Łaskiewicz, E. (2016). Determinants of Hourly Wages Inequality in Selected European Metropolises. The Results from the Multilevel Modelling. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 11(4), 853-869. DOI: <http://dx.doi.org/10.12775/EQUIL.2016.038>

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Determinants of Hourly Wages Inequality in Selected European Metropolises. The Results from the Multilevel Modelling

JEL Classification: J24; O12; R23

Keywords: wage differentials; metropolises; agglomeration externalities; multi-level modelling

Abstract: *The aim of this paper is the identification of the hourly wages heterogeneity in the sample of individuals living in 35 European metropolitan areas. Additionally, we evaluated factors which determine spatial variability. For this purpose, we applied Mincer-type multilevel models for the micro data from the European Social Survey (2010). To delimit metropolitan areas we used Urban Audit's Larger Urban Zones. Our results suggest the greatest impact of cross-country differences in explaining metropolitan variation of wages. We confirmed the gender pay gap equal to 10-11%, the wage premium from permanent contracts (7-10%) and being responsible for supervising other workers (16%). The importance of workers and firms characteristics was proved both for individual-level and metro-level differences. It might suggest the part of inequalities between metropolises is connected with different composition of workers' skills in each metropolis and spatial sorting. Finally, we found that unexplained (by such attributes) proportion of variability across metropolises might be the result of agglomeration effects. The positive impact of Jacobs externalities was found, while we did not confirm the existence of Marshall externalities.*

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Date of submission: March 12, 2016; date of acceptance: November 13, 2016

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Introduction

Due to the traditional view of the spatial equilibrium worker attributes and firm characteristics are indifferent (equally distributed) in the space (Glaeser & Gottlieb, 2009). Hence, wages should be spatially homogenous, even if there are inequalities in the firm-level productivity and/or individual characteristics differences. This is the result of the same labour market composition. Although the existence of the spatial wage differences is possible, such imbalance disappears in the long time due to the labour mobility¹ which causes the wage convergence. It requires two assumptions: no differentials of spatial amenity and insignificant differences in the transport costs (Goldfarb & Yezer, 1976). Even so, several empirical studies investigate the average wages are unequal in space, after eliminating the individual and sectoral attributes. Such observations were provided both at the country (see e.g. Simón, 2010) and regional level (see e.g. De Groot *et al.*, 2011). Accordingly, contextual factors like labour market institutions (i.e. minimal wage regulations or collective bargaining) have to be taken into account in the cross-country studies.

While the existence of spatial heterogeneity of wages at the country and regional levels seems to be obvious due to above, spatial inequalities can also be observed at more local level, like urban areas. There are two forms of spatial heterogeneity (at the local level) which are the subject of an examination in the literature: rural-urban differences and inequalities between urban areas. Although the relationship between city size and wages has been obvious for centuries (e.g. Weber, 1899), the explanation of its causes is still in the centre of interests. As an example Glaeser's and Mare's (2001) study on the wage gap between urban and non-urban areas in the United States. They proved the existence of the 21% wage gap which represented raw urban wage premium. Kim (2003) replicated Glaeser's and Mare's analysis and confirmed the existence of a large gap between urban (metropolitan) and non-urban areas. With regard to the European space, Matano and Naticchioni (2012) study of the high and low density areas of the Italy concentrates on the wage premium among high-skilled workers. Their findings not only proved the existence of the urban wage premium (heterogeneous along the wage distribution), but also put emphasis on the migrants as the beneficiaries of the wage premium. Finally, urban wage premium has been explored in the cross-countries studies. One of them is Gibson and Kim (2010) work in which 3 countries (Switzerland, Poland and New Zealand) were examined. The authors concluded the urban vs.

¹ It is expected labour force migrates from areas of the lower wages to the higher wages locations.

nonurban wage gap cannot be explained only by workers' quality. Finally, as pointed by D'Costa and Overman (2014) wages are higher in large urban areas, by between 1% and 11% depending on the sample considered.

