Public Employment Policies and Regional Unemployment Differences

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Abstract

This paper contributes to the existing literature on public employment showing that the wage setting policy of the public sector is an important determinant of private employment and unemployment. I look at the case of geographically homogeneous wages across regions with different productivity, and show that public employment generates a crowding out effect against private employment. This effect is larger the larger is the public sector share of total employment. However, when the government pays wages according to local productivity the crowing out effect vanishes. I present a two region two sector model based on Pissarides (2000) heterogeneous search and matching model where vacancies are posted by the private and the public sector as in Quadrini and Trigari (2007), Gomes (2014) and Boeing-Reicher and Caponi (2016). I calibrate the model to the Italian labor market and show that the uniform wage setting policy adopted by the central government, in the presence of productivity unbalance across regions, is responsible for up to 33% of the unemployment gap between the North and South. Moreover, I show that the geographical homogeneous wage setting is responsible for a stronger and geographically highly asymmetric response of unemployment to aggregate productivity shocks. I also allow for migration from one region to the other and find that it has only a very limited mitigating role in reducing this gap. Policy experiments suggest that reducing the size of public employment reduces unemployment in lower productive regions while allowing for regional wage setting in the public sector almost eliminates the unemployment differential.

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1 Introduction

A few studies look the macroeconomic effects of public on private employment, focusing especially on the size of the former. Among these studies Algan, Cahuc and Zylberberg (2002), analyzing a panel of OECD countries between 1960 and 2000, find evidence that for any additional public employee one and a half jobs are lost in the private sector. Because of a decrease of labor participation, however, in their analysis this translates in only one third of additional workers in the unemployment pool. That is, they do find evidence that a crowding out effect exists and it is higher than 100%. Similar findings are provided by Malley and Moutos (1996) looking at Swedish aggregate time series data from 1964 to 1990. Mixed empirical evidence is instead reported in the analysis of Lamo, Prez and Snchez-Fuentes (2013). They find positive correlations as well as negative between public and private employment analyzing the variations in the size of employment at business cycle frequencies. They conclude that the different sign is mainly due to the relative rigidity in the labor market as well as the lack of competition in the goods market. The theoretical literature on this relationship is more scarce than the empirical one and mainly focused on static partial equilibrium models that illustrate the empirical findings. Bradley, Postel-Vinay and Turon (2014) propose a structural model with public sector in a partial equilibrium search model, and estimate it with British data. They use the estimated model to run several counterfactual public sector wage and employment policies and find that they have little impact on private sector wages and employment. Burdett (2012) proposes a theoretical model of search with wage posting and concludes that for most possible scenarios public employment should have a significant crowding out effect. A general equilibrium model is instead provided in Ardagna (2007). In her model Ardagna assumes that wages are set by unions and that an increase in public employment increases the unions' bargaining power. This leads to higher private wages and lower employment. Pappa (2009), in a neokeynesian framework with sticky wages, also finds that increases in public employment lead to lower private employment. Quadrini and Trigari (2007) use a general equilibrium business cycle model in which they focus on explaining the cyclical correlation between public and private employment in the US, while Gomes (2014) and Boeing-Reicher and Caponi (2016) also provide general equilibrium models that link unemployment to public employment.

This paper contributes to both strands of the literature by building a theoretical model that identifies a new channel through which public employment affects private employment and overall unemployment. I build a regional model of segmented labor markets in which the government plays an important role by having a national wage setting policy that may lead to more homogenous public than private wages in the presence of regional dispersion of productivity. In building the model I follow Quadrini and Trigari (2007) and Gomes (2014) and I extend Pissarides (2000) model by introducing a public sector that competes with the private for filling its vacancies. The novelty of the model is that it proposes a segmented regional market where unemployed workers search within each region, and the government links all regions by a possibly uniform wage set at a national level. I therefore look at the distortive effect of the wage rule when local productivity diverges from one region to another. Because the wage paid by the public sector needs to be attractive in high productive regions, the same wage results relatively large in the low productive ones. In a model where unemployed workers can find jobs in the private or public sector, a high wage paid by the public increases the outside option of accepting a private sector wage. As in Ardagna (2007), but without unions, this leads to higher bargained wages and leads to lower private employment and possibly higher unemployment. The model also allows for endogenous migration, however its calibration suggests that migration has a limited role in reducing the unemployment gap across regions due to the high cost of migrating.

The model is motivated by a substantive empirical evidence that shows that, particularly in Western European countries, public wages are geographically more homogeneous than private sector wages. Bell, Elliott, Ma, Scott and Roberts (2007), Heitmueller and Mavromaras (2007), Meurs and Edon (2007), Garcia-Perez and Jimeno (2007) and Dell'Aringa, Lucifora and Origo (2007) present evidence of more regionally homogenous public than private wages for the U.K., Germany, France, Spain and Italy respectively. Moreover, Garcia-Perez and Jimeno (2007) also show a positive correlation between a wider wage gap between public and private wages and regional unemployment. A similar fact is found in Dell'Aringa et al. (2007), that shows that only private wages are negatively correlated to regional unemployment while public wages are not. That is, while public wages are more homogenous across regions, private wages decrease with unemployment and their wage gap becomes wider. Other studies do

not include unemployment specifically among the possible variables related with public wages or public/private wage gap, however, in the case of Germany for example, Heitmueller and Mavromaras (2007) clearly show that the gap remains substantially wider for Easter regions than for Western, where unemployment is much higher.

I calibrate the model to reproduce some relevant stylized facts about Italy, one of the Western European countries that presents the largest divide between Northern and Southern regions in terms of unemployment, wages, productivity and other relevant variables as well as a well known national policy for setting public wages homogenously across the country. I show that the institutional setup in public employment can account for up to 35% of the unemployment gap between the North and South. Moreover, I conduct two policy experiments that suggest that reducing the size of public employment reduces unemployment in lower productive regions while allowing for regional wage setting in the public sector would almost eliminate the unemployment differential.

The findings in this paper are novel and complementary to those in Quadrini and Trigari (2007), Gomes (2014) and Boeing-Reicher and Caponi (2016). These studies find that the business cycle volatility of unemployment is amplified by public sector wages if they are not cyclical, i.e. if they are less or no reactive to productivity shocks. In fact, when productivity is low, high wages in the public sector compared to the private ones lead unemployed workers to queue for public sector jobs prolonging their unemployment spells. When productivity is high, the sluggish reaction of the public sector implies that these queues clear rapidly in favor of the private sector. I find complementary results focusing on geographical rather than time productivity differences and homogenous public wages. That is, where productivity is relatively low, relatively high public wages implies queueing for the public sector creating more unemployment, while where productivity is relatively high the relative lower public wage makes the public sector less attractive and imply less queueing and less unemployment. In addition, novel in this paper is the finding that, combining space and time dimensions, aggregate productivity shocks, geographically homogeneous, generate a much stronger response in terms of aggregate unemployment, a response that is also geographically asymmetric. This without imposing a sluggish response of public wages to productivity shocks as instead done in Quadrini and Trigari (2007), but leaving them fully adjusting to the productivity change. These findings

suggest that it is not enough to set public wages pro-cyclically as in Gomes (2014) in order to minimize unemployment volatility, but it is also necessary to have them adjusted to local productivity when it diverges. In terms of policy and relative to the previous empirical literature, the findings of this paper suggest that is the wage setting policy in place that generates crowing out and higher unemployment rather than the size of public employment.

In the model I present, regions are equal in all except for one parameter that indicates the structural productivity of jobs. In order to derive an explicit equation that describes the effect of public sector wages have on the private sector, I assume that workers search in both sectors and offers arrive one at the time from each of the two.[1] This increases the value of being unemployed as an option opposed to accepting a private job and, consequently, increases the outside option for that job. Therefore, higher wages paid by the public increase the reservation wage in the private sector and lowers the profitability of matches to employers. I also assume that public jobs are remunerated equally across regions, regardless the different productivity, while wages in private jobs are determined by Nash bargaining between an employer and her employee. Therefore, because the wage paid by the public needs to be sufficiently high to attract workers in high productivity regions, under an institutional setup that imposes a uniform wage, the wage results as relatively high in low productive regions crowding out private employment.

The model is calibrated to account for several facts about the Italian labor market. Distinguishing between the South and the North of Italy, several facts are worth noting about the different performance of these two regions. First of all, the unemployment rate is and has been very different at least since the 1970s, with the South having an unemployment rate that is three to four times that of the North. Second, the South is significantly less productive than the north. A quick look at GDP per hour worked suggests that one hour worked in the South is worth about 20% less than in the North, this even if the capital per worker is not significantly different between the two regions. Finally, wages are homogeneous across regions in the public sector, while are about 9% lower in the South than in the North within the private sector. The next section presents the facts highlighted above about the Italian labor market. Section

[1] Gomes (2014) shows that the alternative hypothesis of directed search leads to similar results although the effect of public employment on private wages is determined through market tightness.

3 presents the model, while section 4 shows the calibration exercise and the numerical results. In section 5 the evaluation of two possible policies is introduced. Section 6 concludes.

