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Public Sector Employment and Local Multipliers*

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Abstract

This paper assesses the spillover effects of public sector employment on private sector employment at the level of local labor markets in Germany between 2003 and 2007. I find that public sector employment has sizable crowding out effects on the private sector. The results suggest that 10 additional jobs in the public sector destroy 8 jobs in the private sector. I further show that public sector employment has an impact on the structure of the private sector. By raising wages in the private sector, public sector employment crowds out employment in the tradable sector. In contrast, employment in nontradable industries is largely unaffected.

Key Words: Local labor markets; public sector employment; local multiplier effects

JEL Classification: H70, R12

*Thanks to... This study uses the weakly anonymous Establishment History Panel (Years 2003-2010). Data access was provided via onsite use at the external location of the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) in Berlin. The sole responsibility for the analysis and interpretation of the data in the paper remains with the author.

1 Introduction

There is substantial variation in unemployment rates across regions in many European countries.[1] In order to equalize spatial dispersion, some policy makers consider the creation and relocation of public sector employment (Alesina et al., 2001; Smith, 2010). Using data for 412 German administrative districts, this paper studies labor market adjustments in the private sector to public employment growth. This paper contributes to the existing literature by providing novel evidence on the impact of public sector growth on private sector employment in Germany. Further, it assesses how local wages respond to changes in public employment. To my knowledge, this aspect has not been studied in the empirical literature so far.

To analyze if and to what extent public employment creation has spillover effects on the private sector in Germany, I relate changes in private sector employment outcomes between 2003 and 2007 across German districts to an increase in the number of jobs in the public sector, allowing for price adjustments and endogenous factor reallocation. Because public sector employment growth may be endogenous and ordinary least squares estimates would be confounded, I employ an instrumental variable technique that isolates exogenous shocks to labor demand in the public sector. The results of this analysis suggest that that public employment has substantial crowding out effects on employment in the private sector. More specifically, I estimate that 100 additional public jobs crowd out 74 jobs in the private sector. I further show that public sector employment increases local wages and thereby affects the industry mix in the private sector: On the one hand, an increase in wages leads to a deterioration of the competitiveness of the tradable goods sector and employment in this sector decreases. On the other hand, employment in the nontradable industries remains largely unaffected because increases in wages and prices are offset by rising local demand for nontradable goods.

The findings of the present study are informative for local policies that intend to stimulate employment by creating jobs in the public sector because, from a theoretical point of view, the overall effect of public sector employment growth on employment in the private sector is ambiguous: Public employment programs create direct employment and have positive spillover effects on employment in the private sector, as they raise aggregate demand. However, this positive effect on employment may be offset by increasing wage pressure and rising taxes (Algan et al., 2002). What is more, if the public sector produces goods and services that are substitutable to these provided by the private

[1] For example, in Germany, the regional unemployment rate in Berlin in 2013 amounted to 12.7% and is three times larger than in Bavaria (3.8%).

economy, employment in the private sector will be harmed.

My analysis combines studies on the impact of public sector employment with a growing literature on local multipliers and spillover effects. A number of cross-country analyses has explored the impact of public sector employment on labor market outcomes. While the majority of these studies find that public sector employment crowds out employment in the private sector, the magnitude of the effects varies substantially between different studies. Using data on 22 OECD countries, Edin and Holmlund (1997) show that an increase in public sector employment reduces unemployment in the short run but has no significant effect in the long run. Boeri et al. (2000) focus on short-run effects of public employment on the private sector and estimate that 10 additional public jobs destroy 3 jobs in the private economy. Algan et al. (2002) analyze a panel of 17 OECD countries between 1960 and 2000 and find that in the long run, 10 public sector jobs crowd out 15 private jobs. The problem with these studies is that individual countries often differ strongly with respect to their institutional frameworks, which are likely to influence employment outcomes and are very difficult to control for. In addition, only few of the studies account for endogeneity and reverse causality issues. In this paper, I circumvent the problem of different institutional frameworks as the analysis is conducted at the level of local labor markets. Additionally, I use an instrumental variable technique that isolates exogenous shocks to labor demand in the public sector.

Existing literature on local multipliers has so far mainly focused on spillover effects from the tradable sector on employment outcomes in the nontradable sector. Moretti (2010) presents evidence for strong positive spillover effects in the United States, estimating that each additional job in the manufacturing sector creates 1.6 jobs in nontradable industries. Moretti and Thulin (2013) perform a similar analysis for the Swedish labor market and conclude that local multiplier effects are substantially smaller in Sweden. In addition, the authors show that local multipliers vary considerably across industries. In a similar vein, Humphreys and Marchand (2013) examine the spillover effects of the opening of casinos in Canada. They find that each job in the gambling industry creates one or two jobs in the hospitality industry. In contrast to studies of multiplier effects of the manufacturing industry, literature on local spillover effects of public sector employment is scarce. One notable exception is a recent study by Faggio and Overman (2014) who analyze the impact of public sector employment on private sector employment for the UK at the Local Authority level. The authors find no aggregate effects on private employment in the short-run, but show that public sec-

tor employment differentially affects tradable and nontradable private sector employment. When considering longer time periods, they find crowding out effects that are close to unity. An analysis of the effects of public sector employment for Germany and its comparison with existing estimates for the UK is interesting because, as will be shown later, the magnitude of the employment effects depends crucially on the labor supply elasticity, which is likely to differ across both countries. For example, Germany has a more generous benefit system and exhibits lower labor mobility. Because these features determine the labor supply elasticity, the effects of public sector employment on the private sector may also vary.

