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Effects of Poland's Integration with the EU: Structural Interventions and Economic Development in the Eastern Border Regions[1]

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Abstract: In this paper, we discuss the possible effects of Poland's accession to the European Union (EU) on the economic development of the Polish eastern border regions. In accordance with the theoretical previsions, economic integration may have a great impact on the spatial allocation of economic activity. As a result, it is likely that regional income divergence in Poland will increase within the next few years. Structural interventions, accomplished in the framework of the EU Cohesion Policy programmes, are expected to offset this negative tendency. In our study, we attempt to evaluate the possible outcome of the different kinds of infrastructural projects. We show that similar investments may have a diverse impact on production and employment in different regions. Further, we demonstrate that certain transport infrastructure projects may in fact decelerate economic growth in the eastern border regions.

Keywords: Economic integration, infrastructures, regional policy, EU Cohesion Policy

JEL Classification Numbers: F15, H54, R11, R12, R58

1. Introduction

In this paper, we discuss the possible effects of Poland's accession to the European Union (EU) on the economic development of the Polish eastern border regions (Lubelskie, Podkarpackie, Podlaskie and Warmińsko-Mazurskie voivodships[2]). These four voivodships are among the poorest and least developed in the entire EU. A comprehensive description of their primary characteristics can be found in our recent paper (Socha and Rokicki, 2006). It is noteworthy to point out that since 1995, the eastern border regions have diverged from the most developed voivodship (Mazowieckie) in terms of (1) labour productivity (which has fallen from 63.8% to 50.9%), (2) gross domestic product (GDP) per capita and (3) real wages[3]. This is due to the spatial concentration of economic activity in Poland which can partly be attributed to the increased foreign direct investment (FDI) inflows (see Rokicki, 2006).

The per capita GDP in the eastern neighbouring countries is much lower than that in Poland. At the end of 2005, Ukraine's GDP was only 49.8% of Poland's GDP; Belarus' GDP was 53.5% and Russia's GDP was 72% of Poland's GDP. Further, the labour markets on both sides of

eastern boundary are characterised by a low level of integration. The existing differences in the income levels and unemployment rates (higher in Polish regions) are not conducive to intensive migration which is a clear sign of labour market rigidity.

Theoretically, this rigidity could be softened by means of capital movements; however, in the case of the eastern border regions these capital movements are considerably low. Empirical studies (see Cieslik, 2005, 2006) have confirmed their low attractiveness with respect to foreign capital. Moreover, trade relations between these regions from the both sides of the frontier are rather weak. As shown in Table A.1 (see Annex) the largest trade partner of the Polish eastern border regions is Germany, while the volume of export and import to Belarus, Russia and Ukraine has been fairly low. Finally, the transport infrastructure in the eastern border regions is less developed in comparison to that of the other frontiers (Dubrovina, 2006).

Poland's accession to the EU significantly modifies the economic development conditions of the Polish eastern border regions, which have now become the eastern frontier of the entire EU. Further, the suppression of the existing trade barriers at the Western and Southern borders of Poland in May 2004 has created new opportunities for the nearby regions. On the contrary, high transaction costs in the eastern border regions decelerate regional growth rate and may induce internal divergence processes in Poland.

The EU Cohesion Policy is expected to offset this negative tendency. Hence, one-third of the financial transfers from the structural funds, in the framework of the financial perspective 2007–2013, in Poland will be spent on the eastern border regions. According to the governmental strategy for regional development, structural interventions should accelerate economic growth in eastern border regions. However, economic theory suggests that it is unclear whether they will yield the expected results. According to the economic theory, structural interventions could dramatically increase the existing income disparities between the inhabitants of the Polish eastern border regions and their neighbours from Belarus, Ukraine or Kaliningrad.

It is believed that the EU funding may increase the economic growth of the eastern border regions only if it is properly allocated. Unfortunately, neither the economic theory nor the other country's experience suggest that they might have an understating of how to employ the EU Cohesion Policy funds in a manner that maximises the net benefits and fosters real convergence. Thus, we apply regional data to conduct an empirical analysis which explains how (1) investments in physical capital, (2) transport infrastructure, (3) human capital and (4) technology will influence production and employment in the Polish regions. In particular, we focus on the road network based on our assumption that investment in the local road infrastructure should lower the trade costs of private firms, increase the region's attractiveness for investors and create jobs for low-skilled workers. Based on the combination of economic theory, stylized facts and empirical analysis, we are able to forecast the possible impact of the EU Cohesion Policy

programmes on the economic development of the Polish eastern border regions. Further, we consider the possible patterns of future cross-border cooperation between them and their neighbours.

In the subsequent section, we examine the primary theoretical findings and the results of the previous empirical research on the effects of regional policy. In section 3, we discuss the results of our empirical analysis; section 4, provides the concluding remarks.

2. Theoretical framework and former research

It is commonly agreed most often that economic integration should have a positive pro-growth effect on the countries participating in it. Further, endogenous growth models have indicated that integration leads to the so-called 'reallocation effect' which changes the existing location patterns between particular states as a result of market opening[4]. However, these models have not explained the consequences of the spatial allocation of economic activity within the integrating countries. Research in the field of spatial economics has bloomed since the early nineties with the emergence of New Economic Geography (NEG). This new stream combines both the traditional approaches of urban economics and regional science with the Dixit-Stiglitz monopolistic competition model, seeking out the factors underlying the existence of regional income disparities. In this section, we present a brief summary of the primary theoretical findings of the classical NEG models and its 'marriage' with endogenous growth models. Further, we examine the results of several previous empirical studies.

2.1. Theory

In the recent years, many variants of NEG models have been developed. As a result, the general outcome of these models may not be considerably straightforward[5]. First of all, according to the theory, we find that the allocation of industry is strictly related with broadly understood trade costs (comprising transportation costs). The high level of trade barriers makes it unprofitable for firms to cluster together; thereby, the expected market equilibrium involves a dispersion of manufacturing[6]. Undoubtedly, dispersion is more relative than absolute since it is difficult to find exactly symmetric regions. What we can state, however, is that given the high level of trade costs, firms are manufacturing products for only the local market. Therefore, each region accounts for a share of industry which is proportional to its size. Nevertheless, one cannot expect to find such a high level of trade costs inside a single country or even a group of countries (e.g. the EU). Hence, it is much more interesting to summarise the theoretical findings associated with the intermediate and low level trade costs.

Generally, all models predict that as soon as the trade costs decline from a high to intermediate level, the agglomerate manufacturing sector in a smaller number of regions profit considerably.

There are several mechanisms that favour industrial clustering (centripetal forces) and others that work in the opposite direction (centrifugal forces). Agglomeration is more likely to happen if there is (1) a higher migration rate, (2) a larger workforce, (3) a lower elasticity of substitution of manufacturing goods, (4) stronger *home market effect* and *price index effect* and (5) more intense vertical linkages between upstream and downstream industries[7]. On the contrary, a strong *local competition effect*, a high level of congestion and agriculture transport costs, low elasticity of labour supply and the existence of taste heterogeneity may weaken agglomeration or result in a re-dispersion process.

According to numerical simulations, agglomeration takes place in a few regions, while the rest of the regions serve as a periphery supplying agricultural goods[8]. However, the symmetry predicted in these simulations is unlikely to be observed in real economy. Nevertheless, it is often observed that a highly industrialised area is typically surrounded by regions with clear rural characteristics. Indeed, the border regions of the EU can be considered as an apparent example of the periphery surrounding the core regions[9].

There is no doubt that the agglomeration process leads to an increase in the wage rate differentials among regions. Therefore, the divergence in the regional income level has also been observed. On the contrary, it is believed that re-dispersion leads to a decrease in the regional wage differentials, thereby narrowing the regional income disparities. In addition, theoretical approaches that link NEG and endogenous growth models together show that industrial clustering affects both regional and national growth rates. In the same manner, a regional policy that affects the existing spatial distribution of economic activity also affects the regional and national growth rates.

Following Martin (1998, 1999), Baldwin et al. (2003) discussed the possible outcomes of regional policies. They found that the results may differ according to the type of policy. Furthermore, they claimed that there may be a trade-off between regional income inequality and the growth rate of national economy. On the one hand, policies based on income transfers to poor regions increase the market size of and the number of firms in these poor regions, thereby decreasing income inequality. However, on the other hand, as soon as the spatial concentration of the industry diminishes, the economic growth rate of the economy decreases as well[10].