2 The facts

In this section I present statistics on the Italian labor market looking in particular at the role of public employment. I start with evidence that, when we consider the number of public jobs as share of the population, public employment in Italy is uniformly distributed between the North and the South of Italy. This evidence seems to contradict the idea that the government engage in an active policy of inflating public employment in poorer regions with higher unemployment (i.e. the South). I continue the presentation of the facts on the Italian labor market focusing mainly on men as they are the object of the calibration exercise.[2] The reason is that in order to present a model as simple as possible that captures the main features of the analysis, I abstract from labor participation decision. While for men labor participation is uniform across regions, for women it's quite heterogeneous and, therefore, it would need to be part of the explained variables in a model that includes them. Finally, I show evidence that wages, conditionally on several personal characteristics and occupations, are uniformly distributed across regions in the public sector, while in the private Northern workers are paid a premium of about 11.7% compared to the wages in the South.

2.1 Public Employment

The data reported in Table 1 are collected from the Italian Ministry of Economy and the National Institute for Statistics (ISTAT) and are for the whole population of men and women. From the Ministry I collected the aggregate number of public employees as reported by December 31st of each year from 2001 to 2010 by Italian region, while from ISTAT I collected the total number of residents as reported on January 1st of each year from 2002 to 2011, also by region. To simplify the exposition of the data I backtrack Istat data by one day making it consistent with the Ministry data and I aggregate further the data to the level of repartitions, that is, North and South of Italy. The first two columns report the numbers of public

[2]However, for some statistics, as I will explain later, I resent data for men and women together.

employees in each year, in the South and the North, columns three and four the total number of residents and columns five and six the percent of public employees on the total population. The reason to take the whole universe of men and women is that I am interested in the overall size of the public sector.

Table 1: **Public Employment and Population**

Year	Public Employment		Total Residents		P.E. by Residents	
	South	North	South	North	South	North
2001	1,220,533	2,029,740	20,507,342	36,486,400	5.95	5.56
2002	1,222,211	2,041,340	20,557,362	36,763,708	5.95	5.55
2003	1,259,997	2,080,492	20,663,632	37,224,613	6.10	5.59
2004	1,246,174	2,093,301	20,747,325	37,715,050	6.01	5.55
2005	1,244,098	2,101,054	20,760,051	37,991,660	5.99	5.53
2006	1,245,394	2,123,320	20,755,621	38,375,666	6.00	5.53
2007	1,227,846	2,117,954	20,826,769	38,792,521	5.90	5.46
2008	1,212,674	2,141,974	20,856,244	39,188,824	5.81	5.47
2009	1,170,954	2,119,905	20,881,429	39,458,899	5.61	5.37
2010	1,142,357	2,090,501	20,912,859	39,713,583	5.46	5.26

Data from Istat and from the Italian Ministry of Economy (Ragioneria Generale dello Stato). Men only

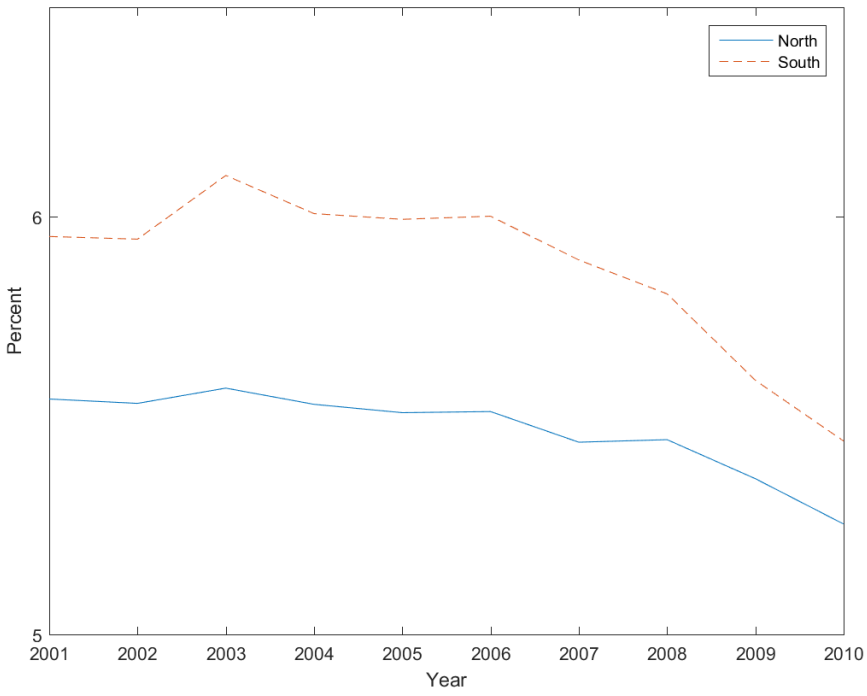
There are two important points to take from the table. First of all, the relative size of public employment in the South is similar to the size in the North. This is true especially for the last few years in the decade considered, but the size is not substantially bigger in the South even at the beginning of the decade. In 2001, for example, the South had 5.95 public employees for every 100 residents, while the North had 5.56. That is, the in The South, there were 39 more public employees every 10,000 residents. Given that the Southern population is of about 21 million residents, compared the about 39 of the North, the gap of public employment in the South is of about 81,000 workers, or about 6.7% of the total public employment in the South. The same calculation for 2010 gives an excess of about 3.5%, a reduction that is well shown by Figure 1. However, the entire excess of public employment can actually be explained by the different demography of the two areas. The sector of public employments that by itself includes most of public workers is education, particularly from kindergarten to high school. In 2001, 1.13 million employees were in this sector. Looking at the geographical distribution, 2.45% and 1.73% are the employees in the school sector per resident in the South and in

the North respectively, this would translate into an excess of about 148,000 employees in the South. Yet, this excess is entirely explained by the demographical composition of the South compared to that of the North as employees in the school per child aged between 0 and 19 in the South and in the North are very similar (10.1 in the South compared to 10.05 in the North, suggesting an excess of only 2,000 units instead of 148,000).[3] The main point to take from this analysis is that, while it is a fact, as shown by Alesina, Danninger and Rostagno (2001) that there exists a significant redistribution of income from the North to the South through public employment, this is not the result of an intentional policy that inflates the public sector in the South compared to that in the North. This is an important fact that justifies the model I propose in section 3, where I assume that the government fixes the number of public employees to be hired in each region exogenously, and particularly independently from the level of unemployment. The model predicts the income redistribution between the North and the South, as an equilibrium outcome that results from several forces at play, the main of which is a homogeneous wage paid by the public administration combined with a productivity deficit of the South compared to the North that depresses labor participation and increases unemployment in the South. This translates in a much higher number of public employees on the total of workers in the South than in the North which couples with lower wages and lower taxes in the private sector (and possibly higher tax evasion as well), causes the flow of resources from North to South.

Figure 1 adds to our picture some dynamics. It is very evident from the picture that the number of public employees has been dropping during the decade in Italy in general and more so in the South. This is true particularly staring from 2006/2007. The figure, together with the expectations that the fall of public employment will continue probably reinforced due to the effort to reduce the high public debt faced by the country, motivates the rest of the analysis in this paper. In fact, some important questions need to be answered about the effect of public employment on unemployment and private employment so that we can formulate accurate predictions of what happens when public employment is significantly reduced. The model I present in the following section is capable of interpreting the relationships between

[3]Following all the calculations, there seems to be now an excess of public employment in the North rather than in the South, as 148,000-81,000=67,000. This indeed, can easily be explained by Rome being included in the Northern regions.

Figure 1: Public Employment per Resident



Data Source: Istat and from the Italian Ministry of Economy (Ragioneria Generale dello Stato).

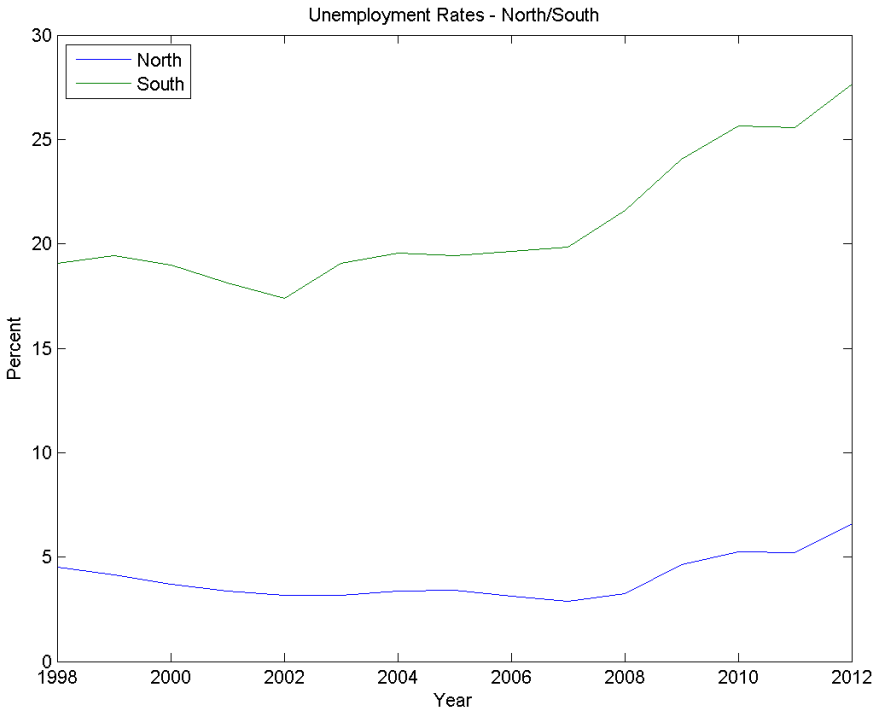
these variables and to generate quantifiable predictions, but before I present the model some other useful facts on employment, unemployment and wages need to be analyzed.

