Local labor market effects of public employment*

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Abstract

This paper quantifies the impact of public employment on local labor markets in the long-run. We follow two different quantitative approaches that we apply to the case of Spanish cities. In the first one, we develop a 3-sector (public, tradable and non-tradable) search and matching model embedded within a spatial equilibrium model. We characterize the steady state of the model which we then calibrate to match the labor market characteristics of the average Spanish city. Then, we use the model to simulate the local labor market effects of expanding public sector employment in a city. In second empirical approach, we use regression analysis to estimate the effects of public sector job expansions on decadal changes (1980-1990 and 1990-2001) in the employment and population of Spanish cities. This analysis exploits the dramatic expansion of public employment that followed the advent of democracy in the 1980-2001 period. The instrumental variables' approach that we follow uses the capital status of cities to instrument for changes in public sector employment. The two empirical approaches yield qualitatively similar results and, thus, cross-check each other. One additional public sector jobs creates 1.2 to 1.4 private sector jobs. However, these new jobs do not translate into a substantial reduction of the local unemployment rate as better labor market conditions attract new households to the city. Increasing public employment by 50% only reduces unemployment from 15.6 to 14.9-15%.

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1 Introduction

Public employment is an important input to deliver public goods and services, with public employees' compensations typically representing around 20-25% of public sector budgets in developed countries. Besides, public employment constitutes a significant fraction of employment. In 2013, the share of public employment in total employment was, on average, 21% in OECD countries[1]. Hence, policies regarding public sector wages and employment are likely to influence the labor market.

There is evidence from different countries which strongly suggests that governments use the distribution of public employment within its geography as a means to reduce spatial economic inequalities. In 1992, up to 400,000 jobs in public works cushioned the raise in unemployment that followed the re-unification in Eastern Germany (Kraus et al., 1998). In Spain, jobs in public works also exist in rural and lagging areas as a means to increase local disposable income (Jofre-Monseny, 2014). In Sweden, the creation of universities in less prosperous cities has been part of the country's regional policy to reduce regional economic disparities (Andersson, 2005). In England, 25,000 public sector jobs were relocated away from London between 2004 and 2010. Among other objectives, the policy aimed at stimulating economic activity in less prosperous areas (Faggio and Overman, 2014). Less explicitly, interregional income redistribution is partly achieved through a higher concentration of public sector jobs in the south both in Italy (Alesina et al., 2001) and in Spain (Marqués-Sevillano and Rosselló-Villallonga, 2004). Focusing on risk sharing between Norwegian regions, Borge and Matsen (2004) show that public employment is a prominent force that counterbalances local economic shocks.

More public employees in a city will increase the demand for local services such as housing, restaurants or hair-dressers, crowding-in private employment. However, this effect can be offset by increases in local wages and prices that might follow the public employment expansion. This crowding-out effect can be particularly acute in the tradable sector since local workers do not significantly affect the demand of locally produced manufactures. In addition, local job creation can increase in-migration rates that might also weaken the link between more jobs in the local economy and a lower unemployment rate of its residents.

The objective of this paper is to quantify the long-run local labor market effects of public employment. We follow two different quantitative approaches that we apply to the case of Spanish cities. In the first one, we calibrate and simulate a search and matching model with geographically mobile workers. In the second one, we resort to regression analysis. The two empirical approaches yield qualitatively similar results and, thus, cross-check each other.

We first develop a 3-sector (tradable, non-tradable and public) search and matching model à la Diamond-Mortensen-Pissarides. The model assumes that (homogeneous) workers (i) only

[1] OECD (2015).

search while being unemployed, (ii) accept any job offered, (iii) and are perfectly mobile. It is assumed that each city is sufficiently small, implying that there is a fixed reservation utility for the unemployed. Workers consume all their income in a tradable good, a non-tradable good and land. The latter two prices are endogenous and clear their respective markets while the price of the tradable good is exogenous and determined at the national (or international) market. Due to geographical mobility, a city whose labor market prospects improve is a city that must become more expensive to live-in. Vacancies and wages in the public sector are exogenously determined while, in the private sector, free-entry implies that firms in the tradable and non-tradable sectors open vacancies until its expected value becomes zero.

We characterize the steady state of the model which we then calibrate to match the labor market characteristics of the average Spanish city. Then, we use the model to simulate the local labor market effects of expanding public sector employment in a city. The geographical mobility of households implies that population in the city increases with a public sector job expansion. The inflow of households limits the increase in local wages. In the non-tradable sector, this wage increase is clearly offset by the raise of the local demand for the non-tradable good and employment in this sector increases substantially. In contrast, the demand for the locally produced tradable good remains unaffected. As a result, the effect on tradable employment is small and is determined by two opposing forces: higher wages on the one hand decrease employment while agglomeration economies, that increase productivity, increase employment. In our baseline calibration, one additional public sector job increases private jobs by 1.267 and city population by 2.573. As a result, large expansions in public employment have modest impacts on the local unemployment rate. Increasing public employment by 50% only reduces the unemployment rate from 15.6 to 14.9%.

In the second empirical approach, we use regression analysis to estimate the effects of public sector job expansions on decadal changes (1980-1990 and 1990-2001) in the employment and population of Spanish cities. This analysis exploits the dramatic increase in public employment that followed the advent of democracy that followed Franco's death. Between 1980 and 2001, public employment grew by 133%, increasing from 1.4 to 3.3 million jobs. We start by analyzing the determinants of this public sector job expansion across cities. Two important results emerge. First, more public sector jobs are created in cities experiencing negative labor demand shocks, providing further evidence that public employment is used by governments to reduce spatial income inequalities. Second, provincial capitals (set back in 1833) experienced a more than proportionate increase in public employment between 1980 and 2001. Specifically, being a capital city implied an additional 0.7 public sector workers each decade per each 100 inhabitants in the base year. This result is the basis for our Two Stage Least Squares (TSLS) strategy which consists in using the capital status of the city to instrument for changes in public sector employment. As for instrument validity, several robustness checks support the maintained assumption that (conditional on initial unemployment, education, location -coast versus inland cities- and size) the capital status of a city is uncorrelated to shocks in employment and population growth. The IV estimates indicate that one additional public sector job increases private jobs by 1.344 and active population by 2.695 individuals. The reduced-form estimates obtained imply that increasing public employment by 50% only reduces the unemployment rate from 15.6 to 15%.

There are, at least, three factors that can rationalize the relatively large effects of public employment on private employment and population that we find. First, in the period that we study (1980-2001), interregional migration rates in Spain have been relatively low but, in contrast, intraregional migration rates have been substantial Bover and Arellano (2001). Specifically, cities have kept attracting migrants from the rural areas within their region and more public sector jobs in capital cities might have intensified this process. Second, the model simulations indicate that the elasticity of land price to city size is key to determine if, and the extent to which, public employment crowds-in or crowds-out private employment. The complier cities in our TSLS regressions are relatively small provincial capitals which can be deemed as cities with a rather elastic land supply. Finally, our model also indicates that multipliers will be larger when public sector wages are high. In Spain, the public sector wage gap is substantial (Hospido and Moral-Benito, 2014), and this is especially true in small provincial capitals given that the distribution of public sector wages is more compressed than that of the private sector.

The paper that is closer to ours is Faggio and Overman (2014) that estimate the local labor market effects of public employment in England. Their main results, based on 2003-2007 employment changes at the British Local Authority level, indicate that public employment does not increase nor decrease overall private employment, although the industry mix is changed in favor of the non-tradable sector. When looking over a longer time horizon (1999-2007), the results suggests that, if anything, public employment crowds-out rather than crowds-in private employment. As already recognized by Faggio and Overman (2014), the highly restrictive planning system prevalent in the England (Hilber and Vermeulen, 2015) implies a very inelastic land (and housing) supply which could explain the absence of significant crowding-in effects of public employment in that country. We complement Faggio and Overman (2014) study in several ways. First, we estimate the local labor market effects of public employment in Spanish cities. For the reasons detailed above, these estimates can be policy-relevant in settings with unrestrictive planning systems and/or with favorable geography and for urban development. Second, we study a time period in which the Spanish public sector developed, with massive and geographically heterogeneous increases in public employment. While in the period studied by Faggio and Overman (2014), public employment increased by less than 6% in England, in our setting the increase was of 133%. Third, we develop a search and matching model with geographical mobility that clarifies the mechanisms through which public employment affects cities and quantifies their relative importance. Finally, another attractive feature of our study is our novel TSLS strategy. Instead of using a standard Bartik (1991) shift-share instrument that uses employment in the base year to predict subsequent employment growth, we use a city feature (the capital status of a city) which dates back to 1833 to predict public employment growth in the 1980-1990 and 1990-2001 decades. Since we document that more public jobs are created in cities experiencing negative labor demand shocks, building a shift-share instrument with the 1980 and 1990 distribution of public employment could be problematic as these distributions could reflect past labor demand shocks that are likely to be correlated over time.

Instead of analyzing the local labor market effects of public employment, Moretti (2010) and Moretti and Thulin (2013) estimate the local multipliers of jobs in the tradable sector in the US and Sweden, respectively. Their results indicate that, on average, one additional job in the tradable sector creates 1.59 and 0.48 jobs in the non-tradable sector in the typical US and Swedish city, respectively. Our results are, thus, in between these two estimates but closer to the US multipliers.

Beaudry et al. (2012), Kline and Moretti (2013) embed standard search and matching models à la Diamond-Mortensen-Pissarides in spatial equilibrium models (Roback, 1982)[2]. Beaudry et al. (2012) set-up a multi-sector and multi-city model with labor market frictions. The empirics of the paper, that examine changes in wages and employment across cities and industries in the US, indicate that a positive labor demand shock in one sector increases wages in the rest of industries in the city, providing empirical support for labor market frictions and bargaining. In turn, Kline and Moretti (2013) deals with the efficiency of place-based policies in the presence of geographical mobility and labor market frictions. In relation to these studies, we go a step forward by calibrating the model and using it to simulate the effects of a local labor market policy. To the best of our knowledge, we are the first to do so in the context of search and matching models with geographical mobility.

Finally, our paper also relates to a recent strand of the macro literature studying the labor market effects of public employment in national economies. Burdett (2012), Gomes (2015a) and Bradley et al. (2015) use search and matching models to analyze the effects of public sector wages and employment on labor market performance[3]. The conclusions reached by these studies are much more negative regarding the effects of public employment than those obtained by the present study. Algan et al. (2002) also study the effects of public employment at the national level using regression analysis applied to a long country-level OECD panel.

[2]Another related study is Wrede (2015) that extends the urban economics literature on quality of life measurement by considering the presence of unemployment

[3]Quadrini and Trigari (2007) and Gomes (2015b) are instead concerned with the effect of public employment on the volatility of labor market outcomes

Their results also suggest strong crowding-out effects. Specifically, they indicate that one public job crowds-out 1.5 private sector jobs and increases the number of unemployed by 0.3 individuals. Our study differs from this literature by estimating effects at the city (rather than at the national) level. Two facts can reconcile our results with those of this literature. First, labor mobility across cities implies that labor supply is much more elastic at the city than at the national level. In fact, in our search and matching model, if we consider the case where land supply is completely inelastic, then no geographical mobility exists and public employment does crowd-out private employment. Second, at the city level, the public wage bill is not financed through local taxes as it is typically financed by some upper-tier government.

