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SPATIAL ECONOMETRIC ANALYSIS OF THE DETERMINANTS OF LOCATION OF MANUFACTURING INDUSTRY AND MARKET SERVICES SECTORS IN POLAND

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Spatial econometric analysis of the determinants of location of manufacturing industry and market services sectors in Poland

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Abstract:

The paper comprises econometric analysis of location determinants of manufacturing industry and market services in Poland. A wide range of location determinants are analyzed taking into account exogenous and semi-endogenous region-specific aspects, sector-specific aspects (such as labor and capital intensity, economies of scale, intensity of forward and backward linkages, wage rates, knowledge intensity and technology level) as well as interactions between sector-specific and region-specific aspects.

The analysis is carried out for an unbalanced data panel of manufacturing industry and market services sectors at the level of 3-digit NACE at the NUTS 2 level (16 voivodeships). The data cover the period from 1995 to 2006. We perform the estimation using Restricted Maximum Likelihood method (REML). The results point to positive spatial autocorrelation both for manufacturing industry and market services sectors. Sector-specific and region-specific effects as proxied by sectoral dummies are important.

Key words: location, industrial manufacturing, market services, Poland, spatial panel, Restricted Maximum Likelihood method

JEL: R12, R15, C23, C31

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1. Introduction[1]

The spatial distribution of economic activity is one of the most important research topics in economics (Brulhart 1998). Despite of it, however, not a lot of effort has been given in the last years to the issue of location determinants in transition economies[2]. The empirical literature in economics is certainly missing empirical studies on location determinants in the case of Poland which would utilize modern econometric techniques for spatial panels and try to apply theoretical postulates of new trade theory as well as new economic geography.

The last 20 years brought about major adjustments to Polish economy related to economic transition as well as to integration with the European Union leading to accession of Poland in May 2004[3]. We could thus expect significant adjustments in the location of manufacturing industry and market services sectors or to occur. An unprecedented internal and external liberalization should have important spatial implications even overcoming inherent path-dependencies and spatial hysteresis. With accession to the European Union and liberalization of trade and factor flows (both capital and labor) the pattern of distribution of economic activity in Poland is not only a matter of regional economics but has a significant external (international) dimension as well. In fact the observed adjustments in location of sectors in Poland as well as in other CEEs fit well into the major trends observed in the EU-15 (referring to conclusions of the pan-European study by Midelfart-Knarvik et al. 2002). Focusing on Polish regions only we should not forget this larger framework..

We acknowledge that the actual pattern of location and concentration and thus of specialization is a result of complex linkages among a large number of factors. According to Midelfart-Knarvik et al. (2002), the pattern of localizations and specialization is a result of multidimensional interactions between the specific features of sectors and specific characteristic of regions and states. This includes the classic argument of significance of relative factor endowments.

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[1] The research presented here is a part of a research project carried out by the Economics of European Integration Department at Faculty of Economics of the Gdansk University entitled “Impact of changes in location of industry and services in Poland on the competitiveness of Polish region in the framework of European integration” and financed within the framework of the research grant of KBN no 0916/H03/2006/30.

[2] There are off course some studies in that field for instance the study by Traistaru et al. (2003) indicating that factor endowments and geographic proximity to European markets and industry center determine location of industrial sectors in accession countries.

[3] The scope and scale of adjustments in the Polish economy related to economic transition and economic integration is well described among others in Zielińska-Głębocka 2003.

The new theories of trade and economic geography are based on the same underlying assumptions of increasing returns to scale, externalities, agglomeration economies, localized knowledge spillovers etc. leading to a complex framework with imperfect competition. Their classic feature is a continuum of possible equilibriums with only some of them being stable. Referring to specific characteristic of regions NEG models point to an importance of the so-called *home market effect* and thus importance of the size of the regional economy[4]. Brulhart (1998), for instance, determines three groups of factors responsible for patterns of spatial concentration of sectors. These are related to factor endowments, localized external effects as well as scale related effects in scale dependant sectors and is in line with the above statement.