Policies aiming at the improvement of intra-regional infrastructure lower the trade costs in poorer regions, which enhances the demand in these regions and results in the relocation of some firms to these regions. Further, dispersion of the industry decreases the economic growth rate and increases the monopoly profits (since the competition also decreases). Assuming that there are more capital owners in the richer regions, we can conclude that nominal income inequalities must necessarily increase. Nevertheless, at the same time, the price index in the poorer regions decreases; hence, the real income inequalities may either rise or fall.

Strategies aimed at enhancing inter-regional infrastructure have exactly the opposite effect.

Such strategies lead to increased spatial concentration of economic activity, increased growth rate and reduced nominal income inequalities. Again, however, their effect on real income is ambiguous. The most encouraging results (if we seek both equity and efficiency) are those of a policy that is focused on increasing inter-regional knowledge spillovers. Contrary to all the types of policies considered up till now, here, there is no trade-off between regional equality and growth rate. Thus, both regional income disparities and agglomeration decrease, while the economic growth rate increases. Any investment that facilitates the exchange of ideas or improves human capital stock can be included in this policy[11].

Baldwin et al. (2003) pointed out that the results of infrastructure improvement may be different in the presence of congestion costs. They argued that these costs result in a certain kind of agglomeration which stimulates the economic growth rate only up to a certain critical point. After this point, further clustering of the industry appears to lower the economic growth rate by increasing the costs of innovation. Therefore, policies aimed at improving inter-regional infrastructure may indeed lead to a higher level of agglomeration and lower the economic growth rate. Furthermore, Baldwin et al. (2003) highlighted another crucial aspect: when centripetal forces are strong, only a relatively large increase in the attractiveness of the poor region may alter the existing location patterns. Hence, regional policies have non-linear effects and become efficient only after certain critical point is reached.

Recapitulating, according to NEG models, it is possible that the European regional policies, instead of reducing regional disparities, have enforced a national convergence process between the so-called cohesion countries[12] and other EU members. This may appear to be not that surprising when the structure of such policies is analysed. It is easy to confirm that a large part of the financial means was spent on inter-regional infrastructures. For instance, the development of a Trans-European Transport Network alone accounted for €2.300 million within 1995–1999 and a further €4.600 million within 2000–2006 (Puga, 2002). Yet, the theory predicts that such kind of projects will lead to a higher growth rate of the entire economy; however, at the same time, they will also increase regional income inequalities.

2.2. Previous empirical research

The theory suggests that the location patterns of economic activity depend on many factors. Neither total dispersion nor catastrophic agglomeration should be expected in the real economy. Nevertheless, according to the theoretical models, most of the industry would cluster together in a small number of regions that serve as an economic core. Thus, economic integration should ideally boost the growth rate in integrating countries. However, it may also alter their internal economic structure and lead to an increase or decrease in the existing regional income disparities.

The empirical evidence with respect to the EU displays two opposite tendencies. On the one hand, on average, the cohesion countries have grown faster than the EU in the recent years

(European Commission, 1999). Therefore, we can state that there is an obvious tendency to converge at the national level. This process, however, has been accompanied with an increasing regional divergence within each cohesion country (see e.g. Begg, 1999; Cuadrado Roura, 1998; de la Fuente and Vives, 1996; Quah, 1996). Moreover, during the 1980s, regional divergence was also observed within other EU members (Gouyette and Neven, 1995).

Martin (1998) attempts to explain this phenomenon by focusing on migration. He claims that the international migration rate is much lower than the inter-regional one because of linguistic, cultural or financial barriers (the costs of migrating from one region to another should be lower than that of migrating from one country to another). As indicated by the theory, a high inter-regional migrate rate would favour the dispersion of industry between nations and would be more conducive agglomeration within each country.

Further, an increasing openness of the global economy may favour the concentration of economic activity in a smaller number of regions. For example, export-oriented firms would most likely locate their capital in regions near the economic core. Hanson (1996) demonstrated that both the United States and Mexican industries were clustered together near the border after the NAFTA agreement was settled[13]. A similar process has also been observed recently in Europe. Overman and Winters (2003) argued that the integration of the United Kingdom with the EU resulted in the relocation of a large part of the industry to areas close to the continent[14]. On the other hand, in most of the Central and Eastern Europe countries, industries had clustered together in the border regions, nearby the EU frontier, even before their accession to the EU (Resmini, 2003). Here, FDI inflows have strengthened the relocation process. Nevertheless, adjustments in the spatial allocation of the industry do not necessarily mean a simple movement towards the core. In fact, many papers report that the ongoing European integration has also increased industrial specialisation (e.g. Brülhart, 1998; Brülhart and Torstensson, 1996; Forslid et al., 2002; Maluquer de Motes Bernet, 2001; Midelfart Knarvik and Steen, 1999).

There is another question that pertains to the effectiveness of the EU Cohesion Policy. However, empirical research has been unable to unambiguously answer whether the programmes financed by the structural funds tend to increase the economic growth rate in the poor regions or whether they do not have any important impact on the regional and national economies. The European Commission has demonstrated the effectiveness of the EU Cohesion Policy through simulations of the HERMIN model. They argued that the positive effects include (1) growth in GDP, (2) labour productivity and (3) employment (see Table 1). Yet, they do not indicate what kinds of structural interventions are the most efficient at the national and regional levels. On the contrary, Martin (1998) claimed that investment in telecommunications is a unique factor which helps to achieve convergence within a country. It should be noted that the EU Cohesion Policy programmes instead finance mainly human capital and transport infrastructure investments. Another analysis conducted by Rodríguez-Pose and Fratesi (2003) for Objective 1 regions shows

Table 1 Macroeconomic effects of structural policy within 1994 – 1999 (ex post).

Change in %	Greece	Spain	Ireland	Portugal	Northern Ireland	Eastern Germany
GDP	2.2	1.4	2.8	4.7	3.9	1.3
Manufacturing	3.4	3.7	4.7	10.6	3.2	0.6
Market services	2.4	1.2	2.4	4.8	4.4	2.2
Fixed assets investment	18.1	9.1	1.1	24.8	7.8	1.2
Labour productivity	2.3	2.1	2.2	6.6	1.2	0.5
Employment	1.0	1.5	4.7	3.7	2.0	0.1

Source: European Commission (2004b).

that only investment in education and human capital counts for regional economic growth. Finally, de la Fuente (2002) states that the Spanish Objective 1 regions have improved their economic condition mainly due to infrastructure investment. Nevertheless, according to his results, investment in human capital also matters.

3. Empirical results

3.1. Methodology and data

We applied an amended version of the model used by de la Fuente (2002) in his analysis of the EU Cohesion Policy spending in Spanish Objective 1 regions. There are several reasons why we employed the same approach in our study. First of all, the model relies on the supply side of the economy and is considerably simple from the theoretical viewpoint. Its simplicity allows for modifications which later permit the testing of the theoretical findings. Further, it simplicity also makes it possible to answer most of the questions concerning the EU Cohesion Policy's effectiveness. Secondly, Poland and Spain have often been compared with each other because of the similarities in their economic situations at the time when they joined the EU. Both Spain (in the past) and Poland (at present) are among the largest beneficiaries of the structural funds. In addition, similar size, population and administrative divisions (16 NUTS2 regions in Poland and 17 in Spain) make comparison even more accurate.

The model is based on the joint estimation of an aggregate Cobb-Douglas production function and a labour demand function. The production factors include technology (A), capital (K), labour (L), public infrastructures (P) and human capital (H). An important novelty in our approach is that we apply data for different regions and different sections of economy (at the NACE two-digit level). This not only allows for increasing the number of observations but also

allows for discovering the differences in the production factor's elasticities among regions and sections[15]. Notwithstanding, we distinguish between eight 'market sections' and the economy as a whole. In our opinion, market sections are the most suitable for testing theoretical previsions[16].

In the case of technology, the level of R&D spending in Poland is so low that one may consider its influence on technological progress as being negligible. If so, then the technical progress is implemented primarily via the FDI channel. FDIs are important because they bring not only more technologically advanced fixed assets but also the know-how). Hence, technology is approximated based on the value of the share capital of enterprises owned (totally or partly) by foreign investors. This assumption does not allow, however, for the existence of technological spillovers among different regions[17].

It appears reasonable to expect the privately-owned capital to be more productive[18]. Thus, we distinguish capital stock in the private sector from that in the public one. Both variables are expressed as the gross value of fixed assets.