Finally, this paper is also related to the literature on pay structures in the private and public sectors. A cross-country analysis across numerous EU countries conducted by de Castro et al. (2013) point to the existence of a significant public-private pay gap in the majority of countries studied. The authors estimate that in Germany, earnings in the public sector are about 10% higher than wages in the private sector. This gap is found to be larger for females than for males. Studies by Dustmann and van Soest (1997; 1998) provide evidence that wages in Germany, conditional on personal characteristics, are higher in the public sector for women, but higher in the private sector for men. Melly (2005) uses quantile based approaches to show that, for both genders, the pay gap is positive and large for workers at the bottom of the wage distribution and decreases with wages. In addition, wages in the public sector are found to be less dispersed (Jürges, 2002).

The remainder of the paper is structured as follows. In the next section I present the logical underpinning of the local multiplier effect of public sector employment on private sector employment. I will then derive a number of hypotheses and describe the empirical approach to test these. Section 3 gives an overview of the datasets that are used in the econometric analysis and provides some descriptive evidence. The empirical analysis is conducted in section 4. Section 5 concludes.

2 Conceptual Framework and Empirical Strategy

2.1 Conceptual Framework and Empirical Predictions

Here I follow Faggio and Overman (2014) who augment the theoretical considerations of Moretti (2010; 2011) concerning the impact of tradable private sector employment on nontradable industries by taking into account the direct and indirect effects of public employment creation on

employment and wages in the private sector. Consider a closed economy with spatially separated regions where labor is perfectly mobile across sectors within regions. Furthermore, assume the existence of a positive public-private sector pay gap. Hence, when jobs are created in the public sector, a region's aggregate income and employment level increases. This, one the one hand, increases the local demand for nontradable services (e.g restaurants, retail). On the other hand, the public sector may provide goods that are substitutes for private sector provision (e.g. private schools, hospitals or postal services). Unless this substitution effect dominates the income effect, employment in the nontradable sector will increase. The magnitude of this multiplier effect depends on consumer preferences for nontradables, technologies in the nontradable sector, and on offsetting general equilibrium effects on wages and prices. That is, the more elastic is labor supply, the smaller will be regional wage increases and the larger will be the multiplier effect on the nontradable sector. Labor supply elasticity, in turn, is determined by exogenous factors such as labor mobility and the generosity of the benefit system.

Assume further that local demand is a negligible component of total demand for tradable goods. Then, the local increase in wages hurts employment in tradable industries. The reason is that the increase in production costs decreases the competitiveness of tradable industries, while positive demand effects resulting from an increase in local income are absent. Increases in local prices of nontradables and housing will further decrease employment in the tradable sector.

This conceptual framework provides a number of empirically testable implications. Firstly, the model predicts that an increase in local labor demand for public employment will cause a change in the structure of employment away from the tradable sector towards the nontradable and the public sector. Secondly, the relative magnitudes of the two countervailing effects in the tradable and the nontradable sector determine whether the overall spillover effect from public to private sector employment is positive or negative. Finally, an increase in public sector employment should lead to an increase in private sector wages as well as to rising prices of nontradables.

2.2 Empirical Strategy

2.2.1 Econometric Specification

In order to test the empirical implications of the conceptual framework for Germany, I conduct an empirical analysis at the level of local labor markets. I start by assessing whether public sector

employment has effects on overall private sector employment and on other labor market outcomes, such as unemployment, the local labor force and migration. Then, I investigate whether these effects are heterogeneous across different industries and explore whether public employment increases local wages. For the analysis of employment outcomes, the following empirical model is estimated:

$$\Delta L_r = \alpha + \beta \Delta PSC_r + \gamma X_r + \epsilon_r. \tag{1}$$

The explanatory variable, ΔPSC_r, represents the regional contribution of public sector employment to overall employment and is defined as

$$\Delta PSC_r = \frac{E^{pub}_{r,2007} - E^{pub}_{r,2003}}{E^{tot}_{r,2003}} \tag{2}$$