The remainder of this paper is organized as follows. In Section 2 we develop the theoretical model. Section 3 presents the calibration of the model (3.1) and the main results of the model simulations (3.2). Section 4 contains the regression analysis. First, we describe the data and variables (4.1). Then, we provide the institutional background and analyze the city-level determinants of the public sector expansion (4.2). In sub-section 4.3 we turn to a descriptive (OLS) analysis of the effects of public employment on the city's private employment and population. The main TSLS analysis is developed in (4.5) and, finally, Section 6 concludes.

2 The Model

In this section we develop a search and matching model à la Diamond-Mortensen-Pissarides embedded within a spatial equilibrium model following Beaudry et al. (2012) and Kline and Moretti (2013). Homogeneous workers can be employed or unemployed. Employees can be either in the tradable sector (t), in the non-tradable sector (n) or in the public sector (g). Workers consume all their income in a tradable good, a non-tradable good and land. Unemployed workers can leave the city at no cost.

2.1 Employment and Unemployment

Unemployed workers search for jobs in the three sectors simultaneously and enjoy the non-labor income b. In the private sector, jobs are filled in via a constant returns to scale matching function, $m(uL, vL) = m_o u^{\chi} v^{(1-\chi)} L$, where u is the unemployment rate, v the vacancy rate and L is the labor force of each city, while χ and m_o 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 Ω_i represents the fraction of vacant jobs in each sector with $i = t, n$, i.e. $\Omega_i = \frac{v_i}{v_t+v_n}$. In turn, vacancies in the private sector are filled at rates $q(\theta)$, where θ represents the tightness of the private labor market in the city (vacancies-unemployment ratio), $\theta \equiv \frac{v_t+v_n}{u} \equiv \frac{v}{u}$.[4] 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, $q'(\theta) < 0$. As for public employment, the job creation rate, f_g, the separation rate, s_g and the wage, w_g, are all exogenously determined.

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 and the wage. The price of the tradable good is exogenous and normalized to one as tradable goods are sold in national (or international markets), implying that instantaneous profit amounts to $A_t(L) - w_t$. We consider that productivity increases with city size due to agglomeration economies[5]. Specifically, the marginal productivity of labor is given by $A_t(L) = A_{t_0}L^{\zeta}$, where $0 < \zeta < 1$ and A_{t_0} captures the exogenous technological level in the tradable sector. In turn, the instantaneous profit of the non-tradable sector is equal to $p_nA_n - w_n$, which increases with both the (endogenous) price of non-tradable goods, p_n, and the constant specific technological level in that sector, A_n[6]. 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

$$rV_t = -k_t + q(\theta)(J_t - V_t), \tag{1}$$

$$rV_n = -k_n + q(\theta)(J_n - V_n), \tag{2}$$

$$rJ_t = A_t(L) - w_t + s_t(V_t - J_t), \tag{3}$$

$$rJ_n = p_nA_n - w_n + s_n(V_n - J_n). \tag{4}$$

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:

[4] By the homogeneity of the matching function this ratio is not a function of L.

[5] See Combes and Gobillon (2015) for a recent review on the empirics of agglomeration economies

[6] We do not consider agglomeration effects in the non-tradable sector as there is less room for productivity increases in that sector (Moretti, 2012)

$$rV_t \; = \; 0, \tag{5}$$

$$rV_n \; = \; 0. \tag{6}$$

2.2 Workers

Each worker consumes a tradable and a non-tradable good, and land. Hence, a worker's utility in a city depends on nominal income, $y = \{b, w_t, w_n\}$ as well as on the city's prices of the non-tradable good (p_n) and land (p_c). We assume that workers have a Cobb-Douglas utility function which delivers the indirect utility $V(y, p_n, p_c) = y\,(1-\delta-\phi)^{(1-\delta-\phi)}\left(\frac{\phi}{p_n}\right)^{\phi}\left(\frac{\delta}{p_c}\right)^{\delta} = \frac{y}{PI}$, defining PI as the city's price index.

$$PI \; = \; \left(\frac{1}{1-\delta-\phi}\right)^{(1-\delta-\phi)} \left(\frac{p_n}{\phi}\right)^{\phi} \left(\frac{p_c}{\delta}\right)^{\delta}, \tag{7}$$

The parameters ϕ and δ reflect workers' preferences for the non-tradable good and land, respectively, being also the income share spent on these two goods. The values for unemployment (U) and employment in the tradable (W_t), non-tradable (W_n) and public (W_g) sectors are given by the following expressions:

$$rU \; = \; \frac{b}{PI} + f_g(W_g - U) + f_t(W_t - U) + f_n(W_n - U). \tag{8}$$

$$rW_g \; = \; \frac{w_g}{PI} + s_g(U - W_g), \tag{9}$$

$$rW_t \; = \; \frac{w_t}{PI} + s_t(U - W_t), \tag{10}$$

$$rW_n \; = \; \frac{w_n}{PI} + s_n(U - W_n), \tag{11}$$

We assume that unemployed individuals can move to another city at zero cost, implying that the utility of the unemployed is equalized across cities. Since we assume that each city is small relative to the whole economy, the value of unemployment is fixed at z. Alternatively, if one considers intraregional migrations between the city and its hinterland, z would be the utility level achieved in the city's hinterland.

$$rU = z, \tag{12}$$

Taking equations 12 and 8 together implies that, in equilibrium, if the labor market prospects of a city improve (high wages, high job finding rates and/or low job separation rates), then the city must become a more expensive place to live-in (higher price index).

The next assumption is that wages in the tradable 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:

$$\frac{1}{PI}\beta J_t = (1-\beta)(W_t - U), \tag{13}$$

$$\frac{1}{PI}\beta J_n = (1-\beta)(W_n - U), \tag{14}$$

where the parameter β 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 (e_g) sectors. These evolve according to the following difference equations:

$$\dot{u} = s_t\, e_t + s_n\, e_n + s_g\, e_g - f_n\, u - f_t\, u - f_g\, u, \tag{15}$$

$$\dot{e_g} = f_g\, u - s_g\, e_g, \tag{16}$$

$$\dot{e_t} = f_t u - s_t\, e_t, \tag{17}$$

$$\dot{e_n} = f_n u - s_n\, e_n, \tag{18}$$

$$u + e_t + e_g + e_n = 1. \tag{19}$$

Notice that the levels of unemployment and employment in the tradable, non-tradable and public sectors are uL, e_tL, e_nL and e_gL, respectively.

In order to close the model, the markets for the non-tradable good and land must clear. The non-tradable good must be purchased by local workers.

$$\phi(w_t e_t + w_n e_n + w_g e_g + b\,u) = p_n A_n e_n, \tag{20}$$

Finally, we assume that land rents accrue to absentee land owners and, following Combes et al. (2012), we assume that land price is increasing with city size according to:

$$p_c = L^{\eta}. \tag{21}$$

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, f_n, p_c, p_n, L, A_t, w_t, w_n, e_t, e_n and u:

$$\frac{k_t}{q(\theta)} = \frac{A_t(L) - w_t}{(r + s_t)}, \tag{22}$$

$$\frac{k_n}{q(\theta)} = \frac{p_n A_n - w_n}{(r + s_n)}, \tag{23}$$

$$w_t = \beta A_t(L) + ((1-\beta)b + \beta\theta(\Omega_t k_t + \Omega_n k_n))\frac{(r + s_g)}{(r + s_g + f_g)} + \frac{f_g(1-\beta)w_g}{(r + s_g + f_g)}, \tag{24}$$

$$w_{nt} = \beta p_n A_n + ((1-\beta)b + \beta\theta(\Omega_t k_t + \Omega_n k_n))\frac{(r + s_g)}{(r + s_g + f_g)} + \frac{f_g(1-\beta)w_g}{(r + s_g + f_g)}, \tag{25}$$

$$u = \frac{s_t s_n s_g}{[s_t s_n s_g + s_g s_t f_n + s_g s_n f_t + f_g s_t s_n]}, \tag{26}$$

$$e_t = \frac{f_t}{s_t} u, \tag{27}$$

$$e_g = \frac{f_g}{s_g} u, \tag{28}$$

$$e_n + e_t + e_g + u = 1, \tag{29}$$

$$\frac{1}{PI}\left[b + \frac{f_g}{(r + s_g + f_g)}(w_g - b) + \frac{(r + s_g)\beta\theta(\Omega_t k_t + \Omega_n k_n)}{(r + s_g + f_g)(1 - \beta)}\right] \; = \; z, \tag{30}$$

$$\phi(w_t e_t + w_n e_n + w_g e_g + b\, u) = p_n A_n e_n, \tag{31}$$

$$p_c \; = \; L^{\eta}, \tag{32}$$

$$A_t(L) = A_{t_0} L^{\zeta}, \tag{33}$$

Equations 22 and 23 are the standard job creation curves that characterize the marginal condition for the demand of labor in the tradable and non-tradable sectors, respectively. Equations 24 and 25 are the respective wage curves that replace the labor supply curves of Walrasian models. In turn, equations 26 to 29 characterize the unemployment and the employment rates in the tradable, non-tradable and public sector in steady state. These are the standard equations that solve the steady state equilibrium in search and matching models. There are 4 additional equations that characterize the equilibrium. Equation 30 guarantees that the value of unemployment is equalized across space. The next two equations characterize the behavior of local consumption prices. Specifically, the price of the non-tradable good must ensure that its market clears (equation 31), while equation 32 relates land price and city size. Finally, 33 pins down the relationship between productivity and city size in the tradable sector.

3 Calibration and simulated results of the model

3.1 Calibration

We calibrate the model to match the labor market characteristics of the average Spanish city. The real interest rate is fixed at $r = 0.012$, which is consistent with an annual interest rate of 4.8%. We normalize the labor force $L = 1$, which also implies that the land price, p_c, is equal to one. We target the 2001 average regional public employment share of 20.9% as a percentage of the total employment. We also target an average unemployment rate of 15.6% and the employment rates of 15.8% and 47.7% in the tradable and non-tradable sectors, respectively. Using the Spanish Labor Force Survey (SLFS) and adopting the methodology applied in (Silva and Vázquez-Grenno, 2013), we calculate the separation rates in the tradable and non-tradable sectors, which are almost identical to each other. Thus, we set $s_t = s_n = 0.015$. For the public sector, we also calculate the job separation rate and we set $s_g = 0.009$. Substituting the job separation rates, the unemployment and employment rates in equations (15), (17) and (18) and considering $\dot{e_t} = \dot{e_n} = \dot{u} = 0$, we obtain the corresponding job finding rates: $f_t = 0.015$, $f_n = 0.046$ and $f_g = 0.012$.