Due to statistical data limitations, the public infrastructure variable accounts for only road infrastructure. In order to test the theoretical hypotheses, we divide the data on the roads into different categories according to their impact on trade costs. Thus, we have the following four primary types that were tested separately: (1) entire road network, (2) national roads (including express-roads and highways) which lower the inter-regional trade costs, (3) voivodship roads (roads with regional character) and (4) powiat roads (roads with local character, which lower the intra-regional trade costs)[19]. Furthermore, we tested the existence of positive spillovers of public infrastructure. Therefore, following Alvarez Pinilla et al. (2003), we calculated the value of the road network by applying the following formula:

$$P_{it} = \overline{P_{it}} + \sum_{r=1}^{N-1} \exp(-D_{ir}) \cdot P_{rt} \ ,$$

where $\overline{P_{it}}$ is the value of road infrastructure in region *i* at time *t*, P_{rt} is the value of road infrastructure in region *r* at time *t* and D_{ir} measures the distance between regions *i* and *r*[20].

Human capital is expressed as the average educational level of the labour force (Some labour is applied to product H; thus, there is more L than H). We allow for increasing returns such that the production function has no additional restrictions[21] and takes the following form:

$$Y_{ijt} = A_{it}^{\theta} \underset{pr}{K}_{ijt}^{\alpha} \underset{pu}{K}_{ijt}^{\beta} P_{it}^{\chi} H_{it}^{\delta} L_{ijt}^{\phi} \ , \qquad (1)$$

where *i* denotes a region, *j* represents a section and *t* is the year.

Labour market equilibrium is determined under perfect competition and no adjustment costs assumptions. This leads to the conclusion that on equalling the marginal product of labour and real wage, the following labour demand function can be obtained:

$$\frac{\partial Y_{ijt}}{\partial L_{ijt}} = \phi A_{it}^{\theta} \underset{pr\,ijt}{K^{\alpha}} \underset{pu\,ijt}{K^{\beta}} P_{it}^{\chi} H_{it}^{\delta} L_{ijt}^{\phi-1} = W \qquad (2)$$

Solving for L and dropping the sub-indices we obtain

$$L^{*} = \left(\frac{\phi A_{it}^{\theta} \underset{pr\,ijt}{K^{\alpha}} \underset{pu\,ijt}{K^{\beta}} P_{it}^{\chi} H_{it}^{\delta}}{W} \right)^{1/(1-\phi)} \qquad (3)$$

Estimation of the coefficients for each production factor allows us to determine the production and labour elasticities with respect to factor allocation. Thus, we are able to assess the possible effect of an increase in the stock of each factor on production and employment. De la Fuente (2002) directly applied the coefficients estimated with respect to the entire country in order to measure the impact of the structural funds on each Spanish region. However, it is obvious that the economic and social characteristics of each region may differ considerably. Therefore, we compiled our sectional data in a manner that allows us to estimate the factor elasticities for different groups of Polish regions. For this project, we constructed an annual panel data set 1995–2005 on 12 (8) two-digit NACE sections and 16 voivodships (NUTS2 level classification).

3.2. National and sectional factor elasticities

We begin our analysis by running a model which employs data for all 16 regions and sections. The results appear to be reasonable since we find that output is positively and significantly correlated with employment, foreign capital, human capital and fixed assets in the private sector (see Table A.2, Annex). Both employment and human capital are statistically significant when lagged one year. In the case of the road network, we observe that it is important only with respect to the inclusion of the spillover effects. Moreover, the coefficients for road network are extremely high which may be evidence for the need to develop the road network. Another interesting aspect is the negative sign of the coefficients for national and voivodship road networks when regressed separately. At the same time, powiat roads have a clear, positive impact on production. This result appears to be considerably important in the context of preparing cohesion policy programmes in Poland. The results suggest that huge infrastructural projects which include the construction of motorways and express-roads may in fact transform

Poland into a transit country and restrain the economic growth rate. However, it is noteworthy to mention that the highest and most positive coefficient was for the entire road network. This suggests the existence of a synergy among the different types of roads. Regardless, one must be extremely careful when judging the outcomes, particularly taking into account that road investment in Poland has been considerably low during the recent years.

The estimation results for the employment equation suggest that employment is positively correlated only with public capital, production level and powiat roads. Moreover, there is a strong and negative correlation between employment and national roads. According to the theory, this would be due to the delocalisation process in poor regions. While lower transport costs would trigger agglomeration in rich areas, an increase in employment in these areas would not be able to offset the loss in the poorest locations[22]. Not surprisingly, employment growth appears to be negatively correlated with wages and employment level in the previous period.

It is important to underline that the direction of relationships between variables, observed in our study, in general, is exactly the same as the one observed in de la Fuente's (2002) work. What differs, however, are the values of the coefficients, with the exception of human capital (which is almost the same). This seems plausible taking into account the different situation and characteristics of the Polish and Spanish economies.

As mentioned previously, our model allows for examining the coefficients of the production and labour demand functions of each two-digit NACE section. This appears interesting from both theoretical and practical points of view because of the following reasons. Firstly, it becomes possible to explain why similar policies have diverse effects on locations with different economic structures. Secondly, it serves, to some extent, as a guide for policy designers who are interested in fostering particular sections. In this paper, we report the results of regressions for the agriculture section which still plays a crucial role in the economies of the eastern border regions[23]. In order to compare these results with those of other sections, we also provide the estimation output for manufacturing since it is a section which should best fit the theoretical premise.

At first glance, regressions for the agriculture section yield some interesting results (see Table A.4, Annex). Here, the accumulation of public capital stock and the construction of new roads (and national roads in particular) are the only ways to increase production. There is, however, one major problem with regard to the value of the above findings: the statistical significance of the production function as a whole is negligible. Nevertheless, it is in no way surprising given the peculiarity of agriculture[24]. On the other hand, the employment function appears to be in keeping with the theoretical premise given the positive correlation between employment and physical capital stock (including the road network). In the case of roads, it is those with regional character (voivodship and powiat roads) which influence employment in a positive manner.

The estimation output for manufacturing (Table A.5, Annex) is also in accordance with the

theory since employment and national road network are the only factors that affect production[25]. The latter being the one which, according to NEG models, leads to agglomeration and accelerates the economy's growth rate. The employment equation indicates that private capital stock also influences production; however, in this instance, the influence is indirect in that it is through an increase in employment. Further, the signs of the other coefficients are as expected: negative at the wages and employment levels and positive at the production level.

For the sake of limited space, we have not reported the results pertaining to the remaining sections. However, it can be stated that they confirm the primary conclusion which can be drawn from the comparison of the results for agriculture and manufacturing: factor elasticities vary strongly between particular sections. Hence, it becomes evident that regions with different sectional structures require specific structural policies.

3.3. Eastern border regions factor elasticities

Most of the studies analyse the regional effects of the EU Cohesion Policy by using the average estimation results for the entire country[26]. We believe that this is an inadequate approach which leads to erroneous conclusions. Almost all the activities of the EU Cohesion Policy are targeted at NUTS2 regions which differ considerably among each other. Therefore, we attempted to estimate the model for each region and then compare the results of the simulation based on regional factor elasticities with the results obtained from the factor elasticities estimated previously for the entire country.

Regrettably, we were unable to obtain sufficient observations to run regressions for all regions separately. Hence, we decided to group regions with a similar per capita income level together, consequently creating three different groups of regions. This first one comprised the five richest Polish voivodships (Dolnośląskie, Mazowieckie, Pomorskie, Śląskie and Wielkopolskie). While they most certainly differ among each other, according to the theory, the overall results of the regional policy programmes should be similar for all members of the same group. The same was done for the group comprising five of the poorest regions (Lubelskie, Podkarpackie, Podlaskie, Świętokrzyskie and Warmińsko-Mazurskie). Here, we could probably find much more similarities, particularly with respect to public infrastructures and human capital. Moreover, four of the above voivodships are collectively referred to as the 'eastern wall'. Finally, the last group, created for the purpose of this study, can be categorised as 'middle income regions', comprising Kujawsko-Pomorskie, Lubuskie, Łódzkie, Małopolskie, Opolskie and Zachodniopomorskie[27].

The estimation results for the group comprising the least developed regions suggest that an increase in any production factor, barring public capital, will lead to production growth (Table A.6, Annex)[28]. It is important to underline the significance of human capital in areas where, according to statistical data, labour force has the lowest education attainment. However, one

could claim that this is only a consequence of the large agriculture sector. Therefore, we ran further regressions where the variable of human capital did not include observations concerning agriculture workers. Surprisingly, we found that the human capital coefficient was even greater than before, confirming its importance.