In this expression, public sector contribution is measured as the change in public sector employment, E^{pub}_r, between 2003 and 2007 in region r, normalized by overall regional employment in the year 2003, $E^{tot}_{r,2003}$. This estimation approach is similar to Card (2007) and Faggio and Overman (2014), where total employment growth is decomposed into the sum of the contributions from the private and the public sector, respectively. Similarly to the main explanatory variable, the dependent variable, ΔL_r, represents the change in private sector employment in district r between 2003 and 2007, normalized by total initial district employment. The parameter of interest, β, is the coefficient on the contribution of public sector employment to overall employment growth. If $\beta > 0$, public sector employment has multiplying effects on the private sector, while a $\beta < 0$ would imply that public sector employment crowds out employment in the private sector. In additional specifications, I split private sector employment into the tradable and the nontradable sector to capture potentially heterogeneous effects. I further employ the empirical model described by equation 1 to estimate the effect of public sector employment on unemployment, the size of the local labor force and migration. For ease of comparison, these variables are also normalized by total initial district employment.

To control for potentially confounding factors, the model is augmented by start-of-period district characteristics, X_r. These controls include the regional qualification structure, as a number of studies find strong correlation between educational composition and employment growth (Glaeser and Resseger, 2010; Südekum, 2010). I also add total initial district population (Südekum, 2008).

In the final specification, the model is further augmented by a dummy indicating whether a district is located in the former Eastern part of Germany and a variable that groups the districts into two basic area types (districts in urban and rural areas), using a classification developed by Lehmer and Möller (2010) for their analysis of the urban wage premium.

For the analysis of the wage outcomes that vary at the individual level, I pool microdata on log real daily wages from 2003 and 2007 to estimate wage equations of the following form:

$$\ln W_{irt} = \alpha + \beta \left(\Delta PSC_r \times \mathbb{I}[t = 2007] \right) + \gamma X_{irt} + \epsilon_{irt}, \tag{3}$$

where the subscript i denotes individual observations. The term $\left(\Delta PSC_r \times \mathbb{I}[t = 2007] \right)$ interacts public sector contribution with a dummy for the year 2007. Thus, the coefficient on this expression measures the impact of public sector contribution on wage growth during 2003-2007. The model is augmented with a set of worker level covariates, X_{irt}, each interacted with time dummies. The vector of individual controls includes a quartic in age and dummies for foreign citizenship, gender, two part-time indicators as well as dummies for 7 broad occupational groups and 13 broad industry categories. Because the explanatory variable varies at the level of districts, while the wage variable varies at the individual level, I use Huber-White robust standard errors clustered at the district level (Moulton, 1986).

2.2.2 Identification and Instrumental Variables Approach

One concern for the estimation of equation 1 is that public sector growth may be correlated with unobserved determinants that also influence employment growth in the private sector. In this case, the OLS estimator of the model described by equation 1 would be inconsistent and biased for β. In principle, this bias can be either negative or positive. If, for example, local governments attempt to offset negative shocks to private sector employment by creating jobs in the public sector, the correlation between public sector employment and the error term is negative and the estimate of β will be downward-biased. In contrast, if public employment responds to overall population growth, estimates of β will suffer from upward-bias. Hence, to identify the *causal* effect of public employment growth on private sector employment, I employ an instrumental variable approach that isolates exogenous variation in the demand for public sector employment following Bartik (1991).[2] My in-

[2] Similar applications can be found in Card (2007), Moretti (2010) and Faggio and Overman (2014).

strument is represented by a weighted average of national changes in public sector employment between 2003 and 2007, with weights reflecting the district specific public employment share in region r in the base year 2003. To address the issue that district changes in public sector employment drive nationwide developments, national changes are computed excluding region r:

$$\frac{E_{2003}^{pub}}{E_{2003}^{tot}} \times \frac{E_{-r,2007}^{pub} - E_{-r,2003}^{pub}}{E_{-r,2003}^{tot}} \tag{4}$$

This expression differs from the expression in equation 2 because it employs *nationwide* public sector employment growth and thereby abstracts from region-specific labor demand shocks that may induce bias. Instead, it reflects the assumption that in the absence of regional shocks, each district would have changed its public sector employment by an equal share. These nationwide changes affect regions differently due to their public-private sector mix in the base year 2003. Then, for example, if national public sector employment growth is positive, the district that initially exhibits a higher share of public sector employment experiences a larger increase in the demand for public jobs.

Because the expression described by equation 4 does not reflect local economic conditions, it is arguably orthogonal to the error term and therefore provides an appealing instrument for ΔPSC_r. Figure 1 sketches the estimation strategy by plotting public sector contribution against the instrument described by equation 4, which is equivalent to the first-stage regression without additional controls. The figure shows that the predictive power of the instrument is substantial and highly significant, with a coefficient of 2.34 and a t-ratio of above 11.