2.2 Unemployment

Figure 2 shows the evolution of unemployment rates in the North and the South of Italy between 1998 and 2012. Evidently unemployment has been about constant in both regions up to 2007 and then, because of the effect of the prolonged recession, has increased substantially across Italy. Interesting however, the increase seems to have been more dramatic in the South than in the North. The model I propose in the next section not only can explain the large unemployment gap between the regions of Italy in the steady state, which I assume is the situation up to 2007, but also can generate an asymmetric reaction to a common productivity shock, such that the south results more reactive than the North. In the model evaluation section I show this point. Meanwhile, the data that is important to extract from the figure is

an average unemployment rate between 1998 and 2007 of 3.48% in the North compared to an average for the South of 19.05%. The rates increase to 6.59% for the North and 27.66% for the South in 2012, that is, while for the North there is an increase of 3 percentage points, in the South the unemployment rate increases by more than 8%.

Figure 2: Unemployment Rates in the North and South of Italy - 1998 to 2012



Data from ISTAT. Men only.

Finally, it is also important to report the share of public employees on the total of the labor force as this has an impact on the probability that an unemployed person can find an occupation in the public sector, which will be the focus of the model below. Table 2 shows these data between 2001 and 2012. As we can see, the shares are not homogeneous across regions, being higher in the South than in the North. However, this is not, as shown above, the result of an intentional policy that inflates the public sector in the South, rather is the effect of the lower participation of women in the South that leaves more public available to men.[4]

[4]Why women participate less in the South than in the North is an open question and is beyond the scope

Table 2: **Public Employment as Share of Labor Force**

Year	North		South	
	Men	Women	Men	Women
2001	9.94	16.90	13.87	21.26
2002	9.88	16.95	13.96	21.33
2003	10.32	16.82	14.41	21.73
2004	9.97	17.02	14.39	21.98
2005	9.89	17.02	14.21	22.76
2006	9.59	17.20	14.19	23.08
2007	9.26	17.11	14.07	23.22
2008	9.14	16.97	13.91	22.57
2009	9.11	16.70	13.71	22.46
2010	8.87	16.51	13.36	21.93
2011	8.72	16.19	13.38	21.52
2012	8.50	15.69	12.72	19.98
Average (2001-2008)	9.74	17.00	14.13	22.22
Average (2009-2012)	8.80	16.27	13.29	21.47

Elaboration on data from Istat and Ragioneria dello Stato.

2.3 Wages

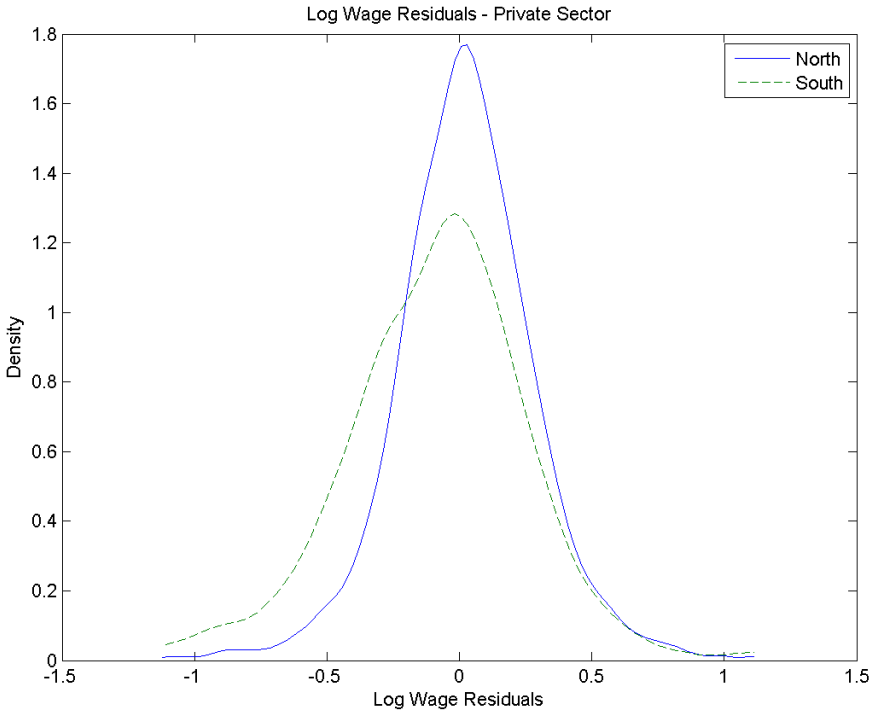
This sections presents evidence on hourly wages across areas of Italy. Alesina et al. (2001) already showed that public employees are homogeneously paid across regions of Italy while private employees are not. Alesina et alii report a wage gap between the North and the South in the private sector of about 14% while in then public sector is less than 1.5% and not statistically significant. They use data from SHIW from the year survey of 1995. With a similar methodology and data from SHIW from 1998 to 2008, I obtain very similar results. In Figures 3 and 4 I show the kernel density estimated distribution of the log hourly wage rate residuals in the North and the South for private and public employment for the whole decade. The log hourly wage residuals are obtained by first regressing log hourly wages on a set of controls similar to those included in Alesina, with the exception of regional dummies.[5] The figures clearly show that, while in the private sector the distribution of residuals in the

of this paper. A model that could explain this puzzle would probably need to take into account the decision of different members within a household. It is possible that in the South, also because of lower living costs, wages earned by males have a stronger impact on the incentive to work of women and this, coupled with higher difficulties of finding jobs, generates lower participation. However, I leave this puzzle to further research.

[5] I include education dummies, occupational rank dummies, age and age squared, but I do not include controls for firm size and for marriage status. Also, I only include men and control for survey years.

North is slightly on the right compared to that in the South, for the public sector those two distributions are hardly distinguishable.

Figure 3: Density Kernel Estimation of Residual Wages - Private Sector



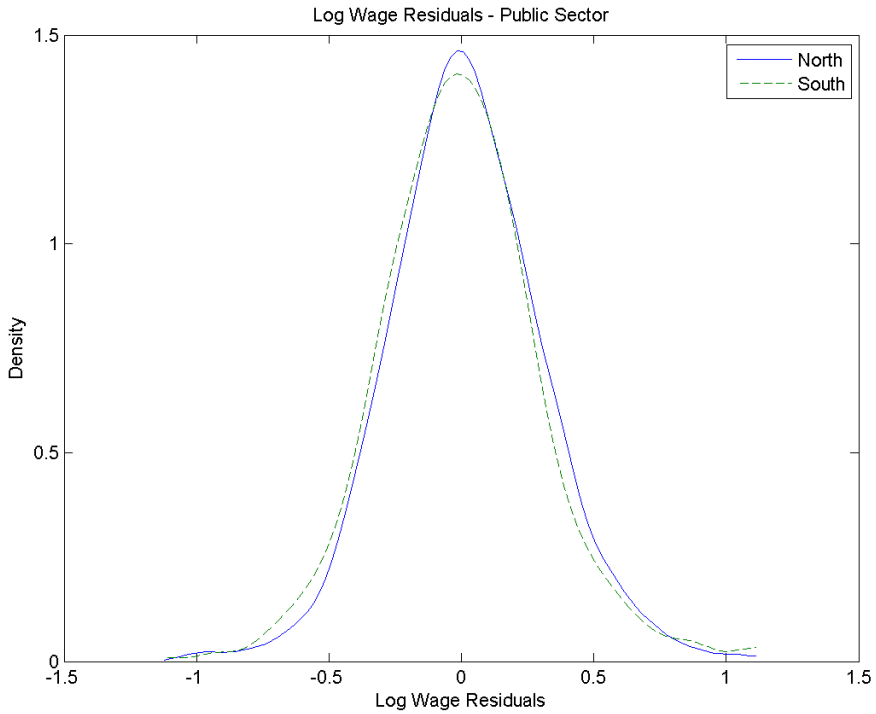
The residuals are calculated regressing log hourly wages on a set of personal characteristics and dummies for survey years. Details of the regressions in Appendix. Data: SHIW. Men only.

Table 3 provides a formal test of the size and significance of the difference between Southern and Northern log-wages in the Private and Public sectors. As we can easily see from the table, in every year available in the survey the wage gap is not significant in the public sector, while it is in the private sector, ranging from about 8% in 2004 to 15% in 2006. On Average, during the decade considered the gap measures 11.7%.

