policy parameters \( f_g \) and \( s_g \).

Another interesting result is that land price, \( p_c \), does not directly affect wages in both the tradable and non-tradable sectors. This result is similar to the one obtained by (Beaudry, Green, and Sand, 2012) and takes place because wage negotiation is not directly affected by land costs, since these costs are incurred whether or not someone is employed. Therefore, land prices only have indirect effects on tradable and non-tradable wages through their impact on the labor force. However, an increase in public wages (\( w_g \)) that positively affects private wages impact on land prices.
2.4 Calibration and simulated results of the model

2.4.1 Calibration

We calibrate the model to match the average job transition rates observed in the Spanish regions between 2001 and 2010. The real interest rate is fixed at $r = 0.012$, which is consistent with an annual interest rate of 4.8 percent. We normalize the labor force $L = 1$, which also implies that the land price, $p_c$, is equal to one. We target the average regional public employment rate of 13.6% as a percentage of the labor force during this period. We also target an average unemployment rate of 12.1% and the employment rates of 14.1% and 60.2% in the tradable and non tradable sectors, respectively. Using the Spanish Labor Market Survey (SLFS) and using the methodology applied in (Silva and Vázquez-Grenno, 2013), we calculate the separation rates in the tradable and non tradable sectors, which are equal to $s_t = 0.014$ and $s_n = 0.014$. With respect to the public sector, we also calculate the job separation rate in that sector using the same methodology, $s_g = 0.009$. Substituting the job separation rates, the unemployment and employment rates in equations (15), (17) and (18) with $\dot{e}_t = \dot{e}_n = \dot{u} = 0$, we obtain the corresponding job finding rates: $f_t(\theta) = 0.0163$, $f_n(\theta) = 0.070$ and $f_g = 0.010$.

In turn, and since we don’t have data on vacancies by sector, we assume that the fraction of vacant jobs in each sector, $\Omega_i$, is equal to the fraction of tradable and non tradable employment in private employment. Thus, we set $\Omega_t = 0.19$ and $\Omega_n = 0.810$. This implies that the aggregate job finding rate is $f(\theta) = f_t(\theta) + f_n(\theta) = 0.0860$. Once $\Omega_i$ is known, we obtain the vacancy rates for the tradable and non tradable sectors using $\frac{v_t}{v_t+v_n} = \Omega_t$. Thus, we get $v_t = 0.038$, $v_n = 0.1620$ and, therefore, $v = v_t + v_n = 0.200$. Using the calibrated values for $u$ and $v$, we can find the labor market tightness $\theta = \frac{v}{u} = 1.653$ and, finally, the job meeting rate $q(\theta) = \frac{f(\theta)}{\theta} = 0.052$.

(Pissarides and Petrongolo, 2001) identify an elasticity of unemployment with respect to the matching function in the range 0.5-0.7. We take 0.6 as reference and thus set the matching parameter at $\chi = 0.6$. Knowing that $f(\theta) = m_\sigma \theta^{1-\chi}$ and using the calibrated value
of the job fining rates, we can find the parameter $m_o = 0.0703$.

We normalize the public wage, $w_p = 1$. Following Hospido and Moral-Benito (2014), we target the average wage gap of 20% between the public sector and private sectors. Thus, we set $\frac{w_p}{w_r} = 1.20$. In turn, we estimate the wage gap between non tradable and tradable sectors using the Spanish Continuous Sample Lives in 2005 (Muestra continua de Vidas Laborales, MCVL). We find a gap of 11.9% after controlling by individual characteristics (age, age square, gender and education). Thus, we set $w_t = 0.833$ and $w_n = 0.736$.

Regarding the role of agglomeration effects, Duranton and Puga (2014) document that empirical studies estimate the urban wage premium between 0.02 and 0.05. Recent studies, however, find the estimated value to be around 0.025 (Combes, Duranton, Gobillon, and Roux (2010), De la Roca and Puga (2013)). Using the MCVL for the year 2005, we estimate the city wage premium, through running several mincer equations. Our baseline specification, that regresses the log of gross wages against the log of population, controlling by age, age square, gender and education, give us an average estimation of 3% of the urban wage premium, which is in line with the previous literature. Thus, we set $\zeta = 0.030$.

According to the Eurostat, the Spanish labor productivity in the tradable sector was 45.7% higher than the average personnel costs between 2008 and 2010. Thus, we set average labor productivity at $A_t(L) = w_t \times 1.457 = 1.214$. Substituting this value and $\zeta$ in the labor productivity function (2.5), we can obtain the parameter, $A_o = 1.214$. In turn, and also according to the Eurostat, the Spanish labor productivity in the non tradable sector was 19% higher than the average personnel costs between 2008 and 2010. Thus, we set, $pA_n = w_n \times 1.19 = 0.876$.

To calculate the elasticity of land with respect to the city size, we take the results reported in Combes, Duranton, and Gobillon (2012) who directly estimates the elasticity of the land prices with respect to population at 0.72. Thus, we set $\eta = 0.72$.