In turn, and since we do not have data on vacancies by sector, we assume that the fraction of vacant jobs in each sector (Ω_i) is equal to the fraction of each sector employment in the total private employment. Thus, we set $\Omega_t = 0.249$ and $\Omega_n = 0.751$. This implies that the aggregate job finding rate in the private sector is $f = f_t + f_n = 0.061$. Once Ω_i is known, we obtain the vacancy rates for the tradable and non-tradable sectors using, $\frac{v_i}{v_t+v_n} = \Omega_i$. Thus, we get $v_t = 0.050$, $v_n = 0.150$ and, therefore, $v = v_t + v_n = 0.200$. Using the calibrated values for u and v, we can find the labor market tightness $\theta = \frac{v}{u} = 1.281$ and, finally, the job meeting rate $q(\theta) = \frac{f}{\theta} = 0.050$.

Pissarides and Petrongolo (2001) identify an elasticity of unemployment with respect to the matching function in the range 0.5-0.7. We take 0.600 as reference and, thus, we set the matching parameter at $\chi = 0.600$. Knowing that $f = m_o\theta^{1-\chi}$ and using the calibrated value of the job finding rates, we can find the parameter $m_o = 0.055$.

We normalize the wage in the public sector to one ($w_g = 1$). Following Hospido and Moral-Benito (2014), we target the average wage gap of 20% between the public sector and private sectors. Thus, we set $\frac{w_g}{w_p} = 1.20$ (where w_p is average wage in the private sector). Successively, we estimate the wage gap between tradable and non-tradable sectors using the Spanish Continuous Sample Lives in 2005 (*Muestra continua de Vidas Laborales*, MCVL) and we find a gap of 11.9% after controlling by individual characteristics (age, age square, gender and education). Thus, we set $w_t = 0.913$ and $w_n = 0.807$.

Regarding agglomeration economies, Ciccone and Hall (1996) and Rosenthal and Strange (2008) find an elasticity of (total factor) productivity with respect to density to be around 0.4-0.5[7]. One concern with these studies is that highly-skilled workers are positively selected into the largest cities, over-estimating the effect of city size on productivity (Combes and Gobillon, 2015)). Thus, we set this elasticity at 3%, i.e. $\zeta = 0.030$.

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[8]. Thus, we set average labor productivity at $A_t(L) = w_t * 1.457 = 1.331$. Substituting this value and ζ in the labor

[7]The studies quantifying the effect of (log) density on (log) productivity (or wages) typically include, as a regressor, the city's land surface. Hence, the elasticity of density is also the elasticity of city size

[8]This is the wage adjusted labor productivity derived from structural business statistics.

productivity function (33) we can obtain the parameter $A_{o_t} = 1.331$. 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, $p_n A_n = w_n * 1.19 = 0.960$.

For the elasticity of land with respect to the city size, we take the results reported in Combes et al. (2012) who directly estimates the elasticity of the land prices with respect to population at 0.72. Thus, we set $\eta = 0.720$.

In order to know what workers spend on land, we first need to know what workers spend on housing services and then multiply this by the share of the land in housing. Davis and Ortalo-Magne (2011) take the share of housing in the household expenditure equal to 0.24 for the US and, for France Combes et al. (2012) take a value equal to 0.23. Imputed rents look abnormally low in Spain (Living Conditions Survey - LCS). However, there are actual rent data from a major listing website (*Fotocasa*) which gives us information on rental prices. In 2012, the average squared meter was 7.220 euros a month. The average dwelling in Spain is $90.6m^2$ (2011 Population and Housing Census). This gives us an annual rent of 7,850.150 euros. If we take the average household income in Spain in 2011 which is 26,775 euros (LCS) we find that housing expenditures as a share of household income amounts to 0.293 of the average household income. For the second parameter, the share of the land in housing, Albouy (2009) takes a value equal to 0.23 and Combes et al. (2012) take 0.25. This parameter is available for Spain in the BBVA capital stock series. Since Davis and Heathcote (2007) show that this parameter follows the housing booms and busts, we compute this value for the pre housing boom period, 1995-1998, and we obtain a share of the land in housing equal to 0.233. Then, considering the product of these two values (the share of the land in housing and the share of the land in housing) we get a share of income spent on land equal to 0.068. Thus, we take $\delta = 7.0\%$.

To calculate the other two parameters of the indirect utility function (share of the income that workers spend on tradable and non-tradable sectors) we draw on data from the Household Budget Survey (HBS) for the year 2006. We set the share of the income that workers spend on the non-tradable goods/services (ϕ) equal to 0.600 and then, the share of the income that workers spend on the tradable goods $(1 - \delta - \phi)$ is 0.330[9]

To find the value of the vacancy costs parameter in the tradable sector k_t we use the job creation condition (22):

$$k_t = \frac{q(\theta)(A_t - w_t)}{(r + s_t)} = \frac{0.050(1.331 - 0.913)}{(0.012 + 0.015)} = 0.736. \tag{34}$$

[9]It is important to highlight the difficulty, and the arbitrariness, that exists in classifying the different categories of household spending. Broadly speaking, we consider as tradable spending, the money spent in industrial goods. The rest was classified as non-tradable spending.

Next, we can obtain the employment opportunity cost, $b = 0.315$, the workers bargaining power, $\beta = 0.313$, the relative price of non-tradable, $p_n = 1.032$ and the vacancy costs in the non-tradable sector, $k_n = 0.324$, from equations (23), (24), (25) and (31). We find parameter $z = 0.3301$ from equation (30) and, finally, the price index $PI = 2.404$. Table 1 summarizes all the calibrated parameters and presents the steady state values of the endogenous variables.

3.2 Simulated results

Table 2 presents the simulated results of the model with a job creation policy scenario that target increases of 25, 50 and 100% in the level of public employment, Le_g. These increases are consistent with the public employment growth observed in the Spanish cities since the beginning of the eighties. The previous three scenarios correspond to an increase in the public job creation rate, f_g, from 0.012 to 0.014, 0.015 and 0.017, respectively. As could be seen in Table 2, our simulations suggest that public employment has almost no effect on tradable jobs and crowds-in non-tradable jobs. Specifically, each public job creates between -0.054 and 0.013 jobs in the tradable sector and between 1.207 and 1.304 additional jobs in the non-tradable sector. These public employment multipliers on local employment could be explained as follows. The increase of public employment negatively affects the job finding in the tradable sector, f_t, while push up the job finding rate in the non-tradable sector, f_n. The intuition is quite straightforward, a local demand effect. In other words, more public employees in the local economy increase the the demand for non-tradable goods and services and, therefore, their relative price, p_n. As a result, the profit of the firms operating in this sector grows, increasing the relative number of vacancies per unemployed worker in that sector. In contrast, employment does not show similar behavior in the tradable sector, Le_t, because in spite of the presence of positive local agglomeration effects, the profit of tradable firms falls as a consequence of to the increase of tradable wages. As a result, the number of vacancies per unemployed worker in the tradable sector decrease and, therefore, the job finding rate, f_t, falls.

The model also allow us to quantify the effects of public employment on the unemployment rate and on the city size. For example, a 50% increase in public employment generates a reduction in the local unemployment rate from 15.6% to 14.9%. The unemployment rate falls because the increase in the public and non-tradable jobs more than compensate the modest reduction in the jobs of the tradable sector. The increase in public jobs improves the private wages (tradable and non-tradable) and, then, attracts workers from other cities. Concretely, for the 50% increase in public jobs, city size rise by 25.7% which corresponds with a multiplier of public employment on total population equal to 2.573. Notice that land price, p_c, positively depends on city size (32) therefore, the increment in the city population

Table 1: Calibrated parameter values for the Spanish economy

Parameters	Value	Source/Target
Wage in the public sector, w_g	1.000	Normalization
Labor productivity parameter, A_{to}	1.331	Eurostat
Labor productivity parameter, A_n	0.960	Eurostat
Labor productivity elasticity , ζ	0.030	MCVL
Separation rate in public sector, s_g	0.009	SLFS
Separation rate in tradable sector, s_t	0.015	SLFS
Separation rate in the non-tradable sector, s_n	0.015	SLFS
Job finding rate in public sector, f_g	0.012	SLFS
Interest rate, r	0.012	Data
Matching function elasticity, χ	0.600	(Pissarides and Petrongolo, 2001)
Matching function scale, m_o	0.055	Matching function
Workers' bargaining power, β	0.313	Solves (24)
Employment opportunity cost, b	0.315	Solves (25)
Cost of vacancy in the tradable sector, k_t	0.736	Solves (22)
Cost of vacancy in the non-tradable sector, k_n	0.334	Solves (23)
Free-mobility flow utility, z	0.301	Solves (30)
Land costs elasticity, η	0.720	(Combes et al., 2012)
Land preferences, δ	0.070	LCS & BBVA & *Fotocasa*
Tradable preferences, $1 - \delta - \phi$	0.330	HBS
Non-tradable preferences, ϕ	0.600	HBS
Variables		
Labor market tightness, θ	1.282	Matching function properties
Job finding rate in the tradable sector, f_t	0.015	SLFS
Job finding rate in the non-tradable sector, f_n	0.046	SLFS
Land price, p_c	1.000	Solves (32)
Labor productivity in tradable sector, A_t	1.331	Eurostat
Relative price of non-tradable goods, p_n	1.032	Equation (31)
Wage in the tradable sector, w_t	0.913	MCVL
Wage in the non-tradable sector, w_n	0.807	MCVL
Public employment rate, e_g	0.209	SLFS
Tradable employment rate, e_t	0.156	SLFS
Non-tradable employment rate, e_n	0.477	SLFS
Labor force, L	1.000	Normalization
Unemployment rate, u	0.121	SLFS

Table 2: Benchmark simulated results with an increase in public employment

	f^g	θ	f_n	f_t	p_n	p_c	w_t	w_n	Le_g	Le_t	Le_n	L	u
Baseline													
	0.012	1.282	0.046	0.015	1.032	1.000	0.913	0.807	0.209	0.158	0.477	1.000	0.156
25%													
	0.014	1.273	0.047	0.014	1.039	1.101	0.920	0.814	0.263	0.159	0.547	1.142	0.152
Multipliers										**0.013**	**1.304**	**2.650**	
50%													
	0.015	1.266	0.048	0.012	1.044	1.186	0.926	0.820	0.313	0.157	0.609	1.267	0.149
Multipliers										**-0.012**	**1.268**	**2.573**	
100%													
	0.017	1.254	0.050	0.010	1.053	1.346	0.935	0.830	0.418	0.147	0.729	1.510	0.144
Multipliers										**-0.054**	**1.207**	**2.445**	

Notes: 1) Multipliers are calculated as: $\frac{\Delta(Le_i)}{\Delta(Le_g)}$ where $i = n, t$.

push up the price of land which, at the same time, operates limiting the growth of the city, because of the impact on the cost of living.