The inequalities of wages might be also in the form of differences between urban areas or more detailed, between metropolises. Among those, who evaluated such variation is the study of Fu and Ross (2010), which proved the significance of the agglomeration effect in the sample of individuals residing in mid-size to large metropolitan areas in the USA. Similar results were found by Glaeser and Gottlieb (2009), who analysed three forms of agglomeration in the Metropolitan Statistical Area (Sunbelt cities) in the USA. Also Burry (2007) found the wage inequalities between 31 metropolises in the USA, supporting additionally the hypothesis about the significant role of the urban amenities. Surprisingly, European metropolises seems to be less commonly explored than those located in the USA. It does not mean there is no variability of wage premium between European metropolises. For example, D'Costa and Overman (2014) found out the wage premium in Great Britain is the higher in the biggest cities, and the lowest in the small ones.

According to above, the main aim of this paper is to fulfil the gap in the cross-countries analyses of the wages inequalities by identifying the wage premium across European metropolises. Additionally, we evaluate agglomeration effects as a source of spatial variation of the hourly wages. We hypothesize that the biggest European cities differ in the wage premium and such spatial heterogeneity cannot be fully explained by cross-countries differences or worker attributes. Moreover, we think that a part of wage inequalities is connected with spatial sorting of workers and firms attributes. To achieve those two goals, we used subsample of micro data from the fifth round of European Social Survey (2010), which enables to calculate the hourly wages in selected metropolises localized in 12 European countries. We control for individual and firm attributes as the sources of wage variation, using Mincer-type equation.

The rest of the paper is structured as follows. The next section contains a brief description of the sources of wages inequalities like: location-specific endowments, living cost, spatial sorting and agglomeration economies. The methods of the research as well as dataset were presented in Section 3. Section 4 provides the results from the multilevel modelling and their discussion. Finally, Section 5 concludes.

Sources of Wages Inequality

As not only the proving of the spatial heterogeneity, but also explaining its origin, is valuable let us concentrate on the potential causes of the inter-metropolises inequalities of wages. Combes *et. al.* (2008) classified the sources of heterogeneity as: location-specific endowments, labour market composition and the forms of agglomeration economies. To explain the first one, we have to relax the assumption of the non-pecuniary attributes of the place. If there is a specific feature of spatial unit, like environmental quality (e.g. extreme climate or pollution), local institutions or additional natural resources (e.g. access to river), the wage premium might be observed. That is, when locations offer some extra (positive or negative) natural or human-made amenities, which affect utility, then the mean wage changes. In such case higher wages in a location correspond to higher utility level of that area (Roback, 1982). Hence, in the places where undesirable for human well-being features occur, different wages might be observable. It definitely changes the understanding of the spatial equilibrium. Firstly, the spatial heterogeneity of wages is possible, without disequilibrium interpretation, as long as it can be explained by the spatial amenities influence. Secondly, the full convergence of wages might not occur because of the location-specific endowments. Due to above, in the empirical works it is common to use different variables to capture for spatial amenities. For example, Glaeser and Gottlieb (2009) used the January temperature to capture the climate influence, while Burry (2007) used the number of days when the minimum temperature falls below 32°F plus days where maximum exceeds 90°F. Clark and Kahn (1988) checked six cultural amenities, measured by ballet and dance companies, instrumental music group, etc. All of them proved the impact of the urban amenities on the wages.

Moreover, there might be a connection between the desirability of the location and the living cost, which is the next factor that differentiates wages between metropolises. The desirable (for human well-being) places are characterised by higher house prices. As people want to leave in such places, the cost of living there rises. To compensate higher living costs, workers demand the wage premium, which results in spatial differences in earnings (see e.g. Roback, 1982). If the wage gap compensates for higher costs of living, then spatial equilibrium is still observed. Hence, to interpret wage inequalities as the disequilibrium the correction of the living costs should be done. In the empirical research, the cost of living are treated as the price index which allows for the housing cost changes (e.g., Azzoni & Servo, 2002; Moretti, 2008). Du Mond *et. al.* (1999) criticized using the Laspeyres index to living cost correction, as the same bundle of goods are take into

account in the index, while it does not always provide equivalent utilities across space. They used partial regression-based cost of living adjustment. Alternatively, Kim (2003) corrected the log wages by the log of index measuring spatial variation in housing prices multiplies by share of expenditure devoted to housing. He argues that most of the living cost variation is the result of the housing price differences. In the large number of studies, the cost-of-living explanation was insufficient and after living cost correction wage gap was still observed. Additionally, it cannot answer why higher wages, expected to be offered by firms, will not result move the firms to non-metropolitan areas where wages are lower.

