A C T A U N I V E R S I T A T I S L O D Z I E N S I S
FOLIA OECONOMICA 5 (307), 2014

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REGIONAL GROWTH DETERMINANTS IN UKRAINE: PANEL DATA ESTIMATES

1. INTRODUCTION

A variety of macroeconomic, structural and institutional factors are among those identified as determinants of regional growth. Following the theoretical guidelines of neoclassical models the majority of regional growth studies deal with the convergence problem. If growth rates converge to the same value over time, it means that there should be a negative link between the regional growth rate and the initial level of income. Evidence for this kind of relationship is provided for either industrial (Crespo Cuaresma et al. 2009: 22-37; Gennaioli et al. 2013), or developing countries (Cravo, Resende 2013: 555-575; Wu 2002: 271-285; Yildirim 2005: 1-10). For transforming economies, regional convergence has been found for the regions of the Czech Republic, Poland and Hungary (Herz, Fogel 2003), Russia (Ledyaeva, Linden 2008: 87-105). As far as we know, this is the first econometric study of regional growth determinants in Ukraine. Our aim is to study several possible sources of regional growth such as investments in physical capital, population growth, foreign trade indicators, inflation etc., with the convergence problem being tested in this setting as well.

Direct effects of capital and labour inputs on regional growth are estimated while controlling for macroeconomic and institutional indicators, as well as for such factors as infrastructure spillovers, geography and worker mobility across regions and sectors (Alfano, Baraldi 2008; Camagni, Capello 2013: 1383-1402; Crespo Cuaresma et al. 2009: 22-37; Dawkins 2003: 131-172; Ledyaeva, Linden 2008: 89-90). Besides the choices of appropriate explanatory variables, extra difficulties are brought about by using different panel data estimators. Although the pooled Ordinary Least Squares (OLS) and fixed effects (FE) estimators are still used by researchers in regional growth studies, for

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example in Ledyaeva and Linden (2008: 89-90), the general method of moments (GMM) estimator is a more appropriate tool for the dynamic panel data setting.

The purpose of this paper is to investigate the determinants of regional economic growth in Ukraine. Our extra interest is in comparing the results obtained for high-income and low-income regions, with a focus upon the convergence issue along the lines of neoclassical theory. The main conclusion is that conditional convergence is much stronger among high-income regions, but this process is rather slow.

The remainder of the paper proceeds as follows. Section 2 presents a brief survey of determinants of regional growth. Section 3 discusses data and the statistical model. Empirical results are analysed at length in Section 4. Finally, Section 5 concludes the paper.

2. DETERMINANTS OF REGIONAL GROWTH

Following the familiar guidelines of neoclassical theory, for example the Mankiw-Romer-Weil (MRW) model (Mankiw, Weil, Romer 1992: 407-437), the regional production function can be approximated by the empirical relationship as follows (Ledyaeva, Linden 2008: 87-105):

$$\Delta \ln y_{it} = \alpha_1 \ln y_{i,t-1} + \alpha_2 \ln k_{it} + \alpha_3 \ln l_{it} + \beta \ln \mathbf{x}_{it}, \quad (1)$$

where: y_{it} is the per capita gross regional product (GRP), $y_{i,t-1}$ is the (initial) lagged per capita GRP, k_{it} is the stock of capital per capita, l_{it} is the labour force and $\mathbf{x}_{it}$ is the vector of exogenous variables in region i during period t.

Among these variables, macroeconomic indicators (inflation, trade-openness, government expenditure, capital flows), structural and employment features (sectorial shares in output, unemployment and activity rates, labour mobility, self-employment rate), socio-geographical characteristics (settlement structure, population density, capital city regions), infrastructure (firm access to websites and telecommunications, access to sea, roads, air and road transport) and institutional quality indices have been used in various empirical studies (Alfano, Baraldi 2008; Crespo Cuaresma et al. 2009: 22-37; Ledyaeva, Linden 2008: 89-90).