2.4 Internal Migration

The National Institute of Statistics in Italy provides aggregate statistics on registrations and cancelations from the registries of the Italian cities (comuni). These statistics also provide the region of cancelation and the region of registration of the same individual, effectively identifying the interregional move of this person. Unfortunately, however, the aggregate statistics

Figure 4: Density Kernel Estimation of Residual Wages - Public Sector



The residuals are calculated regressing log hourly wages on a set of personal characteristics and dummies for survey years. Details of the regressions in Appendix. Data: SHIW. Men only.

Table 3: **Log-Wage Regressions in the Private and Public Sector**

Year	Private Sector				Public Sector			
Year	Sud	St. Err.	N. obs.	R^2	Sud	St. Err.	N. obs.	R^2
1998	-0.1051	0.0148	2277	0.0218	0.0440	0.0213	960	0.0044
2000	-0.1626	0.0216	1378	0.0397	-0.0813	0.0313	452	0.0147
2002	-0.1231	0.0228	1339	0.0214	-0.0668	0.0334	437	0.0091
2004	-0.0806	0.0226	1413	0.0089	-0.0412	0.0445	428	0.0020
2006	-0.1510	0.0203	1302	0.0406	-0.0353	0.0424	358	0.0020
2008	-0.0912	0.0199	1202	0.0172	-0.0419	0.0420	316	0.0032
1998-2008	-0.1171	0.0081	8911	0.0229	-0.0207	0.0136	2951	0.0008
2010	-0.1109	0.0227	1054	0.0222	0.0582	0.0412	266	0.0075
2012	-0.0838	0.0251	1051	0.0105	-0.0084	0.0431	246	0.0002
2010-2012	-0.0971	0.0169	2105	0.0155	0.0309	0.0298	512	0.0021

Author"s Computations on SHIW data. Men only

only provide the net flow between regions, while in terms of gross flows we can only know

the aggregate number of cancelations and registration in each region.[6] Figure 5 reports the aggregate net flows from the Southern regions of Italy to the Northern ones as a percent of the population of South. Again, this is the total number of people who leave the South for the North minus the total number of people who leave the North for the South.

Figure 5: Net Flow of Immigrant from South to North

Data Source: Istat. Men and Women.

To gather some more information on the internal migration between the South and the North of Italy I also use microdata collected by the Bank of Italy in the Survey of Household Income and Wealth (SHIW). This data set is widely used in the literature for analysis on Italian data as it is one of the best sources of data on labor income, participation, education and also on the behavior of households in terms of their investments. For the rest of this section and for most of the calibration exercise I will use these data as to be as consistent as possible with the sample I have available.

[6]These data are not collected directly by ISTAT, rather are communicated to ISTAT by the cities, therefore are administrative data rather than census or sample data. They also cover the total population.

Table 4: **Share of Internal Immigrants***

Year	South-North	North-South
2000	13.32	0.80
2002	13.64	0.83
2004	13.99	0.96
2006	14.14	1.17
2008	14.21	0.80

Elaboration from SHIW data. *The share of Internal Immigrants is calculated as the number of resident in one repartition of Italy who were born in the other over the total residents of that repartition. The sample is the total population of Italy, without any restrictions on age, sex or other characteristics.

Table 4 reports the proportion of residents in the Northern regions who were born in the South of Italy in column 2 and, in column 3, the proportion of residents in Southern Regions who were born in the North of Italy. Clearly, the internal migration in Italy has had one single direction from the South to the North, at least in the recent few decades as this is a sample of the whole living population. We can also notice that the change every two years in column 2 is small but it is close to the net migration flow reported in Figure 5. In fact, recalling that the population in the North is about double that in the South,[7] a change of about 0.32% from 2000 to 2002 in the share of the Southern born residents in the North means that about double that share of Southerners left the South for the North in two years, or about 0.3% per year which is exactly the rate in Figure 5 for 2002. This calculation does not work as precisely for all the years, but it does roughly. To conclude this subsection, Figure 5 and Table 4 together give an indication of an overall low internal migration rate characterized mainly by migration from the South to the North.

[7]See Table 1 for the total population in the two repartitions.

3 The Model

This section provides a full description of the model economy. The model is an extension of Pissarides (2000). There are two distinct geographical regions, characterized by different levels of total factor productivity, π_i. Each region has its own labor market in the sense that unemployed workers search exclusively in their region of residence. I follow Quadrini and Trigari (2007) and introduce a public sector that open vacancies in each region. The public sector, or the government, creates positions to provide public goods. Firms in the private sector create jobs in order to gain profits. Private firms open vacancies to fill job posts whenever the expected profit is positive. The government opens vacancies in order to satisfy an exogenous determined need of public goods. Differently from Quadrini and Trigari (2007), I assume that unemployed workers search in both the private and public sectors, therefore, at any point in time and in each labor market, unemployed workers meet with open vacancies, which can be from either sector. The rate at which unemployed workers and open vacancies meet is regulated by a meeting function $m_i(v_i, u_i)$, where i stays for region, that depends on the number of unemployed workers and the total number of vacancies open, i.e. the sum of the vacancies open by private firms and the ones open by the government.

Upon meeting a private sector firm the worker and the employer observe the match specific productivity shock α, and decide if the candidate is suitable for the job, *i.e.* if α is above the endogenously set reservation value. If so, a match is created and the wage $w(\alpha)$, resulting from individual level Nash bargaining, is paid to the worker. After a match is created a worker can be hit by productivity shocks that arrive at a rate λ_p, the shock may increase or decrease her productivity and, if it decreases to a level lower than a reservation threshold, the match dissolves. Differently from the private sector, productivity in the public sector does not have an idiosyncratic component and is the same for all matches at all time.[8]

The wage paid by the government is exogenously set for the worker and assumed to be

[8]That is, once we control with all the possible factors that lead to fit in one occupation or the other, then the wage rate is fully established by working in that occupation and there is no residual idiosyncratic component to give raise to different salaries. Besides, if we assume that there can be a different productivity within the same occupation and consequently a differentiated wage, then it would be unreasonable to set an equal wage across regions. Besides, many occupations in the public sector that are in non-marketable sectors and, as such, the valued added is approximated by the wages paid, so that it would be difficult to imagine different productivity with same wages within the public sector.

attractive enough so that a meeting with the public employer will always create a match. After a match is created a worker can be hit by a separation shock that arrive at a rate λ_g. This exogenous shock will lead always to separation.[9]

Following Pissarides (2000) the meeting function is written as follows,

$$m_i(v_i, u_i) = m(1, \frac{u_i}{v_i})v_i \equiv q_i(\theta_i)v_i \;\; where \;\; \theta_i = \frac{v_i}{u_i},$$

where $v = v^p + v^g$ is the sum of private and public (government) vacancies. Therefore, dropping the regional notation i

$$q(\theta)v = q(\theta)(v^p + v^g),$$

from which we can have,

$$\frac{m(v,u)}{u} = q(\theta)\frac{v}{u} = q(\theta)(\theta^p + \theta^g),$$

we can now give an interpretation of the functions found where $q(\theta)$ is the rate at which firms, either private or public, meet unemployed workers, while $q(\theta)(\theta^p + \theta^g)$ is the rate unemployed workers meet firms, or, loosely speaking, the probability at which they the find a position open. Moreover, while the rate at which firms meet workers is the same for public and private firms, the rate at which workers meet private firms or public firms ($q(\theta)\theta^p$ and $q(\theta)\theta^g$)) depends on the relative number of vacancies open in the two sectors.

Finally, because of the idiosyncratic productivity shock, in the private sector, the rate at which vacancies are filled can be defined as follows

$$q^p = q(\theta)\frac{\theta^p}{\theta}\int_R^{\bar{\alpha}} dF(\alpha), \tag{1}$$

where $\bar{\alpha}$ is the upper limit of the shock distribution and R is the reservation value. The rate at which unemployed workers find a job is,

$$p^p = q(\theta)\theta^p \int_R^{\bar{\alpha}} dF(\alpha), \tag{2}$$

[9]Public jobs, for the calibrated Italian economy, are generally for life, it is extremely improbable to be fired by the government and there are often low incentives also to quit from it. The separation rate in a model with infinitely lived agents, therefore proxies the flow to retirement.