Perhaps the most significant result, at least from the theoretical viewpoint, concerns the road network coefficient. Here, the development of the entire road network, as well as powiat roads in particular, is positively correlated with production growth. On the contrary, the coefficient for national roads is strongly negative. Hence, with respect to the road network, the theory's prediction is accurate: development of national roads lowers production in poor locations, while investment in powiat roads clearly leads to its increase. Moreover, exactly the same relation can be observed in the case of the employment equation.

With respect to the following question: Do the results pertaining to the least developed areas differ substantially from those concerning the rich and medium locations? The answer is yes. The estimation results for the group comprising the rich regions may serve as a perfect example. Here, we find a positive correlation between production and production factors such as employment, human capital and private capital stock (see Table A.8, Annex). The coefficients for all the above-mentioned production factors are significantly higher than those obtained in the case of poor regions. Neither road infrastructure nor foreign or public capital is statistically significant. This may suggest the existence of a relatively high level of technology and developed road infrastructure in these regions. Yet, it is also evident that development of the regional road network (powiat roads) has a negative impact on production by means of employment reduction. Therefore, we obtain more evidence to confirm the theoretical previsions concerning the importance of transport infrastructure in regional economic development. In this particular example, powiat roads act as a centrifugal force which lowers agglomeration.

3.4. Potential policy results

Once we have estimated the production factor coefficients, we can run a simulation to observe the potential impact of the EU Cohesion Policy programmes on production and employment in the eastern border regions. For the sake of simplicity, we have presented only the short-term results obtained under certain assumptions. Following de la Fuente (2002), we assume that public investment, accomplished within the framework of the EU Cohesion Policy in Poland, does not affect private investment in any manner. Further, we suppose that projects which have been co-financed by the structural funds or the EU Cohesion Fund cannot be completed without the presence of the EU Cohesion Policy.

Firstly, we need to calculate the change in stock of each production factor which can be attributed to structural interventions. However, in this regard, we are confronted with many

problems because calculating the change in stock of education level or fixed assets is not straightforward. Moreover, the assessment method applied in the current study requires detailed information about the localisation, type and final product of the structural interventions. This kind of information cannot be gathered before the execution, or at least an approval, of each project. In the case of the 2004–2006 programming period, some of the projects have not yet been completed; however, the Ministry of Regional Development has already facilitated the full list of contracted projects extracted from SIMIK[29]. Therefore, our simulation has to be limited to an ex-post analysis of the EU Cohesion Policy interventions between 2004 and 2006.

The database extracted from SIMIK and revised at the end of January 2008 includes information on a total of 73262 projects with regional scope and another 198 projects with multi-regional or national scope. It provides information about the cost of each project and distinguishes between total cost and eligible cost[30]. The total cost of all projects included in the SIMIK database approaches PLN 90 billion, while the eligible cost is approximately PLN 50 billion. This accounted for 9.7% and 5.3% of the Polish GDP in 2004, respectively[31].

However, not all the projects co-financed by the structural funds and the EU Cohesion Fund lead to an increase in the production factor stocks. For example, in the case of the physical capital stock, we assume that it rises exclusively as a result of new investment. Thus, all of the projects that aim at the renovation of the existing physical capital, concentrate on widely understood promotions or lead to facilitate credit access for business, and are not taken into account[32]. Similar assumptions can also be made with respect to the remaining production factors. Consequently, the number and cost of projects included in the simulation is much lower in comparison to the total number of projects present in the SIMIK database. To be more precise, the total eligible cost of the selected projects accounts for PLN 33737 million which indicates a decline of more than 30%.

Once the relevant projects are selected, it becomes possible to calculate the change in the logarithm of stock of each production factor. In all these cases, the base year is 2004, yet the computation method differs. The simplest situation pertains to the physical capital stock; here, its increase equals the value of eligible cost in the selected projects. A more complex analysis is required in the case of human capital, where the variation of its stock[33] is compared to the average length of learning of the labour force in each voivodship, estimated using the BAEL database[34]. Finally, the change in stock of the road network is calculated by multiplying the length of the new roadways by the average cost of its construction (taking into account the differences existing between the different road types). The variation in the stock of particular factors is shown in the Table 2 below.

The final step of the simulation involves multiplying the variation in the logarithm of stock of each production factor by the previously estimated production factor elasticities. The impact of the structural interventions on the output is calculated by using a two-stage approach. Firstly, we

Table 2 Variation in logarithm of stock of production factors due to projects accomplished in the frame of Community Support Framework 2004-2006 (base year 2004).

Voivodship	Physical capital public	Physical capital private	Human capital	Road network
Lubelskie	0.0097	0.0085	0.0028	0.0134
Podkarpackie	0.0219	0.0060	0.0027	0.0132
Podlaskie	0.0119	0.0112	0.0040	0.0128
Warmińsko-mazurskie	0.0194	0.0083	0.0036	0.0137

Source: authors' calculations.

Table 3 The impact of Community Support Framework on production and employment in lubelskie voivodship (production factor elasticities for all sections and all regions).

Factor	Δ log stock	output elasticity	direct Δ output	employment elasticity	Δ employ -ment	induced Δ output	total Δ output
Foreign capital	-	0.0240	-	-	-	-	-
Human capital	0.0028	0.1320	0.0004	0.0000	0.0000	0.0000	0.0004
Fixed assets private	0.0085	0.0280	0.0002	0.0000	0.0000	0.0000	0.0002
Fixed assets public	0.0097	0.0000	0.0000	0.0380	0.0004	0.0000	0.0000
Employment	-	0.1190	-	-	-	-	-
Road network	0.0134	1.2200	0.0163	0.0000	0.0000	0.0000	0.0163
Total			0.0169		0.0004	0.0000	0.0170

Source: authors' calculations.

estimate the direct impact resulting from a change in the production factor stock. Thereafter, we calculate the additional effect as a consequence of an increase (or decrease) in employment. As a result of the assumptions made during the estimation of the theoretical model, four different specifications are considered: two estimated for all voivodships together (total economy and market sections separately) and another two estimated for the different groups of regions (again one for the total economy and one for market sections). This allows for a comparison of results which seem to differ substantially.

Table 3 summarises the simulation results in Lubelskie voivodship, with the elasticities estimated for the model including all sections and regions. It can be appreciated that the EU Cohesion Policy programmes of 2004–2006 lead to a 1.7% increase in production and a 0.04% increase in employment. These figures highlight the fact that growth in production can be attributed principally to the change in stock of the road network. On the other hand, the rise in human capital stock, private capital stock and employment hardly affects production. This is mainly due to a low variation in the stock of these factors which in all cases rises less than 1% (see second column in Table 3).

A comparison of the results for the four eastern border regions shows a surprising uniformity among them, regardless of the elasticities applied in the simulation (see Tables 4 and 5). The increase in the output averages to about 1.5% in the case of the entire economy and to 2.5% in the market sections. Employment rises by a minimal fraction which in most of regions does not reach 0.1%. This suggests that only between 728 and 990 workers have found a job as a result of the structural interventions in the eastern border regions[35].

This extremely limited impact of the structural interventions on employment may appear strange, particularly in the case of market sections. Although there is no consensus about the impact of public infrastructure on the growth rate of economy, and thus employment, more dramatic results can be expected. Nevertheless, this phenomenon can be explained based on the peculiarity of the Polish economy which, in the recent years, has experienced a so-called non-employment economic growth (e.g. Bukowski, 2007).

There is, however, another aspect which requires further clarification. This is the apparent similarity between the results of the simulations presented in Tables 4 and 5. Indeed, a greater diversity of the results between the different specifications is expected. Nevertheless, this appears to be a common feature of the voivodships included during the estimations for the poor regions group. On comparing the results of the simulations for all 16 voivodships, we find considerable differences. The simulation which was based on the factor elasticities estimated for all the regions together shows that the impact of the EU Cohesion Policy programmes is almost identical among all the locations. This is, however, a common feature among nearly all the studies devoted to the analysis of regional policy effectiveness[36]. A completely different scenario manifests when we run the simulation plugging the factor elasticities received in the

Table 4 The impact of Community Support Framework 2004-2006 on regional output and employment (model with factor elasticities for all regions together).

Model	**All regions, all sections**			**All regions, market sections only**		
Voivodship	**Δ output**	**Δ employ -ment**	**Δ employ -ment (units)**	**Δ output**	**Δ employ -ment**	**Δ employ -ment (units)**
Lubelskie	1.70%	0.04%	132	2.49%	0.00%	1
Podkarpackie	1.67%	0.08%	321	2.43%	0.00%	6
Podlaskie	1.65%	0.05%	92	2.43%	0.00%	1
Warmińsko-mazurski	1.75%	0.07%	193	2.55%	0.01%	12

Source: authors' calculations.