The extent of internal and external liberalization plays a role affecting the volume and structure of trade, the extent of capital flows and the degree of labor mobility between regions. Distance determining the relative centrality and peripheriality of regions plays a role as well as proximity to large markets is of key importance. The potentially negative aspects of peripheral location can be minimized through high degree of accessibility. Accessibility of the peripheral region can be increased with the development of adequate transport infrastructure.[5]

The results of empirical analysis on determinants of location are inconclusive. Some studies point to rising significance of endowments-based factors while other point to increasing returns and its impact on location. The empirical analysis based on new data sets and applying new econometric techniques should continue.

The aim of the paper is to empirically identify with the use of spatial panel techniques determinants of location of manufacturing industry and market services sectors in Poland within the period 1995 – 2005. We find the decomposition of effects related to economic transition and economic integration of the EU beyond the scope of the study. Furthermore, we would like to stress, that our empirical analysis is in line with this part of empirical studies which is not trying to test competing theories present in the theoretical literature of the subject. We thus adopt a general approach.

The rest of the paper is organized as follows. The next section presents the methodological issues. In Section 3, we perform the econometric analysis of models separately for industrial

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[4] NEG theories and problems are well described among others in a classic book of Krugman (1991) as well as in Baldwin et al. (2003), Fujita and Thisse (2002), Fujita et al. (2001).

[5] Interestingly enough results of some NEG models indicate that in certain cases the development of infrastructure could have negative impact on its overall welfare.

manufacturing and market services sectors with the use of selected estimator. Section 4 concludes.

2. Methodological issues and description of variables

The econometric models we consider are estimated using panel data where the spatial dimension reflects NUTS2 regions in Poland, hence it is necessary to deal with potential spatial autocorrelation between variables (Kopczewska 2006). For that reason we introduce a spatial weight matrix *W*, which shows the structure of the nearest neighborhood. The elements of the matrix are equal to:

w_{ij} = 1, when a region *i* is a neighbor of a region *j*, it means they have a common border;

w_{ij} = 0, when a region *i* is not a neighbor of a region *j*;

w_{ii} = 0, the diagonal elements of the matrix.

The matrix has been standardized by rows (a sum of elements in each row is equal to one).

Spatial correlation is introduced into the model as the spatial lag – we define a new variable which is a product of the dependent variable and the matrix of weights, *W*. The model has the following general form:

[1] $$y = \beta X + \rho W y + u \quad \text{and} \quad u \sim IID\ N(0,1),$$

where *X* is the matrix of explanatory variables, *W* is the spatial weights matrix and ρ is the coefficient of spatial autocorrelation. We have to note that a model of such structure can be considered as a type of autoregressive model and thus should be estimated by Maximum Likelihood Estimator.

The general form of the econometric model which we will utilized as a tool in the empirical study can be written as:

[2]
$$y = X1\alpha + W\_y\rho + X2\beta + D1v + D2\lambda + D3\eta + \xi \quad \text{and} \quad \xi \sim IID\ N(0,1),$$

where *y* is a vector of the explained variable (l_share), *X1* – the matrix of variables changing over time, in regions and in sectors, *W* is a weights matrix defined above, *X2* – matrix of variables which are characteristics of the regions. The next three matrixes contain dummies:

D1 for regions, *D2* for years, *D3* for sectors. It implies that we have three dimensions in the variables and thus three groups of specific effects.

The effects could be estimated either as fixed or random effects. The Wald statistic and the Breusch-Pagan test point to significant influence of both kinds of effects. Therefore the models are estimated as mixed models which contain both fixed and random effects. An estimation method we use is the Restricted Maximum Likelihood Estimator with nested dimensions: regions and sectors[6].

The analysis is carried out at the level of 3-digit NACE sectors for 16 NUTS-2 regions of Poland within the time period of 11 years between 1995 and 2005. All data come from Główny Urząd Statystyczny (GUS) and are given in real values (we employed GUS deflators for 2-digit sectors to adequately adjust the nominal values)[7]. The data for 49 voivodeships in the period of 1995 – 1998 have been adjusted to the present setting of 16 NUTS-2 regions with the use of algorithm developed by the Regional Studies Team of the Gdansk Institute for Market Economics. We would like to note that regional data are taken from the free on-line regional data base of Główny Urząd Statystyczny (GUS)[8].