3 Data Description

I consider employment and wage outcomes for 412 districts in Germany. Information on public and private sector employment is derived from the German Federal and State Statistical Offices. Within its work force statistics (*Personalstandsstatistik*), the German Federal Statistical Office provides yearly information on overall personnel employed in the public sector as of the 30th of June at the district level. As this dataset covers the full universe of public employees, it can be considered as highly reliable. The data covers all workers employed in the public sector, including the

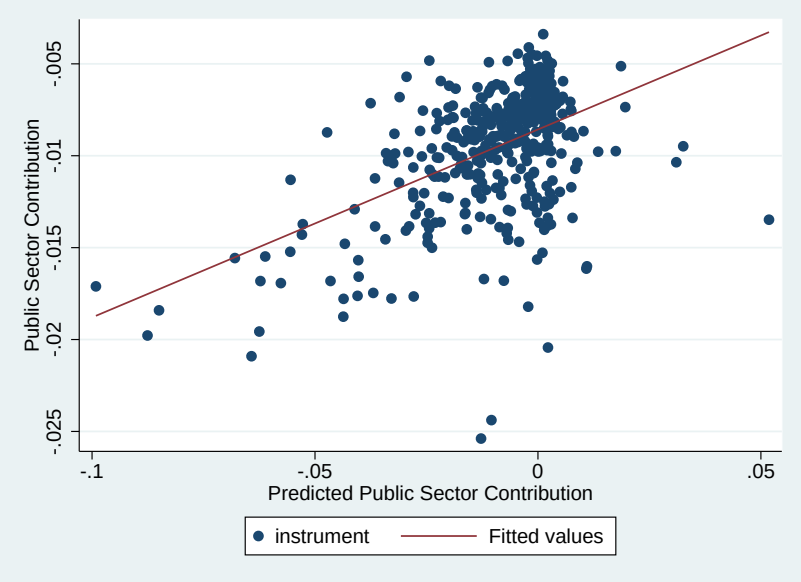

Figure 1: First Stage Regression

Notes: Figure plots the instrument against regional public sector contribution for 402 districts. The line corresponds to the predicted public sector contribution, where the slope is 2.34 and the t-value is 11.12.

central government, state and local authorities and financial and non-financial public enterprises. The data also comprises both types of public employees, i.e. civil servants and blue-collar or white-collar employees. The Federal Statistical office further provides information on overall employment at the district level. This information covers employees subject to social security contributions, self-employed, marginally employed as well as employees in the public sector. Hence, private sector employment can be calculated by subtracting public employment from total employment in each region and year. Because of missing data in the public employment statistics, I am forced to exclude ten districts. Thus, the final sample comprises 402 districts, of which 322 are located in the Western and the remaining 80 in the former Eastern part of Germany.

The information on the variables that are used as regional controls are also obtained from the Federal and Regional Statistical Offices. Table 1 presents summary statistics for the main variables employed in the analysis. In 2003, the share of public employment in overall employment amounted to 11 percent. Between 2003 and 2007, overall employment grew, on average, by 2 percent. As shown by the contributions of public and private sector, which amount to -1% and 3%, respectively, this overall growth results from countervailing developments in the public and the private sector. The standard deviations of these variables are large, indicating that there is substantial variation in sectoral employment changes across German districts.

Table 1: Summary Statistics

	Workforce Statistics		SIAB data	
	Mean	Std. Deviation	Mean	Std. Deviation
Dependent Variables				
Total employment 2003	93,649	(121,668)	1,142	(1,442)
Total employment growth 2003-2007	.02	(.03)	.01	(.044)
Private sector employment 2003	83,948	(108,490)	893	(1,140)
Private sector share 2003	.89	(.04)	.78	(.04)
Contribution private 2003-2007	.03	(.03)	.02	(.04)
Tradable sector employment 2003	-	-	660	(881)
Non-tradable sector employment 2003	-	-	233	(274)
Contribution tradable 2003-2007	-	-	.02	(.04)
Contribution nontradable 2003-2007	-	-	.00	(.02)
Public sector employment 2003	9,701	(13,977)	-	-
Public sector share 2003	0.11	(.04)	-	-
Contribution public 2003-2007	-.01	(.02)	-	-
Δ Unemployment 2003-2007	-.02	(.02)	-	-
Δ Labor Force 2003-2007	-.02	(.02)	-	-
Control Variables				
No degree 2003	0.19	(.05)	-	-
Vocational degree 2003	0.73	(.05)	-	-
University degree 2003	0.08	(.04)	-	-
Population 2003	198,755	(226,310)	-	-

Notes: N=402. Changes in unemployment and the labor force are normalized by total employment in 2003. Education variables are expressed as the local share of employees with the relevant education qualification.

In part of the analysis, I split private sector employment between tradable and nontradable industries. Because the work force statistics from the Federal Statistical Offices that I use to classify employment into the public and the private sector do not provide information on detailed industries at the regional level, I use the Sample of Integrated Labor Market Biographies (SIAB) to obtain a division into tradables and nontradables. The SIAB is a two percent random sample drawn from the full population of the Integrated Employment Biographies provided by the Institute of Employment Research (for details, see Dorner et al. (2010)). This dataset contains employment information on individuals subject to social security contributions and on the marginally employed. It includes information on occupation and workplace location at the district level and detailed industry codes (down to the 5-digit SIC level), as well as on daily wages. To obtain regional employment measures, the individual employment spells are aggregated at the district level, where each spell is weighted by its respective length.