Table 5 The impact of Community Support Framework 2004-2006 on regional output and employment (model with elasticities for groups of regions).

Model	**Groups of regions, all sections**			**Groups of regions, market sections only**		
Voivodship	**Δ output**	**Δ employ -ment**	**Δ employ -ment (units)**	**Δ output**	**Δ employ -ment**	**Δ employ -ment (units)**
Lubelskie	1.48%	0.05%	177	2.27%	0.00%	0
Podkarpackie	1.47%	0.11%	431	2.22%	0.00%	0
Podlaskie	1.44%	0.06%	123	2.22%	0.00%	0
Warmińsko-mazurskie	1.54%	0.10%	259	2.33%	0.00%	0

Source: authors' calculations.

estimation for the groups of regions. The differences between the particular regions in this case are considerable. The voivodships from the group of middle income regions profit the most from the structural policy programmes. In all of these regions, output increase more than 4% and employment, more than 1%. On the other hand, regions with the highest per capita income barely experience any improvement in their economic performance.

Finally, there is one more crucial difference between the two simulations. The results of the first one (factor elasticities for all the regions together) imply a growth in employment in the entire country by merely 7728 persons of which 327 have found a job in the market sections.

Yet, according to the results of the second simulation (factor elasticities for each group of regions), employment rises by 31273 of which 27388 are employed in the market sections. Undoubtedly, the second outcome appears to be considerably more realistic, taking into account the magnitude of the structural interventions in Poland scheduled for the period 2004–2006.

In conclusion, we would like to reiterate that the results of these simulations may be valid for only a short period of time. As mentioned previously, the ongoing structural changes in the Polish economy have influenced our estimation outcomes. This leads us to conclude that the factor elasticities will change to some extent during the coming years. Nonetheless, we believe that the main conclusions drawn from our analysis are valid even for a longer period of time.

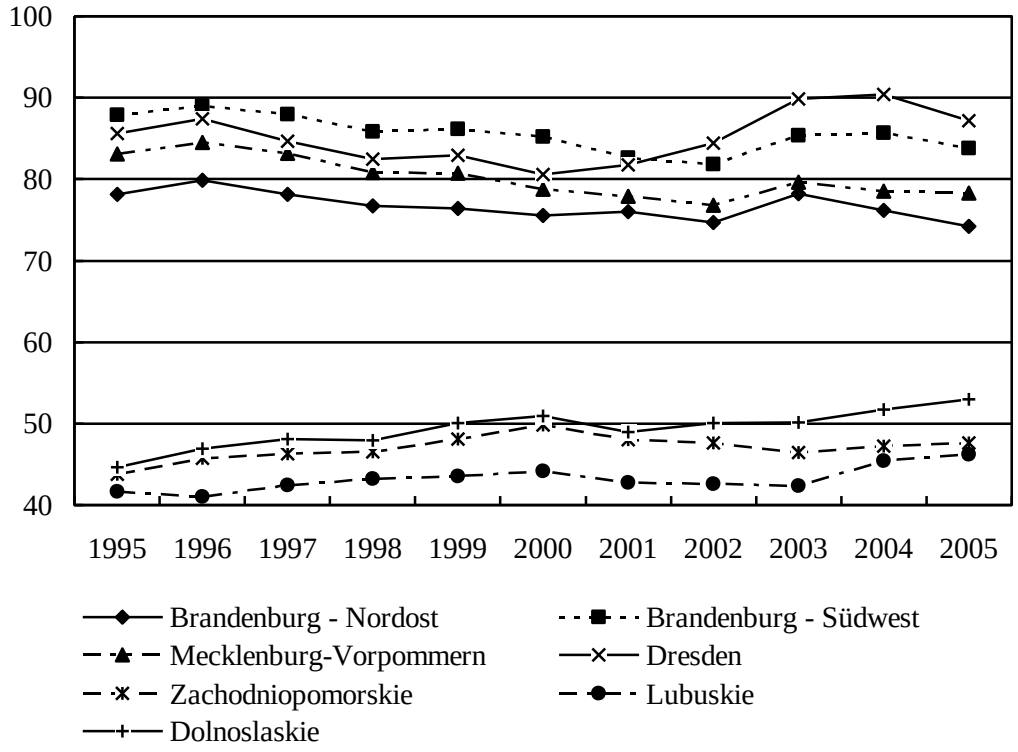
4. Conclusions and policy recommendations

Thus far, we have concentrated on the possible effects of economic integration and the impact of the EU Cohesion Policy on the Polish eastern border regions. However, we would also like to describe their potential implications on cross-border cooperation. Unfortunately, we do not have regional data for Byelorussia, Russia and Ukraine, and hence, we cannot directly compare the economic development of the Polish eastern border regions and their neighbours in the recent years. However, we believe that radical changes cannot be expected, at least on a macro scale.

In our opinion, the situation observed at the Polish western border before Poland's accession to the EU provides a good scenario of what will occur in the next few years at the eastern boundary. Figure 1 presents the evolution of the per capita income in the German eastern border regions and the Polish western border regions between 1995 and 2005. It is evident, from the figure, that there is a tendency to converge; however, the catching up process of the Polish regions is considerably slow. Moreover, the recent decrease in regional income disparities at both sides of the frontier, to a large degree, is due to the poor economic performance of Germany's New Länder rather than a rapid growth of the Polish regions.

We suppose that a regional income convergence process will also occur at the eastern Polish boundary within the next few years. However, the rate of progress and the reasons for the catching up process will be similar to those witnessed at the western border. On the one hand, we do not expect the Polish eastern border regions to grow faster than their western neighbours. In fact, it would not be surprising if their income level worsens in relative terms. Paradoxically, the structural policies may play an important role here by increasing the concentration of economic activity in the most developed areas of Poland. On the other hand, the western border regions of Byelorussia, Russia and Ukraine will probably improve their economic situation, mainly due to increased trans-border cooperation. Regardless, we reiterate that there are no reasons to expect important modifications in the spatial allocation of economic activity on both sides of the frontier.

Figure 1 Evolution of regional income between 1995 and 2005 (PPP per inhabitant, EU27=100)



Source: authors' calculations based on data taken from EUROSTAT database

There are several conclusions and policy recommendations that can be drawn from our study. Some of them may not appear to be considerably surprising, for example, foreign capital inflows will play an important role in the economic development of the eastern border regions. Thus, an investment in the business environment, in order to attract more FDI's, may accelerate regional economic growth[37]. Nonetheless, the eastern border regions have a comparative disadvantage here because they are on the economic periphery. This seriously limits their possibilities for attracting foreign investment.

Furthermore, we can argue that the strategy of encouraging investment in fixed assets is advisable. However, there is a significant and positive direct correlation between production and physical capital only in the private sector. At the same time, the economic impact of public sector investment appears to be negligible. Regardless, this production factor includes many different variables which were not identified in our study. Thus, we cannot affirm that it is

equally inefficient to finance telecommunication infrastructure, water-lines or sewerage infrastructure[38]. Moreover, our estimation results show a small but positive indirect influence of public investment on production through an increase in employment.

Perhaps the most interesting conclusions can be drawn from our analysis devoted to the road transport infrastructure. It appears that an investment in the road network as a whole and particularly in powiat roads boosts both national and regional growth rates. This is a noteworthy result, taking into account that most of the transport infrastructure programmes, co-financed by the EU, are dedicated to the construction and modernisation of roads. However, one important aspect that should not be overlooked is the apparent negative impact that it may have on the production and development of the national road network. According to this theory, an investment in the road network may principally affect less developed areas such as the eastern border regions. Therefore, in this case, we would advise that most of the structural funding be targeted at the local road network.

Finally, we find the results proving a positive correlation between production and human capital considerably encouraging. In line with our study, the positive influence of investment in education is easily the most noticeable in the eastern border regions. Unfortunately, our study only confirms the importance of overall education. Hence, we cannot state the other specific abilities that should be developed under the human capital development programmes. However, we are rather sceptical with regard to all the strategies based on crash courses and vocational training. The Polish experience is evidence to the fact that most of these programmes are poorly targeted and that they do not appreciably increase employment possibilities.