Natural logarithm of the share of the sector in a given region in total employment of that sector in Poland will be our explained variable (l_share)[9]. On the RHS we include a number of explanatory variables. First of all we introduce a vector of sector-specific variables introduced into the models in logs. These include: scale – depicting plant-specific economies of scale as proposed by Amiti (1999), inter – variable depicting the intensity of linkages with other sectors (please refer to Zielińska-Głębocka 2003), k/l – depicting relative capital intensity of the sector (ratio of capital to labor endowment in the sector) as well as wage – an average labor compensation in the sector.

In the model for manufacturing industry sectors we include two additional variables depicting technology level (TL) and average skill levels of workers (WIFO). TL variable reflects

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6 The survey of mixed effects models can be found in the following papers: McCulloch, Searle (2001), Verbeke, Molenberghs (2000), Raudenbush, Bryk (2002). The REML method is desribed among others by Thompson (1962).

7 The GUS data set based on F01 surveys contains detailed data only on enterprises employing more than 9 employees.

8 Available in Polish at the following address http://www.stat.gov.pl/cps/rde/xchg/gus.

9 All utilized variables are described in Table 1 at the back of the paper. We first considered location quotients as the explained variables but drooped the idea because of significant problems in econometric estimation.

technological level of industrial sectors. We utilize the 3-digit classification of OECD (OECD 1995) which on the basis of R&D intensity divides the manufacturing industry sectors into four groups of: low technology, medium-low technology, medium-high and high-technology sectors.

Variable WIFO is a variable constructed on the basis of Vienna-based WIFO Institute's classification of sectors depicting average skill levels of workers (Peneder 1999). It groups manufacturing industry sectors into four groups of: low skills, medium level – blue collar workers, medium level – white collar workers and high skilled workers. In the case of market services we include a variable depicting knowledge intensity of sectors in line with the classification scheme of the Eurostat. The classification distinguishes three groups of sectors: less knowledge intensive, knowledge intensive and highly knowledge intensive.

The vector of regional-specific variables includes first of all a set of dummy variables depicting the location of the region is space. These are: bwest – regions on the western border with Germany, beast – regions on the eastern border of Poland (with Russian Federation, Lithuania, Ukraine and Belarus), bsea – regions with direct access to the Baltic Sea. We include as well a dummy variable for capital region (mazowieckie) in order to take out the potential bias related to the statue of the capital (rcap). The vector includes as well the following variables: land area in square kilometers (area), population of the region (pop) – a proxy for the home market effect, two variables describing the structure of the regional economy – the share of industry (sh_ind) and market services (sh_mserv) in generation of the regional value added. Taking into account the significance of human capital endowment we include the variable giving the size of the regional R&D base (sh_br) which shows the share of employees employed in R&D activities in total regional employment. Last but not least we tested a number of variables proxing the level of infrastructure. In the analysis we include only l_roads which is the log of total length of roads in kilometers in the region.

Apart from the above variables in the extended version of the model we include a number of potential interaction terms between them.

3. Results and interpretation

As has been stress beforehand we will perform the econometric analysis of empirical models separately for manufacturing industry sectors and market services sectors.

Manufacturing industry

In the first set of models we will be dealing with location of manufacturing industry sectors in Poland (3-digit NACE groups from the range 151 – 372). The results of estimation with REML method are given in the Table 2 at the back of the paper.

In the first model (MI1) we introduce a vector of sector-specific explanatory variables as well as fixed effects for regions, time-periods and sectors. This is a three-way panel framework. In the second model (MI2) we substitute the fixed region effects (regional dummy variables) with a vector of region-specific variables both time-varying and time-invariant. In the next model (MI3) we extend it by adding interaction terms between selected sector-specific and region-specific variables.