Another explanation puts the emphasis on the spatial differences in the distribution of the labour force attributes and firm characteristics as the determinant of the spatial heterogeneity of wages. In such case sorting of individual attributes take place, so each spatial unit is characterised by different composition of worker skills. It means the measured and unmeasured productive abilities of the local labour force vary across the space (Combes *et. al.*, 2008), even if individual productivity of equal-skilled workers are the same in the space. Similarly, the characteristics of firms are not the same in the space units, supposing only urban areas are compared. Accordingly, if the labour demand is not balanced by the supply, then firms are expected to offer higher wages to attract workers living in a different place and compensate immigration by the wage premium. This hypothesis was supported by Matano and Naticchioni (2012) who observed that the skilled workers receive higher wage premium when they migrate. Due to above, especially in the areas of higher concentration of skill-intensive industries, higher mean wages might be noted. In the empirical investigation, exploring the “skill-based” explanation requires to control for the unobservable heterogeneity of worker attributes. Such ability is given by panel data approach (see e.g., Combes *et. al.*, 2008) or quartile regression (like in Matano & Naticchioni, 2012). The results obtained by different pieces of research are not the same, i.e. Glaeser and Mare (2001) found little evidence that sorting impacts the urban wage premium in the USA, while Combes *et. al.* (2008), among others, found significant evidence for spatial sorting in France. Finally, spatial sorting is related to the urbanisation externalities, so the proper separation both effects might be difficult, especially using aggregate data. De Groot *et. al.* (2011) suggested that metropolitan areas concentrate educational institution, so the young immigrate from non-metros as they want to study. Most of them stay in cities after studies, which results in the concentration of high skilled workers in metropolises and higher average wages.

The last sources of the spatial heterogeneity of wages, explored mostly in the recent studies (e.g. De Groot *et al.*, 2011; Fu, 2006, 2010; Wheaton & Lewis, 2001), are the agglomeration economies. The mechanism which drives increasing return in agglomeration economies, is the geographical proximity. It results both workers and firms gain benefits (as the wage premium). The results of the agglomeration, in the new economic geography theory, are: transport cost reduction, better (cheaper and wider) access to market and labour force, technology and knowledge spillovers. From the workers' perspective, spatial proximity helps to improve human capital level (i.e. by accumulation, diffusion or even creation of knowledge)². Classifications of the agglomeration effects sources vary among researches. Frenken *et al.* (2007) distinguished: urbanisation externalities, Jacobs externalities, localisation economies and internal increasing returns of scale. De Groot *et al.* (2011) classified: Jacobs externalities, Porter externalities and Marshall-Arrow-Romer externalities, while Wheaton and Lewis (2001) categorised them as: localisation economies, urbanisation economies and establishment economies.

Let us describe briefly how each of them explains the productivity (and indirectly the wages) and how different classification leads to the same forms of agglomeration. According to the urbanisation externalities (economies), firms' productivity rises, which enlarges the earnings, due to the advantages from the spatial concentration of diverse economic activity. As the firms are located in the same place as universities, research laboratories, etc. the possibilities of cooperation and knowledge transfer grow. Such inter-industries spillover of knowledge is called Jacobs externalities. Differently, in localisation economies the advantages are obtained from the concentration of the same industry. Spatial proximity of firms that represent the same sector might result in the knowledge spillover, called Marshall-Arrow-Romer externalities. Another positive aspect of the concentration is intra-sectoral competition increase, which results in the productivity gains (Porter externalities). The last source of agglomeration is the internal increasing returns of scale or establishment economies. Due to it, the potential for the productivity improvement is in a single firm, and the role of the spatial proximity is limited. The increase of returns is obtained through the cost efficiency and economies of scale. Finally, in the empirical investigations of the agglomeration, Fu and Ross (2010) showed that wage differences are the result of the agglomeration effects, rather than differences