To sum up, we would like to underline that, in our opinion, the existing regional policy priorities should be reoriented to some extent. A major part of the EU financial assistance is due to be spent on projects which neither accelerate the growth rate of regional economies nor lead to an increase in employment. On the contrary, certain structural interventions may even worsen the economic performance of the eastern border regions. Nevertheless, any change in the guidelines of the EU Cohesion Policy programmes is highly unlikely since large transport and water management[39] infrastructure projects have greater political acceptance[40]. Furthermore, in many cases, the economic criterion is not the only one that is taken into account.

Notes

[1] This paper was prepared as a part of the project titled 'The Northern Dimension: Changing the European Economic Space by the Cross-border Regional Cooperation between Enlarged EU and Slavic Areas', sponsored by the Japanese Society for the Promotion of Science, Grant-Aid for Scientific Research Category B Project No. 16330052. The authors wish to thank Masahiro Taguchi and two anonymous referees for their helpful comments. The usual

disclaimers apply.

[2] Voivodship is an upper-level unit of the territorial division in Poland; it is equivalent to the NUTS2 level in the EU territorial statistics classification. The existing three-tier territorial division of the country consists of 16 voivodships, 379 powiats (middle level) and 2478 gminas (basic unit).

[3] Similar processes have been observed in Ukraine (e.g. Dubrovina, 2006) where the top five regions (in terms of per capita GDP) are placed in the Eastern part of the country, while the bottom five regions are situated in the West.

[4] See, for example, Baldwin and Forslid (2000b) or Rivera-Batiz and Romer (1991).

[5] For a survey on economic geography, see Baldwin et al. (2003), Fujita et al. (1999) or Fujita and Thisse (2002).

[6] Firms find it profitable to concentrate in one region owing to the existence of forward and backward linkages.

[7] The terms upstream industry and downstream industry distinguish between the different stages of industrial activity (there is also midstream industry). Upstream industry describes the extraction of natural resources and the manufacturing activity, while downstream industry refers basically to distribution.

[8] For numerical simulations, we understand the experiments by using theoretical models. See Fujita et al. (1999) for more details.

[9] The further we move away from the EU geographical centre (regardless of the direction), the lower are the regional wages and incomes. Of course, there are several exceptions in which the regions serve as national growth poles (e.g. Lisbon in Portugal, Athens in Greece, Warsaw in Poland or Helsinki in Finland).

[10] It is important to remember that income transfers are a part of the EU's Common Agricultural Policy, in the present financial perspective. Therefore, one should not omit the possible impact of direct payments while forecasting future trends in regional development.

[11] Similar conclusions can be drawn from Meyer and Lackenbauer (2005). They added dynamics to Martin's model and argued that there will be no trade-off if a two-step approach with respect to regional policy is adopted. The first step should comprise the reinforcement of growth in richer regions, while the second one should foster the creation of innovative companies in poorer regions.

[12] Greece, Ireland, Portugal and Spain.

[13] Surprisingly, an increase in the production and employment on the Mexican side of the border caused a similar reaction in the US border regions. Hence, the border regions of both countries may soon become a supranational production network for the entire North America (Lafourcade and Paluzie, 2005).

[14] However, some sectors of the industry have moved in the opposite direction because of the

increased competition from other EU member countries.

[15] In his study, de la Fuente (2002) assumed that the elasticities of the production factor do not differ among locations. Hence, the regional achievements of the EU Cohesion Policy programmes should differ only as a result of dissimilar allocation. We believe that this is too simple an assumption. Thus, we will indicate that when the regional production functions are assumed to be heterogeneous, the estimation results change considerably. Moreover, the results also differ when we regress different sections (or groups of them).

[16] Market sections include agriculture, manufacturing, construction, trade and repairs, hotels and restaurants, transport, storage and communications, financial intermediation and real estate, renting and business activities. We also tested the model with all sections; however, the results were as expected: production became less sensitive to the changes in all production factors.

[17] The main reason is that technological progress will exist mostly at the plant level. Furthermore, it is difficult to define the manner in which the influence of progress in one location can be measured vis-à-vis another. We allowed for spillovers decreasing with respect to distance (in the same way as in the case of road infrastructure, see below); however, it did not change the estimation results considerably.

[18] This supposition should be valid particularly in transition countries such as Poland where privatisation has clearly improved productivity.

[19] Gmina roads were also tested; however, we have not reported the results since they were not statistically significant.

[20] The distance between two locations is expressed relatively to the average distance of all regions from the capital (Warsaw).

[21] Apart from the obvious restrictions.

[22] The development of powiat roads (which lower intra-regional trade costs) has the exact opposite effect.

[23] Particularly when compared to other parts of Poland.

[24] This is the only section where the amount of output may be strongly influenced by weather, disease or other non-productive factors.

[25] Estimation for manufacturing is the only specification where the labour coefficient is positive and statistically significant without any lags.

[26] This also applies to the simulation by de la Fuente (2002).

[27] This group probably displays the highest level of diversity.

[28] This applies only to the estimation for eight market sections. In the case of the entire economy, private capital stock becomes statistically insignificant (see Table A.7, Annex).

[29] SIMIK is a data transfer and monitoring system operated by the Ministry of Finance which acts as a financial intermediary between the European Commission and its final beneficiaries.

[30] Eligible expenditures is a notion referring to all expenditures incurred for the project which

meet the criteria set by the Managing Authority. Hence, they can slightly differ depending on the particular programme. On average, they constitute about half of the total cost.

[31] Own calculations based on the SIMIK database and the GDP data from the Central Statistical Office.

[32] The data on physical capital stock used for the estimation of production factor elasticities concerns its gross value. Hence, wear and tear is not taken into account.

[33] Expressed as a number of years of additional training per employed person.

[34] BAEL is a national labour force survey conducted quarterly by the Polish Statistical Office.

[35] The numbers vary according to the factor elasticities used in the simulation.

[36] See, for example, the works of Gawlikowska-Hueckel et al. (2003), Nowicki et al. (2003) and Bradley et al. (2006) for Poland and de la Fuente (2002) for Spain.

[37] Yet, an improvement in the business environment requires both investment in public infrastructures and important institutional changes.

[38] In particular, as previously mentioned, there are several studies claiming the positive impact of the telecommunication infrastructure on economic development.

[39] This includes sewerage systems, sewage treatment plants and water-line systems.

[40] Moreover, the Cohesion Fund legislation directly imposes the necessity to spend its financial means on the transport and environmental infrastructures.

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Statistical annex

Table A.1 Share of neighbouring countries in voivodships' exports and imports, 2003, in percent

Voivodship	Belarus		Czech Republic		Lithuania		Germany		Russia		Slovakia		Ukraine	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Dolnośląskie	0.18	0.05	7.02	8.09	1.08	0.14	87.0	87.72	0.79	0.72	2.44	2.74	1.49	0.54
Kujawsko-Pomorskie	1.95	1.08	3.34	9.46	6.97	1.15	69.39	74.50	10.55	4.88	1.53	4.28	6.27	4.66
Lubelskie	6.54	3.00	7.06	8.41	4.06	2.39	45.64	53.74	5.01	13.53	2.83	3.62	28.87	15.31
Lubuskie	1.18	1.07	3.80	8.13	2.79	0.79	84.95	82.99	2.35	4.05	1.99	2.16	2.94	0.82
Łódzkie	2.51	1.22	6.24	11.18	10.24	1.26	57.97	76.37	10.59	1.80	3.50	2.27	8.95	5.91
Małopolskie	0.58	0.46	10.84	10.68	5.59	0.60	56.47	54.42	9.36	10.15	9.74	18.30	7.41	5.38
Mazowieckie	3.51	2.52	15.66	5.52	9.87	0.71	39.89	50.05	15.12	36.98	4.80	2.38	11.14	1.84
unknown	5.17	0.24	12.03	3.66	37.54	0.09	27.17	94.46	5.04	0.74	4.00	0.69	9.05	0.12
Opolskie	0.22	0.07	12.32	7.80	2.40	0.25	78.24	82.51	1.88	2.12	1.85	3.28	3.08	3.98
Podkarpackie	1.16	1.51	5.81	11.12	2.55	0.34	58.07	61.88	3.63	5.45	5.86	13.85	22.92	5.86
Podlaskie	12.09	15.42	1.50	3.21	30.93	15.99	41.14	25.98	8.92	28.87	0.80	4.51	4.63	6.01
Pomorskie	0.75	0.36	4.38	6.15	6.15	1.70	73.73	35.40	9.69	54.52	1.40	1.29	3.89	0.58
Śląskie	0.59	0.24	15.13	14.97	2.72	0.14	71.02	64.41	1.92	5.07	5.21	6.55	3.41	8.62
Świętokrzyskie	1.87	1.96	8.58	14.00	9.17	0.45	56.61	71.85	5.37	2.21	3.70	4.02	14.69	5.51
Warmińsko-Mazurskie	1.76	3.65	3.65	7.25	5.62	5.32	78.50	63.51	7.46	11.40	1.61	5.19	1.40	3.67