First of all, it is worth to point out that in all three models for manufacturing industry the coefficient of spatial autocorrelation is positive though it is statistically significant only in the first two models. It means that at least to a certain degree there is a dependency among observations in a space of positive nature implying clustering effects. Furthermore, in all three models both sector-specific effects and time-specific effects are statistically significant. The R-SQUARED is close to 85 per cent.

In MI1 the impact of all sector-specific variables on the explained variable is statistically significant at 1 per cent level. The direction of impact is positive apart form the impact of average skills proxy (wifo) which is negative. The variables which particularly strongly affect the explained variable are the technology level (TL) and average plant-level economies of scale (scale).

The impact of region-specific variables is statistically significant. It is necessary to point out that regional variables are constructed as deviations from mean. It is positive in the case of śląskie, mazowieckie, dolnośląskie, wielkopolskie, łódzkie, and pomorskie – metropolitan regions of Poland dominated by major urban agglomerations (please refer to the map of Polish regions at the back of the paper). The coefficient for małopolskie (the 7th metropolitan region of Poland) is positive though not statistically significant. The regional effects are negative and statistically significant for świętokrzyskie, opolskie, podlaskie, warmińsko-mazurskie and lubelskie meaning that their overall performance is below the national average.

Substitution of regional dummies with a vector of region specific variables in MI2 does not affect considerably the coefficients on sector-specific variables. It is worth to point out that impact of none of the location describing variables is significant. It is the same with the capital region dummy variable as well as other region-specific variables apart from l_pop and l_roads. The coefficient on l_pop is positive and statistically significant at 10 per cent level. Large home market base, large scale of the regional economy, has a positive impact on location of manufacturing sectors. The coefficient on l_roads is positive and statistically significant at 1 per cent level. Its impact on dependent variable is relatively high. The level of development of basic transport infrastructure plays an important role in the location of industry in Poland. We have to stress again that Poland as a whole should be treated as a peripheral regions in the European core-peripheries framework with severely limited accessibility due to underdevelopment of mainly high quality road infrastructure.

We would like to stress that we have tested numerous other variables related among others to infrastructure (length of motorways, presence of international airports, presents of large international seaports, etc.) they are unfortunately correlated with other explanatory variables in the model and thus cannot be included in the specification.

IN MI3 we add three interaction terms in accordance with our empirical strategy[10]. The first one is between the size of the regional economy as given by the l_pop and the l_scale showing the averaged plant-level economies of scale within a sector. The second is between the size of the market services sector in the region as given by the share of market services in region's value added (sh_mserv) and intensity of linkages in the sector (l_inter). The third one is between the technology level (TL) and the size of the local R&D base as given by sh_br.

The coefficients on variables in the first interaction term are not statistically significant (l_scale, l_pop, l_scale*l_pop). In the case of the second interaction we expect a positive interaction between the two. The coefficient on interaction term is statistically significant at 1 per cent level but negative. It implies that the positive impact of higher linkages intensity in a sector on the explained variable is less positive in regions with bigger share of market services in the regional economy (sh_mserv).

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[10] Aiken et al. (1991) suggest rescaling of the variable included in interactive terms, however, we do not follow this suggestion as it would further complicate the structure of the model.

The coefficient on the third interaction term is positive and statistically significant in line with our expectations. Larger regional R&D base positively affects location decisions of more technologically advanced sectors.

Market services

Market services play a crucial and ever-increasing role in the post-industrial economies already being responsible for the majority of employment and total value added in most of them. We want to check what determines the location of market services sectors in Poland and whether the model fits well their character. Once again we are dealing with an unbalanced data panel for 73 market services sectors at 3-digit NACE in 16 NUTS-2 regions of Poland within the time period 1995-2006. We adopt the same approach as has been the case with manufacturing industry characterized by three principal specifications of the model. The results of estimation with the Restricted Maximum Likelihood method (REML) are provided in Table 3.