² Among others, Di Addario and Potacchini (2008) obtained the significant relation between the wages and employment concentration, Glaeser and Mare' (2001) found the workers learn more quickly in metropolitan areas, while Glaeser and Resseger (2009) learning effect is stronger in more skilled areas.

across individuals. Wheaton & Lewis (2001) also found the significance of the agglomeration economies in the USA cities, showing that equivalent workers receive higher wages if the markets are more dense.

Method and Database

We applied multilevel modelling technique for testing the scale of wages inequality and exploring its sources. We started from estimating several two models based on the Mincer-type equation (1974) to account for the impact of workers and firms attributes on wage differences. After that we enlarged our model by using contextual variables to explore potential impact of agglomeration effects. All models were estimated using micro data from the European Social Survey.

Database

In this research, the fifth round (from 2010) of the European Social Survey (ESS) data was taken, as free available and country representative (Integrated file, edition 3.2 was downloaded from the website: <http://www.europeansocialsurvey.org/>). The greatest challenge in using ESS dataset was assigning individuals according to the place they live in, to metropolitan and non-metropolitan areas. To do this, we used the regional level of the ESS, which contains: NUTS1 (29 units in the sample), NUTS2 (87 units) and NUTS3 (130 units). Then, each spatial unit was matched with the information from the Urban Audit's Larger Urban Zones (LUZ) about metro and non-metro areas. According to the LUZ definition, not only metropolis, but also its surroundings were taken into account as metro area. While the LUZ operates on the NUTS3, it was impossible for some of spatial units to classify them as metro or non-metro.

We were able to assign 52 spatial units as LUZ. It gives 45 metropolises as some of them consist of more than one spatial unit. Finally, we resigned from analysing those countries in which none or only one metropolitan area was identified (e.g. Portugal or Great Britain). It is because we need to be able to control for country-specific situation by using fixed-effects, which is impossible for single-element group. According to above, we reduced the sample to $N = 2,488$ respondents, as only those were employees, lived in metropolitan areas (in selected countries) and provided information about the hourly wages. The sample we used covers $K = 12$ European countries (Bulgaria, Czech Republic, Germany, Spain, Finland, France, Hungary, Ireland, Sweden, Slovakia, Slovenia, Lithuania) and $J = 35$ metropolises.

The distribution of respondents in metropolitan areas was presented on Map 1.

Map 1. Number of individuals in metropolitan areas

Source: own calculations based on ESS.

Multilevel modelling

The multilevel modelling technique was used as it allows for analysing the variation of process simultaneously at different levels. As the wages might differ by the metropolitan areas and countries, multilevel models are able to explore such spatial hierarchy. The two-level linear multilevel model, based on the Mincer formula, can be written as (Łaszkiewicz, 2016):

$$Y_{ijk} = \beta_{0,jk} + \sum_{l=1}^L \beta_l X_{l,ijk} + \sum_{m=1}^M \theta_m Z_{m,jk} + \varepsilon_{ijk}, \quad (1)$$

$$\beta_{0,jk} = \beta_0 + \mu_{jk} + v_k,$$

$$\mu_j \sim N(0, \sigma_\mu^2), \quad \varepsilon_{ijk} \sim N(0, \sigma_\varepsilon^2),$$

where: $i = (1, \dots, N)$ refers to individual level, $j = (1, \dots, J)$ is the metropolitan areas treat as the level 2 and $k = (1, \dots, K)$ is the country level. The dependent variable is Y_{ijk} , $X_{l,ijk}$ is individual-level explanatory variable, $Z_{m,jk}$ is contextual variable, μ_j is random effect for metropolitan area j , v_k

is fixed-effect for country k , σ_{μ}^2 is random effects variance, σ_{ε}^2 is error term variance, β and θ are fixed coefficients.

