

# Regional Variation in the Public Sector Wage Premium in Poland\*

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## Abstract

There are a number of reasons, related to both the supply and demand side of the labour market, for which the public sector employment wage premium may vary spatially. This variation may affect the efficiency of public services provision, private investment and the equilibrium of regional labour markets. The aim of this study is to assess the scale of regional variation in Polish public-private wage differentials. In this paper, we use the individual dataset from the 2012 Structure of Earnings by Occupation (SEO) survey carried out by the CSO and the propensity score matching method, supplemented by quintile regression, to analyse regional differences in public-private wage differentials. The results reveal that in Poland, the public sector premium is highest in the least economically developed regions. Moreover, it significantly varies between regions across the wage distribution. The volatility of the premium may be to some extent explained by the structure of regional economies and by the development of the private sector in particular.

**Keywords:** public-private wage differentials, public-sector wage premium, propensity score matching, Poland, regional differences in wages

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## 1. Introduction

The specifics of public sector employment (as compared to the private segment of the labour market) have been a subject of interest for labour market economists for many decades. The public sector constitutes a considerable part of the national labour market, being the main source of demand for workers with a tertiary education, particularly in certain occupations (e.g., medical doctors, teachers etc.). The role of the public sector in labour market performance exceeds its borders, with public sector employment and wages having an impact on the equilibrium of public finances, the inflation rate and other macroeconomic variables. However, the role and nature of the public sector regarding the economy varies spatially. It may have varying impacts on regional labour markets and economies.

Differences in earnings between ownership sectors play a major role in the relative attractiveness of public, as compared with private employment. Although neoclassical economics postulates that wage arbitrage should lead to wage equalization, significant differences in wages prevail in real economies, mainly due to the many imperfections of labour markets. This effect has gained in strength in recent years. The ongoing process of globalization is pressing more heavily on the private sector, which is generally operating in increasingly competitive markets. It is generating a pressure to lower costs and to search for the most productive workers. On the other hand, in recent years there has also been a tendency for the government to manage public services provision in a more rational and efficient way. Highly qualified workers are often crucial for reaching goals set by the new public management. As a result, a sort of intersectoral competition to attract and keep qualified workers is emerging (Fougère and Pouget 2003). Due to differences in both the demand and supply side of the labour market, those pressures vary according to different geographical areas, with particular differences between big cities, small towns and rural areas. This translates into regional differences in relative wages in the public and private sectors.

In some local labour markets, the public sector remains the main source of demand, particularly for workers with tertiary education (Mueller 1998). This results in the monopsony power of the public sector. Monopsony in this context should not be understood as a situation with a single buyer of labour, but rather a situation in which the supply of labour to an individual firm or institution is finitely elastic. The reason for this lies in the existence of significant frictions in the labour market and the fact that, contrary to traditional neoclassical theory, it is an employer that sets the wage. Barriers to labour force mobility (both in terms of qualifications and of space) are the main source of this friction. It may result in differences between wages offered by similar employers to similar employees in different locations.

Demand for labour, the private aspect, is more spatially concentrated than labour supply. The spatial distribution of private economic activity is, to a large ex-

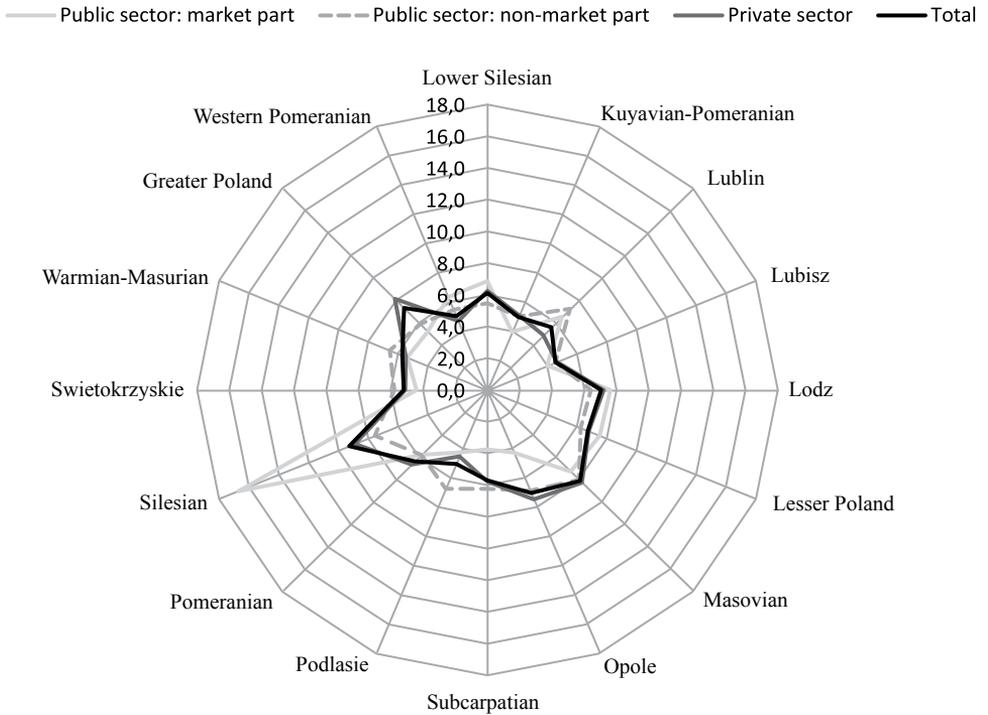
tent, driven by the economic mechanisms described by new economic geography (NEG). According to NEG, industrial clusters emerge and we can observe a spatial variation of wages. These processes are due to the linkages between centripetal and centrifugal forces, especially those of economies of scale (Fujita and Krugman 2004). The distribution of private activity is driven by economic forces, related both to market demand and the supply of factors of production. Public activity, particularly its non-market aspects (education, health care, administration and defence), is more related to the spatial distribution of the population. As a result, it is significantly more evenly distributed over the territory. Similarly, due to specific institutional settings, wages in the public sector are characterized by smaller spatial variation. This is largely a consequence of legal regulations imposed by the public authorities (regulated wages in many branches of the general government sector).

Although many countries have implemented market-oriented mechanisms in the public sector, differences in recruitment processes, wage setting and collective bargaining between public and private sectors prevail. In the public sector, rules of promotion and remuneration are generally strict and related mainly to job tenure (Makepeace and Marcenaro-Gutierrez 2006; Burgess and Metcalfe 1999). Lower wages can be somewhat compensated by other employment benefits, greater job security or more flexible hours. Non-wage benefits, to a large extent, depend on the alternative possibilities available on the local labour market and thus differ regionally. Wages in the private sector are related to labour productivity and the balance between labour demand and supply. It may then be expected that they will vary to a larger extent, with the highest wages achieved in areas characterized by the highest labour productivity. As a result, the public sector wage premium may differ between regions. We may expect the highest levels of public sector wage premium in regions characterized by relatively low levels of labour productivity (and relatively low private sector wages). On the other hand, the lowest levels of public sector wage premium may be expected in regions characterized by the highest levels of development, labour productivity and private sector wages. Such mechanisms, if identified, may lead to substantial differences in the relative attractiveness of public sector employment. It may impact the efficiency of public services provision, particularly in locations where the public sector underpays its workers. In such locations, the public sector may experience recruitment and retention problems. On the other hand, in regions where the public sector overpays its workers (relative to the private sector), it may experience positive selection and less retention problems (Elliott *et al.* 2007).

Elliot *et al.* (2007) indicate that regional differences in the public sector wage premium may lead to indirect effects on regional economies, which may become evident in the long term. In the case of local labour markets with relatively low productivity levels and a high public sector wage premium, we may expect less incentive for private investments. Private firms may be reluctant to invest, as they

may be afraid that higher quality local human capital is being employed by the overpaying public sector. On the other hand, in areas where the local labour market is competitive and private sector employers are offering higher wages than their public sector counterparts, then an indirect effect will be that the public sector is affected by higher staff turnover, retention problems and unfilled vacancies (Elliott *et al.* 2007).

Poland seems to be an interesting case for assessing regional differences in the public sector wage premium. First, despite intensive privatization, the public sector is still a considerably important employer, with employment levels exceeding 3.8 million (first quarter of 2016; CSO 2016), which renders the public sector the greatest “national employer”. This does not just include the core public sector (non-market services including public administration, national defence, education and health care); it also has substantial share in industrial activities and market services. Second, over the past two decades, Poland has faced an inversion from negative to positive of the public sector wage premium. It has been growing with the progress of economic transition, and has turned positive in recent years. Third, the size and structure of Poland’s public sector differ spatially in a significant manner. Figure 1 shows the ownership structure of hired employment in the 16 Polish regions in 2012 (based on LFS data). The black line shows the percentage of total hired employment for each region. Other lines indicate the percentage of private and public employment for each region. Public sector employment has been divided into non-market, core aspects (i.e., public administration and national defence, education and human health – three sections that “produce” public services and which are dominated significantly by the public sector) and market aspects (all remaining sections of the national economy). Clearly, we may indicate regions with an over-proportional share of the non-market public sector (Lublin, Podlasie, Swietokrzyskie and Warmian-Masurian voivodeships). These are the least economically developed regions with the lowest wages. On the other hand, there are regions with a relatively high share of the market-oriented public sector. In this group, Silesian voivodeship stands out, with 16.7% of the market-oriented public sector in total employment. Finally, there are regions where the private sector is overrepresented, like Greater Poland or Opole voivodeships. It is an interesting issue to assess whether differences in levels of economic development between regions are linked with differences in the public sector wage premium, and how it may influence the relative attractiveness of employment in both sectors.