As in the case of the model for manufacturing industry sectors we take into account the potential spatial autocorrelation between the observations. The coefficient of autocorrelation is positive and statistically significant at 10 per cent level only in the case of the first two specifications (MS1 and MS2). In the third one – MS2 extended through introduction of interaction terms the impact of spatial autocorrelation disappears.

It is worth to point out that the goodness-of-fit obtained is relatively high with R-squared close to 89 per cent in all three models. Furthermore, sector-specific and time-specific effects are statistically significant in all three models as well.

In the first model coefficients on all sector-specific variables are positive and statistically significant at 1 per cent level (knowledge intensity being the only one significant at 5 per cent level). Similarly to the model for manufacturing industry sectors the coefficients are the highest on a proxy for plant-level economies of scale. They are also high on knowledge intensity. Furthermore, coefficients on capital intensity and intensity of linkages are significantly lower than in the case of manufacturing industry sectors which is in line with our expectations. At the same time coefficient on average wages is higher by approximately 40 per cent in comparison to manufacturing industry implying a greater vulnerability to wage rates. In other words, market services sectors with higher economies of scale, greater extent of vertical linkages, higher capital intensity, higher knowledge intensity are likely to be more spatially concentrated.

In MS1 regional dummy variables are statistically significant. They are positive and statistically significant for all seven major metropolitan regions of Poland with the highest coefficients on mazowieckie and śląskie. These regions, in comparison to national average, get a higher share of sectors than is explained by variables present in the model. The negative coefficients appear on dummies for świętokrzyskie, podlaskie, lubuskie, opolskie, warmińsko-mazurskie, lubelskie and podkarpackie pointing to their underperformance in comparison to the national average. Kujawsko-pomorskie and zachodniopomorskie seem not to differ significantly from the national average.

In MS2 the coefficients on sector-specific variables do not differ a lot from the results in MS1. Out of the whole vector of regional-specific variables, similarly to manufacturing industry, only the impacts of scale of the regional economy and the level of development of infrastructure are statistically significant with the expected signs.

Introduction of three interaction terms in MS3 leads to a number of changes in the obtained results in comparison to MI2. The impact of average plant-level economies of scale as proxied by l_scale and the scale of the regional economy as proxied by l_pop on the dependant variable are positive. However, the interaction term between them is evidently significant but negative. Statistical significance implies that a model excluding the term (MS2 in our case) could be considered misspecified (Baum 2006). The result implies that the marginal effect of the intensity of economies of scale in the sector on its concentration in the region is decreased when the scale of regional economy is larger (Greene 2003). In other words in larger regions the impact of average plant-level economies of scale is reduced.

The coefficient on the second interactive term is negative and statistically significant at 1 per cent implying that the positive impact of higher linkages intensity of a sector on its concentration in the region is less positive in regions with bigger share of market services in the regional economy (sh_mserv).

The impact of the third interaction term is positive implying that the marginal effect of higher knowledge intensity of a sector on the size of the sector in a region is increased in regions with larger R&D base. Which is in line with our expectations.

4. Conclusions

The aim of the paper was to empirically identify with the use of spatial panel techniques the determinants of location of manufacturing industry and market services sectors in Poland within the period 1995 – 2005. The results of the empirical analysis in the paper are very promising. We have to note here that this is one of the first attempts to explain the location – specialization patterns in Poland at NUTS 2 level utilizing a spatial panel methodologies for two and three-way panels. We found empirical support for positive spatial autocorrelation between industry and services sectors at the level of NUTS regions of Poland. The location of sectors is driven to a large extent by sector-specific features though region-specific effects are important as well. The size of the region as well as the level of development of infrastructure are of prime importance. Large R&D base pulls higher-technology manufacturing sectors as well as higher knowledge intensity services sectors to the region. The results for interactive terms require further work.

In the future we would like to continue the work utilizing different spatial econometric techniques. We would like to test the robustness of the obtained results to the use of more complex spatial weighting matrixes. Furthermore, we would like to include a more complete set of variables reflecting factor endowments of regions and then include the theoretically suggested interaction terms with sector-specific variables.