The SIAB does not contain a measure of public sector employment. To restrict the sample to private sector employment, I therefore first exclude three sectors which are typically considered as public: SIC75 (public administration and defense), SIC80 (education), and SIC85 (health and

social work). Although the majority of the services provided by these sectors is likely to be provided publicly, one has to bear in mind that this sample restriction certainly also leads to the exclusion of some workers employed in the private sector (e.g. private school teachers). Further, I follow Faggio and Overman (2014) and exclude mining and quarrying (SIC10-SIC14), electricity, gas and water supply (SIC40-SIC41), transport and communication (SIC60-SIC64), as well as extraterritorial organizations and bodies (SIC90-SIC95). These sectors are excluded because they provide public goods or are heavily regulated, or a share of employment in these industries is public. The definition of tradable and nontradable industries follows Dustmann et al. (2014), who classify sectors based on the geographical range of their markets. More specifically, they define industries with export volumes below the 25th percentile of the distribution of export volumes in 1995 as nontradables and sectors above this threshold as tradable sectors.[3] Table 1 also presents summary statistics for the SIAB data. Here, around 23% of 2003 employment is classified as public. The share is larger than in the data from the Federal Statistical Office, which is likely to result from the sectoral classification of the private-public employment split. The positive private sector contribution, which is somewhat smaller in the SIAB data, results entirely from employment increases in the tradable sector.

The wage variable is real gross daily wages, which are also obtained from the SIAB. As wages in this dataset are top-coded at the social security contribution threshold, I impute right-censored wages using an imputation algorithm by Gartner (2005). Wages are deflated by the national Consumer Price Index (base year: 2005), which does not account for local price levels.

4 Results

4.1 The Impact of Public Sector Employment on Private Sector Employment

I start the empirical analysis by exploring the relationship between public sector employment growth and employment growth in the private sector. To do so, I estimate equation 1, where the dependent variable is the contribution of private sector growth to overall employment growth between 2003 and 2007. The OLS results are presented in the upper panel of Table 2. In the first column, the only explanatory variable is public sector contribution. The estimated coefficient is negative and statistically highly significant, implying that public sector employment crowds out employment in the private sector. The point estimate of -.522 is economically large and suggests that ten additional

[3] I thank Alexandra Spitz-Oener for making the classification available to me.

jobs in the public sector crowd out approximately 5 jobs in the private sector.

In the remaining columns of Table 2, the bivariate model is augmented with a set of additional explanatory variables which might independently affect private sector employment growth. In column 2, I control for total start-of-period population in a district. The coefficient on total initial population is negative but insignificant and leaves the magnitude and significance of β unchanged. Column 3 augments the regression model with the shares of employees that are medium-skilled and high-skilled, with the share of low-skilled workers being the reference category. These controls modestly increase the estimated negative crowding out effect of public sector employment. Finally, in column 4, I include a dummy variable that indicates whether a district is located in the former Western part of Germany as well as information on districts' area type. Unsurprisingly, private sector contribution is larger in the Western part of Germany, while the coefficient on the urban area dummy is small in size and statistically insignificant. Notably, the inclusion of the additional explanatory variables leaves the significant, negative relationship between public sector employment growth and the growth of private sector employment largely unaffected. When all control variables are simultaneously included (column 5), the point estimate of -.574 implies that the creation of ten jobs in the public sector crowd out approximately six jobs in the private sector.

As discussed in section 2.2.2, public sector employment can be endogenous as it may respond to overall population growth or be used as a tool to offset negative shocks to private sector employment. Therefore, I repeat the main estimates for private sector employment when the public sector contribution variable is instrumented by the weighted average of nationwide changes in public employment using two-stage least square estimation. Panel C of Table 2 presents the first-stage estimates for the IV model. The first-stage regression has a high explanatory power and the instrument contributes considerably to this fit. As indicated by the positive and highly significant point estimates, it accounts for significant variation in public sector employment growth, with t-ratios of around six in all specifications. In the fully augmented specification, the partial R^2 between public sector employment and the instrument is reassuringly high at .177. In none of the specifications, the F-statistic for the joint significance of the instrument excluded from the structural model is smaller than 33, so the weighted national growth of public sector employment seems to be an appropriate instrument for public sector contribution.