**Figure 1. Percentage of each region in hired employment in Poland: public versus private sector (in percent)**

Source: author's own calculations based on the individual LFS data (2012).

The aim of this paper is to assess regional variations in Polish public-private wage differentials and to test our hypothesis on the relationship between the economic structure of regional economies and public sector wage premium levels. We have used the propensity score matching (PSM) approach and the individual dataset from the 2012 Structure of Earnings by Occupation (SEO) to assess inter-voivodeship wage premium differences. The year 2012 was the latest year for which individual data from the SEO are available. In order to show the heterogeneity of the premium across the wage distribution in different regions, we used quantile regression as a supplementary analysis.

The paper is structured as follows. First, we report the review of the empirical literature. In this section, we document the methodological evolution of research on the adjusted sector wage premium, present the main conclusions from the literature on the public sector wage premium and discuss empirical studies on regional differences in public-private wage differentials. In the following section, we present the properties of our dataset (the Structure of Earnings by Occupation). In this section, we statistically describe our sample, focusing on regional variations in public and private sector employment and wage structure. Finally, we move to our empirical study based on PSM analysis. As a complementary analysis, we discuss

the results of quantile regression in order to assess regional differences in sector wage premiums across the wage distribution. The paper ends with our conclusions and a discussion of ideas for further studies.

## **2. The public sector wage premium: a review of the empirical literature**

Although the public sector wage premium has been a subject of interest for many researchers, regional differences in this premium have rarely been assessed. In this section, we first briefly describe the methods used to assess public-private sector wage differentials, before presenting the main conclusions of empirical analysis of wage differentials by ownership sector, with particular attention to research on the Polish economy. This is the background against which we provide a review of the very few studies on the regional heterogeneity of the public sector wage premium in Western European countries.

Empirical research on the public sector wage premium has undergone a significant methodological evolution. There are many statistical procedures used for wage gap analyses that enable us to isolate the effects that differences in employment structure have on earnings. There is probably no single method that would enable us to address all the methodological problems that arise while studying intersectoral wage gaps. Three problems are commonly discussed in the literature. The first of these is non-random selection, both in employment and in public sector employment. Not taking this issue into consideration may result in biased estimates of the wage premium. Second, if public sector employees are on average very different from their private sector counterparts (better educated, longer job tenures, work in bigger entities, etc.), standard parametric approaches to estimating the adjusted sector wage gap may yield misleading results due to the common support problem. Third, adjusted wage premiums may differ for different parts of the wage distribution, and yet conclusions drawn from simple OLS estimates refer only to the average wage level.

The methods applied may be grouped into parametric and nonparametric methods. The former includes single-equation wage models (e.g., Jacobsen 1992; Disney and Gosling 2003); quantile regression models (e.g., Lucifora and Meurs 2006); double-equation models with the Oaxaca–Blinder decomposition (e.g., Oaxaca and Ransom 1994); switching regression (e.g., Adamchik and Bedi 2000; Falaris 2004; Heitmueller 2006; Tiagi 2010) and the Heckman selection model (e.g., Dustmann and Van Soest 1998; Melly 2006; Chernozhukov and Hansen 2005). Nonparametric methods are based on matching procedures (e.g. Mizala, Romaguera and Gallegos 2011).

Evidence of a positive public sector wage premium has been found for the majority of developed countries. Low-paid earners generally benefit most from

employment in the public sector (as compared to their counterparts in the private sector), while individuals earning relatively high salaries earn more in the private sector. Most empirical papers indicate that employment in the public sector is generally more beneficial for women and for people with lower levels of education. In the case of transition economies, a negative public sector wage premium was observed in the initial period of the transition (the wage gap is estimated to be about 20% on average in favour of the private sector). When progress is made in the transition process, the absolute value of the wage gap decreases to zero or even becomes positive in some countries (Lausev 2014).

Similar conclusions may be drawn from the literature on a public-private sector premium in the Polish labour market. One of the first analyses of the public sector wage premium in Poland was conducted by Newell and Socha (1998). It revealed a private sector wage premium (5.1% for men and 8.6% for women) in 1992. In the data from the year 1996, the premium had mostly vanished. Their research used LFS data and single-equation estimation. A similar type of analysis was also conducted by Lehmann and Wadsworth (2000) and Adamchik, Hyclak and King (2003). Their results are consistent with Newell and Socha's findings (1998). Adamchik and Bedi (2000) used a different methodological approach. They applied endogenous switching regression in order to control for sector selection. They used age and whether the person had entered the labour market prior to 1990 as instruments. Their results revealed a significant public sector pay penalty (-7% for men and -10% for women). More recent estimates of the public sector wage premium for Poland revealed a vanishing public sector pay disadvantage. Grotkowska and Wincenciak (2014) used LFS data for 2010 and Mincer's earnings regression with the Heckman correction, supplemented by the quantile regression model, to show that the public sector wage penalty did not differ significantly from zero for the majority of the wage distribution. Grotkowska *et al.* (2016) presented the evolution of the premium in recent years. Contrary to earlier results for Poland, they show an increasing public sector wage premium and suggest that both private and public sector employees themselves choose the sector in which they can earn more than they would in the opposite scenario.

In most papers, regional dummies were only used as control variables. However, in the literature, we can find several empirical investigations of regional differences in the public sector wage premium in Western European countries. In most cases, they reveal significant regional disparities (Elliott *et al.* 2007).

In the United Kingdom, many empirical investigations have been conducted into pay differences by sector and between geographical areas (Shah and Walker 1983; Blackaby and Murphy 1995). For data on recent years, Bell *et al.* (2007) used standardized spatial wage differentials and quantile regression to show that in high-cost and low-amenity areas, such as south-east England, the public sector underpays relative to the private sector, therefore creating recruitment problems

which lead to persistent problems with the delivery of public services in some parts of the UK.

For Italy and Spain, public-private wage differentials are stable and linked to permanent regional economic disparities. Alesina *et al.* (2001) analysed public sector wage differentials in a regional context, showing that the conditional public sector wage premium is much higher in southern Italy than it is in the north. Wages in the Italian public sector serve as a redistribution device (from the (rich) north to the (poor) south). Dell'Aringa *et al.* (2007) also showed that significant differences exist in public-private wage differentials across Italian regions using quantile regression and geographically weighted regression methods. Similar mechanisms were identified for the Spanish labour market. Garcia-Perez and Jimeno (2007) indicated that public sector wages (and thus the public sector premium) served as a regional social policy tool, using a simple Mincer earnings equation with regional dummies. In Spain, however, public sector wages are more diverse as regional governments have more independence in terms of wage-setting in the public sector. They found that regional variations in the public sector wage premium were positively correlated with the local unemployment rate and negatively correlated with labour productivity in Spanish regions.

Heitmueller and Mavromaras (2007) investigated differences in the German public sector wage premium, with particular interest given to differences between the regions of former Eastern and Western Germany. They found there to be a negative public sector wage premium in the Western regions in the period prior to 1997, as opposed to East Germany, where a positive premium was identified. Moreover, in the post-GDR part of Germany, the premium almost doubled in the later period. The Oaxaca–Ransom weighted pay differential decomposition method shows a small and stable negative public sector premium in the Western regions, and a large and increasing positive public sector pay premium in the Eastern regions by the end of the 1990s.

France remains the only large Western European country in which average public-private pay differentials generally do not differ significantly by region. However, Meurs and Edon (2007), using standard methods of estimation, geographically weighted regressions and quantile regressions estimated by region, found that the pattern of public wage premiums varies according to gender and skill,

This review of the literature allows us to conclude that public-private wage differentials vary regionally and often depend on how developed the regional economy is. As for regional aspects of the public sector wage premium in Poland, there has been no research in this area so far to our knowledge; this paper aims to bridge this gap.