According to the structure of the sample (number of metropolises, countries and the number of individuals in each metropolises), we decided to use both random and fixed-effects to capture for spatial heterogeneity. The number of spatial units, required for the unbiased estimates of random effects variance is at least 20-30 (see: Łaszkiwicz, 2013). Additional motivation to use random effects for metropolises was the possibility to calculate the scale of variability and explain it by contextual variables.

The parameters of the Eq. 1 were estimated using restricted maximum likelihood method. The individual-level sampling weight was applied as it is suggested in the ESS. All calculations have been made in Stata 13.

Dependent and explanatory variables

We used as the dependent variable the logarithm of the gross hourly wages (before tax and insurance reduction), calculated using the gross wages, information about the period that wages covers and total hours normally worked per week in main workplace with overtime included. The explanatory variables used in this study represent three groups: 1) attributes of workers, 2) companies attributes, 3) industry composition of metropolitan areas. The first two groups are individual-level variables, while the third one contains contextual variables.

According to the Mincer equation, we explained wage variation across individuals by using: experience – measured by the total number of years in full or part time work and its cube, schooling – as completed years of full-time education. Also, we added: gender, subjective general health, responsibility for supervising other employees and type of employee's contract (according to its duration). Firm characteristics included in models covers the size of establishment (companies with not more than 10 employees is a reference category), represented by a set of dummy variables. Finally, the agglomeration effects was approximated by Shannon's entropy index and Krugman specialisation index. Both measures were calculated using data from the ESS. To specified the industries we used the NACE classification, which enable us to grouped workers into 82 sectors. Statistical summary of explanatory variables was presented in Table 1.

Table 1. Definitions and summary of variables

Variable	Definition	N	mean or %
wage	Natural logarithm of the gross hourly earnings	2 480	2.423
experience	Total number of years in full or part time work	2 471	18.758
schooling	Completed years of full-time education	2 482	14.503
gender	Binary variable which takes the value of 1 if male and 0 otherwise	2 488	50.152
health	Self-reported health condition, which takes the values from 1 (very satisfied) to 5 (strongly dissatisfied)	2 488	2.022
responsibility	Binary variable which takes the value of 1 if worker is responsible for supervising other employees and 0 otherwise	2 488	29.371
<i>Establishment size (as a set of binary variables):</i>			
establishment size 1	The number of employees from 10 to 24	2 488	17.986
establishment size 2	The number of employees from 25 to 99	2 488	20.718
establishment size 3	The number of employees from 100 to 499	2 488	16.355
establishment size 4	The number of employees higher than 500	2 488	17.787
contract	Binary variable which takes the value of 1 if worker has permanent job contract and 0 otherwise	2 488	77.775
diversity	Shannon's entropy index for metropolises	35	2.671
specialisation	Krugman specialisation index	35	0.613

Source: own calculations based on ESS.

The Shannon's entropy captures Jacobs externalities from diversity. The higher the value of index, the more diversified the employment structure in a metro area. In contrast, the impact of Krugman specialization index informs about the composition of the metropolis economy and so evaluates the Marshall-Arrow-Romer externalities. Small values of Krugman's index mean that the sectoral structure of employment in metropolis is similar to the others (no specialization), while high value informs about uniqueness of sectoral composition and strong specialization.

Empirical Results and Discussion

We divided this section into two parts. In the first paragraph, we presented the results and discussed the impact of Mincer-type determinants of wage. Next, we evaluated the importance of agglomeration effects.