Panel B of Table 2 presents the second-stage results for the instrumental variable model. The

Table 2: Effects of Public Sector Growth on Private Sector Employment, OLS and IV

	(1)	(2)	(3)	(4)	(5)
			Panel A: OLS estimates		
Contribution public	-.522***	-.520***	-.595***	-.602***	-.574***
	(.101)	(.101)	(.093)	(.107)	(.089)
Total population (log)		-.001			-.001
		(.002)			(.002)
Share medium skilled			-.131***		-.124**
			(.036)		(.060)
Share high-skilled			-.011		.129**
			(.043)		(.064)
West				.011**	.009
				(.005)	(.007)
Urban				-.004	-.016**
				(.003)	(.004)
R^2	.076	.076	.114	.091	.150
			Panel B: IV Second Stage		
Contribution public	-.682***	-.674***	-.852***	-.926***	-.738***
	(.205)	(.204)	(.233)	(.235)	(.234)
R^2	.069	.070	.096	.070	.142
			Panel C: IV First Stage		
Instrument Variable	2.339***	2.392***	2.082***	2.099***	2.211***
	(.353)	(.358)	(.354)	(.361)	(.353)
R^2	.239	.242	.262	.265	.273
F-test on excl. instrument	43.84	44.68	34.65	33.81	39.21

Notes: N = 402. Robust SE in parentheses. The dependent variable is the contribution of private sector to total employment growth. All controls are measured as of 2003. The instrumental variable is equal to the 2003 fraction of public employment in overall employment multiplied by the national growth of public sector employment in all but the own district between 2003 and 2007. The dependent variable in Panel C is public sector contribution. * Significant at 10%, ** at 5%, *** at 1%.

2SLS estimates are negative, precisely estimated and give a lower estimate for β compared to their OLS counterparts. This indicates that the OLS results suffer from upward-bias and capture some reverse causality in the sense that private sector employment causes the creation of public sector employment, and not vice versa. In the fully specified model (column 6), the coefficient translates into a loss of approximately 7.4 jobs in the private sector for any 10 additional public sector jobs. When comparing these results to the estimates obtained by Faggio and Overman (2014), it is noticeable that, for the same time span, the authors do not find a significant impact of public sector employment growth on the evolution of private sector employment in the UK.

The robustness of this basic results is verified to a number of permutations of the baseline spec-

ification described by equation 1.[4] One threat to the identification strategy applied in this analysis is that serially correlated shocks also drive the initial share of a district's public employment. To address this concern, I construct an alternative instrument that uses the public sector employment share in the year 2000 combined with national changes in public sector employment between 2003 and 2007. As a second test, the results are replicated when observations are weighted by the start-of-period district population in order to account for differences in district sizes. Further, I aggregate the 412 administrative districts in Germany to 260 labor market regions (Koller and Schwengler, 2000), which take commuter flows into account and therefore reflect local labor markets more appropriately (Eckey et al., 2006). Reassuringly, in all cases I find a robust crowding out effect of public sector employment on employment growth in the private sector.

As the point estimate for β is smaller than minus unity in the baseline specification in both the OLS and the IV model, net employment must rise when public sector employment grows. More specifically, for any additional 100 jobs that are created in the public sector, net employment rises by 26 jobs. These employment increases can result from decreases in unemployment or from increases in the labor force if some previously inactive people become active. Further, it may be that new residents migrate from other districts. In order to analyze along which margin employment adjusts, I estimate variants of equation 1, where the dependent variables represent the change in the local labor force, the change in unemployment as well as the change in net migration between 2003 and 2007. For ease of comparison, all variables are normalized by total initial district employment. The 2SLS results are presented in Table 3.[5] Columns 1, 3 and 5 depict the results with public sector contribution as the only explanatory variable, while the specifications in column 2, 4 and 6 include the full set of control variables used in column 6 of Table 2.

The results in Panel A and B suggest that public employment growth leads to an increase in the local labor force and to a decrease in unemployment. The point estimates imply that out of the 26 jobs created, twice as much are filled by employees who were previously inactive than by workers who were unemployed. However, in the fully specified model, neither of the estimated coefficients is significantly different from zero. The results for net migration in Panel C show that the migration adjustments to regional public sector employment growth are positive but relatively small in size and imprecisely estimated. Yet, it is important to note that this result strengthens the

[4]The results of these robustness checks are depicted in Appendix Table 6.
[5]The corresponding OLS results are presented in Appendix Table 7

Table 3: Effects of Public Sector Growth on Unemployment and Migration, 2SLS Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Δ Labor Force		Panel B: Δ Unemployment		Panel C: Δ Net migration	
Contribution public	.754**	.175	.435**	-.087	-.086	.047
	(.315)	(.303)	(.186)	(.173)	(.069)	(.077)
Covariates	no	yes	no	yes	no	yes
F-stat	43.84	39.21	43.84	39.28	43.48	41.11

Notes: N = 402. Robust SE in parentheses. Controls are used as indicated in Table 2. All controls are measured as of 2003. The dependent variables are the change in the local labor force, in the number of unemployed and in net migration between 2003 and 2007, normalized by total district employment in 2003. The instrumental variable is equal to the 2003 fraction of public employment in overall employment multiplied by the national growth of public sector employment in all but the own district between 2003 and 2007. * Significant at 10%, ** at 5%, *** at 1%.

validity of the local labor market approach. If mobility responses were large, local impacts on wages and employment would rapidly diffuse across regions and be hard to identify (Autor et al., 2013).