### 3. Data and estimates

#### 3.1. Data and econometric strategy

In our study we use data from the Structure of Earnings by Occupation (SEO) survey, which is a rather atypical data source for this type of analysis in Poland. In most previous empirical papers on the public sector wage premium, data from the Labour Force Surveys (LFS) were used. The LFS offer complex information on the personal characteristics, family and economic background of the respondents. However, information on wages in this dataset is of rather poor quality, based as it is on the respondents' declarations. Furthermore, the percentage of missing values in the data on wages is significant (e.g., 27.6% for 2013) and a non-random distribution of refusals to answer might also prove problematic. Firm-level SEO data overcome those problems.<sup>1</sup>

SEO covers firms with over nine workers (including full- and part-time employees). In 2012, a total of 725,200 workers were included in the sample. The SEO survey provides precise information on wages and details of remuneration systems; however, information on the personal characteristics of employees is quite limited. The data do not offer information on family background and only general characteristics of the worker's human capital (level of education, job tenure, occupation, etc.). In the SEO survey, information on wages and working time is reported by the employer (and therefore may not be fully consistent with reality). As information on wages seems to be more trustworthy in the public sector, the data on private sector wages and the working time reports might be underestimated (as a result of the shadow economy in the private sector).

The limitations of the data determined our econometric strategy. Due to the selection equation's lack of appropriate instruments for estimation, the application of a two stage approach (Heckman 1979) was excluded. Instead, we applied a nonparametric methodology of propensity score matching. For each region, we compared the wages of workers in the public sector with those of their private sector counterparts. It allowed us to control for the impact of all observable characteristics on wages. As a supplementary analysis, we estimated the parameters of the quantile regression model in order to assess variations of the public sector premium parameter across the wage distribution in different regions. This facilitated the analysis of regional differences in the sectorial wage premium for low- and highly-paid workers.

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<sup>1</sup> This kind of data was incidentally used in the literature to assess sector wage differentials. In the case of transition economies, public sector wage premium estimates were conducted, e.g., using the firm-level Harmonized Hungarian Wage Survey by Telegdy (2007) and Lausev (2012).

### **3.2. Employment and remuneration structures in the public and private sectors by region**

The SEO data from 2012 show that the public sector is strongly feminized: 61.9% of workers in the public sector are women (in the private sector, this percentage is 40.9%). The percentage of women in the public sector considerably exceeds the national average in Podlasie (69.4%), Warmian-Masurian (68.9%) and Lubusz (66.6%) voivodeships. On the other hand, in some regions the percentage of men is relatively high (Silesian – 45.1% and Subcarpathian – 40.5%). Workers in the public sector are generally older and better educated. More than half of public sector workers (52.3%) graduated from a tertiary education institution (for the private sector, this percentage is only 29.1%). The percentage of tertiary graduates in the public sector is highest in the least developed regions (Podlasie – 60.3%, Warmian-Masurian – 56.3%). This fact is related to occupational employment structure. More than two thirds (63.4%) of public sector employees work in occupations belonging to the first three groups of the one-digit ISCO classification (managers, professionals and technicians), with an average of 42.4% of professionals. This percentage also varies across regions. It is highest in Podlasie (49.4%), Warmian-Masurian (45.6%) and Lublin (45.2%) voivodeships. In the same time, more than 70% of workers in the public sector are employed in institutions belonging to one of the three NACE sections (public administration and national defence, social security or health and education). Details of employment structure in both sectors are provided in Tables A1–A3 in the Appendix.

In Table 1, statistics on relative hourly wages in the public sector (relative to the private sector) are provided by region (SEO 2012). Generally, hourly wages are higher in the public sector than the private (with a 19% gross premium). The difference is particularly large for women, for those with lower levels of education and for older workers. Employers' characteristics also matter. The biggest public worker pay advantage was found for the smallest firms in the sample (firms employing between 10 and 50 workers). When we look at the ratio of average wages in both sectors at the national level, we notice that there are only three categories of the labour force for whom the private sector average is higher, these being: those with tertiary education, managers and those with elementary occupations.

**Table 1. Ratio of the average hourly wage for workers in the public and private sectors across Polish voivodeships**

Public/Private ratio	Polish voivodeships																
	Total	Lower Silesian	Kuyavian-Pomeranian	Lublin	Lubusz	Lodz	Lesser Poland	Masovian	Opole	Subcarpathian	Podlasie	Pomeranian	Silesian	Swietokrzyskie	Warmian-Masurian	Greater Poland	Western Pomeranian
<b>Total</b>	1.19	1.14	1.41	1.32	1.32	1.23	1.26	1.00	1.25	1.41	1.45	1.19	1.26	1.31	1.37	1.29	1.28
<b>Men</b>	1.16	1.04	1.30	1.23	1.25	1.13	1.21	0.99	1.21	1.34	1.41	1.18	1.29	1.21	1.30	1.21	1.23
<b>Women</b>	1.30	1.34	1.59	1.50	1.49	1.40	1.39	1.07	1.41	1.57	1.53	1.29	1.32	1.51	1.53	1.45	1.40
	<b>Gender</b>																
<b>Tertiary</b>	0.96	0.96	1.21	1.17	1.01	1.06	1.01	0.86	1.09	1.26	1.28	0.99	1.05	1.19	1.07	1.03	1.06
<b>Secondary vocational</b>	1.09	0.96	1.07	1.10	1.16	1.06	1.18	1.04	1.00	1.11	1.11	1.03	1.16	1.15	1.09	1.08	1.13
<b>General secondary</b>	1.09	0.99	1.07	1.08	1.02	1.06	1.22	1.11	0.94	1.05	1.11	0.99	1.17	1.12	1.04	1.05	1.01
<b>Basic vocational</b>	1.16	0.96	1.02	1.01	0.94	1.02	1.28	1.09	0.90	1.06	1.02	1.07	1.44	1.02	0.93	1.08	1.12
<b>Primary and lower</b>	1.08	0.99	0.99	1.10	0.98	0.98	1.15	1.05	0.90	1.04	0.93	0.95	1.36	0.99	0.89	1.00	1.00
	<b>Education level</b>																
<b>Managers</b>	0.81	0.76	1.00	0.91	0.78	0.81	0.86	0.76	0.99	0.90	1.06	0.88	0.91	0.84	0.86	0.90	0.99
<b>Professionals</b>	1.09	1.13	1.41	1.30	1.23	1.20	1.11	0.94	1.17	1.43	1.34	1.17	1.19	1.39	1.25	1.16	1.11
<b>Technicians</b>	0.91	0.77	0.96	0.98	0.92	0.87	0.93	1.02	0.77	0.92	1.00	0.87	0.98	0.96	0.91	0.89	0.91
<b>Clerks</b>	1.08	0.99	1.14	1.16	1.13	1.09	1.10	1.02	1.09	1.15	1.16	1.04	1.11	1.08	1.08	1.10	1.19
	<b>Occupation</b>																



The raw public-private wage gap differs regionally in Poland. It varies from 0% in Masovian voivodeship up to 45% in Podlasie voivodeship. The public-private wage ratio for women is highest in Kuyavian-Pomeranian, Subcarpathian and Warmian-Masurian voivodeships. There are three voivodeships in which the relative wage ratio for men is lower than average. These are Lower Silesian, Lodz and Masovian voivodeships. For women, the public-private wage ratio is only lower than average in Masovian voivodeship.

Although the public-private wage ratio for those with tertiary education is generally smaller than one, there are only three regions “responsible” for this effect. These are Pomeranian, Lower Silesian and Masovian voivodeships. In fact, in the case of Masovian voivodeship, a region including the capital city of Warsaw, the ratio is equal to 0.86. On the other hand, there are many regions, particularly those that are relatively less economically developed, where public sector employment offers a higher wage on average to tertiary graduates than the private sector. The biggest positive gross premium was found in Podlasie, Subcarpathian and Kuyavian-Pomeranian voivodeships (where the ratio exceeds 1.2). A similar pattern may be identified when we look at inter-regional differences in terms of wages across occupational groups. The public sector wage penalty (in gross terms) is highest in regions with the highest GDP per capita, such as Masovian and Lower Silesian voivodeships. On the other hand, there are regions (such as Podlasie or Kuyavian-Pomeranian) where being a manager, on average, brings in a higher wage in the public sector (in comparison with private employment). For blue-collar workers, the public sector is particularly favourable in terms of wages in regions where there is a relatively large market-oriented public sector (Silesian and Lesser Poland voivodeships). The public sector pays younger workers more in all regions; however, the gross premium is highest in less economically developed regions (Subcarpathian, Podlasie, Warmian-Masurian and Kuyavian-Pomeranian voivodeships). The public sector pay advantage is relatively greater in the case of smaller companies in Lodz, Subcarpathian and Lublin voivodeships, while in firms with more than 1000 employees, public sector wages are highest in the region of Lubusz compared to the rest of the country.