Assuming the convergence process of growth rates over time, parameter α_1 is expected to be negative. Within the growth framework, it is customary to associate a higher level of initial per capita GRP with the stock of either human capital or physical capital per capita (Ledyaeva, Linden 2008: 89-90).

Parameters α_2 and α_3 reflect the positive contribution of capital and labour to regional growth. Sometimes the determinants of growth are lagged by one year in order to take into account the time it takes for investment to capitalise into growth (D'Costa et al. 2013).

As mentioned by Camagni and Capello (2013: 1383-1402), traditional local supply conditions such as capital and labour or local resources should be extended to include infrastructure endowment. In a wider context, endogenous development literature recognises numerous regional growth factors ranging from intangible, atmosphere-type, local synergies to governance factors and, more recently, social capital, relational capital and knowledge assets. Under the umbrella of territorial capital, the set of localised assets – natural, human, artificial, organisational, relational and cognitive ones – were analysed to explain regional growth. For the 269 NUTS-2 regions of EU27, it has been obtained that areas in Eastern Europe most benefit from transport infrastructure and creativity, while the effects of entrepreneurship and R&D activities are rather limited.

Earlier criticisms of the neoclassical exogenous growth and trade theories such as convergence not through trade or factor mobility, but rather through diminishing returns to capital investment, zero interregional factor mobility, differences in production technologies and/or savings rates across regions, the assumption that all regions will eventually reach a constant per capita income, consumption, and capital/labour ratio values are addressed by "*endogenous growth theory*" and the "*new economic geography*" (Dawkins 2003: 131-172). Variants of the former assume the endogeneity of savings rates, technological change and innovation, as well as the positive infrastructure spillovers and effects of tax-financed public services. The latter is based on economies of scale, transportation costs and skills requirements. Regional growth depends on geographic factors such as climate and topography as well. Recent models of the new economic geography incorporate worker mobility across regions and sectors, land costs or the endogeneity of different industrial structures.

Most of the empirical studies are in support of income convergence among European regions between and within countries. As found by Crespo Cuaresma et al. (2009: 22-37) for a dataset of 244 European regions between 1995 and 2005, income convergence between countries is dominated by the catching-up of regions in the CEE countries, whereas convergence within countries is driven by regions in the old EU member states. Capital city regions are growing faster, as are regions with higher (tertiary) education, reflecting the advantages of urban agglomeration and human capital accumulation. In the presence of risky regional business costs, the agglomeration of capital regions may occur despite regional policies focusing on the dispersion of capital across regions (Broll et al. 2013: 645-657). Nevertheless, regional convergence has been found for risky countries such as Brazil (Cravo, Resende 2013: 555-575) and Russia (Ledyaeva, Linden

2008: 87-105). Among other countries, conditional convergence has been found for a sample of 31 Czech, Polish, and Hungarian regions between 1990–2002 (Herz. Fogel 2003), China (Wu 2002: 271-285) and Turkey (Yildirim 2005: 1-10). Recently, Gennaioli et al. (2013) have presented results that regional growth is influenced by similar factors to national growth, such as geography and human capital. Based on a sample of 1 503 regions from 82 countries, it was found that regional convergence is faster in richer countries, as well as in countries with better capital markets.

Another study for 249 EU NUTS-2 regions during the period 1990–2003 by Petrakos et al. (2007) confirms that regional growth is stimulated by the accumulation of human capital (higher shares of population with tertiary education), as well as by transport infrastructure (though only above a critical threshold), public and private investment, and a smaller public sector. A non-linear impact was found for growth determinants such as economic structure, regional economic integration and agglomeration effects. As established by Brülhart and Sbergami (2009: 48-63), agglomeration boosts GDP growth only up to a certain level of economic development, being useful mainly for the poorest countries.