3.3 Alternative simulations of the the model

In order to analyze the importance of the different forces that are behind our benchmark results, in this sub-section we present the results of the simulations of the model in two particular cases. Firstly, we analyze the effects of the increase in the public employment ignoring the possibility of labor mobility across cities and, secondly, we evaluate the effects of the boost in public jobs, after removing the public wage premium.

3.3.1 The model without labor mobility

Considering the model without labor mobility across cities, in fact, we are setting the city size, and this implies no agglomeration economies in the tradable sector and fixed land prices. In terms of the equations of the model, this entails that conditions (30), (33) and (32) are not necessary anymore and, therefore, the variables L, A_t and p_c turn into parameters. Table 3 shows the simulated results with an increase in the public job creation rate from 0.012 to 0.020 (50 % increase in the level of public employment), which is the same public employment target used in the second scenario of Table 2. In this economy, job creation in the public sector affects the private sector through the incremento on private wages, as well as, through the positive impact on price of non-tradable goods. Then, the net profit of tradable firms will be negatively affected, which in turn, reduces job finding rate in the sector. In contrast, due to a positive local demand effect, the job finding rate in the non-tradable sector increases, rising p_n and, therefore, the net profit of non-tradable firms.

Notice, that in absence of labor mobility, the public employment multiplier on the tradable sector becomes much more negative (from -0.038 to -0.944) while the positive multiplier effect

Table 3: Simulated results without Labor mobility across cities

	f^g	θ	f_n	f_t	p_n	p_c	w_t	w_n	Le_g	Le_t	Le_n	L	u
Baseline													
	0.012	1.282	0.046	0.015	1.032	1.000	0.913	0.807	0.209	0.158	0.477	1.000	0.156
50%													
	0.020	1.180	0.053	0.006	1.049	1.058	0.934	0.832	0.314	0.059	0.488	1.000	0.139
Multipliers										**-0.944**	**0.105**	**0.000**	

Notes: 1) Multipliers are calculated as: $\frac{\Delta(Le_i)}{\Delta(Le_g)}$ where $i = n, t$.

on non-tradable jobs practically disappears, falling from from 1.268 to 0.105. Also note that the unemployment rate falls by an additional percentage point (from 14.9% in the benchmark scenario to 13.9% here). These results suggest that, in our model, labor mobility across cities plays an important role, not only for the employment, but also for the unemployment side. The higher the inflow of workers from other cities, the higher the crowding-in (out) effect in the non-tradable (tradable) sector but the lower the reduction in the unemployment rate.

3.3.2 The model with no public wage premium

We recalibrate the model with a public sector less attractive for local workers. Concretely, we eliminate the public sector wage premium with respect to the private sector and recalibrate the model to keeping unchanged the rest of targets. Table 4 shows the simulated results with a 50% increase in public employment which corresponds with an increase in the public employment job creation rate from 0.012 to 0.019.

The simulated results show that public employment expansion generates more (less) crowding-out (in) effect in the tradable (non-tradable) sector. More specifically, each additional public employment destroys -0.552 tradable jobs and creates 0.369 non-tradable jobs. Since the public sector is a less attractive as an outside option, the increment in public employment will increase by relatively less the implicit bargaining power of workers in the private sectors and, therefore, their wages. As a result, less people will migrate to the city, in fact, in this scenario, the city size increases only by 8.1% instead of 26.7% in the benchmark scenario (the population multiplier decreases from 2.573 to 0.778). This simulation highlights that, the effect of public employment on private employment heavily depends on the public sector wage premium. In particular, the higher the relative wage in the public sector the more positive becomes the public employment multiplier effect on private employment.

Table 4: Simulated results with no public sector wages premium

	f^g	θ	f_n	f_t	p_n	p_c	w_t	w_n	Le_g	Le_t	Le_n	L	u
Baseline													
	0.012	1.282	0.046	0.015	1.015	1.000	0.968	1.096	0.209	0.158	0.477	1.000	0.156
50%													
	0.019	1.276	0.051	0.010	1.019	1.058	0.974	1.101	0.313	0.100	0.516	1.081	0.140
Multipliers										**-0.552**	**0.369**	**0.774**	

Notes: 1) Multipliers are calculated as: $\frac{\Delta(Le_i)}{\Delta(Le_g)}$ where $i = n, t$.

4 Reduced-form estimates: Evidence from the late development of the Spanish public sector: 1980-2001

In this section, using regression analysis, we estimate the city-level effects of public sector job expansions. To that end, we exploit the uneven geography of the substantial increase in public sector employment that took place in Spain with the advent of democracy in the period 1980-2001. Since we are interested in the long-run effects of public employment (changes between steady states in terms of the model developed above), we will examine decadal changes (1980-1990 and 1990-2001) in the employment and population of Spanish cities. This exercise enables us to assess the degree to which the simulated results of the model match carefully estimated reduced-form coefficients. This section is organized as follows. After describing the data and variables used in the analysis, we provide a description of the geography of the public sector jobs expansions. Then, we report Ordinary Least Squares (OLS) estimates before turning to the main instrumental variables' analysis that uses the capital status of a city as an instrument for local public sector job changes.

4.1 Data and variables

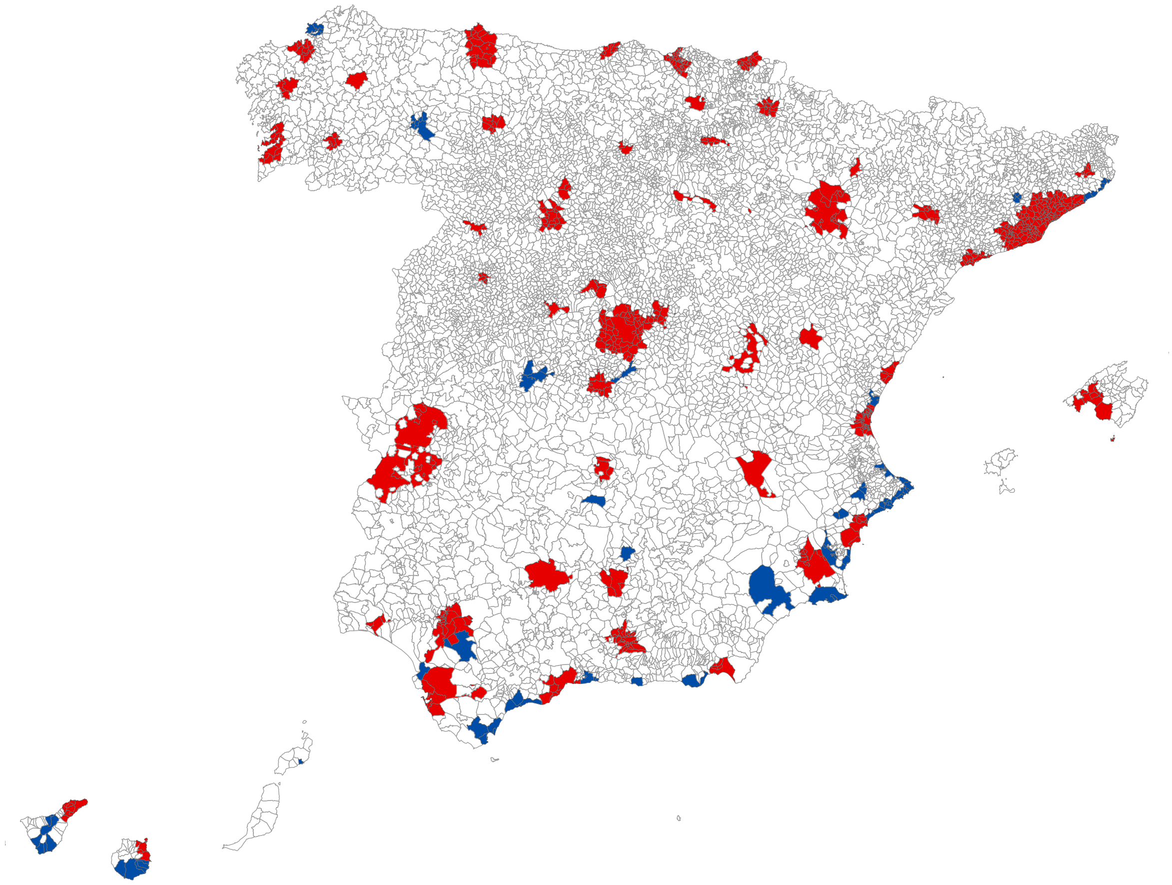
We primarily use Census data on employment and population. As for employment, the data are drawn from Censuses of Establishments carried out in 1980, 1990 and 2001 and contain counts of employees by municipality and main economic activity (2-digit level) of the establishment in which the employee works. As for population, we we will use population counts by labor market status from the 1981, 1990 and 2001 Population Censuses. We also have access to some data on employment and population from 1970 Censuses. We then construct city-wide counts of these variables using the 2008 urban area definitions built by the Ministry of Housing[10]. We work with a total of 83 cities (urban areas) whose locations and extensions are shown in Map 1. In 2001, these cities concentrated 67% of the population.[11] The median city (Ourense) had 126,410 inhabitants in 2001. The size of the two largest cities

[10]The same definitions are used in De la Roca and Puga (2013).

[11]We do not consider Ceuta and Melilla, the two Spanish enclaves in North-Africa.

- 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.

Figure 1: Urban areas (cities) in Spain



Source: Cities (urban areas) in 2008 -*Ministerio de la vivienda*. Capital cities (52) in red and non-capital cities (31) in blue. The map excludes *Menorca* (far east) and *La Palma*, *La Gomera* and *El Hierro* (far west) as no urban area is found in these islands.

In terms of outcomes, we consider (changes in) employment, E, which is the sum of the workers in the tradable sector (E_t), the non-tradable sector (E_n) and the public sector (E_g)[12]. We assimilate the tradable sector to the manufacturing industries, while non-tradable employment contains the workers in private activities that produce goods that can not be traded and includes the construction sector. In the last employment category, the public sector, we include three industries: public administration (that includes police and the military), education and health. There are workers in the education and health sectors that are not government workers. Unfortunately, our data does not allow us to break down between private and public employees within these two sectors. Having this caveat in mind,

[12]We do not consider agriculture, farming and mining activities as they have been covered differently in different Censuses.

we include the health and education sectors in our definition of the public sector for two reasons. First, because the majority of these workers are directly employed by governments (67 and 61% of the workers in 1999 in education and health, respectively[13]). Second, because there are many public services in education and health that, being partly financed by the public sector, are provided by private firms. The most prominent instance is that of primary and secondary education where the teachers' salaries in the majority of private schools (the so-called *Escuelas concertadas*) are paid by regional governments. Similar arrangements also exist in the health sector. Our model also predicts that public sector expansions increase city size. Thus, we also consider (changes in) the city-level (economically) active population, working age population and total population (L). In the regression analysis, will examine decadal (1980-1990 and 1990-2001) increases in the employment and population measures detailed above measured relative to the city population in the base year (1980 or 1990).