In the public sector instead is,

$$q^p = q(\theta)\frac{\theta^g}{\theta}, \tag{3}$$

and,

$$p^g = q(\theta)\theta^g. \tag{4}$$

3.1 Value of being Unemployed

It is useful to start with the definition of the value of unemployment because it is from its definition that most of the relevant results of the model are generated. The unemployed worker receives an utility flow from her unemployment status indexed by b.[10] However, unemployed workers are also actively engaged in searching for a job and the benefit of that search is given by the expected result. This is represented by the expected change in value sue to finding a private job, times the rate at which such jobs are found, plus the expected change in value due to obtaining a public job, times the rate at which those jobs arrive. That is, the flow value of unemployment is,

$$rU = b + p^p(W_p^e - U) + p^g(W_g - U), \tag{5}$$

where W_p^e is the expected value of a private job and W_g is the value of a public job, which if it arrives has a certain value because it does not depend on the ex ante unknown idiosyncratic productivity. It is already clear from the definition of unemployment what the effect of an increase in public job vacancies can be. If the government increases the vacancies of public jobs, the effect on p^g is clearly positive, this increases the overall value of unemployment and, we should expect in this class of models, the reservation wage. This should generate a negative effect on the private employment, crowding it out. However, there is another element to the model that can mitigate, or even nullify this effect, which is the government budget and the imposition of labor taxes to balance it. That is, more public jobs also increase public

[10]Since I calibrate the model to the Italian economy, I do not consider b to be unemployment benefits paid by employment insurance schemes, as unemployment benefits are rare in Italy. Instead, I interpret it as utility flow from being unemployed, which also includes household production and within the household transfers of resources.

expenditure which requires higher taxes, and lower net wages, to be financed. Moreover, the other open question is, even if private employment decreases, will it decrease more or less than the increase of public employment? i.e. what would it be the overall effect on unemployment?

3.2 Value of a match to a worker

The value of a match in the private sector to a worker depends on the productivity specific to that match and is determined by the following asset equation,

$$rW_p(\alpha) = w_p(\alpha)(1-t) + \lambda^p \int_R^{\bar{\alpha}} [U - W_p(\alpha)] dF(\alpha) - \lambda^p F(R)[W_p(\alpha) - U], \tag{6}$$

where $w(\alpha)$ is the wage rate paid to the worker and t is a proportional tax collected by the government in order to provide public job wages. The expected value of a private match to a worker is given by,

$$rW_p^e = w_p^e(1-t) + \lambda^p F(R)(U - W_p^e), \tag{7}$$

the value of a public match is instead given by,

$$rW_g = w_g(1-t) + \lambda^g(U - W_g), \tag{8}$$

Among other differences between private and public jobs is their expected duration which is determined by the different arrival rates of dissolving shocks λ. The choice to allow the separation rate to be different is motivated by the data, but also by the typical difference between public and private contracts, the public offering a much higher degree of job security. Moreover, within the public sector, there are not provisions for firing in case of low productivity, hence the choice to keep the separation rate constant.

3.3 Value of a match to an employer

The value of a job to a private employer also depends on the productivity specific to that match. The productivity is the product of the shock α and the market specific productivity parameter π. Therefore the value of the job is

$$rJ_p(\alpha) = \pi\alpha - w(\alpha) + \lambda^p \int_R^{\bar{\alpha}} [V_p - J_p(\alpha)]dF(\alpha) - \lambda_p F(R)[J_p(\alpha) - V_p] \tag{9}$$

taking the expectation of equation 9

$$rJ_p^e = \pi\alpha^e - w^e + \lambda_p F(R)(V_p - J_p^e), \tag{10}$$

where the superscript e indicates the expectation conditional on α being greater than R

$$\alpha^e = E[\alpha|\alpha > R]. \tag{11}$$

I also assume that each public job generates an equally productive output within each region.[11] Therefore, the value of a job match for the government is given by,

$$rG = \pi - w_g + \lambda_g(V_g - G) \tag{12}$$

3.4 Value of posting a vacancy

Finally, the value of posting a vacancy in the private sector is given by,

$$rV_p = -c + q^p(J_p^e - V_p). \tag{13}$$

while in the public sector is,

$$rV_g = -c_g + q^g(G - V_g), \tag{14}$$

[11] This assumption simplifies the model in generating the uniform wage that we observe and the effects of which are under scrutiny. However, the public sector is generally more concentrated in few sectors of the economy and offers, most of the times, the same environments in terms of technology used, physical capital per worker etc... to all its employees. Those are all reasons why we may expect productivity within the public sector to be in fact more concentrated, once personal characteristics such as experience, education etc... are netted out. Besides, for non tradable good and services value added is measured by the wage paid, hence for this important sector of public employment we cannot statistically differentiate productivity across workers that are paid the same wage. There may still productivity differences across public employees that give rise for example to different quality of public goods (this is certainly the case for publicly provided health care between the South and the North of Italy). While this is an interesting point, it is not obvious how to measure and find data on productivity differences within the public sector. Moreover, modelling these differences gives rise to a set of complications that would make the model much less readable and probably not very improved in explaining unemployment differences.

3.5 Wage Setting

To keep things simple I assume that in the public sector the wage rate is determined exogenously by the government and is equal to the productivity of workers, plus the cost of opening a vacancy in the public sector.[12]

In substance I assume that workers are able to extract all the surplus from production, including the forgone cost of keeping a vacancy open c_g.[13]

$$w_g = \pi + c_g. \tag{15}$$

For the private sector I follow the literature in assuming that the wage rate is determined by Nash bargaining, theretofore,

$$w(\alpha) = argmax(W_p(\alpha) - U)^{\beta}(J_p(\alpha) - V_p)^{1-\beta}.$$

Which can be solved in terms of the flow value of unemployment as,

$$[\beta + (1-\beta)(1-t)]w(\alpha) = \beta\pi\alpha + (1-\beta)rU. \tag{16}$$

Equation (16) is the textbook wage equation found for example in Pissarides (2000). What makes this equation different however, is the flow value of unemployment which includes the discounted value of finding a private sector job and the discounted value of finding a public sector job. Solving for the value of unemployment we can finally find an equation for $w(\alpha)$,

[12]This assumption helps in solving the model as it makes the public wage exogenous in the equation of the private wage. If, instead, we allow workers to bargain directly with the government, possibly with idiosyncratic productivity as in the private sector, then the bargained wage would be a function of the value of unemployment which, in turns, depends on private wages. As long as the government keeps wages on average equal across regions, the distortive effect of public employment should be recovered, however such a model is much more complex to work with.

[13] This is equivalent to assuming that the wage is set by a monopolistic union that, as in Mortensen and Pissarides (1994), unilaterally determines the share of surplus that goes to workers as opposed to the share that goes to the Government. The government determines the size of public employment, that is the number of workers to hire. I also assume that the wage rate paid by the government is homogeneous across regions. The objective of the unions is to maximize the value of the median worker, which in this case is the worker in the North, given that is the region with the higher concentration of labor force. That is, $w_g = argmax_{\phi} W_g$ where, $W_g = U + \phi(W_g + G - V_g - U)$. and ϕ is the share of surplus that goes to workers. The solution to this particular problem is trivial since the unions set the share that goes to workers equal to one, driving down the surplus to the government $G - V_g$ to zero. As a result, workers are paid the full amount that the government would loose if they were not be working, which is the full amount produced, plus the cost of searching a new worker.

$$w(\alpha) = \frac{1}{1-(1-\beta)t}\left[\beta\pi\alpha + \frac{r+\lambda^g}{p^g+r+\lambda^g}((1-\beta)b + \beta\theta_p c) + \frac{(1-\beta)(1-t)p^g}{p^g+r+\lambda^g}w_g\right] \quad (17)$$

3.6 Government

The Government in this model decides how many public jobs are needed for supplying the public goods, i.e. sets e_g, the number of public jobs per person, and sets t to pay for those public jobs. The budget constraint the government faces is given by

$$w_g(1-t)(\gamma_n e_{gn} + \gamma_s e_{gs}) + c * (v_n + v_s) = t(\gamma_n w_n^e e_{pn} + \gamma_s w_s^e e_{ps}), \quad (18)$$

e_{gi} is the number of public employees over labor force in region i, γ_i for $i = n, s$ is the share of the labor force in the Northern and Southern regions, and e_{pi} is the employment rate in region i.

3.7 Introducing Migration

In this section I slightly modify the model to allow for migration from the South region to the North. A few assumption need to be made to keep the model tractable. First of all, I assume that only unemployed workers migrate. This makes sense within this model as the only benefit to migrate is that to find a better job, besides, excluding on the job searching, those who already work have already discounted the option to move to have better chances. I also assume that in each region there is a population growth rate that is exogenous and fixed (ψ_i) and, while I allow the size of the overall population change overtime, I impose that in steady state in each region the share of population in the country remains fixed. This leads to a steady state condition in which the shares become endogenous and determined by the population growth rates and, most importantly, by the migration rate. That is, I call the migration rate ρ and, given that only unemployed workers migrate, the number of migrants rom South to North is given by ρL_s. For the shares of population to remain constant in steady state the population growth net of migration in each region has to be equal, that is

$$\frac{\psi_n L_n + \rho L_s}{L_n} = \frac{\psi_s L_s - \rho L_s}{L_s} \tag{19}$$

or equivalently,

$$\psi_n + \rho \frac{\gamma_s}{\gamma_n} = \psi_s - \rho. \tag{20}$$

With γ_n endogenous, this leads to the solution,

$$\gamma_n = \frac{\rho}{\psi_s - \psi_n}. \tag{21}$$

Finally, ρ is also an important endogenous parameter determined by the difference between the benefit of migrating, which is given by the difference in value of unemployment, and an idiosyncratic cost of migrating that is different for any unemployed worker and distributed across them following an exponential distribution.[14] That is,

$$\rho(U_s, U_n, cm) = P(U_n - U_s \geq cm). \tag{22}$$

where $P(.)$ is the cumulative distribution function of the exponential distribution.