To find the value of the vacancy costs parameter in the tradable sector $k_t$ we use the job

\footnote{This is the wage adjusted labor productivity derived from structural business statistics.}
creation condition (21):

$$k_t = \frac{q(\theta)(A_t(L) - w_t)}{(r + s_t)} = \frac{0.052(1.2142 - 0.8333)}{(0.012 + 0.014)} = 0.7618. \quad (33)$$

Next, we can obtain the employment opportunity cost, $b = 0.521$, the workers bargaining power, $\beta = 0.213$, the relative price of non tradable, $p_n = 0.864$, the vacancy costs in the non tradable sector, $k_n = 0.042$ from equations (22), (23), (24) and (31). We find parameter $z = 0.338$ from equation (25) and, finally, the price index $PI = 2.162$. Table 1 summarizes all the calibrated parameters and presents the steady state values of the endogenous variables.

### 2.4.2 Simulated results

In Table 2, we present the simulated results of the model with a job creation policy scenario that targets and increase of 25%, 50% and 100% in the level of public employment, $Le_g$, which are consistent with the public employment growth rates observed in the Spanish cities. The scenarios correspond to an increase in the public job creation rate, $f^g$, from 0.010 to 0.013 and 0.0156, respectively. Regarding the employment effects, our simulations suggest that public employment crowds-in non tradable jobs and crowds-out tradable jobs. More in detail, each public administrative job creates between 1.64 and 1.81 additional jobs in the non tradable sector and destroys between 0.16 and 0.23 jobs in the tradable sector.

To understand this result observe that the job finding rate in the non tradable sector, $f_n(\theta)$, increases while it falls in the tradable sector, $f_t(\theta)$. The intuition is quite straightforward: the public employment policy increases the the demand in the non tradable sector and, therefore, their relative price, $p_n$. As a result, the profit of the firms increase, increasing the relative number vacancies per unemployed worker in that sector. In contrast, employment does not show similar increase in the tradable sector, $Le_t$, because in spite of the presence of positive agglomeration effects, the firms profit falls due to the increase of tradable wages.
Table 1: Calibrated parameter values for the Spanish economy

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
<th>Source/Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage in the public sector, $w_g$</td>
<td>1.00</td>
<td>Normalization</td>
</tr>
<tr>
<td>Labor productivity parameter, $A_{t0}$</td>
<td>1.214</td>
<td>Eurostat</td>
</tr>
<tr>
<td>Labor productivity parameter, $A_n$</td>
<td>0.876</td>
<td>Eurostat</td>
</tr>
<tr>
<td>Labor productivity elasticity, $\zeta$</td>
<td>0.030</td>
<td>MCVL</td>
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<tr>
<td>Separation rate in public sector, $s_g$</td>
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<td>SLFS</td>
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<tr>
<td>Separation rate in tradable sector, $s_t$</td>
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<td>SLFS</td>
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<tr>
<td>Separation rate in the non tradable sector, $s_{nt}$</td>
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<td>SLFS</td>
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<tr>
<td>Job finding rate in public sector, $f_g$</td>
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<td>SLFS</td>
</tr>
<tr>
<td>Interest rate, $r$</td>
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<td>Data</td>
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<tr>
<td>Matching function elasticity, $\chi$</td>
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<td>(Pissarides and Petrongolo, 2001)</td>
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<tr>
<td>Matching function scale, $m_o$</td>
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<td>Matching function</td>
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<td>Workers’ bargaining power, $\beta$</td>
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<td>Solves (23)</td>
</tr>
<tr>
<td>Employment opportunity cost, $b$</td>
<td>0.521</td>
<td>Solves (24)</td>
</tr>
<tr>
<td>Cost of vacancy in the tradable sector, $k_t$</td>
<td>0.762</td>
<td>Solves (21)</td>
</tr>
<tr>
<td>Cost of vacancy in the non tradable sector, $k_n$</td>
<td>0.042</td>
<td>Solves (22)</td>
</tr>
<tr>
<td>Free-mobility flow utility, $z$</td>
<td>0.474</td>
<td>Solves (25)</td>
</tr>
<tr>
<td>Land costs elasticity, $\eta$</td>
<td>0.72</td>
<td>(Combes, Duranton, and Gobillon, 2012)</td>
</tr>
</tbody>
</table>

As a result, the number of vacancies per unemployed worker in the tradable sector decrease and, therefore, the job find rate, $f_t(\theta)$, falls.

The simulated scenarios also permit to quantify the effects of public employment in the unemployment rate. More in detail, the 100 percent increase in public employment generates a relatively small reduction in the local unemployment rate from 12.1% to 11.4%.