The first two panels of Table 5 provide summary statistics for employment and population levels in 1980 and 2001 at the city level. The third panel reports summary statistics for the outcome variables that we will examine below, namely, pooled employment and population decadal changes (1980-1990 and 1990-2001) relative to the population level at the decade's beginning.

Starting with total population, the city average increased by 11.5% between 1980 and 2001. Since the sample is fixed over time (N=83), 11.5 is also the growth rate of the entire urban population in Spain. This figure exceeds 8.6%, the population growth experienced by Spain as a whole during this period, and indicates that the share of the population living in urban areas increased between 1980 and 2001. This higher growth experienced by cities is explained by intraregional rather than by interregional migrations (Bover and Arellano, 2001). Note that the average population growth rate over one decade (third panel) is 9.5%, which reveals that in Spain, small cities have grown more than large cities. In fact, mean reversion in population growth is a prevalent feature of our city-level data and one that needs to be taken into account in the regression analysis. The economically active population has grown far more (78%) in Spanish cities during this period as women entered the labor force massively[14]. Similarly, (urban) employment increased by 88% between 1980 and 2001. This increase has not been uniform across economic sectors as the economy experienced a process of tertiarization with the employment in the tradable sector growing by only 6.6% between 1980 and 2001.

[13]This figures have been computed with the first term Labor Force Survey of 1999

[14]According to the 1981 and 2001 Censuses, between these two years the participation rate of females aged 25-64 increased from 21 to 58%

Table 5: Employment and population in Spanish cities (1980-2001): Summary statistics

Variable	Mean	Median	SD	Min	Max
Employment and population levels in 1980 (N=83)					
Tradable employment	21,127	5,577	61,225	113	474,588
Non-tradable employment	30,026	10,625	75,550	1,551	513,539
Total employment	64,353	18,914	163,557	2,032	1,067,467
Active population	82,000	23,789	208,017	2,526	1,367,068
Working age population	180,138	52,284	428,575	10,672	2,812,315
Total population	296,136	96,763	689,109	18,022	4,546,343
Public employment	13,200	5,495	30,638	368	243,589
Employment and population levels in 2001 (N=83)					
Tradable employment	22,523	6,218	62,847	993	487,367
Non-tradable employment	67,688	23,003	172,171	5,397	1,252,375
Total employment	119,700	43,641	294,959	10,447	2,033,004
Active population	141,829	52,138	340,127	13,247	2,357,121
Working age population	228,056	87,123	520,014	19,828	3,609,102
Total population	330,320	126,410	747,146	31,158	5,135,225
Public employment	29,489	12,459	64,742	1,872	488,260
Employment and population decadal changes relative to the city's population in the base year (1980-1990 & 1990-2001 pooled changes, N=166)					
Tradable employment	0.005	0.005	0.019	-0.052	0.115
Non-tradable employment	0.061	0.052	0.041	-0.067	0.264
Total employment	0.095	0.089	0.058	-0.137	0.308
Active population	0.109	0.103	0.060	-0.119	0.356
Working age population	0.109	0.090	0.091	-0.029	0.584
Population	0.105	0.078	0.160	-0.088	0.959
Public employment	0.029	0.028	0.019	-0.031	0.093
Control variables: Pooled observations for 1980 and 1990 (N=166)					
Unemployment rate	18.085	16.990	6.089	4.226	40.564
Share college graduates	8.047	7.790	3.194	2.357	16.980
Coast	0.446	0.000	0.499	0	1
Coast north	0.084	0.000	0.279	0	1
Share second-homes in 1991	18.684	11.603	16.252	3.830	77.826

Notes: Variables as defined in the main text.

4.2 The geography of the public sector employment expansion

In Spain, the development of the public sector took place surprisingly late. This development started with the advent of democracy that followed Franco's death in 1975 and the passage of the new constitution in 1978. While in 1980, the tax revenue to GDP ratio was only of 22.6%, by 2001 this ratio had reached 33.9%[15]. This growth in the relative size of the public sector, combined with vigourous economic growth (the average annual real GDP growth rate between 1980 and 2001 was 2.95%) resulted in very large increases in public sector jobs. Table 6 shows the number of jobs in public administration, education and health sectors in 1980, 1990 and 2001.

Table 6: Public sector jobs in Spain (1980-2001)

Year	Public sector	Public administration	Education	Health
1980	1,372,463	526,479	463,377	382,607
1990	2,114,351	816,514	665,896	631,941
2001	3,199,055	1,260,872	967,717	970,466

Source: Nationwide employment counts.

Between 1980 and 2001, there were job increases of 139, 109 and 154% in public administration, education and health, respectively. Taking the three sectors together, the increase in the number of public sector jobs during this period amounts to 133%, growing from 1.4 million in 1980 to almost 3.3 million jobs in 2001. For the three sectors that comprise our public sector definition, public administration jobs increased from 0.526 to 1.261 million, education sector jobs went from 0.463 to 0.967 million while the increase in health employment went from 0.382 to 0.970 million. In the urban areas that we study, the increase in public sector jobs between 1980 and 2001 was slightly smaller than that recorded in Spain as a whole (123 versus 133%). This, coupled with the higher population growth of the urban areas, implies that public sector employment has grown disproportionately more in the non-urban areas of Spain.

Across cities, public sector jobs are also unevenly distributed. The size of the public sector is determined by and large by its administrative status. In Spain, there are provincial and regional capitals. 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% of total government spending[16]. A similar picture is obtained if one looks at the distribution

[15] OECD Statistics

[16] Excluding social security spending. See Carrión-i Silvestre et al. (2008) for a detailed explanation of the

of public employees across layers of governments. In 2001, regional governments employed 45% of public employees whereas the central government and local governments employed the remaining 34 and 21%[17].

Figure 2 plots the presence of public employees in cities, distinguishing between regional and provincial capitals, and non-capital cities. With two exceptions (Santiago de Compostela and Mérida), the cities hosting regional governments are also provincial capitals[18]. Non-capital cities like El Ejido, Elda-Petrer and Torrevieja have the lowest presence of public employees in 2001 with less than 5 employees per 100 inhabitants. At the other end, provincial capitals such as Soria, Teruel, Ciudad-Real or Toledo have more than 15 public 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. Holding population size constant, the presence of public employment 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 shift in public employment from provincial to regional capitals. On the contrary, pre-democratic provincial capitals kept their *status quo* in terms of public employment. On the one hand, provincial institutions (*Diputaciones* being the more prominent one) persisted into democratic Spain. On the other hand, provincial capitals managed to pull regional government public jobs. In light of this, we will only consider two types of cities: capitals (regardless of them being provincial or regional) and non-capitals. There are 52 capital cities (50 provincial capitals in addition to Santiago de Compostela and Mérida) and 31 non-capital cities. Figure 1 shows capital cities (in red) and non-capital cities (in blue) within Spain.

Figure 3 plots the (per capita) increase in public sector employment between 1980 and 2001 in capital and non-capital cities. It shows that when the public sector employment grew after the advent of democracy, this growth was more pronounced in capital cities. The first row in Table 7 quantifies the (raw) over-representation of public employment in capital cities. While non-capital cities had 6.32 public sector workers per 100 inhabitants in 2001, the corresponding figure for capital cities was 11.12. Although the difference is smaller in magnitude, per capita public sector workers also increased more in capital cities between 1981 and 2001. The increase was 3.55 in non-capital cities versus 5.14 in capital cities. Rows 2 to 5 in Table 7 shows that the over-representation of public employment in capital cities, both in 2001 levels as well as in 1980-2001 changes, occurs in public administration but also in the education and health sectors, as institutions like universities and hospitals tend to concentrate in capital cities.

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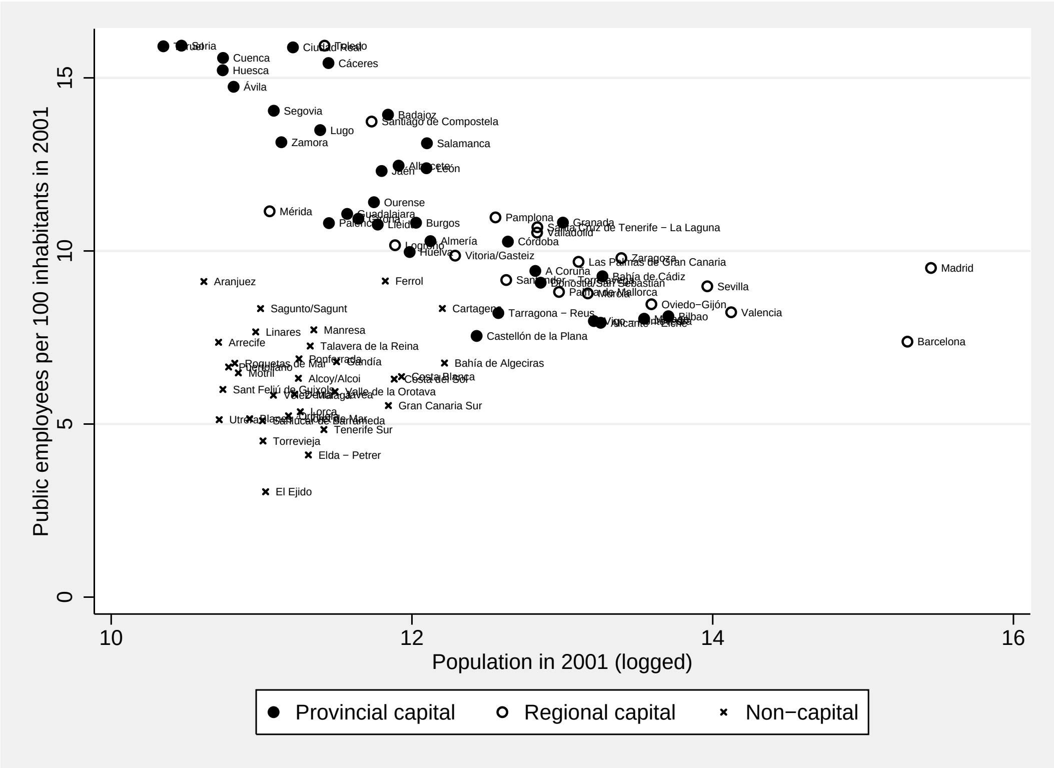
decentralization process.

[17]Registro Central de Personal, Ministerio de Hacienda y de Administraciones Públicas.

[18]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 cities in two bicephalic regions: Galicia (La Coruña and Vigo) and Extremadura (Cáceres and Badajoz).

Figure 2: Public sector employees in 2001 per 100 inhabitants



Source: Census and own elaboration.