Results are quite similar for transforming and developing countries. Herz and Fogel (2003) maintain that structural variables like the labour participation rate and the economy's sectorial differences are significant in explaining regional growth in the CEE countries. Wu (2002: 271-285) finds that regional growth in China is positively affected by investments in physical capital, infrastructure, labour productivity, human capital and foreign investment, as well as by economic reform policies and openness. This corresponds with the results for transitioning economies that countries with sound macroeconomic policies, financial development, high foreign direct investment and comprehensive structural adjustment tend to have better economic performances (Workie 2005: 239-251). As technological change produces stronger growth effects in rich regions than poor ones, it more than offsets the convergence results from capital deepening in China and India (Badunenko, Tochkov 2010: 539-570). However, capital deepening does not contribute to regional growth in Russia, leaving technological change as the only source of regional growth.

For Russia, Ledyaeva and Linden (2008: 89-90) maintain that the export of goods and services is likely to stimulate regional growth, but this result is sensitive to the choice of estimator. On the other hand, regional export activities in Russia benefit from agglomeration effects, and even the smallest exporters have gained from informational and/or shipping cost spillovers (Cassey, Schmeiser 2013: 495-513). The positive impact of exports and the capital stock on regional growth has recently also been found for China (Dreger, Zhang 2013).

3. DATA AND STATISTICAL MODEL

The dataset is a balanced panel with 26 Ukrainian regions for the period 2002–2012. Data on output per capita, labour, and capital for each region were compiled from official databases (www.ukrstat.gov.ua). Summary statistics of the regional product per capita and other variables are reported in Table 1.

Table 1. Summary statistics for the selected variables

Region	*Y*	Δ*K*	*L*	*LSTR*	*SERVICE*	*GOODS*
High-income regions						
Dnipropetrovsk	9 875	3 664	3 893	17	500	13 844
Donetsk	9 413	3 774	4 580	10	577	15 544
Poltava	8 527	4 540	1 539	40	141	8 502
Zaporizhya	8 024	2 848	1 847	24	561	10 924
Kyiv	7 640	6 052	1 755	36	807	3 565
Kharkiv	7 368	3 346	2 812	20	395	2 563
Odesa	7 148	3 665	2 408	34	2 610	3 568
Luhansk	6 333	2 578	2 383	14	264	8 974
Mykolayiv	6 240	2 826	1 212	33	788	6 836
Kyiv Metropolitan Area	23 190	11 851	2 722	—	5 158	14 838
Low-income regions						
Lviv	5 783	2 930	2 571	40	266	2 124
Ivano-Frankivsk	5 718	2 593	1 388	57	169	3 179
Cherkasy	5 353	2 369	1 328	45	52	2 993
Crimea	5 205	3 848	1 983	37	697	1 557
Sumy	5 132	1 909	1 212	34	204	3 681
Kirovohrad	5 130	2 463	1 054	39	85	1 817
Chernihiv	5 069	1 846	1 152	39	28	1 846
Volyn	5 013	2 075	1 042	49	131	2 354
Vinnytsya	4 784	1 987	1 688	52	102	1 809
Rivne	4 747	2 116	1 158	53	277	1 845
Zakarpatya	4 660	1 742	1 248	64	211	4 657
Khmelnytsk	4 599	2 139	1 364	47	83	1 309
Zhytomyr	4 540	1 995	1 319	43	51	1 793
Kherson	4 484	1 838	1 118	39	250	1 631
Ternopil	4 117	1 569	1 105	57	40	772
Chernivtsi	3 899	2 071	909	59	30	782

Notes: *Y* is thse average regional output per capita in 2002 *hryvnas*, Δ*K* is the average investment per capita in 2002 *hryvnas*, *L* is the average total population number (in thousands), *LSTR* is the average share of rural population, *SERVICE* and *GOODS* is the average value of regional export of services and goods per capita in 2002 *hryvnas*.

Source: own calculations.