Finally, notice that land price, $p_c$, also increases as a consequence of the increase in the city size. Thus, the job creation policy in the public sector increases tradable and non tradable wages and, therefore, attract workers from other cities, which in turn increase the land price and introduce a limit to the growth of the city size.
Table 2: Benchmark simulated results with an increase in public employment

<table>
<thead>
<tr>
<th>$f^g$</th>
<th>$A_t$</th>
<th>$L$</th>
<th>$p_n$</th>
<th>$p_r$</th>
<th>$f_n(\theta)$</th>
<th>$f_r(\theta)$</th>
<th>$w_n$</th>
<th>$w_t$</th>
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<td>0.0100</td>
<td>1.214</td>
<td>1.000</td>
<td>0.864</td>
<td>1.000</td>
<td>0.070</td>
<td>0.0163</td>
<td>0.736</td>
<td>0.833</td>
<td>0.136</td>
<td>0.602</td>
<td>0.141</td>
<td>0.121</td>
</tr>
<tr>
<td>0.0117</td>
<td>1.218</td>
<td>1.100</td>
<td>0.873</td>
<td>1.071</td>
<td>0.071</td>
<td>0.0145</td>
<td>0.744</td>
<td>0.840</td>
<td>0.170</td>
<td>0.664</td>
<td>0.136</td>
<td>0.119</td>
</tr>
<tr>
<td>∆($Ln_i$)</td>
<td>∆($Ln_g$)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>0.013</td>
<td>1.221</td>
<td>1.194</td>
<td>0.881</td>
<td>1.137</td>
<td>0.072</td>
<td>0.0130</td>
<td>0.751</td>
<td>0.859</td>
<td>0.205</td>
<td>0.722</td>
<td>0.128</td>
<td>0.117</td>
</tr>
<tr>
<td>∆($Ln_i$)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>0.0156</td>
<td>1.226</td>
<td>1.364</td>
<td>0.894</td>
<td>1.251</td>
<td>0.074</td>
<td>0.0100</td>
<td>0.763</td>
<td>0.857</td>
<td>0.273</td>
<td>0.826</td>
<td>0.110</td>
<td>0.114</td>
</tr>
<tr>
<td>∆($Ln_i$)</td>
<td>∆($Ln_g$)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.636</td>
<td>-0.229</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.5 The model without labor mobility

Now, we eliminate the presence of both agglomeration economies and land costs in our model. In other words, we consider the effects of public job creation without labor mobility across cities. This implies that conditions (25), (26) and (32) are not necessary anymore and, therefore, the variables $L$, $A_t$ and $p_c$ become parameters. Table 3 shows the simulated results with an increase in the public job creation rate from 0.010 to 0.0156, which is the same scenario to the last one simulated in Table 2 with labor mobility. In this economy, job creation in the public sector only affects the private sector through its impact on private wages as well as in the price of non-tradable goods since the agglomeration effect on labor market productivity is not operative now. Thus, and similar to the benchmark scenario, the net profit of the tradable firms will be reduced which in turn reduces job finding rate in that sector. In contrast, the job finding rate in the non-tradable sector still increases due to presence of a positive demand effect in that sector that increases $p_n$ and, therefore, the net profits of non-tradable firms.

Additionally, notice that, in the absence of labor mobility, the positive multiplier effect of public employment on non-tradable jobs is considerable reduced from 1.636 to 0.063 while it becomes much more negative in the tradable sector (from -0.229 to -0.974). As a result, our model suggests that labor mobility across cities plays an important role in the number of jobs but has not significative effect in the unemployment rate.
Table 3: Simulated results without Labor mobility across cities

<table>
<thead>
<tr>
<th>$f^g$</th>
<th>$A_t$</th>
<th>$L$</th>
<th>$p_n$</th>
<th>$p_c$</th>
<th>$f_n(\theta)$</th>
<th>$f_t(\theta)$</th>
<th>$w_n$</th>
<th>$w_t$</th>
<th>$e_q$</th>
<th>$e_n$</th>
<th>$e_t$</th>
<th>$u$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0100</td>
<td>1.214</td>
<td>1.000</td>
<td>0.864</td>
<td>1.000</td>
<td>0.070</td>
<td>0.163</td>
<td>0.736</td>
<td>0.833</td>
<td>0.136</td>
<td>0.602</td>
<td>0.141</td>
<td>0.121</td>
</tr>
<tr>
<td>0.0156</td>
<td>1.214</td>
<td>1.000</td>
<td>0.890</td>
<td>1.000</td>
<td>0.074</td>
<td>0.100</td>
<td>0.760</td>
<td>0.852</td>
<td>0.200</td>
<td>0.606</td>
<td>0.079</td>
<td>0.115</td>
</tr>
</tbody>
</table>

| $\Delta(L_n)$ | $\Delta(L_g)$ | 0.063 | -0.974 |
3 Data and variables

3.1 Data

We primarily use employment data at the municipality level from Censuses carried out in 1970, 1980, 1990 and 2001. These data contain information on counts of employees by municipality and main economic activity (3-digit level) of the establishment in which the employee works. We construct city-wide employment levels using the 2008 urban area definitions built by the Ministry of Housing\(^4\). We work with a total of 83 cities (urban areas) that in 2001 concentrated 67 percent of the population.\(^5\) The median city (Ourense) had 126,410 inhabitants in 2001. The size of the two largest cities - Madrid (5,135,225) and Barcelona (4,391,196) - exceeds that of Soria (35,151) and Teruel (33,158) - the smallest two - by a factor of one hundred.