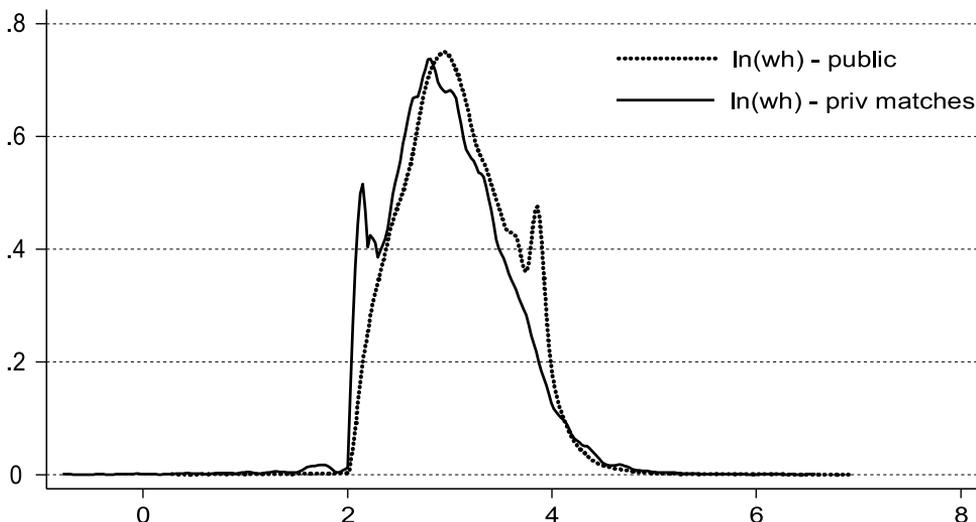
All in all, there is clear evidence that the size of the raw public sector wage premium is regionally diversified. Since employment structures also differ, this regional variation may be partly explained by differences in the characteristics of public workers. There is reason to believe that differences in the degree of economic development and in the structure of labour supply across regions are important. This may stem from the fact that wage setting patterns in both sectors react differently depending on local labour market conditions.

### 3.3. Analysis of the public sector wage premium using the propensity score matching method

The problem of assessing the public sector wage premium is usually regarded as a treatment evaluation problem, with public sector employment being a treatment. In order to estimate the treatment effect, it is necessary to apply a method that will enable the simulation of an experimental environment in which we can compare identical individuals that only differ by the fact of being treated. From several different available methods, and taking into account the information available in our dataset, we decided to use the propensity score matching (PSM) method. Working in the public sector was defined as a treatment. As matching variables, we used gender, age, level of education, job tenure, firm size, two-digit occupations from the ISCO classification and the type of labour contract. Certainly, it does not guarantee the identity of individuals in terms of other, unobserved characteristics.

First, we applied the PSM method to the whole sample and subsequently repeated a similar process for each region. We experimented with different matching estimators (one-to-one matching without replacement, nearest-neighbour matching within a calliper of 0.01, Mahalanobis-metric and kernel matching) (Abadie *et al.* 2004). As a criterion for choosing the matching method, we used covariate imbalance testing (the balance of treated and untreated matches in terms of chosen variables) (Leuven and Sianesi 2015). The results of the covariate imbalance testing are presented in Table A4 in the Appendix). Eventually, we decided to apply propensity matching with the common support option and a calliper of 0.01. This matching procedure resulted in a significant reduction of the bias. The calculated moments of matching variables for the matched observations in both regimes are almost equal. However, probably due to the extremely large sample, structural differences across the chosen variables are statistically significant, even for matched observations.

The average hourly earnings (PLN 25.76) for the matched public sector employees were higher than the average hourly wage earned by their matches in the private sector (PLN 23.12), with a relative premium of 11.4% (of the private sector wage). Figure 2 presents the wage distribution for public sector workers (dots) and the distribution for their private sector matches (line). Individuals with similar characteristics generally earn less once employed in the private sector. This, however, seems to reverse at the top quantiles of the wage distribution.



**Figure 2. Logarithm of hourly wage for public sector workers (dots) and for their private sector matches (line)**

Source: author's own calculations based on SEO data 2012.

In the second step of the analysis, we found twin workers in the public and private sectors in each voivodeship. The results revealed significant differences in the scale and even in the positivity or negativity of the public sector wage premium across Polish regions (see Table 2).

**Table 2. Average hourly wages for treated (public sector) and untreated (private sector) employees for propensity score matches in Polish voivodeships (PLN)**

Voivodeship	Treated (public sector employees)	Untreated (private sector employees)	Difference (public – private)
Lower Silesian	24.47	24.87	-0.40
Kuyavian-Pomeranian	24.47	22.44	2.03
Lublin	23.56	20.74	2.82
Lubusz	23.44	20.17	3.27
Lodz	23.76	22.23	1.53
Lesser Poland	24.99	23.06	1.93
Masovian	28.32	28.79	-0.47
Opole	23.53	22.25	1.28

<b>Voivodeship</b>	<b>Treated (public sector employees)</b>	<b>Untreated (private sector employees)</b>	<b>Difference (public – private)</b>
Subcarpathian	23.67	21.75	1.91
Podlasie	23.98	20.43	3.55
Pomeranian	25.86	26.19	-0.33
Silesian	26.33	25.42	0.90
Swietokrzyskie	23.54	21.42	2.12
Warmian-Masurian	23.58	23.30	0.28
Greater Poland	24.81	24.95	-0.14
Western Pomeranian	23.92	22.21	1.72

Source: author's own calculations based on SEO (2012) individual data.

The results obtained clearly show that the differences documented in the previous section regarding the average wage ratio in the public and private sectors across Polish regions were only partly related to regional differences in employment structure in both sectors. In four voivodeships, the estimated premium was found to be negative (Masovian, Lower Silesian, Pomeranian and Greater Poland voivodeships). In the remaining 12 regions, the premium was found to be positive; however, it varied considerably, ranging from 0.29 PLN in Warmian-Masurian voivodeship (1.19% of the average private sector wage rate) up to 3.55 PLN in Podlasie voivodeship (17.38%).

When we compare the size of the premium and the relative levels of regional economic development, we will find that the less economically developed the region, the higher the level of the public sector wage premium. To show this relationship more comprehensively, we calculated the public sector wage premium within groups of regions, classified using cluster analysis. First, we grouped the voivodeships into relatively homogenous groups based on their macroeconomic and structural characteristics. We used K-means clustering (Górecki *et al.* 2014) using the following variables (for 2012): unemployment rate, GDP per capita, FDI, number of foreign firms operating, price index, price per square meter of property, the ratio of tertiary graduates (within the total population), gross value of fixed assets and value added per worker. We clustered the voivodeships into two, three, four, five and six groups, and using the Caliński-Harabasz criterion, we decided to use the classification of four groups for further analysis. The average values of the clustering variables for each group are presented in Table A6 in the Appendix.

Group A contains just one, the most developed region: Masovian voivodeship, which includes the capital city of Warsaw. This region clearly stands out from other areas of Poland, with a relatively high GDP per capita and high wages,

low unemployment levels and high investment (both domestic and foreign). On the other hand, it is also characterized by the highest living costs out of all of the compared groups. The second group (B) consists of well-developed regions, with GDPs per capita only slightly higher than the national average. The unemployment rate is higher than in group A, although the difference is less than one percentage point. Group C clusters less-developed regions, with GDPs per capita at 83% of the national average, higher unemployment rates and lower investment activity. Finally, group D contains the poorest regions, with a gap of almost 25% in their GDP per capita, high unemployment rates and low levels of investment. The average cost of living is only slightly lower than in the regions clustered in groups B and C.

As can be seen from Table 3, the public sector wage premium decreases as regions become more economically developed. This might be related to differences in wage distribution in different regions: in the richest regions, the percentage of top earners is considerably higher than in poorer areas.

**Table 3. Classification of voivodeships based on cluster analysis, with average hourly wages for matches in the private and public sectors**

Group	Voivodeship	Treated (public)	Untreated (private)	Difference (public – private)
Group A	Masovian	28.32	28.79	-0.47
Group B	Lower Silesian, Lesser Poland, Silesian, Greater Poland	25.15	24.57	0.57
Group C	Kuyavian-Pomeranian, Lublin, Lodz, Subcarpathian, Pomeranian, Western Pomeranian	24.21	22.59	1.61
Group D	Lubusz, Opole, Podlasie, Swietokrzyskie, Warmian-Masurian	23.61	21.52	2.10

Source: author's own calculations based on SEO data 2012.

To explore this issue, we applied the quantile regression approach, allowing us to analyse the public sector wage premium in Polish regions across the wage distribution. On the other hand, this may result from differences in economic activity structure. As public sector activity (the core part related to public services provision) is relatively evenly distributed over the national territory, we may expect the public sector wage premium to be related to the distribution of private activity. To investigate this hypothesis, we calculated the correlation coefficient between the calculated public sector wage premium and sector-specific employment rates in Polish regions. Sector-specific employment rates included the private employment rate (defined as the ratio of private (hired) employment to the number of individuals aged 15 and over), the non-market public employment rate (defined as the ratio

of public employment in administration, education and healthcare to the number of individuals aged 15 and over) and the market public employment rate (defined as the ratio of public employment in all sections apart from administration, education and healthcare to the number of individuals aged 15 and over). In the first two cases, the correlation coefficients were significant at the 10% level of significance and were  $-0.4897$  and  $0.4015$ , respectively. In the last case, the correlation coefficient was  $-0.2059$  and was not significantly different from 0. Therefore, we may conclude that the extent of the public sector wage premium is negatively correlated with the level of public sector development in a given region.