3.8 The Unemployment Rate

The model allows for population growth in a non trivial way as growth is channelled through unemployment. This follows by the assumption that only unemployed workers can search for jobs and, therefore, "new born" in the economy need to face un unemployment spell before becoming employed. This assumption is also consistent with the data that shows un unemployment rate for youth that is fourth times as high than for the general population.[15] So, given the rate at which new born arrive (a rate that can be negative) and at which migrants come from another region, we have that the change in unemployment in the North is given by the change in the unemployment rate and the change in population, that is,

[14]The choice of the exponential distribution is due to simplify the calibration as this distribution has only one parameter.

[15]This is true for Italy, but is also a general phenomenon for European countries with the only notable exception of Germany. See Eurostat and OECD for youth unemployment rates.

$$\dot{U_n} = \psi_n L_n + \lambda(1 - u_n - e_{gn})L_n - p_{pn}u_n L_n + \lambda_g e_{gn} L_n - p_{gn}u_n L_n + \rho\frac{\gamma_s}{\gamma_n}L_n \tag{23}$$

besides, we also have that

$$\dot{U_n} = \frac{dU(t)}{dt} = \frac{d[u(t)L(t)]}{dt} = \dot{u}L + u\dot{L} = u\dot{L} \tag{24}$$

since in steady state we impose $\dot{u} = 0$.

Moreover, from equation (20), we know that,

$$\frac{\dot{L_n}}{L_n} = \psi_n + \rho\frac{\gamma_s}{\gamma_n} \tag{25}$$

therefore we have,

$$u_n[\psi_n + \rho\frac{\gamma_s}{\gamma_n}] = \psi_n + \lambda(1 - u_n - e_{gn}) - p_{pn}u_n + \lambda_g e_{gn} - p_{gn}u_n + \rho\frac{\gamma_s}{\gamma_n} \tag{26}$$

which gives.

$$u_n = \frac{\gamma_n(\psi_n + \lambda + (\lambda_g - \lambda)e_{gn}) + (1 - \gamma)\rho}{\gamma_n(\psi_n + \lambda + p_{pn} + p_{gs}) + (\gamma_s)\rho} \tag{27}$$

As for unemployment in the South we follow the same derivation to find,

$$u_s = \frac{\psi_s + \lambda + (\lambda_g - \lambda)e_{gs} - \rho}{\psi_s + \lambda + p_{ps} + p_{gs} - \rho} \tag{28}$$

4 Calibration

Although the model is fairly simple and parsimonious, there are still fifteen parameters that need to be given numerical values and two functions to be given a specific form. My calibration strategy follows two basic criteria, on the one hand I rely on what has been done previously in the literature for the parameters and the functional forms for which I do not have direct evidence from Italian data; on the other hand, I use, as much as possible, the same data used to report the empirical facts above. Starting with the functional forms, I follow Pissarides and Petrongolo (2001) and I assign to the matching function a Cobb-Douglas form $m(u, v) = u^{\eta}v^{1-\eta}$ with $\eta = 0.5$. To the idiosyncratic distribution of shocks I assign a log normal form

in order to replicate the distribution of the log-wage residuals presented in section 2. That is, $\alpha \sim LogN(0, \sigma^2)$.

For the bargaining power of workers and firms I choose to make a "neutral" assumption and set the value of the parameter β equal to 0.5.[16] I set the model time to be a quarter and therefore I choose the interest rate to be 0.01, a 4% annual interest rate.

The other parameters are chosen to match statistics directly or indirectly. The arrival rates of the shocks that break matches in the public and private sectors are set to match statistics of the number of jobs held by men lost over the total in those two sectors. For the public sector I take the statistics from the *Ragioneria dello Stato* on the number of public employees that cease to work for the public administration, over the total of the public employees, every year from 2001 to 2008. Averaging these number for the entire period 0.73% of public employees cease to work every three months, hence, since the break up rate for the public sector is exogenous, I directly set $\lambda^g = 0.0073$. For the private sector I take the numbers given in Brutti (2011) for men, 3.31% for the North and 4.24% for the South as a quarterly average for the years 2004 to 2007.[17] These statistics contribute to pin down the arrival rate of the shocks that changes the match productivity, however, given that the actual destruction rate in the private sector is endogenous, they also contribute in pinning down other relevant parameters, such as the unemployment benefits, the cost of posting a vacancy and the variance of the shock distribution, which I do not match directly.

The shares of public jobs e_{gi} are chosen to match the total number of men who hold public jobs over the total number of men in the labor force, therefore I set $e_{gn} = 0.0974$ and $e_{gs} = 0.1413$.[18]

The public sector wage setting rule in Quadrini and Trigari (2007) matches a premium that

[16] Since Italy has a labor market largely characterized by the strength of labor unions, this may seem a value hard to justify. However, the model does imply that unions have a strong effect on wages, both privately and publicly set, effect that comes indirectly through the wage setting process in the public sector.

[17] These numbers are not provided directly in Brutti (2011) as there are not detailed statistics for men in the North and the South. I derive these numbers by first taking the probability of loosing a job for men in the whole country and then taking the estimated difference between men in the North and in the South, this being 0.91%.

[18] The significant difference between North and South is explained by the lower participation rate of women in the South that leaves more public jobs available to men. Of course, the large difference can also have an impact on explain unemployment gap, however, I conduct sensitivity analysis re-calibrating the economy imposing the same number of public jobs available in the two regions and find that the difference in available public jobs has little impact in explaining the unemployment gap.

is paid to public workers in the US, and sets the wage rate in the public sector 3% higher than in the private sector. The data available for Italy say that, once personal characteristics such as education and experience are taken into account, public log-wages in the North are actually marginally lower than private sector log-wages by about 1.02%. I normalize π equal to one, and therefore $w_g = 1 + c_g$, and use the public-private wage rate difference as a target to pin down the wage distributions. Additional targets for the distributions are the ratios of means and variances of the log-wages distributions. I.e., I target the 11.71% wage gap between Southern and Northern wages, and I also target the 84.78% higher variance in the South compared to the North wage distribution.[19] These targets mainly pin down the parameters of the idiosyncratic distribution of productivity. That is, I normalize the mean of the distribution in the North equal to zero (the log-mean), so that the 11.71% difference pins down the mean in the South. The variance of the distribution is instead pinned by the ratio of the variances of the log-wages, together with the difference in the job losses probabilities in the private sector between North and South. In fact, being the job loss endogenous and dependent on the distribution of the shock, its variance has a direct effect on it. I target the unemployment rates in the North, the overall average for men at 3.48%, which mainly contributes in pinning down the cost of posting a vacancy and unemployment benefits, and leave that in the South free. The parameter that governs the distribution of the cost of moving is calibrated by targeting a migration rate of 0.287% per year, or 0.0717% per quarter, while I set the population growth rates to be roughly consistent with the observed growth rates and the targeted share of male labor force living in the North: 65%, therefore I target $\gamma_n = 0.65$, set $\psi_s = 0.045$ and, consequently $\psi_n = -0.0565$.[20]

[19] I do not calibrate the variance of the shock distribution using the actual variance of the residual wages from the data. The reason is that even though I do control for several important characteristics of individuals such as level of education and age, many other factors can imply a large heterogeneity across unemployed workers, for example the type of education or the quality of school attended, cannot be taken into account. The model assumes that unemployed agents are homogeneous and all the heterogeneity is post-meeting due to the idiosyncratic productivity shock attached to the match. For this reason we should expect the variance generated by the model lower than the variance of the residual wages, unless we are able to take into account all possible factors that explain ex-ante heterogeneity . However, if we assume that the unexplained ex-ante heterogeneity is distributed homogenously across regions in terms of first and second moments, we can look at the ratio between the variances in the North and the South.

[20] ψ_n comes from the natural (before migration) growth rate in the Southern region in 2002 (data: ISTAT), ψ_s is adjusted to be consistent with the share of population, but anyway close to the actual data for the same years. Given the different flow of immigrants from out of the country to Southern and Northern regions, we cannot expect those flows to exactly reproduce the share of populations. Moreover, these flows are available

Because I have as many targets as parameters left to be determined, all the targets are matched exactly. In this case, an evaluation of the calibration can be obtained by looking at other statistics that can be obtained by the model simulation as compared to correspondent data statistics.[21]

4.1 Results and Model Evaluation

Table 5 shows all the parameter values obtained through the calibration. In bold are the six parameters that are calibrated matching the six targets mentioned above. First can be noticed that the mean of the productivity distribution in the South is about 13% lower than in the North.[22] This difference in values is primarily imposed by matching the 11.7% difference in the wage distribution between the two areas. The ex-ante productivity gap is larger than the wage gap, a clear effect of the geographically uniform public employment wage. The wage paid to public employees is relatively high in the South compared to the ex-ante average productivity in that region, this affects the bargaining process in the private sector increasing the southern workers outside option and, consequently, their wages.