In terms of outcome variables, we mostly consider (changes in) the employment in the tradable sector, \(N_T\), that we assimilate to manufacturing industries, and in the non tradable sector (\(N_N\)). Our main explanatory variable is the employment in the public administration sector (\(N_G\)). We focus on this specific component of public employment for two reasons. First, in contrast to other activities in which the public sector intervenes such as the health and education sectors, all public administration workers are public employees. Second, as will shown below, the geography of public administration employment does differ very markedly from the geography of population. To avoid a mechanical correlation between public administration and non tradable employment, we leave out from the non tradable sector those activities where the public sector plays a major role as employer or regulator such as in the R&D or the Radio and Television industries. We also exclude from our analysis the agricultural, farming, mining and energy industries. In the Appendix C we provide the details of the industry classifications (and bridges) used throughout the paper.

\(^4\)The same definitions are used in De la Roca and Puga (2013).
\(^5\)We do not consider Ceuta and Melilla, the two Spanish enclaves in North-Africa.
3.2 Public (administration) employment growth in Spain

In Spain the development of the public sector took place surprisingly late. Figure 1 shows the evolution of tax revenue to GDP for Spain, France, Germany and the US between 1965 and 2006. In 1965, the fraction of output devoted to tax payments was 14.7 percent in Spain, a low figure compared to 24.7, 31.6 and 34.2, the corresponding figures for the US, Germany and France, respectively. By contrast, in 2006 (before the start of the financial crisis) tax revenue to GDP in Spain was 36.9, a fraction larger than that in the US (26.8) and Germany (35.7), although still smaller than that of France (44.4). This late development of the public sector in Spain coincides in time with the advent of democracy after Franco’s death in 1975. In fact, the growth of the public sector is most intense between 1975 and 1990, a period in which tax revenue to GDP increased from 18.4 to 32.5 percent.

Figure 1: Public sector growth in Spain

This process of growth in the tax revenue to GDP ratio was accompanied by a parallel...
increase in public employment. According to Census data, the number of public administration workers grew by 140 percent (from 523,434 to 1,258,512) between 1980 and 2001, while the population only grew by 8 percent during this period. The numbers of workers in the health and education sectors (where most workers are public employees) experienced a similar growth rate in this period (128 percent), going from 845,984 to 1,930,578. Hence, our period of study (1980-2001) is characterized by a very large increase in public employment. This is an attractive feature of the present study.

3.3 The geography of public (administration) employment growth

Public employment is not evenly distributed across Spanish cities, with administrative personnel showing substantial spatial concentration. The size of the public administration sector in a city is determined, to a large extent, by its political status. In Spain, there are provincial and regional capital cities. Provinces (and the associated capitals) were established in 1833 by Javier de Burgos and constituted the main territorial division of the country until the advent of democracy. Although provinces were not suppressed, 17 regions (Comunidades Autónomas) were built as aggregations of one or several provinces in 1981. Twenty years later, Spain was a decentralized country where its Comunidades Autónomas spending amounted to roughly 46 percent of total government spending\(^6\). A similar picture is obtained if one looks at the distribution of public employees across layers of governments. In 2001, regional governments employed 45 percent of public employees whereas the central government and local governments employed the remaining 34 and 21 percent\(^7\).

Figure 2 plots the presence of administrative personnel in all cities, distinguishing regional and provincial capitals, and non-capital cities. With two exceptions (Santiago de Compostela and Mérida\(^8\)), the cities hosting regional governments are also provincial capitals. Two non-

\(^6\)Excluding social security spending. See Carrión-i Silvestre, Espasa, and Mora (2008) for a detailed explanation of the decentralization process.

\(^7\)Registro Central de Personal, Ministerio de Hacienda y de Administraciones Públicas.

\(^8\)These two cities are historically important. While Mérida was the capital of the roman Lusitania province, Santiago is the destination of a major Catholic pilgrimage route. Moreover, these are the third
capital cities (El Ejido and Elda-Petrer) have the lowest presence of public administration employees in 2001 with about 1.7 employees per 100 inhabitants. At the other end, Soria and Teruel (two provincial capitals) have more than 7 public administration employees per 100 inhabitants. More generally, this figure corroborates that being a capital comes along with public employees, and the difference is especially large for small cities.

Figure 2: Public administration employees in 2001 per 100 inhabitants

Holding population size constant, the presence of public administrative personnel is similar in provincial and regional capitals. This suggests that the process of regional decentralization that took place in Spain between 1981 and 2001 was not accompanied by a significant relocation of administrative personnel from provincial to regional capitals. On the contrary, pre-democratic provincial capitals retained their share of public administration employment. Cities in two bicephalic regions: Galicia (La Coruña and Vigo) and Extremadura (Cáceres and Badajoz).
On the one hand, provincial institutions (*Diputaciones* being the more prominent one) persisted into the new democratic regime. On the other hand, provincial capitals managed to pull regional public administration jobs.