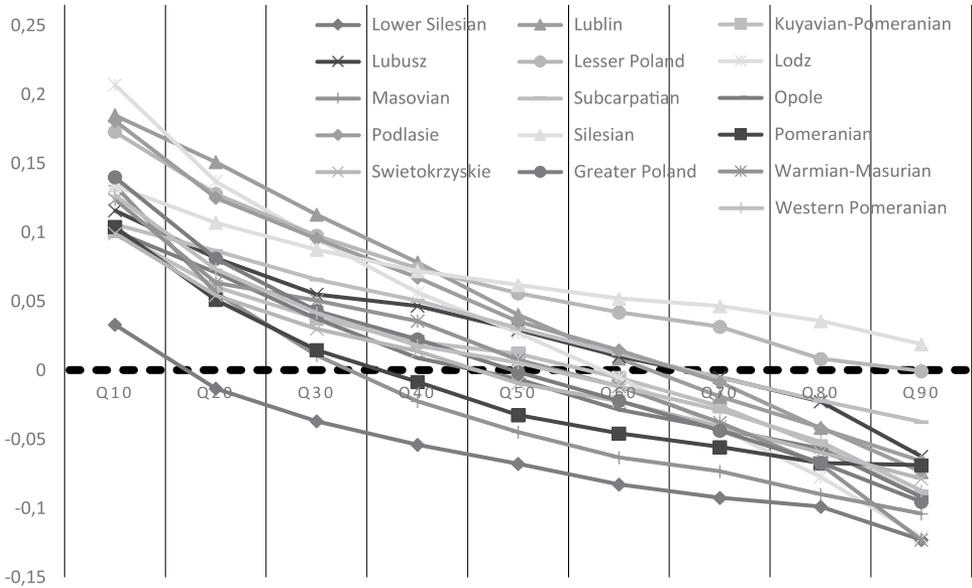
### 3.4. The public sector wage premium: results of quantile regression

The quantile regression approach enables us to extend the analysis of the public sector wage premium across the whole wage distribution, not only for its average value. Quantile regression calculates the  $n$ -th quantile of the logarithmic distribution of hourly wages  $\ln w_j$ , conditional on as a linear function of the regressors:

$$Q_\theta(\ln w_j | X_j) = X_j \beta_n, \text{ where } n \in (0,1) \quad (1)$$

In the quantile regression estimates, apart from a sector dummy, the control variables included gender, age (and age squared), education level, job tenure, firm size, type of contract, employment system and occupation at the two-digit ISCO level.

The results revealed a decreasing public sector wage premium across the wage distribution in all regions. For individuals earning less, working in the public sector is connected with an average of 15% higher wages. On the ninth decile of the wage distribution, the public sector wage premium turned out to be negative. For less-developed regions, a positive public sector wage premium can be observed for most deciles of the wage distribution (e.g., Lubusz, Lublin and Lesser Poland). At the same time, particularly for economically developed regions, we documented a negative premium for public sector workers, starting from the fourth decile (e.g., Masovian, Pomeranian and Lower Silesian). Figure 3 illustrates estimates of the parameter representing public sector employment for each region.



**Figure 3. The public sector wage premium in deciles of the wage distribution for each voivodeship**

Source: author's own calculations based on SEO data 2012.

In each and every region, the public sector premium decreases when wages increase. It is, however, worth noticing that the slope of the line differs significantly. The greatest difference in the public sector premium between the first and last deciles exists in the north-eastern regions of Poland, while the most homogeneous premium was revealed in the south-western regions. The public sector wage premium is relatively high and stable across the wage distribution, particularly for regions characterized by having a relatively strong market part of the public sector (Silesian, Lesser Poland and Subcarpathian). In these regions, there is no public sector pay penalty for top earners, while a positive public sector wage premium can be observed for low-paid workers. The labour markets in these regions can be described as public sector driven. Second, there are regions in which there is no public sector premium, even in the first deciles of the wage distribution (Lower Silesian voivodeship). Alternatively, it exists but it is very low (Pomeranian and Masovian voivodeships). The labour markets of these regions may be characterized as private sector driven, particularly for well-paid workers. For the most economically developed voivodeship (Masovian), a large number of public institutions located in the capital city collide with a great accumulation of private sector head offices, which attract the most productive human capital.

#### 4. Conclusions

Differences in the spatial distribution of economic activity, particularly in the private sector, leads to variation in the public sector wage premium. Less developed regions are generally characterized by having higher public sector wage premiums. According to the results obtained in our study, in Poland they vary from -1.7% in Mazovian region up to 17.4% in Podlasie. This may be related to economic structure (i.e., the extent of private sector development) and, in turn, to differences in the wage distribution in particular regions. The public sector wage premium varies significantly across the wage distribution. The private sector pay penalty is relatively stable for relatively less developed regions. In regions with a stronger private sector, the public sector pay premium decreases dynamically with the following deciles of the wage distribution.

In this paper, we employed PSM and quantile regression to analyse regional differences in public-private wage differentials. These are two methods that solve certain problems related to the research on public-private wage differentials (e.g. differences in workers' observable characteristics, differences of pays across wage distribution). At the same time, there are issues that have not been solved (e.g., selection mechanisms). It would be extremely interesting to investigate employment selection mechanisms by region and for both sectors. However, we would need an appropriate dataset offering adequate information.

The results obtained suggest that in fact, the public sector may experience serious employment and employee retention problems in the most developed regions. This may significantly hamper its efficiency and, in turn, may have negative spillover effects on other parts of economy benefiting from public services. However, further studies would be necessary in order to test such hypothesis. In case it is confirmed, it would then be worth considering the implementation of certain changes in public sector remuneration systems that would lead to a wider variation of wages on offer, which would result in more attractive wages (in relative terms) on offer in the most developed locations, in which the private sector offers most attractive employment opportunities.

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**Appendix**  
**Table A1. Public sector employment structure by gender, education level, occupation (ISCO), age group and firm size across Polish regions**

Public sector	age group and firm size across Polish regions																
	Total	Lower Silesian	Kuyavian-Pomeranian	Lublin	Lubusz	Lodz	Lesser Poland	Masovian	Opole	Subcarpathian	Podlasie	Pomeranian	Silesian	Swietokrzyskie	Warmian-Masurian	Greater Poland	Western Pomerian
<b>Men</b>	38.1	34.4	36.5	36.8	33.4	35.4	38.1	39.0	31.6	40.5	30.6	38.0	45.1	37.0	31.1	38.1	36.9
	61.9	65.6	63.5	63.2	66.6	64.6	61.9	61.0	68.4	59.5	69.4	62.0	54.9	63.0	68.9	61.9	63.1
<b>Women</b>	52.3	51.9	55.1	55.0	51.5	53.4	52.9	53.3	54.6	51.3	60.3	55.0	43.0	54.7	56.3	55.0	52.0
	24.6	24.8	20.7	24.9	26.8	25.1	24.1	24.9	23.9	25.0	22.5	22.4	27.3	24.0	23.5	22.6	24.6
<b>General secondary</b>	5.6	5.0	6.3	4.7	4.8	6.2	5.0	7.5	4.5	4.5	5.0	5.4	5.4	3.8	3.9	5.2	5.4
<b>Basic vocational</b>	13.3	13.2	13.4	11.6	12.0	10.9	14.3	10.4	12.6	15.1	8.9	12.9	19.7	12.7	11.2	13.1	12.9
<b>Primary and lower</b>	4.3	5.1	4.4	3.8	4.9	4.4	3.7	3.8	4.3	4.1	3.3	4.4	4.5	4.9	5.1	4.2	5.1
<b>Education level</b>																	
<b>Managers</b>	6.6	7.0	6.6	6.4	7.7	6.6	6.0	7.0	7.9	6.5	6.7	7.2	5.1	7.2	7.5	6.6	6.8
	42.4	44.4	42.8	45.2	45.1	44.6	43.9	42.5	42.7	43.3	49.7	43.4	34.9	42.5	45.6	44.4	39.8
<b>Occupation</b>																	

<b>Technicians</b>	14.4	14.1	17.0	14.9	14.8	15.2	14.3	13.4	13.9	15.4	14.3	14.8	13.9	16.4	15.2	12.5	18.1
<b>Clerks</b>	9.6	7.5	7.7	7.5	8.1	8.3	8.9	15.7	10.6	6.1	7.3	8.9	8.8	6.2	7.1	8.9	8.9
<b>Sales</b>	4.7	4.8	4.2	4.7	5.2	5.3	4.7	5.0	4.8	5.3	4.1	4.5	3.7	4.1	5.4	5.0	4.8
<b>Farmers</b>	0.2	0.4	0.1	0.2	0.2	0.1	0.1	0.1	0.7	0.5	0.1	0.2	0.2	0.1	0.2	0.4	0.2
<b>Craftsmen</b>	6.5	5.3	5.8	5.9	4.4	5.8	6.9	4.5	4.2	6.3	2.8	6.1	11.4	8.1	5.0	7.0	6.9
<b>Machine operators</b>	6.9	6.9	5.7	6.2	4.5	5.8	6.8	4.9	5.5	7.5	4.8	5.8	13.1	6.9	3.9	6.4	6.2
<b>Elementary</b>	8.7	9.5	10.1	9.0	10.0	8.4	8.5	7.0	9.7	9.0	10.2	9.1	8.9	8.5	10.0	8.7	8.3