A critical parameter to pin down in this type of models is the recruiting cost. The calibrated flow cost of recruiting is 0.1278 (column 5 in Table 5) about 12% of the average wage in the North and slightly higher in the South.[23] This value implies that about 0.4% of the total wage bill is spent on recruiting, a value significantly lower to the one estimated by Michaillat (2012) for the US of 0.9%. Finally, the flow value of being unemployed is calibrated to about 60% of the average wage rate in the North and 68% in the South. This value includes a large pool of resources that directly or indirectly benefit unemployed workers such as intra-family transfers, home production and, most importantly, a taste for leisure that can be enjoyed while unemployed.[24] Finally, the rate of unemployment in the South is 8.60%. While this result is

only for the total population and not for the sole labor force.

[21] Alternatively, I could have chosen to over-identify the calibration and analyze the distance between the data and simulated moments. However, in order to have a proper measure of this distance I would also need a covariance matrix for weighting the data moments, which I don't have since some targets come from previous literature. Besides, I choose to calibrate based on the targets that are the most important given what the model aims at explaining, which is equivalent to giving these targets a infinite weight in an estimation.

[22] Since I normalize the mean of the distribution of $log(\alpha)$ equal to zero in both regions, μ_i is equal to $log(\pi_i)$.

[23] I also performed a calibration of a model where recruiting costs differ proportionally to the structural productivity between the South and the North, the results hold with approximately the same values.

[24] Only a very small fraction of unemployed workers can benefit from properly defined unemployed benefits in Italy. Most of the unemployed who never had a previous formal employment for a long enough period of time,

Table 5: **Calibration - Parameter Values**

Parameter	North	South
Productivity Distribution, Mean μ	-0.0000	**-0.1287**
Shock arrival rate (priv)λ^p	**0.0993**	
Shock arrival rate (gov)λ^g	0.0073	
Variance shock distrib. σ^2	**0.0667**	
Recruiting cost c	**0.1278**	
Recruiting cost gov. c_g	**0.0171**	
Unemployment Benefit b	**0.6205**	
Interest rate r	0.0100	
Matching elasticity η	0.5000	
Bargaining Power β	0.5000	
Mean of the Moving Cost distrib. ξ	1.3865	
Public Empl. Share e_g	0.0974	0.1413

Table 6: Calibrated Statistics

Statistics	North	South
Unemployment Rate	0.0348	0.0860
Destruction Rate	0.0331	0.0424
Employment Rate	0.8678	0.7727
Average Wage	1.0276	0.9140
Reservation Wage	0.9954	0.8894
Public Sector Wage	1.0171	1.0171
Average Productivity	1.0411	0.9273
Reservation Productivity	0.9768	0.8780
Hiring Cost	0.0022	0.0088
Wage variance S/N	1.8478	
Log-Wage. Diff.	0.1171	
Log-Wage. Premium	-0.0102	
Tax Rate	0.1218	
South-North Mig. rate	0.0717	

about 10% lower than the actual unemployment reported by the above statistics, it shows that, given the institutional setup of the economy, the model is capable of delivering a large unemployment rate gap between the regions due to a relatively small difference in average productivity. In fact, the model explains about 33% of the gap between the regions.

do not qualify and cannot collect unemployment insurance. Those are the majority in the unemployed pool.

4.2 Sensitivity - The Importance of Public Employment

In order to evaluate the importance of the public sector in determining the unemployment gap, I re-calibrate the model first with an equal share of public employment across regions and then without any public employment. In the first sensitivity calibration I set the rate of public employment equal to the national average in both regions, in the second exercise I set it equal to zero. All the calibration targets remain the same as before. In the second exercise the difference between public and private wage is dropped. Table 7 shows the parameter values of the new calibration, Table 8 the results.[25]

Table 7: **Calibration Sensitivity - Parameter Values**

	Benchmark		Equal P.E		No P.E.	
Parameter	North	South	North	South	North	South
Productivity Distribution, Mean μ	0.0000	-0.1287	0.0000	-0.1273	0.0000	-0.1241
Shock arrival rate (priv)λ^p	**0.0993**		**0.0983**		**0.1025**	
Variance shock distrib. σ^2	**0.0667**		**0.0685**		**0.0614**	
Recruiting cost c	**0.1278**		**0.1277**		**0.1607**	
Recruiting cost gov. c_g	**0.0171**		**0.0187**		**-**	
Unemployment Benefit b	**0.6205**		**0.6141**		**0.7951**	
Public Empl. Share e_g	0.0974	0.1413	0.1128	0.1128	0.0000	0.0000

The first two columns of the Tables report the calibrated benchmark, while columns 3 to 6 report the parameter values obtained in the two sensitivity calibrations. Starting with Table 8 we can see in the first row column 4 that the unemployment rate in the South diminishes going from different share of public employment to an equal share in both regions by about 0.7%. This suggests that differential share of public employment have an effect on generating unequal unemployment, although this effect appears small. Looking at column 6 we see that in the case of no employment the calibration exercise reproduces an unemployment rate in the South even smaller, now about 1.4% smaller than the benchmark calibration. Turning now to Table 7 we can observe that the parameter values change little from the benchmark calibration to the equal share, while the change is quite substantial for the calibration without public employment. In particular, this last calibration indicates a much higher value for unemployment benefits, from about 0.62 to almost 0.8, as well for the recruiting cost, from 0.13 to 0.16. The reason why

[25]I also re-calibrated the model with no taxes and with a fixed tax rate equal to the benchmark calibration. None of the alternative exercises bring significantly different results, therefore I do not report them for brevity.

unemployment benefits are much higher in this calibration is because three moments being targeted are the log-wage difference between average wages in the North and the South and the destruction rates in both regions. The destruction rates diverge in the two regions and this implies a large productivity difference. At the same time, the wage difference is constrained by the targeted moment and this requires the calibration to increase the parameter that gives to the Southerners a higher relative outside option so to counter the effect of productivity on wages. In fact, the replacement ratio of unemployment benefits in the North is now about 77.8%, while for the South is about 87.4%. In other words, the main effect that the uniform public wage rate has in the benchmark calibration is now partially recovered by a higher unemployment benefit.[26]

Table 8: **Calibration Sensitivity - Statistics**

	Benchmark		Equal P.E		No P.E.	
Statistics	North	South	North	South	North	South
Unemployment Rate	0.0348	0.0860	0.0348	0.0788	0.0348	0.0718
Destruction Rate	0.0331	0.0424	0.0331	0.0424	0.0331	0.0424
Employment Rate	0.8678	0.7727	0.8524	0.8084	0.9652	0.9282
Average Wage	1.0276	0.9140	1.0291	0.9153	1.0223	0.9093
Tax Rate	0.1221		0.1218		-	

4.3 The Asymmetric Response to a Productivity Shock

In this section I simulate what happens when the economy is hit by a productivity shock proportionally uniform across regions. The original calibration replicates a steady state economy and, as such, I use target values that averaged over a long period up to 2008, before Italy entered in a prolonged economic economic crisis. Starting from 2008 and especially in 2011 and 2012, unemployment in Italy increased substantially following the financial and sovereign debt crisis that affected all the Mediterranean Europe. However, noticeably the Southern regions were much more affected in terms of job loss than Northern regions. To see if the model is

[26]This high value of unemployment benefits is close to the value suggested by the calibration in Hagedorn and Manovskii (2008). Nevertheless, as the authors mention in their article, this high value can be justified for short spells of unemployment, more difficult is to justify it for longer spells as typically are those faced by Italian men. In this sense the uniform public wage rate can be seen as a mechanism that reduces the need to have such an implausible value for unemployment benefits.

capable of generating such an asymmetric response I simulate it assuming a drop in productivity proportionally equal in both regions. I calibrate the shock to obtain an unemployment rate in the north of 6.59%, i.e. the unemployment rate in 2012. In the same period the unemployment rate in the South skyrocketed to 27.66%, i.e. 6.7% higher than the previous period. In addition I also fix the shares of public employment to the levels registered in the period between 2008 to 2012, that is significantly lower in both regions than in the previous years, 8.8% in the North and 13.29% in the South. Table 9 reports the results of this simulation. The upper panel of the table reproduces the simulation results under the assumption that the government keeps the budget balanced, the panel below with constant taxes. Looking at what happens with constant taxes is helpful to disentangle the effect of taxes from the effects that come mainly through wages. The first two columns reproduce the benchmark economy, while columns 3 to 6 reproduce the simulation results under two alternative scenarios, the first in which public wages are kept homogeneous across the country (homogenous wages), the second which assumes that public wages are paid in each region according to local productivity (heterogeneous wages).