To analyze in a more systematic fashion if there is inertia in the location of public administrative personnel, we study what determines 1980-2001 changes in public administration jobs. Since population is likely to be the most important determinant, we start by considering that, at a given point in time, the number of public administrative personnel in a city is explained by a drift and its population, that is, $N_G = \alpha + \beta \, POP + \epsilon$, with $\alpha$ and $\beta$ possibly being year-specific. Subtracting the 1980 from the 2001 level yields:

$$dN_{G,80-01} = (\alpha_{01} - \alpha_{80}) + \beta_{01}(POP_{01} - POP_{80}) + (\beta_{01} - \beta_{80})POP_{80} + (\epsilon_{01} - \epsilon_{80})$$  \hspace{1cm} (34)

where $dN_{G,80-01}$ is the 1980-2001 increase in the city public administration employment. Given the aggregate increase in the Spanish public sector in the 1980-2001 period (i.e. $\beta_{01} > \beta_{80}$), equation 34 implies that public administration employment growth will be larger the larger the baseline city size is ($POP_{80}$), and the larger the population growth in the period ($POP_{01} - POP_{80}$). To assess if public administration jobs increased more in cities where the presence of administrative personnel was historically high, conditional on the population level in 1980 and the 1980-2001 population increase, Figure 3 shows the partial correlation between 1980-2001 changes in public administration jobs ($N_{G,01} - N_{G,80}$) against public administration employment in 1970($N_{G,70}$). Specifically, to partial out the correlation induced by the common influence of $POP_{80}$ and $POP_{01} - POP_{80}$, the plotted variables are the residuals of an equation against these two variables. The data shows a positive relationship with a Partial R-Squared of 12.5 percent, indicating that, indeed, cities with more public administrative personnel in 1970 attracted more public administrative jobs in the 1980-2001 period. This concentration of the new public administrative jobs in cities where the administration
was historically high guide our instrumental variable strategy that we explain in detail below.

Figure 3: Public admin. job increase (1980-01) versus 1970 public admin. jobs

Note: Both variables are the residuals of a regression on population in 1980 and the 1980-2001 population change.

4 Econometric specification

Using data from 1980, 1990 and 2001 census, we estimate the effects of 1980-1990 and 1990-2001 changes in public administration employment on contemporaneous changes in tradable and non tradable (private) employment. The baseline specification is:

\[ dN_{P,i,t} = \delta + \gamma dN_{G,i,t} + \eta x_i + \xi_t \]  

(35)

where \(dN_{P,i} \) and \(dN_{G,i,t} \) are the change over time in the number of private jobs and the number of public administration jobs in city \(i\), and \(P \subset (N_T, N_N)\). One possible problem with equation 35 is that shocks in private employment could be correlated with public ad-
ministration employment changes. For instance, if governments use public employment as a redistributive tool to support lagging regions (Alesina, Danninger, and Rostagno (2001)), public employment could be negatively correlated with employment changes in the private sector. It could also be the case that thriving cities have more tax revenues to hire administrative personnel and, as a consequence, positive shocks in private employment are positively correlated with public administration employment shocks. We deal with this potential problem in two ways. First, we will control for observed determinants of private employment growth ($x$) inasmuch as possible. Second, we will also resort to an instrumental variables strategy based on the observation that there is path-dependency in the location of public administration jobs as seen in section 3.3. Following Moretti (2010), we define our (shift-share) instrument ($dN_{Gi,t}$) as:

$$dN_{Gi,t} = \left( \frac{N_{Gi,70}}{\sum_i N_{Gi,70}} \sum_i N_{Gi,t} \right) - N_{Gi,t-1} \quad (36)$$

where $\sum_i N_i$ is the national employment in the corresponding sector and year. Hence, the instrument first computes the public administration employment in 2001 that would be observed if each city would retain its 1970 national share in national public administration employment. Then, it predicts the 1980-1990 and 1990-2001 changes by subtracting the observed public administration employment level in the year $t-1$. The instrument is arguably exogenous to the extent that it is independent of private employment shocks that might have occurred in the 1980-2001 period. Figure 3 suggested that this instrument is relevant. We will return to this question below.

5 Results

Before moving to the regression analysis, we start this section by plotting, in Figure 4 the 1980-01 changes in employment in the tradable (first panel) and non tradable (second panel) sector versus contemporaneous changes in public administration jobs in all cities. Note that
the two graphs differ in terms of the average increase in jobs in the vertical axis. Although positive, the average job increase in the tradable sector is small (1,396), with some cities like Bilbao or Oviedo-Gijón loosing a large number of jobs in manufacturing industries. In contrast, all cities experience positive increases in non tradable sector jobs (36,206) which reflects the ongoing tertiarization process of the Spanish economy. Turning to our research question, while there is a slightly negative association between changes in tradable and public administration jobs, the corresponding correlation between the non tradable and the public administration sectors is clearly positive.