We furthermore acknowledge that the analysis should also be performed on data sets at higher levels of spatial disaggregation (perfectly at the level equivalent to British local administrative districts – Polish *powiat*) which is however severely limited by the availability of data.

The results obtained for Poland should also be compared to experiences of other countries of Central and Eastern Europe which underwent analogous processes of economic transition and gradual integration with the European Union. The study should be performed at a highly disaggregated regional level. This could also be considered as a test of NEG theories considering the impact of gradual trade and factor flows integration. The pan-European study should be performed as well checking whether the trends observed in the new Member States of the European Union fit into trends identified beforehand for the EU15.

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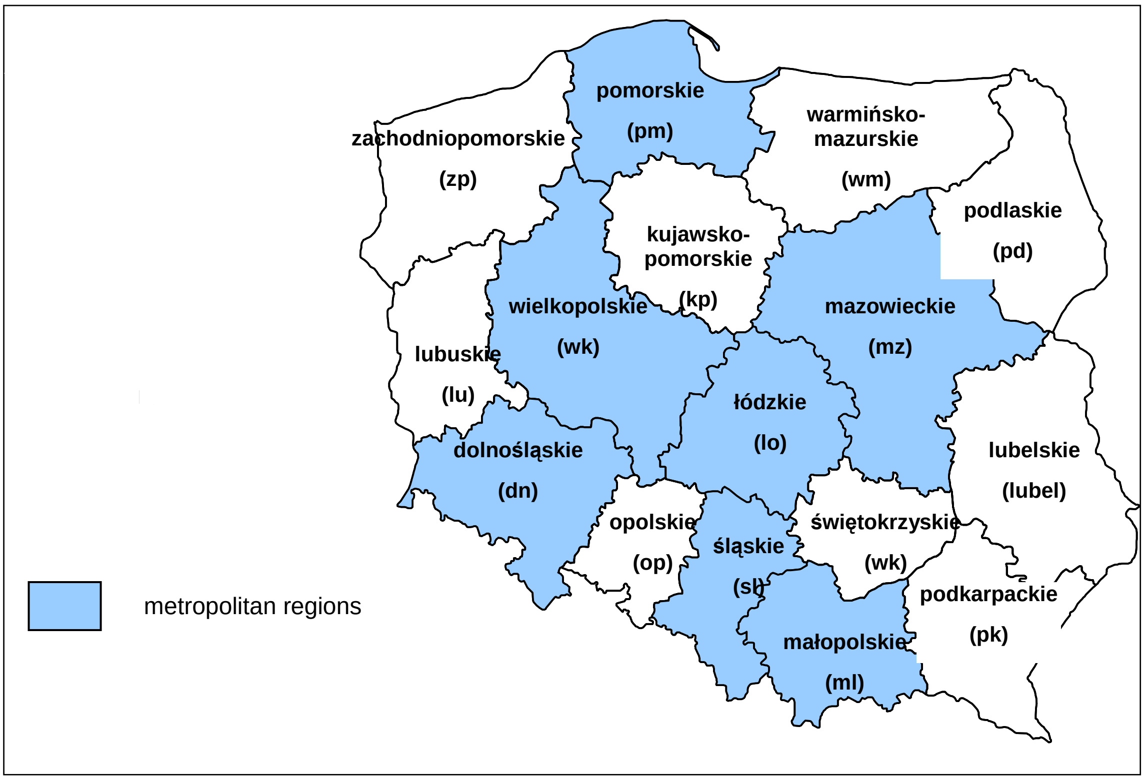
Map 1NUTS2 regions (voivodeships) of Poland*