Evaluation of Mincer-type equation

We started from the simple "null" (without any regressors) models to check for the differences in the average hourly wages across metropolises

and countries (Table 2). The estimated variance of the random effects was around five times higher in the model with no fixed-effects for countries. As no correction for the cross-country differences was made, the value of the intraclass correlation coefficient (ICC) was also high (52%). A large decrease of random effects variance in the model with fixed-effects proves that the cross-countries inequalities have a predominant role in explaining spatial heterogeneity of wages. It is consistent with our expectation according to which country-level differences in labor market institution, minimum wage, purchasing power (and living costs), taxes and insurance (as we operate on the wages before correction for it) differentiate metropolitan wages. Hence, after controlling for country-specific conditions, the share of the differences between metropolitan areas in the total variability of wages decreased to 17%.

Table 2. Two-level models with and without fixed-effects for countries

Variable	No fixed-effects			Country fixed-effects		
	coef.	95% CI		coef.	95% CI	
const*	2.137	1.930	2.344	2.248	2.132	2.363
σ_{μ}^2	0.361	0.255	0.513	0.066	0.017	0.264
σ_{ε}^2	0.328	0.226	0.477	0.328	0.226	0.478
ICC		52%			17%	
Log likelihood		-1507			-1482	

* Constant or mean of fixed-effects.

Source: own calculations.

The next step was the examination of workers and firms characteristics, by estimating Mincer-type multilevel models (Table 3). First of all, adding the regressors caused the reduction (but not fully elimination) of inequalities between metropolises. The random effects variance decreased from 17% to 3%, when we added workers characteristics. It suggests the spatial sorting of traditional human capital attributes are responsible for part of the metropolitan differences. Accordingly, wage inequalities might be partly the effect of spatial heterogeneity of workers features. It is possible that for some of the metropolises the composition of worker skills stimulates higher wages. However, because spatial sorting might be mistakenly treated as urbanization externalities, we need to be cautious with such conclusion. The correction of inter-metropolises variation occurred also as the effect of adding companies attributes. However, the scale of the reduction was much lower (from 3% to 1%). Similar explanation as for workers attributes might

be done for this change. Again, small proportion of inter-metropolises variability could not be explained by individual-level regressors, suggests the importance of urbanization externalities.

Table 3. Two-level model with individual-level explanatory variables

Variable	Workers attributes			Workers and firms features		
	coef.	95% CI		coef.	95% CI	
const*	0.503	-0.003	1.008	0.420	-0.018	0.858
experience	0.039	0.026	0.052	0.035	0.0244	0.046
experience ²	-0.0007	-0.001	-0.0004	-0.0006	-0.0009	-0.0004
schooling**	0.093	0.066	0.120	0.086	0.064	0.107
gender	0.119	0.004	0.234	0.116	0.017	0.215
health	-0.034	-0.077	0.009	-0.031	-0.068	0.006
responsibility	0.163	0.059	0.268	0.156	0.067	0.246
establishment size 1				0.117	-0.024	0.259
establishment size 2				0.283	0.077	0.489
establishment size 3				0.140	0.040	0.240
establishment size 4				0.232	0.133	0.330
contract				0.096	0.028	0.164
σ_{μ}^2	0.009	0.0003	0.284	0.003	0.0003	0.038
σ_{ε}^2	0.281	0.172	0.457	0.268	0.169	0.427
country		Yes			Yes	
fixed effects						
ICC		3%			1%	
Log likelihood		-1321			-1482	

* Mean of fixed-effects. ** Fitted values from the regression for schooling.

Source: own calculations.

The signs of all parameters were as expected. Each extra year of worker experience increases his individual's wage by amount of 3.9%, but the growth of return, from the experience, decreases each (additional) year by 0.07%. As the return to experience value seems to be comparable with other researches (e.g. Backman, 2014), return to schooling was too small. When we used years of full-time education as a measure of schooling, we obtained return to schooling equal to 4.4% (detailed results was omitted due to the limited space). According to Patrinos (2016), an average returns to schooling should be around 10% (in high income economies) or 8% (Europe). We suppose that the parameter was underestimated because of the endogeneity problem. As pointed by several authors (see: e.g. Heckman *et. al.*, 2003), one of the serious problem in the Mincer equation is the endogeneity of schooling. To deal with it, we instrumented schooling by educational level and occupation of respondents' parents. In result, the return to schooling increased to 9.2%, which is consistent with the others' findings (Patrinos, 2016).