4.2 Effect Heterogeneity by Sector

So far, I have presented robust evidence that public sector employment has substantial crowding out effects on private sector employment. The theoretical framework outlined in section 2.1 suggest that those negative spillovers should vary considerably across industries. That is, public employment should crowd out employment in tradable industries but have positive spillover effects on nontradable industries. In this section, this prediction is inspected in more detail. Because the employment data from the Federal Statistical Office does not provide detailed information on sectoral employment at the district level, I perform this part of the analysis using the Sample of Integrated Employment Biographies which provides industry codes down to the 5-digit SIC2003 level. Unfortunately, the SIAB lacks a measure of public and private sector employment. As discussed in detail in section 3, private employment is therefore constructed as in Faggio and Overman (2014). In order to assess the degree to which this affects the results, I first replicate the analysis from the previous section and estimate the effect of public sector employment on overall private employment. The IV results for this regression are presented in Panel A of Table 4.[6]

The 2SLS estimates in column 1 and 2 have a negative sign and are statistically significant once the regional controls are included. The size of the point estimate in column 2 is somewhat smaller than the coefficient that is obtained when performing the analysis with employment data from the Federal Statistical Office (see column 5 in Table 2). One explanation for the different magnitudes

[6]The corresponding OLS results are depcited in Appendix Table 8.

is that the SIAB results abstract from substitution effects of private sector activity in sectors that are traditionally dominated by public sector provision (e.g. health care and education) as these industries are excluded from the analysis. Further, the point estimate is statistically less significant, which is likely to result from measurement error.

Table 4: Effects of Public Sector Growth on the Tradable and Nontradable Sector, 2SLS Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Private Employment		Panel B: Tradable		Panel B: Nontradable	
Contribution public	-.165	-.528*	-.612**	-.560**	.447***	.125
	(.257)	(.303)	(.236)	(.284)	(.125)	(.125)
Covariates	no	yes	no	yes	no	yes
F-stat	43.79	38.40	43.78	41.55	43.78	41.55

Notes: N = 402. Robust SE in parentheses. Each cell corresponds to a single regression. The dependent variable is the contribution of private sector to total employment growth. Controls are used as indicated in Table 2. All controls are measured as of 2003. The instrumental variable is equal to the 2003 fraction of public employment in overall employment multiplied by the national growth of public sector employment in all but the own district between 2003 and 2007. * Significant at 10%, ** at 5%, *** at 1%.

The comparison of results using both datasets suggests that one can be reasonably confident in using the SIAB data to analyze heterogeneous effects across sectors, although substitution effects in the tradable sector might be somewhat underestimated. Bearing in mind this limitation, I estimate models described by equation 1 separately for the tradable and the nontradable sector, where the sector classification follows Dustmann et al. (2014). The sector-specific results are depicted in Panel B and C of Table 4. Consistent with expectations, the coefficients on tradable employment in column 3 and 4 are negative and statistically significant. The estimated effect of public employment growth on the nontradable sector is positive but imprecisely estimated in the fully specified model (column 6). When comparing my estimates to the results obtained in Faggio and Overman (2014), it is interesting to note that the effects are broadly similar in the tradable sector. Yet, in contrast to what has been found in the UK, I was not able to find conclusive evidence for positive multiplier effects on the nontradable sector in Germany. One possible explanation for the different results is that labor market rigidities, such as the more generous benefit system in Germany, reduce the labor supply elasticity, which in turn decreases the size of the positive local multiplier effect on nontradable industries. In addition, those positive multiplier effects result from increases in net wages, while the negative spillover effects on the tradable sector are caused by increases in gross wages. Hence, the different findings in the nontradable sector may be attributable to the fact that Germany has a more progressive tax system than the UK.

4.3 Effects on Wages

A central prediction of the conceptual framework in Faggio and Overman (2014) is that increased public sector employment raises local wages. While an increase in local income raises the demand for nontradable goods and employment in this sector, employment in tradable industries decreases because local wage increases are not counteracted by positive demand effects. In the previous section I have verified these predictions for employment in the private sector but have not explored price effects, which constitute the main channels through which private employment is eventually affected. To consider the impact of public sector employment on wages in the private sector, I estimate log wage regressions as described by equation 3.

Table 5: Effects on Gross Daily Wages in the Tradable and Nontradable Sector, 2SLS estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Private Employment		Panel B: Tradable		Panel B: Nontradable	
Contribution public	.029***	.022***	.033***	.024***	.016***	.016***
	(.012)	(.008)	(.013)	(.009)	(.005)	(.005)
Occupation ctrls.	no	yes	no	yes	no	yes
Industry ctrls.	no	yes	no	yes	no	yes
R^2	.620	.657	.611	.656	.643	.656

Notes: N = 1,320,066/967,168/352,898 in Panels A/B/C. All models include an intercept, dummies for education levels, potential experience and its square, dummies for part-time employment, foreign citizenship, and interactions of all individual level controls with the time dummy. Observations are weighted by the length of a worker's employment spell in a given year. The instrument is interacted with a dummy for the observations of year 2007. Robust standard errors in parentheses are clustered at the district level. * Significant at 10%, ** at 5%, *** at 1%.