**Age**

<b>Up to 30</b>	12.4	12.0	12.7	10.1	12.1	11.9	11.4	13.2	11.9	10.3	11.2	13.1	14.2	9.6	11.1	13.1	12.2
<b>31 to 40</b>	25.3	24.3	25.9	24.3	25.3	24.0	25.0	26.3	25.4	24.3	24.0	25.0	26.6	24.8	23.9	25.2	24.7
<b>41 to 50</b>	31.5	29.9	31.7	33.2	30.6	30.9	33.4	28.8	31.3	34.7	33.2	30.2	33.2	32.7	33.0	31.5	29.9
<b>51 to 60</b>	28.6	31.3	27.6	30.2	29.5	30.5	27.9	28.8	29.3	28.7	29.7	29.0	24.5	30.6	30.2	28.0	31.1
<b>More than 60</b>	2.3	2.4	2.1	2.2	2.4	2.7	2.2	2.9	2.0	1.9	1.8	2.6	1.5	2.3	1.9	2.2	2.2

**Firm size**

<b>11 to 50</b>	22.9	24.6	25.7	26.1	34.3	26.4	23.7	14.0	33.0	33.0	24.0	20.9	19.6	24.0	34.3	25.5	23.6
<b>50 to 250</b>	31.0	35.9	38.6	31.8	41.1	29.8	27.2	25.0	34.8	31.0	36.6	37.0	25.5	34.1	39.0	32.2	40.0
<b>250 to 1000</b>	21.6	19.0	14.2	17.8	14.8	22.1	24.1	23.8	22.2	22.3	19.4	24.7	22.4	29.6	18.7	17.9	23.5
<b>More than 1000</b>	24.4	20.4	21.5	24.4	9.8	21.6	25.0	37.2	10.1	13.8	20.0	17.4	32.4	12.3	8.0	24.4	12.9

Source: author's own calculations based on SEO data from 2012.

**Table A2. Private sector employment structure by gender, education level, occupation (ISCO), age group and firm size across Polish regions**

Private sector	age group and firm size across Polish regions																
	Total	Lower Silesian	Kuyavian-Pomeranian	Lublin	Lubusz	Lodz	Lesser Poland	Masovian	Opole	Subcarpathian	Podlasie	Pomeranian	Silesian	Subcarpathian	Warmian-Masurian	Greater Poland	Western Pomeranian
<b>Men</b>	<b>Gender</b>																
	59.1	56.3	61.2	62.6	60.3	59.9	56.3	55.8	66.6	65.8	59.4	60.9	61.8	62.7	62.5	57.9	57.8
<b>Women</b>	<b>Education level</b>																
	40.9	43.7	38.8	37.4	39.7	40.1	43.7	44.2	33.4	34.2	40.6	39.1	38.2	37.3	37.5	42.1	42.2
<b>Tertiary</b>	<b>Occupation</b>																
	29.1	26.5	21.0	26.6	18.2	27.6	30.5	43.0	20.1	22.0	24.3	28.8	27.1	26.7	18.5	23.2	23.0
<b>Secondary vocational</b>	28.3	27.4	28.8	33.7	27.9	29.1	27.1	25.5	29.5	32.4	32.2	25.6	31.9	31.4	27.9	27.8	25.9
	10.0	10.0	9.6	7.8	9.8	10.9	11.0	11.9	8.0	6.7	8.6	10.8	8.6	7.2	9.2	9.2	11.4
<b>Basic vocational</b>	26.1	26.0	32.5	26.3	34.7	24.8	26.2	15.2	34.7	33.1	26.7	28.3	27.4	29.2	33.2	32.6	28.4
	6.6	10.1	8.1	5.6	9.4	7.6	5.2	4.4	7.7	5.7	8.3	6.4	5.0	5.4	11.1	7.2	11.3
<b>Managers</b>	9.0	8.4	7.2	7.5	6.8	7.5	8.8	12.7	6.2	6.9	7.8	9.5	8.1	6.7	7.2	8.8	7.3
	16.6	16.4	12.1	15.5	9.5	14.9	17.1	24.5	12.1	12.2	12.6	17.6	16.8	13.8	10.9	11.9	13.3

<b>Technicians</b>	10.8	9.7	10.9	9.4	8.8	12.1	10.6	13.0	9.7	9.6	9.2	11.7	11.5	9.3	7.7	8.9	9.2
<b>Clerks</b>	8.7	6.9	7.8	7.0	7.0	9.2	8.6	10.7	7.1	8.3	6.6	8.9	9.4	7.2	6.0	8.8	8.2
<b>Sales</b>	12.6	14.0	11.0	10.2	8.2	10.4	16.6	15.1	7.7	10.7	17.4	8.4	8.8	9.2	10.8	15.6	11.7
<b>Farmers</b>	0.2	0.0	0.2	0.2	0.2	0.2	0.1	0.1	0.5	0.0	0.1	0.5	0.1	0.1	0.2	0.3	0.7
<b>Craftsmen</b>	18.9	16.7	23.2	27.6	25.0	20.8	17.0	9.2	31.1	24.2	22.3	22.3	19.4	26.9	30.1	22.0	21.3
<b>Machine operators</b>	15.4	18.3	16.6	13.2	23.1	16.9	12.3	9.7	19.0	20.7	13.2	13.6	19.3	19.9	16.4	15.7	18.9
<b>Elementary</b>	7.8	9.6	11.0	9.3	11.3	8.1	9.0	5.1	6.5	7.3	10.7	7.5	6.6	7.0	10.6	8.1	9.5

**Age**

<b>Up to 30</b>	27.0	28.6	24.9	21.9	23.9	24.5	28.8	31.7	23.0	22.8	23.0	26.4	24.6	23.3	22.5	28.4	24.6
<b>31 to 40</b>	31.4	30.1	29.3	30.6	30.5	30.4	30.2	34.5	26.7	30.2	29.5	30.9	31.2	30.2	29.0	32.5	29.7
<b>41 to 50</b>	21.9	20.8	23.8	25.5	22.8	22.8	21.7	18.7	24.4	26.1	25.0	21.9	22.8	23.7	24.8	21.5	22.0
<b>51 to 60</b>	18.1	18.8	20.2	20.4	21.0	20.4	17.8	13.7	23.7	19.3	20.7	19.0	19.7	21.1	21.8	16.2	21.9
<b>More than 60</b>	1.6	1.7	1.7	1.6	1.7	1.9	1.6	1.3	2.2	1.6	1.8	1.8	1.7	1.7	1.9	1.4	1.8

**Firm size**

<b>11 to 50</b>	24.7	18.1	30.5	29.3	27.4	29.1	27.2	16.7	30.0	24.9	31.4	26.8	29.3	29.1	31.7	23.9	32.9
<b>50 to 250</b>	27.0	20.6	33.2	32.3	33.6	24.8	29.1	23.8	30.1	26.7	34.3	32.2	29.4	29.4	29.7	24.2	29.2
<b>250 to 1000</b>	26.1	28.7	26.1	24.0	24.3	25.7	21.7	29.7	23.9	23.7	23.9	26.5	26.0	20.1	27.2	25.6	22.0
<b>More than 1000</b>	22.2	32.6	10.2	14.4	14.7	20.5	21.9	29.8	16.0	24.7	10.4	14.6	15.3	21.4	11.4	26.3	16.0

Source: author's own calculations based on SEO data from 2012.