Tables 4 and 5 show the regression results of equation 35. Specifically, these Tables reports the coefficients measuring the impact of public administration job changes \( dN_{Gi,t} \) on tradable and non tradable job changes over the periods 1980-1990 and 1990-2001. In both cases we present Ordinary Least Squares (OLS) and 2-Stage Least Squares (2SLS) estimations. Different columns consider different control variables, \( x \), that include (1) the \((t − 1, t − 2)\) change in population, (2) the \((t − 1, t − 2)\) employment change in the tradable sector, (3) the initial population level \((t − 1)\), (4) the initial own sector employment level \((t − 1)\), (5) the initial unemployment rate \((t − 1)\), (6) the initial skill composition of the cities \((t − 1)\), (7) yearly dummies and, (8) a prediction of the change own sector employment change defined as:

\[
\overline{dN}_{Pi,t} = \sum_k \left( \frac{N_{ki,t-1}}{\sum_i N_{ki,t-1}} \sum_i N_{ki,t} \right) - \sum_k N_{ki,t-1}
\]

where \( k \) indexes narrowly defined industries in the relevant sector (tradable or non tradable). The predicted employment change in 37 captures the component of the 1980-1990 and 1990-2001 local employment shock (in the tradable or non tradable sector) explained by city’s industry mix in 1980 and 1990 interacted with 1980-1990 and 1990-2001 fate of industries at the national level respectively. That is, Bilbao’s loss of tradable jobs between 1980-1990 is
Figure 4: Changes in tradable and non tradable jobs (1980-01) versus contemporaneous changes in admin. jobs

Note: Cities with more than 1,000,000 excluded for the sake of presentation (Madrid, Barcelona, Sevilla & Valencia).
partly explained because one of the industries in which Bilbao was specialized in 1980 (the iron and steel industry) lost 38 percent of the jobs at the national level during this period. Finally, in the 2SLS estimations we also include an specification with the population and it’s square in 1970 (the base year for our instrument).

Table 4: The multiplier effects of public administration jobs on non tradable sector

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>2SLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>dN_{G,t+10-t}</td>
<td>0.91***</td>
<td>0.77***</td>
</tr>
<tr>
<td></td>
<td>(0.28)</td>
<td>(0.24)</td>
</tr>
<tr>
<td>dN_{N,t+10-t}</td>
<td>0.79***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.24)</td>
<td></td>
</tr>
<tr>
<td>dN_{G,t}</td>
<td>0.73</td>
<td>1.06**</td>
</tr>
<tr>
<td></td>
<td>(0.64)</td>
<td>(0.53)</td>
</tr>
<tr>
<td></td>
<td>1.17**</td>
<td>(0.53)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.89**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.43)</td>
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Partial R²

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<tr>
<td>Partial R²</td>
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<td>0.19</td>
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<td>F-stat.</td>
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<td>17.7</td>
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<td>26.7</td>
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Reduced-form estimates

<table>
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<th>2SLS</th>
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<tbody>
<tr>
<td>dN_{G,t}</td>
<td>0.18</td>
<td>0.31**</td>
</tr>
<tr>
<td></td>
<td>0.16</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>0.15</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Notes: 1) Coefficients are the effects of public administration job changes (1980-1990 & 1990-2001) on contemporaneous changes in tradable jobs. 2) N=166. 3) Robust standard errors in parenthesis. 4) ***, **, * denote statistical significance at the 1, 5 and 10 percent.

The first three columns in the Table 5 report OLS estimates. These results indicate that more public administration employment expands employment in the non tradable sector. Here, one public administrative job creates 0.79 additional jobs in the non tradable sector (third column).

The columns four to seven show the 2SLS results. In addition to being a valid instrument, \( dN_{G,t} \) must also be relevant. The third and fourth rows report First-Stage statistics. The partial R-squared values are relatively large and the F-test values are higher than 10 in all specifications, and evidence the strength of our instrument which results in, qualitatively and qualitatively, similar 2SLS estimates with less precision (standard errors are higher with
respect to the OLS estimates). Specifically, our preferred estimation indicates that one public administrative job creates 1.17 additional jobs in the non tradable sector.

Table 5: The multiplier effects of public administration jobs on Tradable sector

<table>
<thead>
<tr>
<th>Dep.Var.: $\Delta$ employment in tradable sector ($dN_{T,t+10-t}$), $t = 1980, 1990$</th>
<th>OLS</th>
<th>2SLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>$dN_{G,t+10-t}$</td>
<td>-0.27</td>
<td>-0.06</td>
</tr>
<tr>
<td>Partial $R^2$</td>
<td>0.16</td>
<td>0.13</td>
</tr>
<tr>
<td>F-stat.</td>
<td>18.2</td>
<td>13.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reduced-form estimates</th>
<th>OLS</th>
<th>2SLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>$dN_{G,t}$</td>
<td>-0.14</td>
<td>-0.06</td>
</tr>
<tr>
<td>Controls</td>
<td>0.09</td>
<td>0.10</td>
</tr>
</tbody>
</table>

| $dN_{T,t+10-t}$ | Y | Y | Y | Y | Y | Y | Y |
| $N_{T,t}$ | Y | Y | Y | Y | Y | Y | Y |
| $Pop_t$ | Y | Y | Y | Y | Y | Y | Y |
| $dN_{T,t-10}$ | N | Y | Y | N | Y | Y | Y |
| $dPop_{t-10}$ | N | Y | Y | N | Y | Y | Y |
| Unemployment$_t$ | N | N | Y | N | N | Y | Y |
| Education$_t$ | N | N | Y | N | N | Y | Y |
| $Pop, pop^*$ in 1970 | N | N | N | N | N | N | Y |