Comment: names and codes utilized in empirical analysis (in brackets)*

Table 1List of variables

Variable	No of observations	Mean	Standard deviation	Minimum	Maximum
share	18102	8,2678	11,1350	0,0031	99,74
scale	16299	120,8658	444,5816	1,6667	25540,75
inter	18171	0,6495	0,3249	-23,4821	0,9912
k/l	18161	56,3182	129,4188	0,0228	3125,852
w/l	18170	14,1375	15,6069	0,2390	1858,54
tl	103 (18128)	2,0194	1,0333	1	4
wifo	103 (18128)	2,0291	1,0470	1	4
kn_int	97 (17072)	1,6082	0,6667	1	3
sh_ind	176 (39072)	24,3021	4,4417	16,5396	39,5144
sh_mserv	176 (39072)	46,4663	4,9433	36,5410	63,1523
sh_br	176 (39072)	0,6182	0,3283	0,17	1,71
roads	176 (39072)	23493,61	8776,6	10831	49880
pop	176 (39072)	2400266	1197869	1007965	5157729
area	176 (39072)	19542,69	6619,216	9412	35557

Source: Own calculations.

Table 2 REML estimation results for Polish manufacturing industry over the period 1995-2005

Model / Variable	MI 1	MI2	MI 3
l_scale	0,8815 (0,0157) ***	0,8869 (0,0156) ***	0,5611 (0,4368)
l_inter	0,2322 (0,0424) ***	0,2247 (0,0422) ***	1,098 (0,2536) ***
l_k/l	0,0691 (0,0140) ***	0,0660 (0,0139) ***	0,0681 (0,0139) ***
l_wage	0,1071 (0,0370) ***	0,1078 (0,0369) ***	0,0974 (0,0369) ***
l_w_lq	0,0226 (0,0117) **	0,0192 (0,0116) *	0,0184 (0,0116)
tl	1,1510 (0,2181) ***	1,1430 (0,2173) ***	1,0577 (0,2198) ***
wifo	-1,418 (0,3276) ***	-1,4405 (0,3264) ***	-1,4569 (0,3256) ***
bwest	-	0,4055 (0,2586)	0,4000 (0,2576)
beast	-	-0,2572 (0,2663)	-0,2510 (0,2653)
bsea	-	-0,1215 (0,2581)	-0,1173 (0,2571)
rcap	-	-0,4775 (0,4411)	-0,5046 (0,4397)
l_pop	-	0,4147 (0,2340) *	0,3455 (0,2880)
sh_ind	-	-0,0075 (0,0060)	-0,0079 (0, 0060)
sh_mserv	-	-0,0020 (0,0071)	-0,0086 (0,0074)
sh_br	-	0,0011 (0,0674)	-0,2460 (0,1141) **
l_roads	-	1,0310 (0,1699) ***	1,0122 (0,1697) ***
Interaction : l_scale* l_pop	-	-	0,0223 (0,0298)
Interaction : l_inter *sh_mserv	-	-	-0,0182 (0,0052) ***
Interaction : tl *sh_br	-	-	0,1230 (0,0459) ***
w_kp	0,2402 (0,1071) **	-	-
w_lubel	-0,2914 (0,1198) **	-	-
w_lb	-0,1877 (0,1245)	-	-
w_lo	0,2060	-	-

Model / Variable	MI 1	MI2	MI 3
	(0,1042) **		
w_ml	0,1000 (0,1007)	-	-
w_mz	0,7134 (0,1030) ***	-	-
w_op	-0,6105 (0,1131) ***	-	-
w_pk	-0,0359 (0,1154)	-	-
w_pd	-0,5649 (0,1328) ***	-	-
w_pm	0,1430 (0,1081)	-	-
w_sl	0,8896 (0,0995) ***	-	-
w_sw	-0,9690 (0,1101) ***	-	-
w_wm	-0,4063 (0,1204) ***	-	-
w_wk	0,2716 (0,1032) ***	-	-
w_zp	-0,0369 (0,1104)	-	-
w_dn	0,5388 (0,0438) ***	-	-
Significant sector effects	Yes	Yes	Yes
Significant time effects	Yes	Yes	Yes
No of observations	7478	7478	7478
R-SQUARED	0,8503	0,8507	0,8565
Wald chi2	4766,09 [0,000]	4517,53 [0,000]	4549,96 [0,000]

Source: Own calculations in STATA 10.