**Table A3. Public sector employment structure in each region in relation to total (national) public sector employment structure by gender, education level, occupation (ISCO), age group and firm size**

Public structure / General structure	Gender																
	Western Pomeranian	Greater Poland	Warmian-Masurian	Swietokrzyskie	Silesian	Pomeranian	Podlasie	Subcarpathian	Opole	Masovian	Lesser Poland	Lodz	Lubusz	Lublin	Kuyavian-Pomeranian	Lower Silesian	
<b>Men</b>	0.91	0.96	0.97	0.88	0.93	1.00	1.02	0.83	1.06	0.80	1.00	1.18	0.97	0.82	1.00	1.00	0.97
<b>Women</b>	1.06	1.03	1.02	1.08	1.04	1.00	0.98	1.10	0.96	1.12	1.00	0.89	1.02	1.11	1.00	1.00	1.02
	<b>Education level</b>																
<b>Tertiary</b>	0.99	1.05	1.05	0.99	1.02	1.01	1.02	1.05	0.98	1.15	1.05	0.82	1.05	1.08	1.05	1.05	0.99
<b>Secondary vocational</b>	1.01	0.84	1.02	1.09	1.02	0.98	1.02	0.97	1.02	0.92	0.91	1.11	0.98	0.96	0.92	0.92	1.00
<b>General secondary</b>	0.89	1.12	0.83	0.86	1.11	0.90	1.34	0.81	0.81	0.90	0.97	0.97	0.68	0.70	0.92	0.92	0.96
<b>Basic vocational</b>	0.99	1.01	0.87	0.90	0.82	1.07	0.78	0.95	1.13	0.67	0.97	1.48	0.95	0.85	0.99	0.99	0.97
<b>Primary and lower</b>	1.20	1.03	0.88	1.14	1.03	0.87	0.89	1.01	0.95	0.77	1.02	1.06	1.13	1.19	0.97	1.19	1.19
	<b>Occupation</b>																
<b>Managers</b>	1.07	1.00	0.98	1.17	1.00	0.91	1.06	1.20	0.98	1.03	1.09	0.78	1.10	1.14	1.01	1.01	1.04
<b>Professionals</b>	1.05	1.01	1.07	1.06	1.05	1.03	1.00	1.01	1.02	1.17	1.02	0.82	1.00	1.08	1.05	1.05	0.94

<b>Technicians</b>	0.98	1.18	1.03	1.02	1.05	0.99	0.93	0.96	1.07	0.99	1.02	0.96	1.14	1.05	0.87	1.25
<b>Clerks</b>	0.78	0.80	0.78	0.84	0.86	0.92	1.63	1.10	0.63	0.76	0.92	0.92	0.64	0.74	0.92	0.93
<b>Sales</b>	1.02	0.90	1.00	1.11	1.13	1.00	1.07	1.02	1.13	0.87	0.95	0.79	0.87	1.14	1.07	1.03
<b>Farmers</b>	2.06	0.35	1.18	1.22	0.59	0.34	0.39	3.27	2.59	0.60	0.87	0.74	0.49	1.11	2.06	0.87
<b>Craftsmen</b>	0.82	0.90	0.91	0.68	0.89	1.06	0.70	0.65	0.97	0.42	0.94	1.75	1.25	0.77	1.08	1.06
<b>Machine operators</b>	1.00	0.83	0.90	0.66	0.83	0.99	0.70	0.80	1.09	0.69	0.85	1.90	1.00	0.56	0.93	0.91
<b>Elementary</b>	1.10	1.17	1.04	1.16	0.97	0.98	0.81	1.12	1.04	1.18	1.06	1.03	0.99	1.16	1.00	0.96

**Age**

<b>Up to 30</b>	0.97	1.03	0.82	0.98	0.96	0.92	1.07	0.96	0.83	0.90	1.06	1.15	0.78	0.89	1.06	0.98
<b>31 to 40</b>	0.96	1.02	0.96	1.00	0.95	0.99	1.04	1.01	0.96	0.95	0.99	1.05	0.98	0.94	1.00	0.98
<b>41 to 50</b>	0.95	1.01	1.06	0.97	0.98	1.06	0.92	1.00	1.10	1.06	0.96	1.05	1.04	1.05	1.00	0.95
<b>51 to 60</b>	1.10	0.97	1.06	1.03	1.07	0.98	1.01	1.03	1.01	1.04	1.02	0.86	1.07	1.06	0.98	1.09
<b>60+</b>	1.05	0.94	0.95	1.07	1.19	0.99	1.27	0.90	0.85	0.81	1.15	0.68	1.00	0.83	0.98	0.95

**Firm size**

<b>11 to 50</b>	1.07	1.12	1.14	1.49	1.15	1.03	0.61	1.44	1.44	1.05	0.91	0.86	1.04	1.50	1.11	1.03
<b>50 to 250</b>	1.16	1.24	1.02	1.33	0.96	0.88	0.81	1.12	1.00	1.18	1.19	0.82	1.10	1.26	1.04	1.29
<b>250 to 1000</b>	0.88	0.66	0.82	0.68	1.02	1.11	1.10	1.03	1.03	0.90	1.14	1.04	1.37	0.86	0.83	1.09
<b>1000+</b>	0.84	0.88	1.00	0.40	0.89	1.02	1.52	0.41	0.56	0.82	0.71	1.33	0.50	0.33	1.00	0.53

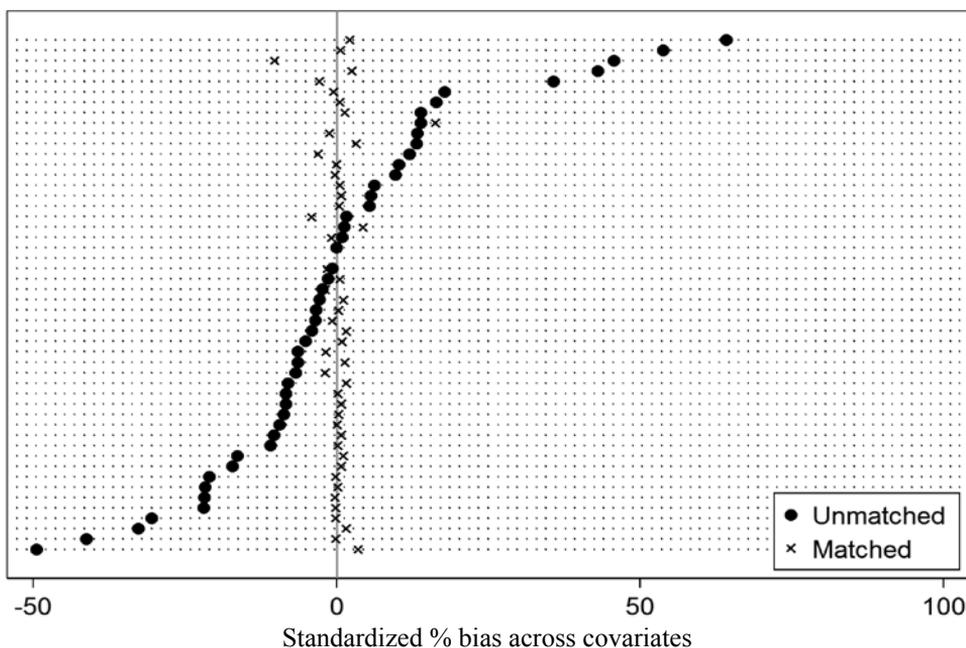
Source: author's own calculations based on SEO data from 2012.

**Table A4. Covariate balance testing of propensity score matching**

Variable		Mean		% bias	% reduction	t-test	
		Treated	Control			t	p>t
Gender	U	0.61949	0.4091	43.1		182.36	0.000
	M	0.61939	0.60728	2.5	94.2	10.06	0.000
Age	U	43.828	39.015	45.7		192.92	0.000
	M	43.824	44.901	-10.2	77.6	-41.81	0.000
Job tenure	U	13.385	8.2958	53.8		229.68	0.000
	M	13.377	13.315	0.7	98.8	2.39	0.017
Tertiary	U	0.5227	0.29051	48.6		207.12	0.000
	M	0.52273	0.53655	-2.9	94	-11.2	0.000
Secondary vocational	U	0.24564	0.28255	-8.4		-35.43	0.000
	M	0.24562	0.24234	0.7	91.1	3.09	0.002
General secondary	U	0.05601	0.09967	-16.4		-68.43	0.000
	M	0.05599	0.0531	1.1	93.4	5.15	0.000
Basic vocational	U	0.13278	0.26094	-32.7		-136.72	0.000
	M	0.13279	0.12683	1.5	95.3	7.18	0.000
Primary and lower	U	0.04287	0.06634	-10.3		-43.39	0.000
	M	0.04286	0.04118	0.7	92.8	3.38	0.001
11 to 50	U	0.22943	0.24657	-4		-17.03	0.000
	M	0.22944	0.22385	1.3	67.4	5.4	0.000
50 to 250	U	0.31022	0.27016	8.8		37.51	0.000
	M	0.31023	0.31619	-1.3	85.1	-5.2	0.000
250 to 1000	U	0.21626	0.26126	-10.6		-44.64	0.000
	M	0.21627	0.21671	-0.1	99	-0.43	0.670
Over 1000	U	0.24408	0.22201	5.2		22.16	0.000
	M	0.24406	0.24325	0.2	96.3	0.76	0.447
Type of contract	U	1.1412	1.36	-45.4		-189.56	0.000
	M	1.1413	1.1273	2.9	93.6	14.63	0.000
Remuneration system_1	U	0.81248	0.80131	2.8		11.98	0.000
	M	0.81256	0.81707	-1.1	59.6	-4.69	0.000
Remuneration system_2	U	0.18752	0.19869	-2.8		-11.98	0.000
	M	0.18744	0.18293	1.1	59.6	4.69	0.000
Managers	U	0.06559	0.08994	-9.1		-38.3	0.000
	M	0.06562	0.0629	1	88.8	4.49	0.000
Professionals	U	0.4242	0.16647	58.9		253	0.000
	M	0.42428	0.4315	-1.7	97.2	-5.9	0.000
Technicians	U	0.14445	0.10765	11.1		47.35	0.000
	M	0.14447	0.1497	-1.6	85.8	-5.98	0.000