Table 9: Simulation - Asymmetric response to an Aggregate Productivity Shock

	Benchmark		Homog. Wages		Heter. Wages	
Statistics	North	South	North	South	North	South
Unemployment Rate	0.0348	0.0860	0.0659	0.2213	0.0592	0.1244
Employment Rate	0.8678	0.7727	0.8461	0.6458	0.8528	0.7427
Average Wage	1.0276	0.9140	0.8755	0.7846	0.8742	0.7764
National Unemp. Rate	0.0527		0.1413		0.0878	
Log-Wage. Diff.	-0.1171		-0.1096		-0.1186	
Tax Rate	0.1218		0.1314		0.1147	
Emigration Rate	0.0717		0.0568		0.0620	
Constant Taxes						
Statistics	North	South	North	South	North	South
Unemployment Rate	0.0348	0.0860	0.0620	0.2017	0.0619	0.1343
Employment Rate	0.8678	0.7727	0.8500	0.6654	0.8501	0.7328
Average Wage	1.0276	0.9140	0.8747	0.7831	0.8747	0.7774
National Unemp. Rate	0.0527		0.1284		0.0941	
Log-Wage. Diff.	-0.1171		-0.1106		-0.1180	
Tax Rate	0.1218		0.1218		0.1218	
Emigration Rate	0.0717		0.0579		0.0613	

Looking at columns 3 and 4 in the upper panel, the table clearly shows that the model can deliver a strong asymmetric response to a productivity shock common to both regions. In fact, the same shock of a drop of about 16.6% in productivity (I lower the mean of the productivity distributions by 0.1665), is associated to an increase of about 3% in the rate of unemployment in the North and an increase of about 13% in that of the South, more than doubling it.[27] Another interesting prediction that the model delivers is about migration. The model predicts that the migration rate from South to North also drops slightly due to the shock, from an initial rate of 0.0717% per quarter, or 0.287% per year, the rate reduces to 0.0568% per quarter, equal to 0.2272% year. This drop is indeed very close to the 0.223% that we see in the data for the period post 2008 in Figure 5. The reduced migration, which in the data is also the result of return migration from the North to the South, in part explains the much higher impact on unemployment of the shock in the South compared to the North. Looking at the same columns but in the lower panel, i.e. with constant taxes, we see that the effect of the shock is slightly lower due to the fact that taxes do not increase to keep the budget balanced while private employment decreases. Finally, looking at columns 5 and 6, we see what it would have happened if wages were not geographically homogenous, although time flexible, but flexible also across regions. Looking at the upper panel we see that for the same shock unemployment increases slightly less in the North, because of lower taxes, but a lot less in the South, less than 4% compared to more than 13% with homogeneous wages. A similar result is obtained in the case of constant taxes.

Turning now the attention to the aggregate rate of unemployment, i.e. row 4 in both panels, we observe that, even if public wages change at the same rate of the changes in productivity, the the effect of homogeneous public wages is of overall higher fluctuations in the unemployment rate. We see in fact that with homogenous wages the unemployment rate goes from 5.27% to 14.13% with balanced budget or 12.84% with constant taxes, while with heterogenous wages the unemployment rate would be respectively 8.78% or 9.41%. That is, even without a mechanism that makes public wages adjusting slowly to productivity changes, as in Quadrini and Trigari (2007) and Gomes (2014), geographical homogeneity alone contributes to explain a higher

[27] According to OECD data multifactor productivity dropped between 2007 and 2009 by about 5%, the model needs a much higher drop in order to replicate the increase in the unemployment rate in the North.

volatility of unemployment with changes in productivity. From a policy point of view this is also an important result as it shows that homogenous wage setting has important amplifying effects on unemployment.

5 Policy Experiments

In the previous section when simulating the asymmetric response to a productivity shock I reduced the level of public employment in both regions according to what we find in the data. In fact, most likely because of the efforts in reducing public debt, Italy is experiencing a slow, but continuous reduction of public employment mainly driven by not replacing or only partly replacing retiring public employees. In this section I conduct two policy experiments, one in which public employment is further reduced of an equal share in both regions, one in which I let the wage of public employees to be set regionally, according to the local productivity. A third experiment combines the two policies.

Table 10: Simulation - Policy Experiments

	Benchmark		Lower P.E.		Heter. Wage		Combined	
Balanced Budget Statistics	North	South	North	South	North	South	North	South
Unemployment Rate	0.0348	0.0860	0.0333	0.0788	0.0335	0.0474	0.0322	0.0451
Employment Rate	0.8678	0.7727	0.8791	0.7940	0.8691	0.8113	0.8801	0.8277
Average Wage	1.0276	0.9140	1.0269	0.9126	1.0271	0.9061	1.0265	0.9054
Public Sector Wage	1.0171	1.0171	1.0171	1.0171	1.0171	0.8963	1.0171	0.8963
National Unemp. Rate	0.0527		0.0486		0.0378		0.0360	
Log-Wage. Diff.	-0.1171		-0.1180		-0.1253		-0.1255	
Tax Rate	0.1218		0.1086		0.1130		0.1012	
Emigration Rate	0.0717		0.0732		0.0766		0.0777	
Constant Taxes Statistics	North	South	North	South	North	South	North	South
Unemployment Rate	0.0348	0.0860	0.0352	0.0835	0.0348	0.0497	0.0351	0.0505
Employment Rate	0.8678	0.7727	0.8772	0.7893	0.8678	0.8090	0.8772	0.8223
Average Wage	1.0276	0.9140	1.0276	0.9134	1.0276	0.9067	1.0276	0.9068
Public Sector Wage	1.0171	1.0171	1.0171	1.0171	1.0171	0.8963	1.0171	0.8963
National Unemp. Rate	0.0527		0.0519		0.0395		0.0399	
Log-Wage. Diff.	-0.1171		-0.1178		-0.1251		-0.1251	
Tax Rate	0.1218		0.1218		0.1218		0.1218	
Emigration Rate	0.0717		0.0721		0.0758		0.0758	

Table 10 resumes the results of the policy experiments. The first panel presents the experi-

ments under balanced budget, the second panel keeps the tax rate fixed across experiments and equal to the benchmark. Starting from the first panel, lowering public employment by a 10% in both regions implies a reduction of unemployment in the South by about 0.7 percentage points, and a smaller decrease in the North. Columns 5 and 6 show the results of letting the wage of public employees adjust to the regional productivity. This means that while in the North the wage rate remains the same, in the South drops significantly by about 13%. This policy has a significant effect on Southern unemployment lowering it by about 4.1% points and a small negative effect on the Northern unemployment as well. Finally, combining the policies decreases further unemployment in both regions but by a very small amount. The second panel gives a slightly different picture. First of all, we see that lowering public employment has a much smaller effect on Southern unemployment and an even slightly positive on the Northern one. This implies that most of the negative effect seen in the first panel is actually due to lowering taxes. Paying public wages according to regional productivity still implies a large effect on Southern unemployment, only slightly lower than in the balanced budget case. However, when we combine the policies we find that lowering public employment when heterogenous wages are paid it actually increases unemployment in both regions and in the aggregate. This implies that once the wage setting rule is such that public wages are flexible enough, paid according to productivity, then public employment has an equalizing effect mimicking the stabilizing effect found by Gomes (2014) in business cycle for pro-cyclical public wages. In terms of migration, it is interesting to notice that all policies imply a slightly higher migration rate from South to North, particularly when public wages are heterogeneous. This is due to the fact that lower expected wages imply a lower value of unemployment in the South compared to the North, hence a higher incentive to migrate.

6 Conclusions

The focus of this paper is the macroeconomic effect that through the labor market public sector wages and employment has on private employment and unemployment. In particular I look at the geographical homogeneity of the wage rate paid by the government, as induced by the particular institutional set up of the government sector, and the effect that this has when regions are differently productive. I present a model in the spirit of Pissarides (2000),

similar to the ones in Quadrini and Trigari (2007), Gomes (2014) and Boeing-Reicher and Caponi (2016), but adapted to take into account regional heterogeneity. I calibrate the model to the Italian labor market and I show that the model is capable of explaining about one third of the unemployment gap between the South and the North of Italy, i.e. about 5 of the 15 percentage points of difference. Moreover, it is also capable of explain the large asymmetric response of unemployment to the recession began in 2008, which I simulate as implied by a productivity shock homogenous across regions. In fact, the same drop of about 16% in productivity, generates an increase of about 3% in the rate of unemployment in the North and an increase of about 13% in that of the South, more than doubling it. In addition, I show that, even if public wages change at the same rate of the changes in productivity, its geographical homogeneity implies an overall higher fluctuation in the aggregate unemployment rate. That is, even without a mechanism that makes public wages adjusting slowly to productivity changes, as in Quadrini and Trigari (2007) and Gomes (2014), this homogeneity alone contributes to explain a higher volatility of unemployment with changes in productivity. From a policy point of view this is also an important result as it shows that homogenous wage setting has important amplifying effects on unemployment, not only across regions but also across time. I further simulate the model under different policy scenarios and show that reducing the size of public employment by a 10%, reduces the unemployment in lower productivity regions by less than 1% while allowing for regional wage setting in the public sector would almost eliminate the unemployment differential. From the policy simulations we can conclude that that it is indeed how public wages are set that determines the effect on unemployment, rather than the size of public employment itself. Indeed, by combing the two policies, and keeping taxes constant, is possible to notice that increasing public employment actually has the effect of decreasing unemployment (both the high unemployment region and in the aggregate), a result that is similar to the stabilizing effect found by Gomes (2014) in business cycle for pro-cyclical public wages.

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