Source: authors calculations based on Central Statistical Office data

Table A.2 Results of regressions for all regions and all sections

Specification	All roads		National roads		Voivodship roads		Powiat roads	
Dependent variable	production	employment	production	employment	production	employment	production	employment
employment	0.119***	-	0.128***	-	0.134***	-	0.134***	-
	(4.197)		(4.506)		(4.717)		(4.747)	
foreign capital	0.024*	0.012	0.017	0.007	0.025*	0.012	0.030**	0.014
	(1.753)	(1.157)	(1.187)	(0.658)	(1.769)	(1.162)	(2.125)	(1.303)
human capital	0.132**	-0.056	0.198***	-0.037	0.205***	-0.053	0.142**	-0.042
	(2.253)	(-1.262)	(3.413)	(-0.849)	(3.552)	(-1.225)	(2.454)	(-0.956)
fixed assets (public sector)	-0.002	0.038***	-0.003	0.037***	-0.004	0.037***	0.001	0.038***
	(-0.129)	(4.262)	(-0.226)	(4.167)	(-0.264)	(4.155)	(0.069)	(4.324)
fixed assets (private sector)	0.028***	0.005	0.026***	0.003	0.028***	0.004	0.027***	0.004
	(3.705)	(0.860)	(3.471)	(0.612)	(3.658)	(0.839)	(3.557)	(0.825)
road network	1.220***	0.230	-0.812***	-0.936***	-0.747**	-0.362	0.547***	0.221***
	(4.063)	(1.079)	(-2.601)	(-4.802)	(-2.264)	(-1.579)	(4.748)	(2.666)
wages	-	-0.260***	-	-0.228***	-	-0.240***	-	-0.240***
		(-8.026)		(-7.209)		(-6.800)		(-7.176)
log wages	-	-0.151***	-	-0.140***	-	-0.149***	-	-0.150***
		(-9.788)		(-9.065)		(-9.499)		(-9.724)
log employment	-	-0.083***	-	-0.085***	-	-0.083***	-	-0.083***
		(-9.854)		(-10.150)		(-9.877)		(-9.864)
log production	-	0.101***	-	0.103***	-	0.102***	-	0.103***
		(11.050)		(11.301)		(11.192)		(11.340)
Observations	1716	1716	1716	1716	1716	1716	1716	1716

Note: .01 - ***; .05 - **; .1 - *; t-statistics in parenthesis. R^2 not reported as it has no explanatory value in 3sls estimation.
The table contains the estimation results of four different specifications (all roads, national roads, voivodship roads and poviat roads). First column of each specification provides estimation results for production equation while the second the results for employment equation.

Table A.3 Results of regressions for all regions and market sections only

Specification	All roads		National roads		Voivodship roads		Powiat roads	
Dependent variable	production	employment	production	employment	production	employment	production	employment
employment	0.136***	-	0.145***	-	0.153***	-	0.158***	-
	(3.923)		(4.193)		(4.420)		(4.579)	
foreign capital	0.031*	-0.002	0.024	-0.007	0.029*	-0.003	0.035**	-0.002
	(1.828)	(-0.163)	(1.410)	(-0.557)	(1.661)	(-0.198)	(2.033)	(-0.171)
human capital	0.208***	-0.045	0.296***	-0.021	0.314***	-0.047	0.245***	-0.019
	(2.690)	(-0.739)	(3.859)	(-0.357)	(4.119)	(-0.794)	(3.200)	(-0.317)
fixed assets (public sector)	-0.016	0.027***	-0.020	0.026***	-0.020	0.026***	-0.016	0.028***
	(-1.155)	(2.890)	(-1.457)	(2.811)	(-1.464)	(2.779)	(-1.188)	(2.979)
fixed assets (private sector)	0.090***	0.010	0.089***	0.008	0.090***	0.010	0.089***	0.009
	(5.328)	(0.792)	(5.222)	(0.658)	(5.289)	(0.779)	(5.279)	(0.752)
road network	1.758***	0.290	-0.222	-1.041***	-0.614	-0.336	0.555***	0.295***
	(4.805)	(1.070)	(-0.598)	(-4.244)	(-1.579)	(-1.156)	(4.081)	(2.782)
wages	-	-0.347***	-	-0.314***	-	-0.327***	-	-0.314***
		(-8.394)		(-7.747)		(-7.193)		(-7.262)
log wages	-	-0.247***	-	-0.231***	-	-0.243***	-	-0.250***
		(-11.699)		(-10.879)		(-11.377)		(-11.844)
log employment	-	-0.113***	-	-0.115***	-	-0.112***	-	-0.115***
		(-9.807)		(-10.122)		(-9.849)		(-10.026)
log production	-	0.106***	-	0.106***	-	0.106***	-	0.109***
		(8.791)		(8.858)		(8.829)		(9.013)
Observations	1152	1152	1152	1152	1152	1152	1152	1152

Note: .01 - ***; .05 - **; .1 - *; t-statistics in parenthesis. R^2 not reported as it has no explanatory value in 3sls estimation.

Table A.4 Results of regressions for agriculture

Specification	All roads		National roads		Voivodship roads		Powiat roads	
Dependent variable	production	employment	production	employment	production	employment	production	employment
employment	-0.183		-0.040		0.128		0.015	
	(-1.058)		(-0.314)		(0.841)		(0.104)	
foreign capital	-0.055	-0.009	-0.053	-0.015	-0.053	-0.013	-0.058	-0.009
	(-0.965)	(-0.311)	(-0.930)	(-0.523)	(-0.830)	(-0.454)	(-1.001)	(-0.321)
human capital	0.122	0.025	0.150	0.017	0.365	-0.014	0.230	0.092
	(0.467)	(0.208)	(0.620)	(0.149)	(1.418)	(-0.129)	(0.875)	(0.777)
fixed assets (public sector)	0.279**	0.220***	0.260*	0.224***	0.363**	0.226***	0.223*	0.207***
	(2.007)	(4.761)	(1.746)	(4.876)	(2.211)	(4.903)	(1.745)	(4.708)
fixed assets (private sector)	0.327	0.386***	0.347	0.386***	0.406	0.392***	0.187	0.387***
	(1.195)	(4.420)	(1.228)	(4.426)	(1.218)	(4.469)	(0.750)	(4.667)
road network	4.254***	1.094*	4.117***	-0.680	-1.146	1.002*	0.774	1.017***
	(2.761)	(1.910)	(3.419)	(-1.271)	(-0.765)	(1.712)	(1.615)	(4.382)
wages	-	0.079	-	0.127	-	-0.032	-	0.266***
		(0.881)		(1.508)		(-0.371)		(2.678)
log wages	-	-0.100*	-	-0.080	-	-0.081	-	-0.128***
		(-1.953)		(-1.601)		(-1.642)		(-2.590)
log employment	-	-0.156***	-	-0.140***	-	-0.141***	-	-0.188***
		(-3.848)		(-3.543)		(-3.472)		(-4.810)
log production	-	0.157***	-	0.143***	-	0.187***	-	0.140***
		(4.245)		(3.869)		(5.454)		(3.907)
Observations	144	144	144	144	144	144	144	144

Note: .01 - ***; .05 - **; .1 - *; t-statistics in parenthesis. R^2 not reported as it has no explanatory value in 3sls estimation. The results for production equation are not statistically significant.