Comments:

a) Explained variable: l_share (log of share of a given sector in a given region in total employment of the sector in Poland)
b) Statistically significant at *** 1, ** 5 or * 10 per cent level.
c) Standard errors (SE) are given under coefficients.
d) Wald chi2 – Wald test for specification of the model
e) [ ] Prob values
f) R-SQUARED calculated as a squared value of the Pearson's linear correlation index between empirical values of the endogenous variable and its theoretical values determined with fixed and random effects.

Table 3 REML estimation results for Polish market services sectors over the period 1995-2005

Model / Variable	MS1	MS2	MS 3
l_scale	0,8007 (0,0151) ***	0,7991 (0,0150) ***	3,2990 (0,3927) ***
l_inter	0,0890 (0,0233) ***	0,0895 (0,0232) ***	0,7446 (0,1509) ***
l_k/l	0,0517 (0,0091) ***	0,0512 (0,0091) ***	0,0479 (0,0091) ***
l_wage	0,1415 (0,0268) ***	0,1377 (0,0267) ***	0,1403 (0,0266) ***
l_w_lq	0,0244 (0,0132) *	0,0221 (0,0131) *	0,0186 (0,0131)
kn_int	0,6444 (0,2711) **	0,6187 (0,2704) **	0,5680 (0,2747) **
bwest	-	0,3435 (0,2637)	0,3456 (0,2631)
beast	-	-0,1788 (0,2707)	-0,1716 (0,2700)
bsea	-	0,0946 (0,2629)	0,0950 (0,2623)
rcap	-	-0,0928 (0,4499)	-0,0048 (0,4490)
l_pop	-	0,8831 (0,2526) ***	1,5252 (0,2706) ***
sh_ind	-	-0,0034 (0,0056)	-0,0013 (0,0055)
sh_mserv	-	-0,0039 (0,0066)	-0,0083 (0,0067)
sh_br	-	-0,0535 (0,0628)	-0,2427 (0,1074) **
l_roads	-	0,9673 (0,1580) ***	0,9579 (0,1574) ***
Interaction : l_scale* l_pop	-	-	-0,1702 (0,0267) ***
Interaction : l_inter *sh_mserv	-	-	-0,0136 (0,0031) ***
Interaction : kint*shbr	-	-	0,1241 (0,0617) **
w_kp	-0,0149 (0,0907)	-	-
w_lubel	-0,2720 (0,0938) ***	-	-
w_lb	-0,6597 (0,0960) ***	-	-
w_lo	0,1609 (0,0864) *	-	-

Model / Variable	MS1	MS2	MS 3
w_ml	0,3696 (0,0839) ***	-	-
w_mz	1,2917 (0,0862) ***	-	-
w_op	-0,6125 (0,0934) ***	-	-
w_pk	-0,1560 (0,0925) *	-	-
w_pd	-0,6653 (0,0991) ***	-	-
w_pm	0,3463 (0,0848) ***	-	-
w_sl	1,0358 (0,0838) ***	-	-
w_sw	-1,0444 (0,0933) ***	-	-
w_wm	-0,5677 (0,0941) ***	-	-
w_wk	0,2613 (0,0849) ***	-	-
w_zp	0,0004 (0,0898)	-	-
w_dn	0,5265 (0,0424) ***	-	-
Significant sector effects	Yes	Yes	Yes
Significant time effects	Yes	Yes	Yes
No of observations	6603	6603	6603
R-SQUARED	0,8868	0,8876	0,8889
Wald chi2	5100,89 [0,000]	4060,12 [0,000]	4152,36 [0,000]

Source: Own calculations in STATA 10.

Comments:

a) Explained variable: l_share (share of a given sector in a given region in total employment of the sector in Poland)
b) Statistically significant at *** 1, ** 5 or * 10 per cent level.
c) Standard errors (SE) are given under coefficients.
d) Wald chi2 – Wald test for specification of the model
e) [ ] Prob values
f) R-SQUARED calculated as a squared value of the Pearson's linear correlation index between empirical values of the endogenous variable and its theoretical values determined with fixed and random effects.

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