Table 7: Public sector jobs in capital versus non-capital cities

	2001		1980-2001	
	Capital	Non-capital	Capital	Non-capital
Public sector	11.120	6.320	5.140	3.550
Public administration	4.530	2.390	2.060	1.460
Education	3.170	1.950	1.510	0.850
Health	3.420	1.970	1.560	1.240

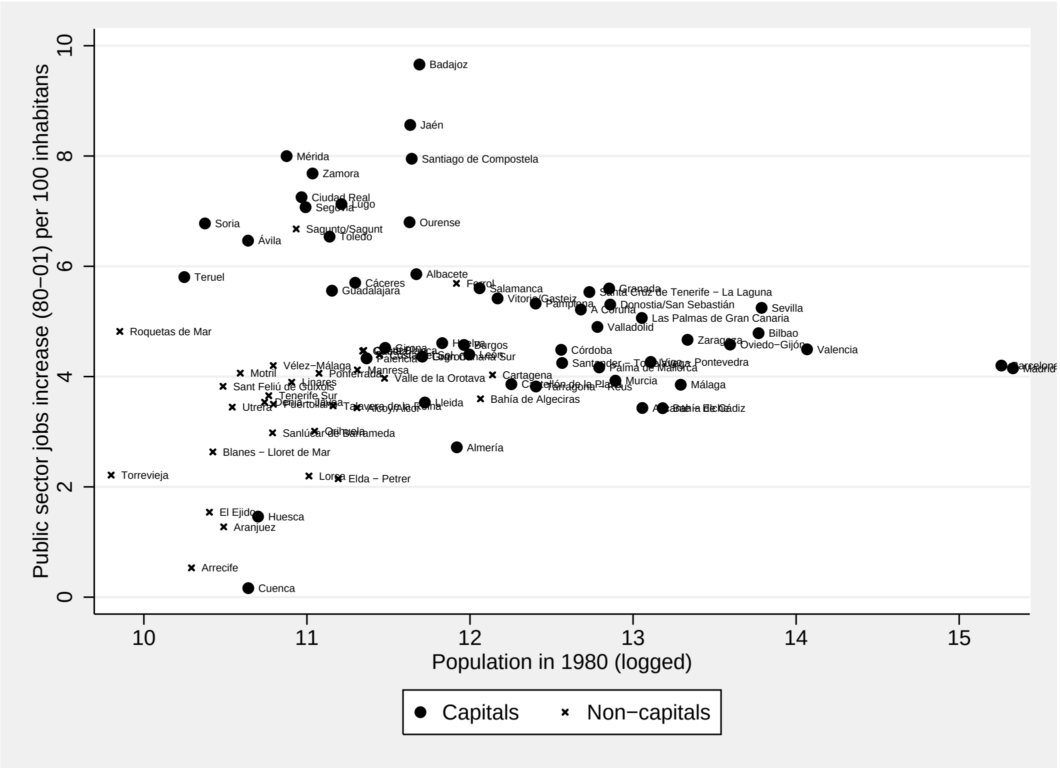
We now turn to a more systematic analysis of the city-level determinants of the public sector employment expansion in the period 1980-2001. Specifically, we run regressions of the following type:

$$\frac{E_{g,t+10} - E_{g,t}}{L_t} = \alpha_t + \beta\ Capital + \delta\ z + \epsilon_t \tag{35}$$

where the left-hand side variable is the decadal increase in public sector jobs (1980-90 or 1990-2001) relative to the population level in the base year (1980 or 1990)[19]. In turn, α_t is a set of time dummies while *Capital* is an indicator variable for capital cities. Finally, z

[19]This variable will become the main explanatory variable in the next section when we turn to the multiplier effects of public employment. Its summary statistics are provided in the third panel (last row) of Table 5.

Figure 3: Public sector job increase between 1980 and 2001 per 100 inhabitants



Source: Census and own elaboration.

contains some control variables that we will consider in some specifications. The results are reported in Table 8.

The first column shows the results with no other control variables than time dummies. These estimates indicate that, in the period 1980-2001, being a capital implied an additional 0.7 public workers each decade per each 100 inhabitants in the city in the base year. In the second column, we also consider population growth as a control variable despite its endogenous nature (public sector jobs might increase population as the model developed above predicts). When doing so, the capital effect increases, implying that being a capital comes with 1.1 public jobs for each 100 inhabitants. The population growth coefficient (0.036) indicates that an increase of 100 residents is associated with an increase in 3.6 public sector workers. In the last specification (column 3), we turn to test if public employment has been used to offset local economic shocks. To that end, we include a Bartik (1991) shift-share variable that captures demand driven private employment changes in city i:

$$\frac{\overline{E_{p,t+10}} - E_{p,t}}{L_t} = \frac{\sum_k \left(\frac{E_{ki,t}}{\sum_i E_{ki,t}} \sum_i E_{ki,t+10} - E_{ki,t} \right)}{L_t} \tag{36}$$

where E_p stands for private employment (the sum of tradable and non-tradable workers)

Table 8: The determinants of public sector job increases

	(1)	(2)	(3)
Capital	0.007***	0.011***	0.016***
	(0.002)	(0.002)	(0.003)
Population growth		0.036***	0.042***
		(0.007)	(0.008)
$\frac{\overline{E_{p,t+10}}-E_{p,t}}{L_t}$			-0.194***
			(0.060)
R-squared	0.041	0.119	0.165
Observations	166	166	166

Notes: 1) 1980-1990 and 1990-2001 pooled observations 2) Robust standard errors clustered at the city-level in parentheses. 3) *** denotes statistical significance at the 1% level. 4) Population growth is the contemporaneous decadal population growth rate. 5) $\frac{\overline{E_{p,t+10}}-E_{p,t}}{L_t}$ is the private job changes' predictor defined in 36.

and k indexes the (2-digit) industries within the private sector. The predicted employment change in 36 captures the component of the 1980-1990 and 1990-2001 local employment shock explained by the city's industry mix in the base year (1980 or 1990) interacted with the decadal (1980-1990 or 1990-2001) fate of industries at the national level. The results indicate that for each job lost due to a demand shock in a city, the public sector has created 0.194 jobs in the public sector in that city. This provides direct evidence that public employment has been used as a prominent policy instrument to offset local economic shocks. Note that these policy responses are important since they will bias downwards the Ordinary Least Squares (OLS) estimates in the regressions (to which we now turn) that estimate the effect of public employment on local private employment. As for the capital variable, this last specification implies that capital cities gained 1.6 additional public sector jobs more each decade in the period 1980-2001.

4.3 Public employment multipliers: OLS estimates

We now turn to the main analysis, namely, the estimation of public sector employment multipliers on employment and population. Specifically, we estimate the impact of (decadal) changes in public employment on contemporaneous changes in measures of employment and population. All employment and population changes are divided by the city's population level at the beginning of the decade. We run variants of the following specification.

$$\frac{Y_{t+10}-Y_t}{L_t} = \mu_t + \gamma\,\frac{E_{g,t+10}-E_{g,t}}{L_t} + \eta\, x_t + \zeta_t \tag{37}$$

where Y stands for tradable (E_t), non-tradable (E_n) and total employment (E), and active, working age, and total population (L). In addition to the change in public employment (E_g), the specification includes time dummies (μ_t), a vector containing control variables (x_t) and the error term (ζ_t). The results are reported in Table 9 where each row shows the effect a public sector job increase on a different outcome. The first column show the results of specifications that only include the time dummies as controls. In the second column, we also include the unemployment rate and the share of college graduates measured at the beginning of the decade. Some of the cities in our sample are fast-growing coastal cities associated with tourism such as Torrevieja, Costa del Sol or Tenerife Sur. Thus, in the third column we also include the share of vacation homes in 1991 as well as two coastal indicators: one for the north Atlantic coast (*Mar Cantábrico*) with less tourism and one for the Mediterranean, the Andalusian Atlantic and the Canaries coasts. Finally, as we have already commented when describing the summary statistics in Table 5, there is mean reversion in population growth. Hence, in column 4, we include a second order polynomial of the (logged) population level in 1970. The summary statistics for these controls are provided in the bottom panel of Table 5.

Table 9: Public employment multipliers: OLS estimates

Outcomes:	1	2	3	4
a)Tradable employment	0.087	0.116*	0.101	0.102
	(0.073)	(0.060)	(0.064)	(0.064)
b) Non-tradable employment	0.545***	0.649***	0.602***	0.614***
	(0.156)	(0.145)	(0.134)	(0.133)
c) Total employment	1.632***	1.765***	1.703***	1.716***
	(0.183)	(0.164)	(0.160)	(0.160)
d) Active population	1.780***	1.940***	1.853***	1.862***
	(0.211)	(0.185)	(0.168)	(0.169)
e) Working age population	0.938**	1.117***	0.865***	0.865***
	(0.438)	(0.421)	(0.334)	(0.295)
f) Population	1.679***	1.875***	1.447***	1.458***
	(0.573)	(0.576)	(0.456)	(0.452)
Unemployment rate	N	Y	Y	Y
Share college graduates	N	Y	Y	Y
Coastal dummies	N	N	Y	Y
Share second-homes in 1991	N	N	Y	Y
Logged pop in 1970 (2nd order pol.)	N	N	N	Y
N	166	166	166	166

Notes: 1) 1980-1990 and 1990-2001 pooled observations 2) Robust standard errors clustered at the city-level in parentheses. 3) ***,** and * denote statistical significance at the 1, 5 and 10% level. 4) Unemployment rate and share college graduates measured at the beginning of the decade. 5) Coastal dummies includes two dummies: One for the north Atlantic coast (*Cantábrico*) and one for the the Mediterranean, the Atlantic in Andalusia and the Canaries coasts.

Focusing on the last, and more complete, specification, the results indicate that public sector jobs do not significantly increase nor decrease employment in the tradable sector. In contrast, the results reported in the second row indicate that one additional job in the public sector creates about 0.5-0.6 jobs in the non-tradable sector. The effect on total employment (third row) is about 1.6-1.7 which includes the public job being created and the additional positive effect on private employment. Across the different model specifications, the results do not undergo any major changes. As for population, the results indicate that creating public sector jobs increase the active, the working age and total population, suggesting that taking geographical mobility into account might be important when assessing the local labor market effects of public employment expansions.

As uncovered by the analysis of the determinants of the public sector job expansions in Table 8, the public sector used public job openings to offset negative private employment shocks. This policy responses will tend to underestimate the (OLS) coefficients presented in Table 9. On the other hand, we have seen that cities that grow more hire more public employees (probably) to provide public services to a larger population. Since growing cities are likely to create more private as well as public jobs, this will tend to over-estimate the effect of public employment on private jobs. Hence, the estimates provided in this section could be either under- or over-estimates of the effect of public sector expansions on private employment and population. Thus, we now turn to our instrumental variables approach to estimate the causal multiplier effects of public sector jobs.

4.4 Public employment multipliers: TSLS estimates

We have seen above that capital cities (as opposed to non-capital cities) experienced larger increases in public sector jobs when the Spanish public sector developed in the period 1980-2001. This observation is the basis of the instrumental variables approach that we adopt which consists in using the capital status of a city to instrument for changes in public employment relative to the population level in the base year. Table 10 reports the 2SLS estimates of equation 37 and shares the structure of Table 9. That is, each row shows the public employment coefficient on an employment or a population outcome. In terms of control variables, the first column corresponds to the specification reported in the last column of Table 9. This baseline specification includes time dummies, the unemployment rate and the share of college graduates at the beginning of the decade, the tourism variables (the coast indicators and the share of second-homes in the city), and the 2nd order polynomial of the (logged) population level in 1970.