Notes: 1) Coefficients are the effects of public administration job changes (1980-1990 & 1990-2001) on contemporaneous changes in tradable jobs. 2) N=166. 3) Robust standard errors in parenthesis. 4) ***, **, * denote statistical significance at the 1, 5 and 10 percent.

The first three columns in the Table 5 reports OLS estimates. These results indicate that more public administration jobs have no effects in the tradable sector. Specifically, the estimates are negative, economically low and not statistically different from zero. The same qualitative result is obtained when we run the 2SLS estimations.

The positive effect of public administrative employment on non tradable employment, combined with the no effects of public administrative employment on tradable jobs, imply that placing public administrative personnel in a city changes the city’s industry mix by expanding the employment in non tradable sectors. In addition, the positive effect on the non tradable sector and the no effect on the tradable sector, more public administration jobs imply a positive effect on the total private employment.

Finally, the second panel of both Tables (4 and 5) shows the estimates of regressions
where the explanatory variable of interest, i.e. public administration jobs \((dN_G,t)\), has been replaced by the instrument \((d\overline{N}_G,t)\) isolating the variation explained by the fact that, due to path dependency, public administration grew more in cities that in 1970 had a large public administration. These (reduced-form) estimates indicate that the higher the predicted public administration job increase, the higher the increase in the non tradable sector and has no significant effects on tradable jobs. Hence, these estimates are qualitatively similar to their OLS counterparts.

6 Summary and final remarks

In this paper we present a search and matching model with three sectors (public, tradable and non tradable), agglomeration economies and local land market that allows us to analyze the public administration employment on the local labor markets outcomes. The main implication of our theoretical model is that the effect of public employment on the local labor markets is an empirical question. This is due that public employment affects private employment trough different channels that operate in opposite directions. Concretely, if the agglomeration and demand effects are higher than the wage effects then, the profits of the firms will increase and more vacancies will be created, increasing the private employment.

The simulations indicates that an increase in the local public employment crowds-in employment in the non tradable and crowds-out the employment in the tradable sector. More specifically, and depending on the scenario analyzed, each public administrative job creates 1.742 jobs in the non tradable sector and destroys around 0.189 jobs in the tradable sector.

In the empirical part of the paper we have estimated the long-run effects of public administration employment on private employment, distinguishing between the effects on the tradable and non tradable sectors. Specifically, we examine employment changes in Spanish cities between 1980 and 2001, a period of time characterized by a very large increase in public
employment in Spain. Exploiting path dependency in the location of public administration activities, our instrumental variables strategy uses the 1970 employment distribution across cities to predict the location of public administration jobs in the 1980-2001 period. Our results, consistent with the theory and the simulations, indicate that public administration employment has a positive multiplier effect for the non tradable sector (restaurants, bars, hair-dressers, etc.) and a negative (not statistically different from zero) effect for the tradable sector. Concretely, we estimate that each additional job in the public administration, in a given city, expands the private employment in 1.17 jobs.

Finally, our results suggest that local public employment policies could generate other local labor effects different than those initially desired. In particular, placing public administrative personnel in a city could change the city’s industry mix by expanding the employment in non tradable sectors.
References


Appendix: The wages equations

To obtain the wage equations (23) and (24) we start using the first order conditions (21) and (22). Next, we solve for $J_t$ in (3) and $J_{nt}$ in (4)

$$J_t = \frac{A_t(L) - w_t}{(r + s_t)}, \quad (A-1)$$

$$J_{nt} = \frac{p_n A_n - w_{nt}}{(r + s_n)}, \quad (A-2)$$

Notice that the job creation conditions (21) and (22) are obtained by using (A-1), (A-2), (1), (2) and the free entry conditions (5) and (6).

Then, we solve for $W_t - U$ and $W_n - U$ in using (8), (10) and (11),

$$\begin{align*}
(W_t - U) &= \frac{\frac{w_t}{PI} - rU}{(r + s_t)}, \quad (A-3) \\
(W_n - U) &= \frac{\frac{w_n}{PI} - rU}{(r + s_n)}, \quad (A-4)
\end{align*}$$

Now substitute (A-1), (A-2), (A-3) and (A-4) in (13) and (14) and solve for $w_t$ and $w_{nt}$

$$w_t = (\frac{\beta A_t(L)}{PI} + (1 - \beta)rU)PI, \quad (A-5)$$
\[ w_n = \left( \frac{\beta p_n A_n}{PI} \right) + (1 - \beta) rU(PI), \quad (A-6) \]