Variable		Mean		% bias	% reduction	t-test	
		Treated	Control			t	p>t
Clerks	U	0.09639	0.0871	3.2		13.68	0.000
	M	0.09617	0.09073	1.9	41.5	7.56	0.000
Sales	U	0.04692	0.12583	-28.4		-117.83	0.000
	M	0.04694	0.04543	0.5	98.1	2.92	0.004
Farmers	U	0.00204	0.00169	0.8		3.49	0.000
	M	0.00205	0.00239	-0.8	2.3	-2.97	0.003
Craftsmen	U	0.06489	0.1895	-38.1		-158.02	0.000
	M	0.06492	0.06543	-0.2	99.6	-0.84	0.400
Machine operators	U	0.06896	0.15384	-27.2		-113.51	0.000
	M	0.06899	0.06823	0.2	99.1	1.22	0.221
Elementary	U	0.08654	0.07798	3.1		13.23	0.000
	M	0.08657	0.0837	1	66.4	4.16	0.000

Source: author's own calculations based on SEO data from 2012.



**Figure A5. Graphical summary of the covariate imbalance chart, showing the standardized percentage bias for each covariate**

Source: author's own calculations based on SEO data from 2012.

Table A6. Public sector wage premium parameter in deciles of wage distribution across regions

		q10	q20	q30	q40	q50	q60	q70	q80	q90
<b>Voivodeship</b>										
<b>Lower Silesian</b>	Coef.	0.101***	0.0607***	0.0379***	0.0208***	0.0120**	-0.00536	-0.0260***	-0.0548***	-0.0914***
	S.E.	[0.00569]	[0.00447]	[0.00467]	[0.00539]	[0.00498]	[0.00551]	[0.00668]	[0.00726]	[0.00691]
<b>Kuyavian-Pomeranian</b>	Coef.	0.101***	0.0607***	0.0379***	0.0208***	0.0120**	-0.00536	-0.0260***	-0.0548***	-0.0914***
	S.E.	[0.00569]	[0.00447]	[0.00467]	[0.00539]	[0.00498]	[0.00551]	[0.00668]	[0.00726]	[0.00691]
<b>Lublin</b>	Coef.	0.185***	0.151***	0.113***	0.0782***	0.0403***	0.00869	-0.0190***	-0.0416***	-0.0736***
	S.E.	[0.00749]	[0.00599]	[0.00543]	[0.00493]	[0.00555]	[0.00658]	[0.00699]	[0.00746]	[0.0115]
<b>Lubusz</b>	Coef.	0.116***	0.0814**	0.0552***	0.0468***	0.0294***	0.0102	-0.00506	-0.0227*	-0.0625***
	S.E.	[0.0102]	[0.0101]	[0.00854]	[0.00977]	[0.00957]	[0.00912]	[0.00852]	[0.00901]	[0.0152]
<b>Lodz</b>	Coef.	0.207***	0.137***	0.0953***	0.0564***	0.0273***	-0.00519	-0.0422***	-0.0772***	-0.121***
	S.E.	[0.00678]	[0.00718]	[0.00617]	[0.00614]	[0.00475]	[0.00532]	[0.00503]	[0.00689]	[0.0119]
<b>Lesser Poland</b>	Coef.	0.173***	0.128***	0.0976***	0.0738***	0.0559***	0.0421***	0.0315***	0.00831**	-0.000591
	S.E.	[0.00420]	[0.00453]	[0.00404]	[0.00483]	[0.00431]	[0.00462]	[0.00523]	[0.00366]	[0.00754]
<b>Masovian</b>	Coef.	0.134***	0.0562***	0.0109***	-0.0225***	-0.0449***	-0.0633***	-0.0733***	-0.0900***	-0.104***
	S.E.	[0.00547]	[0.00323]	[0.00353]	[0.00306]	[0.00350]	[0.00413]	[0.00442]	[0.00421]	[0.00586]
<b>Opole</b>	Coef.	0.101***	0.0710***	0.0374***	0.00904	-0.00641	-0.0285**	-0.0424***	-0.0570***	-0.0919***
	S.E.	[0.0106]	[0.0118]	[0.00923]	[0.00960]	[0.0126]	[0.0111]	[0.0110]	[0.0151]	[0.0161]
<b>Subcarpathian</b>	Coef.	0.106***	0.0868***	0.0660***	0.0505***	0.0307***	0.0121**	-0.00548	-0.0221***	-0.0375***
	S.E.	[0.00767]	[0.00579]	[0.00584]	[0.00469]	[0.00599]	[0.00473]	[0.00599]	[0.00769]	[0.0113]

<b>Podlasie</b>	Coef.	0.181***	0.125***	0.0955***	0.0673***	0.0353***	0.0146	-0.00861	-0.0422***	-0.0659***
	S.E.	[0.0132]	[0.00936]	[0.00838]	[0.00834]	[0.00750]	[0.00932]	[0.00877]	[0.0113]	[0.0187]
<b>Pomeranian</b>	Coef.	0.104***	0.0512***	0.0148***	-0.00841	-0.0326***	-0.0458***	-0.0556***	-0.0675***	-0.0689***
	S.E.	[0.00660]	[0.00512]	[0.00462]	[0.00525]	[0.00480]	[0.00647]	[0.00715]	[0.00777]	[0.0117]
<b>Silesian</b>	Coef.	0.134***	0.107***	0.0875***	0.0720***	0.0620***	0.0521***	0.0465***	0.0358***	0.0189***
	S.E.	[0.00478]	[0.00454]	[0.00332]	[0.00372]	[0.00315]	[0.00375]	[0.00517]	[0.00482]	[0.00677]
<b>Swietokryskie</b>	Coef.	0.0993***	0.0545***	0.0301***	0.0140*	-0.00936	-0.0225**	-0.0409***	-0.0597***	-0.0786***
	S.E.	[0.0129]	[0.00954]	[0.00871]	[0.00787]	[0.00863]	[0.00957]	[0.00868]	[0.0105]	[0.0118]
<b>Warmian-Masurian</b>	Coef.	0.124***	0.0637***	0.0507***	0.0358**	0.00777	-0.0116*	-0.0379***	-0.0681***	-0.123***
	S.E.	[0.0101]	[0.0116]	[0.00955]	[0.00784]	[0.00744]	[0.00540]	[0.00758]	[0.00930]	[0.0150]
<b>Greater Poland</b>	Coef.	0.140***	0.0810***	0.0432***	0.0224***	-0.00115	-0.0221***	-0.0437***	-0.0671***	-0.0953***
	S.E.	[0.00696]	[0.00514]	[0.00389]	[0.00404]	[0.00505]	[0.00654]	[0.00652]	[0.00660]	[0.00743]
<b>West Pomeranian</b>	Coef.	0.127***	0.0734***	0.0416***	0.0180**	0.00553	-0.0117	-0.0290***	-0.0519***	-0.0873***
	S.E.	[0.00851]	[0.00670]	[0.00701]	[0.00798]	[0.00942]	[0.00754]	[0.00734]	[0.00923]	[0.00969]

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

For the sake of brevity, control variables were hidden. All econometric results are available upon request.

Source: author's own calculations based on SEO data from 2012.

**Table A7. Average values of clustering variables for clustered groups of voivodeships**

	<b>Group A</b>	<b>Group B</b>	<b>Group C</b>	<b>Group D</b>
<b>Average GDP per capita (PLN)</b>	67400.0	43720.8	34947.2	32268.2
<b>GDP per capita (Poland=100)</b>	159.4	103.4	82.6	76.3
<b>Gross average earnings (PLN)</b>	4927.3	3860.3	3622.6	3482.3
<b>Average registered unemployment rate (%)</b>	10.7	11.5	15.7	16.5
<b>Average share of FDI (Poland=100)</b>	49.6	15165.6	4943.9	1671.1
<b>Average share of investment expenditures (Poland=100)</b>	21.9	9.18	4.97	2.32
<b>Average cost of living (PLN)</b>	526.9	486.0	483.6	476.0
<b>Average price per square meter of property on the primary market (PLN)</b>	6857.8	5374.4	4963.5	4507.9
<b>Average price per square meter of property on the secondary market (PLN)</b>	7557.5	4916.9	4435.0	3812.7
<b>Number of RandD institutions per 100,000 residents</b>	16.8	9.7	6.7	5.3
<b>Average added value per worker (Poland=100)</b>	132.2	101.1	88.7	86.4

Source: author's own calculations based on CSO data [<https://bdl.stat.gov.pl/BDL>].