Panel A of Table 5 presents the IV estimates of log gross daily wages for the entire private sector.[7] The first column includes worker-level characteristics as controls (age, age^2, dummies for foreign citizenship, education levels, working-time arrangement), each interacted with time dummies. The second column includes dummies for seven broad occupational categories as well as 13 broad industry indicators and their interaction with a dummy for the year 2007. In both specifications, the point estimates are positive and highly significant, indicating that public sector employment creates upward pressure on wages in the private sector, which is in line with the theoretical considerations in Faggio and Overman (2014). The point estimate in column 2 suggests that an increase in public sector contribution by 1 percentage point causes wages in the private sector to rise by 2.2 percent. Panel B and C of Table 5 repeat these estimates separately for the tradable and the nontradable

[7] The corresponding OLS results are depcited in Appendix Table 8.

sector. The positive and significant coefficients demonstrate that wages rise in both sectors, although the increase is somewhat more pronounced in the tradable sector.

5 Conclusion

Making up for about 11% of overall employment, the public sector is the largest employer in Germany. By analyzing local labor markets, this paper explores the consequences of public sector employment on the private sector. To so so, I relate changes in private sector employment and earnings across Germany local labor markets to changes in public sector employment. My findings suggest that public sector employment growth has substantial crowding out effects on the private sector. In particular, 100 public sector jobs crowd out 74 private jobs. In addition, this study presents evidence that public sector employment growth exerts significant upward pressure on local wages in the private sector. Consequently, employment losses are not evenly distributed across industries. Instead, the crowding out effect of public sector employment mainly accrues to the tradable sector, where wage increases deteriorate the competitiveness in of the local industries. As opposed to this, employment in the nontradable sector is relatively unaffected because negative effects resulting from wage increases are offset by an rising local demand for nontradable goods. The results of this study suggest that when governments attempt to increase employment levels by creating public employment programs, it is crucial to consider potential negative spillover effects on the private sector.

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Appendix

Table Appendix

Table 6: Effects on Private Sector Employment, Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel C: Instrument		Panel A: Weighted		Panel B: LMR	
Contribution public	-1.374***	-1.283**	-.713***	-.843***	-.842***	-1.037***
	(.475)	(.417)	(.211)	(.248)	(.146)	(.166)
Covariates	no	yes	no	yes	no	yes
R^2	.019	.159	.084	.118	.293	.347
F-stat	22.106	20.462	45.377	37.262	26.592	17.402
Observations	402	402	402	402	260	260

Notes: Robust SE in parentheses. Controls are used as indicated in Table 2. All controls are measured as of 2003. The instrumental variable is equal to the 2003 fraction of public employment in overall employment multiplied by the national growth of public sector employment in all but the own district between 2003 and 2007. * Significant at 10%, ** at 5%, *** at 1%.

Table 7: Effects of Public Sector Growth on Unemployment and Migration, OLS Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Δ Labor Force		Panel B: Δ Unemployment		Panel A: Δ Net migration	
Contribution public	0.877***	0.535***	0.399***	0.110	-0.052	-0.022
	(.195)	(.145)	(.135)	(.105)	(.033)	(.034)
Covariates	no	yes	no	yes	no	yes
R^2	.112	.415	.074	.628	.010	0.112

Notes: N = 402. Robust SE in parentheses. The dependent variables are the change in the local labor force, in the number of unemployed and in net migration between 2003 and 2007, normalized by total district employment in 2003. Controls are used as indicated in Table 2. All controls are measured as of 2003. * Significant at 10%, ** at 5%, *** at 1%.

Table 8: Effects of Public Sector Growth on the Tradable and Nontradable Sector, OLS Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Private Sector		Panel B: Tradable		Panel B: Nontradable	
	Dependent Variable: Employment					
Contribution public	.072	.010	-.146	-.041	.214	.045
	(.121)	(.123)	(.108)	(.107)	(.056)	(.056)
Covariates	no	yes	no	yes	no	yes
R^2	.001	.052	.005	.064	.028	0.188
	Dependent Variable: Wages					
Contribution public	.018***	.015***	.019***	.015***	.013***	.013***
	(.005)	(.005)	(.006)	(.005)	(.003)	(.003)
Covariates	no	yes	no	yes	no	yes
R^2	.620	.658	.612	.655	.643	.656

Notes: N = 402. Robust SE in parentheses. Each cell corresponds to a single regression. The dependent variable is the contribution of private sector to total employment growth. Controls are used as indicated in Table 2. All controls are measured as of 2003. * Significant at 10%, ** at 5%, *** at 1%.