Table 10: Public employment multipliers: TSLS estimates

	1	2	3	4	5
a) Tradable employment	0.267	0.314	0.364	0.351	0.287
	(0.294)	(0.319)	(0.337)	(0.329)	(0.314)
b) Non-tradable employment	1.078***	1.259***	1.404***	0.861***	1.020**
	(0.415)	(0.489)	(0.449)	(0.325)	(0.416)
c) Total employment	2.344***	2.573***	2.769***	2.129***	2.307***
	(0.571)	(0.666)	(0.638)	(0.447)	(0.588)
d) Active population	2.695***	2.967***	3.156***	-	2.667***
	(0.672)	(0.778)	(0.713)		(0.681)
e) Working age population	4.443***	4.983***	5.148***	-	4.265***
	(1.463)	(1.678)	(1.510)		(1.442)
f) Population	6.356***	7.062***	7.037***	5.820***	6.257***
	(2.027)	(2.357)	(2.196)	(2.174)	(2.034)
Unemployment rate	Y	Y	Y	Y	Y
Share college	Y	Y	Y	Y	Y
Tourism variables	Y	Y	Y	Y	Y
2^{nd} order logged pop. polynomial	Y	Y	Y	Y	Y
Weather	N	Y	N	N	N
Regional fixed effects	N	N	Y	N	N
Lagged dependent variable	N	N	N	Y	N
Motorways	N	N	N	N	Y
F-test of excluded instruments	15,750	15,160	15,010	-	14,340
N	166	166	166	166	166

Notes: 1) 1980-1990 and 1990-2001 pooled observations 2) Robust standard errors clustered at the city-level in parentheses. 3) ***,** and * denote statistical significance at the 1, 5 and 10% level. 4) Unemployment rate and share college graduates measured at the beginning of the decade. 5) Coastal dummies includes two dummies: One for the north Atlantic coast (*Cantábrico*) and one for the the Mediterranean, the Atlantic in Andalusia and the Canaries coasts. 6) Weather includes annual days of frost, hours of sun and rainfall. 7) Regional fixed effects for the 7 NUTS1 Spanish regions. 8) The estimates for active population and working age population not shown in the specification with lagged dependent variables as these outcomes are not available for 1970. For this specification, the F-statistic is not reported as for each outcome it takes a different value 9) Motorways is the decadal contemporaneous increase in the number of motorway rays.

Regarding the second stage results, the tradable employment coefficient is not statistically different from zero although the point estimate is larger than its OLS counterpart. Jobs in the (private) non-tradable sector increase in a city when public sector jobs are created. Specifically, a new job in the public sector creates about another job (1.078) in the non-tradable sector. Considering the job created by the public sector itself, the effect on total employment is 2.344 (row c). The effects on population are sizable, too. One job in the public sector increases the city's labor force by 2.695 workers (row d) and the working age population by 4.443 (row e). Finally, the coefficient on total population is 6.356, indicating that city size is very responsive to the creation of public sector jobs (row f). Note that the 2SLS (positive) estimates of public employment on total employment and on population are larger than their corresponding OLS estimates. This suggests that the latter are downwards biased and confounded by the strong policy responses consisting in offsetting negative shocks in private employment by expanding public sector jobs.

For the estimates in Table 10 to be reliable, the instrument used needs to be both relevant and valid. In terms of relevance, the estimates in Table 8 indicate that, indeed, capital cities attracted more public sector jobs. According to the last column of this Table, capital cities gained 1.6 additional public sector jobs each decade in the period 1980-2001. In any case, at the bottom of Table 10, we report the F-test of excluded instruments to formally assess the relevance of the instrument used. The value of the F-test, obtained in a regression where the standard errors are clustered at the city-level, is 15.75 and corroborates that, indeed, capital cities attracted more public sector jobs. In fact, the instrument coefficient in the first stage regression is 0.017 which is very close to 0.016, the estimate obtained in the last specification of Table 8.

Regarding instrument validity, the identifying assumption is that, conditional on control variables, the capital status of a city is uncorrelated to unobserved shocks in employment and population decadal changes. As explained above, provincial capitals were established in 1833 and, therefore, are clearly pre-determined with respect to our outcome variables. However, capital cities differ from non-capital cities in several respects. Capital cities have a lower unemployment rate (the average unemployment rate -pooling 1981 and 1991- is 16.91 and 20.04 for capital and non-capital cities) and a larger fraction of college graduates (the average share of college graduates -pooling 1981 and 1991- is 9.71 and 5.75 or capital and non-capital cities). As Map 1 shows, capital cites are also less likely to be on the Mediterranean and Canaries' coasts. Finally, capital cities are larger as can be readily seen in Figure 2. Although including these controls had a modest impact on the OLS coefficients (see Table 9, their exclusion do confound the 2SLS estimates. Thus, our identifying assumption is that capital status is uncorrelated to shocks in employment and population changes once we control for initial unemployment, education, location (coast versus inland) and size. Several robustness checks to which we now turn, indirectly support the validity of this maintained assumption.

In the US, weather has been an important determinant of city growth, see e.g. (Rappaport, 2007). In column 2 of Table 10 we include as controls the city's annual averages in days of frost, hours of sun and rainfall[20]. The results remain unchanged indicating that a correlation between weather and capital status is not confounding our estimates.

As explained above, capital cities are less likely to be on the Mediterranean and Canaries' coasts. More generally, Figure 1 also reveals that while capitals are evenly distributed across Spain, non-capitals are concentrated in the east and the south-east. Since the east has performed particularly well in the period of study, the results could be biased by the fact that regions performing better have a higher proportion of non-capital cities. Thus, in column 3, we include dummies for the 7 (broad) NUTS1 Spanish regions[21]. The results, that exploit changes between cities within regions remain largely unchanged and indicate that regional specific trends in employment and population are not confounding our results.

In column 4 we move to city-specific pre-treatment trends in employment and population. Specifically, we include, as an additional control variable, the lagged dependent variable (1970-1980 and 1980-1990 values for 1980-1990 and 1990-2001 observations, respectively). Since we do not have the active and the working-age population for 1970, we can not estimate this specification for rows d) and e). Reassuringly, our estimates do not undergo any significant changes suggesting that our results are not driven by pre-existing city-specific time trends.

In the period that we study, Spain developed an important motorway network that has been found to affect city growth, see, e.g. (Garcia-López, 2012) and (Garcia-López et al., 2015). Since the created network might have provided better connection to capital cities, in column 5 we include, as an additional control variable, the decadal contemporaneous increase in the number of motorway rays in the city[22]. The results suggests that the positive effects that we document from public sector jobs on private employment and population are not capturing higher infrastructure investments in capital cities. Overall, once we account for basic differences across cities in terms of unemployment, education, location (coastal versus non-coastal cities) and size, the results do not seem to be sensitive to a number of identification threats.

We conclude this section by comparing the estimated multipliers with those obtained when simulating the search and matching model in section 2. According to the regressions, one additional public sector job increases private employment by 1.344 and active population by 2.695. The corresponding multipliers found in section 2 (Table 2) were 1.256 and 2.573, respectively. Admittedly, the multipliers for the tradable sector are not so similar. While

[20] *Agencia Estatal de Metereología*. 1980-2010 averages. There are a handful of cities without a climate observatory. For these cities, we impute the values of the closest observatory.

[21] North west: Galicia, Asturias and Cantabria; North East: Basque Country, Navarre, La Rioja, Aragon; Madrid; Centre: Castile and Leon, Castile-la Mancha, Extremadura; East: Catalonia, Valencian Community and Balearic Islands; South: Andalusia, Region of Murcia; Canary islands

[22] Number of motorway rays in each city computed using the *Mapa General de Carreteras - Ministerio de Fomento* from the years 1980, 1990 and 2001

the multiplier is -0.012 according to the simulated model, the corresponding TSLS (point) estimate is 0.267 although this estimate is not statistically different from zero. All in all, the empirical findings following the two different empirical approaches yield remarkably similar results and, thus, the two approaches cross-check each other.

4.5 Do public sector jobs reduce local unemployment?

The regression results obtained above clearly indicate that public sector jobs do increase private employment. However, they also show that population also increases and, thus, the effect on the unemployment rate is not obvious. To assess the implied effects on the unemployment rate by the estimates presented in Table 10, we take the average Spanish city in 2001 and assume that public employment increases by 50%, which is the policy experiment that we have simulated with the calibrated search and matching model in section 2. The findings are reported in Table 11.

Table 11: The local labor market effects of public sector job expansions

Variables	Mean 2001	Multiplier	New Equilibrium	% Change
Total employment	119,700	2.340	154,261	28.870
Active population	141,829	2.700	181,565	28.020
Working age pop.	228,056	4.440	293,566	28.730
Population	330,320	6.360	424,036	28.370
Unemployment rate	15.600		15.040	-0.560[a]
Participation rate	62.190		61.850	-0.340[a]
Public employment	29,489		44,234	50.000

Notes: 1) The new equilibrium is the result of adding to the 2001 mean, the respective multiplier times 14,745 (a 50% increase in public employment starting from 29,489 jobs). The last two columns (shown for the ease of comparability) shows the baseline simulations reported in Table 2. 2) [a] are changes expressed in percentage points.

Column 2 reproduces the estimated multipliers reported in the first column in Table 10. The new equilibrium is the result of adding to the 2001 mean, the respective multiplier times 14,745, which is a 50% increase in public jobs for the average city in 2001. Increasing public employment by 50% increases total employment by 28.9%. At the same time, however, active population grows at a similar rate (28.02%) and, as a result, the unemployment rate experiences a rather limited decrease. In particular, the unemployment rate only decreases from 15.6 to 15.04%. These results are, again, very similar to those predicted by the simulations in section 2. In the baseline scenario (Table 2), increasing public employment by 50% increases total employment and active population by 27.84% and 26,70%, respectively, with the unemployment rate falling from 15.6% to 14.9%.

As explained above, one important phenomenon occurring in the Spanish labor markets in the period that we study is a drastic increase in female labor force participation. Hence, public employment might have contributed to increase (female) labor force participation. Our estimated effects on the active and the working-age city population levels suggest that this was not the case. Specifically, public sector jobs increase the labor force and the working-age population in the city by a similar magnitude and, as a consequence, participation in the labor market remains unaltered. All in all, migration seems to be the main margin through which local labor markets adjust to public sector jobs expansions. This finding provides empirical support for not considering labor force participation decisions in the model developed in section 2.