Table A.5 Results of regressions for manufacturing[1)]

Specification	All roads		National roads		Voivodship roads		Powiat roads	
Dependent variable	production	employment	production	employment	production	employment	production	employment
employment	0.546***	-	0.562***	-	0.594***	-	0.553***	-
	(3.587)		(3.900)		(3.389)		(3.534)	
foreign capital	0.022	0.008	0.025	0.011	0.017	0.010	0.022	0.007
	(0.754)	(0.559)	(0.903)	(0.803)	(0.591)	(0.742)	(0.749)	(0.541)
human capital	0.149	0.030	0.132	-0.003	0.178	0.005	0.177	0.037
	(1.112)	(0.473)	(1.068)	(-0.049)	(1.336)	(0.073)	(1.326)	(0.579)
fixed assets (public sector)	-0.014	0.002	-0.003	0.010	-0.016	0.007	-0.014	-0.003
	(-0.386)	(0.127)	(-0.077)	(0.575)	(-0.435)	(0.422)	(-0.380)	(-0.199)
fixed assets (private sector)	0.011	0.113***	0.070	0.122***	0.014	0.119***	0.009	0.102***
	(0.215)	(4.340)	(1.387)	(4.556)	(0.267)	(4.477)	(0.169)	(3.877)
road network	0.765	0.776***	2.478***	0.297	0.566	0.218	0.118	0.360***
	(1.305)	(2.630)	(4.470)	(1.105)	(0.835)	(0.682)	(0.511)	(2.784)
wages	-	-0.309***	-	-0.367***	-	-0.370***	-	-0.277***
		(-6.174)		(-7.277)		(-6.570)		(-5.113)
log wages	-	-0.348***	-	-0.325***	-	-0.330***	-	-0.370***
		(-8.073)		(-7.565)		(-7.501)		(-8.187)
log employment	-	-0.434***	-	-0.391***	-	-0.404***	-	-0.447***
		(-11.721)		(-10.800)		(-11.131)		(-11.567)
log production	-	0.157***	-	0.167***	-	0.163***	-	0.171***
		(4.894)		(5.097)		(4.981)		(5.334)
Observations	144	144	144	144	144	144	144	144

Note: 1) In regression for manufacturing labour is statistically significant without any lag.
.01 - ***; .05 - **; .1 - *; t-statistics in parenthesis. R^2 not reported as it has no explanatory value in 3sls estimation.

Table A.6 Results of regressions for 5 eastern regions (market sections)

Specification	All roads		National roads		Voivodship roads		Powiat roads	
Dependent variable	production	employment	production	employment	production	employment	production	employment
employment	0.115**	-	0.151***	-	0.148***	-	0.142***	-
	(2.187)		(2.821)		(2.780)		(2.751)	
foreign capital	0.040*	0.019	0.027	0.006	0.042*	0.020	0.038*	0.011
	(1.837)	(0.939)	(1.163)	(0.271)	(1.854)	(0.984)	(1.741)	(0.559)
human capital	0.281**	-0.002	0.373***	-0.108	0.377***	-0.095	0.286**	0.043
	(2.436)	(-0.019)	(3.312)	(-1.013)	(3.318)	(-0.855)	(2.509)	(0.372)
fixed assets (public sector)	-0.021	0.030	-0.028	0.026	-0.031	0.024	-0.022	0.031*
	(-0.916)	(1.634)	(-1.257)	(1.467)	(-1.361)	(1.342)	(-1.001)	(1.716)
fixed assets (private sector)	0.066**	0.008	0.060**	0.009	0.061**	0.008	0.065**	0.008
	(2.341)	(0.361)	(2.115)	(0.384)	(2.118)	(0.334)	(2.341)	(0.340)
road network	1.593***	0.870	-1.633**	-1.899***	-1.106	-0.784	0.650***	0.602***
	(2.807)	(1.565)	(-2.200)	(-3.411)	(-1.443)	(-1.228)	(3.245)	(3.132)
wages	-	-0.303***	-	-0.278***	-	-0.280***	-	-0.259***
		(-3.856)		(-3.603)		(-3.297)		(-3.228)
log wages	-	-0.339***	-	-0.326***	-	-0.331***	-	-0.353***
		(-7.750)		(-7.569)		(-7.541)		(-8.067)
log employment	-	-0.193***	-	-0.192***	-	-0.186***	-	-0.198***
		(-7.505)		(-7.607)		(-7.294)		(-7.741)
log production	-	0.152***	-	0.154***	-	0.152***	-	0.156***
		(5.553)		(5.724)		(5.599)		(5.696)
Observations	360	360	360	360	360	360	360	360

Note: .01 - ***; .05 - **; .1 - *; t-statistics in parenthesis. R^2 not reported as it has no explanatory value in 3sls estimation.

Table A.7 Results of regressions for 5 eastern regions (all sections)

Specification	All roads		National roads		Voivodship roads		Powiat roads	
Dependent variable	production	employment	production	employment	production	employment	production	employment
employment	0.120***	-	0.144***	-	0.141***	-	0.137***	-
	(2.737)		(3.252)		(3.190)		(3.184)	
foreign capital	0.043**	0.030*	0.031*	0.019	0.044**	0.030*	0.041**	0.025
	(2.411)	(1.926)	(1.691)	(1.207)	(2.465)	(1.956)	(2.327)	(1.599)
human capital	0.202**	-0.083	0.257***	-0.138*	0.257***	-0.130	0.199**	-0.052
	(2.314)	(-0.936)	(3.010)	(-1.776)	(2.980)	(-1.620)	(2.306)	(-0.633)
fixed assets (public sector)	-0.001	0.051***	-0.007	0.048***	-0.008	0.047***	-0.001	0.051***
	(-0.023)	(3.108)	(-0.295)	(2.950)	(-0.344)	(2.882)	(-0.022)	(3.166)
fixed assets (private sector)	0.026	0.004	0.025	0.004	0.026	0.004	0.026	0.004
	(1.596)	(0.343)	(1.520)	(0.326)	(1.553)	(0.323)	(1.612)	(0.319)
road network	1.062**	0.597	-1.422**	-1.421***	-0.715	-0.543	0.512***	0.425***
	(2.294)	(1.433)	(-2.419)	(-3.306)	(-1.179)	(-1.122)	(3.090)	(2.935)
wages	-	-0.226***	-	-0.213***	-	-0.216***	-	-0.199***
		(-3.902)		(-3.710)		(-3.440)		(-3.369)
log wages	-	-0.231***	-	-0.224***	-	-0.229***	-	-0.237***
		(-7.240)		(-7.122)		(-7.166)		(-7.405)
log employment	-	-0.157***	-	-0.157***	-	-0.154***	-	-0.159***
		(-7.817)		(-7.873)		(-7.687)		(-7.909)
log production	-	0.156***	-	0.155***	-	0.153***	-	0.158***
		(7.462)		(7.438)		(7.347)		(7.556)
Observations	538	538	538	538	538	538	538	538

Note: .01 - ***; .05 - **; .1 - *; t-statistics in parenthesis. R^2 not reported as it has no explanatory value in 3sls estimation.

Table A.8 Results of regressions for 5 rich regions (market sections)

Specification	All roads		National roads		Voivodship roads		Powiat roads	
Dependent variable	production	employment	production	employment	production	employment	production	employment
employment	0.207***	-	0.207***	-	0.209***	-	0.207***	-
	(2.881)		(2.883)		(2.909)		(2.896)	
foreign capital	0.006	-0.002	0.007	0.002	0.008	0.000	-0.004	-0.007
	(0.156)	(-0.057)	(0.167)	(0.060)	(0.185)	(0.013)	(-0.086)	(-0.222)
human capital	0.289*	-0.086	0.263	-0.060	0.301*	-0.108	0.297*	-0.113
	(1.847)	(-0.819)	(1.534)	(-0.552)	(1.937)	(-0.997)	(1.926)	(-1.055)
fixed assets (public sector)	0.016	0.030*	0.016	0.030*	0.016	0.030*	0.014	0.029*
	(0.659)	(1.852)	(0.644)	(1.886)	(0.646)	(1.888)	(0.581)	(1.824)
fixed assets (private sector)	0.129***	0.095***	0.130***	0.094***	0.128***	0.094***	0.127***	0.098***
	(3.576)	(4.451)	(3.558)	(4.388)	(3.496)	(4.392)	(3.561)	(4.558)
road network	-0.109	-0.628	0.187	-0.164	0.072	0.456	-0.230	-0.346**
	(-0.180)	(-1.526)	(0.328)	(-0.460)	(0.134)	(1.138)	(-0.982)	(-1.981)
wages	-	-0.350***	-	-0.320***	-	-0.362***	-	-0.375***
		(-5.168)		(-4.785)		(-4.947)		(-5.272)
log wages	-	-0.129***	-	-0.126***	-	-0.132***	-	-0.127***
		(-4.262)		(-4.111)		(-4.318)		(-4.197)
log employment	-	-0.079***	-	-0.082***	-	-0.081***	-	-0.079***
		(-4.202)		(-4.334)		(-4.273)		(-4.162)
log production	-	0.072***	-	0.074***	-	0.072***	-	0.070***
		(3.678)		(3.793)		(3.654)		(3.572)
Observations	360	360	360	360	360	360	360	360

Note: .01 - ***; .05 - **; .1 - *; t-statistics in parenthesis. R^2 not reported as it has no explanatory value in 3sls estimation