To obtain \( rU \) we use equations (8),(21) and (22) and substitute \( J_i = \frac{k_i}{q(\theta)} \) in (13) and (14)

\[
(W_t - U) = \frac{\beta}{(1 - \beta)} \frac{k_t}{q(\theta)PI}, \quad (A-7)
\]

\[
(W_n - U) = \frac{\beta}{(1 - \beta)} \frac{k_n}{q(\theta)PI}, \quad (A-8)
\]

Next, we obtain \( W_g - U \) using (8) and (9)

\[
(W_g - U) = \frac{(w_g - b)}{PI} - f_t(\theta)(W_t - U) - f_n(\theta)(W_n - U) \frac{r + s_g + f_g}{(r + s_g + f_g)}, \quad (A-9)
\]

Finally, knowing that \( \frac{f(\theta)}{q(\theta)} = \theta \), we substitute (A-7), (A-8) and (A-9) in (8) and obtain

\[
rU = \frac{1}{PI} \left[ b + f_g \left( \frac{(w_g - b - \left( \frac{\beta \theta}{1 - \beta} (\Omega_t k_t + \Omega_n k_n) \right)}{(r + s_g + f_g)} \right) + \frac{\beta \theta}{(1 - \beta)} (\Omega_t k_t + \Omega_n k_n) \right]. \quad (A-10)
\]

By substituting (A-10) into (A-5) and (A-6) we obtain the wage equations (23) and (24).
B Appendix: Derivation Nash solution

B.1 Appendix: tradable sector

\[
\max_w (W_t - U)\beta (J_t - V_t)^{1-\beta}, \quad (A-11)
\]

\[
rV_t = 0, \quad (A-12)
\]

Then the FOC's

\[
\beta (W_t - U)^{\beta-1} \frac{dW_t}{dw_t} J_t^{1-\beta} + (W_t - U)^\beta (1 - \beta) \frac{dJ_t}{dw_t} J_t^{-\beta} = 0, \quad (A-13)
\]

\[
\beta (W_t - U)^{-1} \frac{dW_t}{dw_t} J_t = (1 - \beta) \frac{dJ_t}{dw_t}, \quad (A-14)
\]

\[
\beta \frac{dW_t}{dw_t} J_t = -(W_t - U)(1 - \beta) \frac{dJ_t}{dw_t}, \quad (A-15)
\]

From Equations 3 and A-12:

\[
J_t = \frac{A_t(L) - w_t}{r + s_t}, \quad (A-16)
\]

then,
\[
\frac{dJ_t}{dw_t} = \frac{-1}{r + s_t}, \quad (A-17)
\]

Subtracting \(rU\) from both sides of Equation 10

\[
r(W_t - U) = \frac{w_t}{PI} + s_t(U - W_t) - rU, \quad (A-18)
\]

operating,

\[
(W_t - U) = \frac{\frac{w_t}{PI} - rU}{r + s_t}, \quad (A-19)
\]

then,

\[
\frac{dW_t}{dw_t} = \frac{\frac{1}{PI}}{r + s_t}, \quad (A-20)
\]

Substituting Equation A-17 and A-19 in A-15 we obtain Equation 13,

\[
\frac{1}{PI} \beta J_t = (1 - \beta)(W_t - U), \quad (A-21)
\]

B.2 Appendix: non tradable sector

\[
\max_w (W_n - U)^\beta (J_{nt} - V_n)^{1-\beta}, \quad (A-22)
\]
\[ rV_{nt} = 0, \tag{A-23} \]

Then the FOC’s

\[ \beta (W_n - U)^{\beta - 1} \frac{dW_n}{dw_n} J_n^{1-\beta} + (W_n - U)^\beta (1 - \beta) \frac{dJ_n}{dw_n} J_n^{-\beta} = 0, \tag{A-24} \]

\[ \beta (W_n - U)^{-1} \frac{dW_n}{dw_n} J_n = (1 - \beta) \frac{dJ_n}{dw_n}, \tag{A-25} \]

\[ \beta \frac{dW_n}{dw_n} J_n = -(W_n - U)(1 - \beta) \frac{dJ_n}{dw_n}, \tag{A-26} \]

From Equations 4 and A-23:

\[ J_n = \frac{p_n A_n - w_n}{r + s_n}, \tag{A-27} \]

then,

\[ \frac{dJ_n}{dw_n} = \frac{-1}{r + s_n}, \tag{A-28} \]

Subtracting \( rU \) from both sides of Equation 11
\[ r(W_n - U) = \frac{w_n}{PI} + s_n(U - W_n) - rU, \]  
(A-29)

operating,

\[ (W_n - U) = \frac{w_n}{PI} - rU \frac{1}{r + s_n}, \]  
(A-30)

then,

\[ \frac{dW_n}{dw_n} = \frac{\frac{1}{PI}}{r + s_n}, \]  
(A-31)

Substituting Equation A-28 and A-30 in A-26 we obtain Equation 14,

\[ \frac{1}{PI} \beta J_n = (1 - \beta)(W_n - U), \]  
(A-32)
### Appendix: Industry classifications

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