5 Summary and final remarks

In this paper we have quantified the impact of public employment on local labor markets in the long-run, following two different quantitative approaches that we apply to the case of Spanish cities. In the first one, we have developed a 3-sector (public, tradable and non-tradable) search and matching model embedded within a spatial equilibrium model in the spirit of Beaudry et al. (2012) and Kline and Moretti (2013). We have characterized the steady state of the model and calibrated it to match the labor market characteristics of the average Spanish city. Then, we use the model to simulate a policy consisting in expanding public sector employment in a city. In second empirical approach, we have used regression analysis to estimate public sector job growth on decadal changes (1980-1990 and 1990-2001) in the employment and population of Spanish cities. This analysis has exploited the dramatic increase of public employment in the 1980-2001 period, following Franco's death in 1975 and the advent of democracy in 1978. We have resorted to an instrumental variables' approach that uses the capital status of cities to instrument for changes in public sector employment.

The two empirical approaches yield qualitatively similar results and, thus, cross-check each other. One additional public sector jobs creates between 1.2 to 1.4 private sector jobs. However, these new jobs do not translate into a substantial reduction of the local unemployment rate as better labor market conditions attract new workers to the city. Increasing public employment by 50% only reduces unemployment by from 15.6 to 14.9-15%. One important message of this paper is that taking geographical mobility into account can be crucial for properly evaluating the equity and efficiency of regional and local policies, as has been emphasized by Kline and Moretti (2013) and Glaeser and Gottlieb (2008) when assessing the rationale for place-based initiatives.

References

Albouy, D. (2009). "The Unequal Geographic Burden of Federal Taxation." *Journal of Political Economy*, *117*(4), 635–667.

Alesina, A., Danninger, S., and Rostagno, M. (2001). "Redistribution Through Public Employment: The Case of Italy." *IMF Staff Papers*, *48*(3), 2–44.

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

Andersson, R. (2005). "The efficiency of Swedish regional policy." *The Annals of Regional Science*, *39*(4), 811–832.

Bartik, T. J. (1991). *Who Benefits from State and Local Economic Development Policies?* No. wbsle in Books from Upjohn Press, W.E. Upjohn Institute for Employment Research.

Beaudry, P., Green, D. A., and Sand, B. (2012). "Does Industrial Composition Matter for Wages? A Test of Search and Bargaining Theory." *Econometrica*, *80*(3), 1063–1104.

Borge, L.-E., and Matsen, E. (2004). "Public Employment and Regional Risk Sharing." *Scandinavian Journal of Economics*, *106*(2), 215–230.

Bover, O., and Arellano, M. (2001). "Learning about migration decisions from the migrants: Using complementary datasets to model intra-regional migrations in Spain." *Journal of Population Economics*, *15*(2), 357–380.

Bradley, J., Postel-Vinay, F., and Turon, H. (2015). "Public Sector Wage Policy and Labor Market Equilibrium: A Structural Model." Tech. rep.

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

Carrión-i Silvestre, J. L., Espasa, M., and Mora, T. (2008). "Fiscal Decentralization and Economic Growth in Spain." *Public Finance Review*, *36*(2), 194–218.

Ciccone, A., and Hall, R. E. (1996). "Productivity and the Density of Economic Activity." *American Economic Review*, *86*(1), 54–70.

Combes, P.-P., Duranton, G., and Gobillon, L. (2012). "The Costs of Agglomeration: Land Prices in French Cities." CEPR Discussion Papers 9240, C.E.P.R. Discussion Papers.

Combes, P.-P., and Gobillon, L. (2015). "Chapter 5 - the empirics of agglomeration economies." In J. V. H. Gilles Duranton, and W. C. Strange (Eds.), *Handbook of Regional and Urban Economics*, *Handbook of Regional and Urban Economics*, vol. 5, 247 – 348, Elsevier.

Davis, M. A., and Heathcote, J. (2007). "The price and quantity of residential land in the United States." *Journal of Monetary Economics*, *54*(8), 2595–2620.

Davis, M. A., and Ortalo-Magne, F. (2011). "Household Expenditures, Wages, Rents." *Review of Economic Dynamics*, *14*(2), 248–261.

De la Roca, J., and Puga, D. (2013). "Learning By Working In Big Cities." Working Papers 2013-1301, CEMFI.

Faggio, G., and Overman, H. (2014). "The effect of public sector employment on local labour markets." *Journal of Urban Economics*, *79 - Spatial Dimensions of Labor Markets*, 91–107.

Garcia-López, M.-A. (2012). "Urban spatial structure, suburbanization and transportation in Barcelona." *Journal of Urban Economics*, *72*(2), 176–190.

Garcia-López, M.-A., Holl, A., and Viladecans-Marsal, E. (2015). "Suburbanization and highways in Spain when the Romans and the Bourbons still shape its cities." *Journal of Urban Economics*, *85*(C), 52–67.

Glaeser, E. L., and Gottlieb, J. D. (2008). "The Economics of Place-Making Policies." *Brookings Papers on Economic Activity*, *39*(1 (Spring), 155–253.

Gomes, P. (2015a). "Heterogeneity and the public sector wage policy." Tech. rep.

Gomes, P. (2015b). "Optimal public sector wages." *The Economic Journal*, *125*(587), 1425–1451.

Hilber, C. A. L., and Vermeulen, W. (2015). "The impact of supply constraints on house prices in england." *The Economic Journal*, n/a–n/a.

Hospido, L., and Moral-Benito, E. (2014). "The public sector wage premium in spain: Evidence from longitudinal administrative data.", banco de España WP 1422.

Jofre-Monseny, J. (2014). "The effects of unemployment protection on migration in lagging regions." *Journal of Urban Economics*, *83*, 73 – 86.

Kline, P., and Moretti, E. (2013). "Place Based Policies with Unemployment." *American Economic Review*, *103*(3), 238–43.

Kraus, F., Puhani, P. A., and Steiner, V. (1998). "Do public works programs work? Some unpleasant results from the East German experience." Tech. rep.

Marqués-Sevillano, J. M., and Rosselló-Villallonga, J. (2004). "Public employment and regional redistribution in spain." *Hacienda Pública Española*, *170*(3), 59–80.

Moretti, E. (2010). "Local multipliers." *American Economic Review*, *100*, 373–377.

Moretti, E. (2012). *The New Geograpgy of Jobs*. Houghton Mifflin Harcourt, New York.

Moretti, E., and Thulin, P. (2013). "Local multipliers and human capital in the united states and sweden." *Industrial and Corporate Change*, *22*(1), 339–362.

OECD (2015). *Government at a Glance 2015*. OECD Publishing.

Pissarides, C. A., and Petrongolo, B. (2001). "Looking into the Black Box: A Survey of the Matching Function." *Journal of Economic Literature*, *39*(2), 390–431.

Quadrini, V., and Trigari, A. (2007). "Public employment and the business cycle*." *The Scandinavian Journal of Economics*, *109*(4), 723–742.

Rappaport, J. (2007). "Moving to nice weather." *Regional Science and Urban Economics*, *37*(3), 375–398.

Roback, J. (1982). "Wages, rents, and the quality of life." *Journal of Political Economy*, *90*(6), 1257–1278.

Rosenthal, S. S., and Strange, W. C. (2008). "The attenuation of human capital spillovers." *Journal of Urban Economics*, *64*(2), 373 – 389.

Silva, J. I., and Vázquez-Grenno, J. (2013). "The ins and outs of unemployment in a two-tier labor market." *Labour Economics*, *24*(C), 161–169.

Wrede, M. (2015). "Wages, rents, unemployment, and the quality of life: A consistent theory-based measure." *Journal of Regional Science*, *55*(4), 609–625.

A Appendix: The wages equations

To obtain the wage equations (24) and (25)we start using the first order conditions (22) and (23). Next, we solve for J_t in (3) and J_{nt} in (4)

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

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

Notice that the job creation conditions (22) and (23) 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),

$$(W_t - U) = \frac{\frac{w_t}{PI} - rU}{(r + s_t)}, \tag{A-3}$$

$$(W_n - U) = \frac{\frac{w_n}{PI} - rU}{(r + s_n)}, \tag{A-4}$$

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

$$w_t = (\frac{\beta A_t(L)}{PI} + (1 - \beta) rU) PI, \tag{A-5}$$

$$w_n = (\frac{\beta p_n A_n}{PI} + (1 - \beta) rU)(PI), \tag{A-6}$$

To obtain rU we use equations (8),(22) and (23) and substitute $J_i = \frac{k_i}{q(\theta)}$ in (13) and (14)

$$(W_t - U) = \frac{\beta}{(1-\beta)} \frac{k_t}{q(\theta)PI}, \tag{A-7}$$

$$(W_n - U) = \frac{\beta}{(1-\beta)} \frac{k_n}{q(\theta)PI}, \tag{A-8}$$

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

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

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

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

By substituting (A-10) into (A-5) and (A-6) we obtain the wage equations (24) and (25).

B Appendix: Derivation Nash solution

B.1 Appendix: Tradable sector

$$\max_w (W_t - U)^\beta (J_t - V_t)^{1-\beta}, \tag{A-11}$$

$$rV_t = 0, \tag{A-12}$$

Then the FOC's

$$\beta(W_t - U)^{\beta-1}\frac{dW_t}{dw_t}J_t^{1-\beta} + (W_t - U)^{\beta}(1-\beta)\frac{dJ_t}{dw_t}J_t^{-\beta} \;=\; 0, \tag{A-13}$$

$$\beta(W_t - U)^{-1}\frac{dW_t}{dw_t}J_t \;=\; (1-\beta)\frac{dJ_t}{dw_t}, \tag{A-14}$$

$$\beta\frac{dW_t}{dw_t}J_t \;=\; -(W_t - U)(1-\beta)\frac{dJ_t}{dw_t}, \tag{A-15}$$

From Equations 3 and A-12:

$$J_t \;=\; \frac{A_t(L) - w_t}{r + s_t}, \tag{A-16}$$

then,

$$\frac{dJ_t}{dw_t} \;=\; \frac{-1}{r + s_t}, \tag{A-17}$$

Subtracting rU from both sides of Equation 10

$$r(W_t - U) \;=\; \frac{w_t}{PI} + s_t(U - W_t) - rU, \tag{A-18}$$

operating,

$$(W_t - U) \;=\; \frac{\frac{w_t}{PI} - rU}{r + s_t}, \tag{A-19}$$

then,

$$\frac{dW_t}{dw_t} = \frac{\frac{1}{PI}}{r+s_t}, \tag{A-20}$$

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

$$\frac{1}{PI}\beta J_t = (1-\beta)(W_t - U), \tag{A-21}$$

B.2 Appendix: Non-tradable sector

$$\max_w (W_n - U)^{\beta}(J_{nt} - V_n)^{1-\beta}, \tag{A-22}$$

$$rV_{nt} = 0, \tag{A-23}$$

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

$$r(W_n - U) = \frac{w_n}{PI} + s_n(U - W_n) - rU, \tag{A-29}$$

operating,

$$(W_n - U) = \frac{\frac{w_n}{PI} - rU}{r + s_n}, \tag{A-30}$$

then,

$$\frac{dW_n}{dw_n} = \frac{\frac{1}{PI}}{r + s_n}, \tag{A-31}$$

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

$$\frac{1}{PI}\beta J_n = (1 - \beta)(W_n - U), \tag{A-32}$$