Moreover, we found significant gender pay gap. In both regressions the estimated difference between males and females in the mean wages is 11%. Additional wage premium is achieved by those workers who are responsible for supervising others. Their salaries are higher by 16% in comparison with other employees. Finally, establishment size and type of contract differentiate the wages. Workers who have permanent contracts earn around 10% more than those with fixed-term contracts. Our findings are close to the results of Silva and Turrini (2014). They found wage differences between permanent and fixed-term contracts in the EU countries equal to 15%. Finally, establishment size also explain the variability of wages. According to our results, the smallest companies paid the lower wages.

Investigation of agglomeration effects

Despite incorporating several different variables to explain the wage inequalities across metropolitan areas, the differences in wages could not be fully explained. Such a situation might be a result of the agglomeration effects or unobserved individual characteristics, which were not account. To verify if the unexplained portion of inter-metropolises variation is the result of agglomeration effects we incorporated into model two contextual variables, which account for specialization and diversification of economic activity (Table 4).

The results show that diversity of industries within particular metropolis has positive and statistically significant impact on the wages. This suggests a major role of diversity externalities in the process of knowledge creation and diffusion in European metropolises. The geographical proximity of different industries not only supports the innovation but also reduces transport costs. Hence, the companies which are located in sectoral diversified place are able to offer higher earnings. This is the key of Jacobs externalities, which occurs in the selected metropolitan areas of Europe. Our findings seem to be consistent with the wider context of empirical evidences. According to the review of empirical studies prepared by Beaudry and Schiffauerova (2009), in the case of cities, high-tech industries and services Jacobs externalities are more frequent to observe than Marshall externalities. For the sample of metropolises that we used, we did not find the proof of specialization, which suggests lack of Marshall externalities.

Table 4. Two-level model with contextual variables

Variable	Coef.	95% CI	
const*	0.167	-0.206	0.541
experience	0.030	0.018	0.041
experience ²	-0.001	-0.001	0.000
schooling**	0.077	0.051	0.103
gender	0.095	0.003	0.188
health	-0.058	-0.099	-0.018
responsibility	0.159	0.067	0.252
establishment size 1	0.100	-0.045	0.245
establishment size 2	0.253	0.038	0.468
establishment size 3	0.131	0.025	0.237
establishment size 4	0.223	0.118	0.327
contract	0.069	0.010	0.127
diversity	0.148	0.091	0.206
specialisation	0.182	-0.011	0.374
σ_{μ}^2	0.000	0.000	0.000
σ_{ϵ}^2	0.265	0.166	0.422
country-fixed effects		Yes	
Log likelihood		-1260	

* Mean of fixed-effects. ** Fitted values from the regression for schooling.

Source: own calculations.

What is interesting, the estimated variance of random effects in the extended model is statistically equal to zero. The unexplained 1% of variability assigned to metro-level was explained fully by agglomeration effects. The estimates for individual-level factors are similar to those which were obtained in the model with no contextual variables (see: Table 3). It might be a signal there is no collinearity in our model. Although our findings are consistent with the results of others, we need to be very cautious with drawing more general conclusion. It is because the size of the sample we used in this study is extremely small, the way we defined the metropolises is very general and the number of higher-level spatial units is low.

Conclusions

This paper explored the spatial variability of wages across selected metropolitan areas in Europe. Our approach, based on using multilevel models, enables us to identify a few sources of spatial heterogeneity, widely discussed in the existing literature. The first one is spatial variety of workers and firms attributes, which are responsible not only for individual-level differences of wages, but also explain partly the differences between metropolises. The second factor which differentiates the earnings at metro

level is cross-country differences. We found that a great proportion of inter-metropolitan area inequalities are the effect of specific condition of the country. Finally, the small proportion of variability, which could not be explained by Mincer-type factors and between countries differences, occurs due to the existence of agglomeration effects. We identified only Jacobs externalities, which suggests the positive influence of sectoral diversification on the wages in metropolises.

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