All Ukrainian regions are divided into two sub-samples on the basis of average GRP per capita in the period 2002–2012. With respect to either output or investment per capita, the leading region is unambiguously the Kyiv Metropolitan Area. The high-income regions, mostly eastern and southern ones, are characterised with higher investment per capita, a low share of the rural population and a much stronger export orientation. However, it should not be taken for granted that higher capital accumulation or openness guarantee stronger regional growth, as it could reflect inefficient investment activities in natural resource-based regional economies. On the other hand, it cannot be ruled out that less developed regions may be able to take advantage of their backwardness, especially due to the development of agriculture and the food-processing industry, or efficient investment in modern production facilities. The actual direction and magnitude of the output effects for several potential determinants should be captured by the growth regressions.

Our model is as follows:

$$\begin{aligned}\Delta \ln y_{it} = {} & \alpha_1 \ln y_{i,t-1} + \alpha_2 \Delta \ln k_{it} + \alpha_3 \Delta \ln L_{it} + \beta_1 LSTR_{it} + \\ & \beta_2 \ln service_{it} + \beta_3 \ln goods_{it} + \beta_4 \Delta \ln P_{it} + \beta_5 D2009 + \nu_i + \tau_t + \varepsilon_{it}\end{aligned}, \quad (2)$$

where: k_{it} is the regional stock of physical capital per capita, L_t is the total population number, $LSTR_{it}$ is the share of rural population in total population (in per cent), $service_{it}$ is export of services per capita (in *hryvnas*), $goods_{it}$ is export of goods per capita (in *hryvnas*), P_{it} is the regional consumer price level, $D2009$ is a dummy variable with the value 1 for the 2009 world financial crisis and 0 otherwise, ν_i is a region-specific effect, τ_t is a period-specific effect common to all regions and ε_{it} is the error term.

Similarly to other studies (see: Ledyaeva, Linden 2008: 87-105), investment per capita and the change of labour force are used as explanatory variables for the regional growth rate, while the lagged stock effects are assumed to operate through the lagged output per capita variable. The share of rural population, $LSTR_{it}$, captures the effect of urbanisation on regional growth. It is likely that urbanised regions with a lower share of the rural population have better preconditions for economic growth.

The net exports of goods and services per capita, $goods_{it}$ and $service_{it}$, are included in order to analyse the benefits of the openness of the regional economy in general and export-led growth in particular. Controlling for several geographic characteristics, Frankel and Romer (1999: 379-399) have stated that foreign trade has a large and robust, though only moderately statistically significant, positive effect on income.

4. EMPIRICAL RESULTS

Equation 2 is estimated by a GMM (Arellano-Bond) dynamic panel estimator to better take endogeneity and outliers into account. The Arellano-Bond estimator is preferred if time-invariant regional characteristics (fixed effects) are correlated with the explanatory variables or it is necessary to better control for the endogeneity of all the explanatory variables. The Arellano-Bond procedure with two dependent variable lags has been used. Similar to other studies (Ledyaeva, Linden 2008: 87-105), two-step estimates were used as they are more efficient. In our GMM instrumental estimations, a sensitivity analysis was carried out to check the robustness of the results to different specifications of price and open economy effects. Regarding estimates for the full sample of 26 regions (Table 2), both the Sargan test on the validity of the instruments used and the Arellano-Bond test of second order autocorrelation indicate that the estimator is consistent for the baseline specification, including price variables.

Table 2. Determinants of regional product per capita growth

Variable	All regions	
	I	II
Constant	1.560 (4.27*)	0.530 (2.76*)
ln $y_{i,t-1}$	-0.221 (-4.04*)	-0.055 (-2.36**)
Δln k_{it}	0.063 (4.09*)	0.018 (1.92***)
Δln L_t	3.086 (2.03**)	1.665 (1.01)
$LSTR_{it}$	-0.239 (-3.75*)	-0.071 (-1.50)
ln $service_{it}$	-0.007 (-3.60*)	---
ln $goods_{it}$	0.019 (3.03*)	---
Δln P_{it}	-0.406 (-8.56*)	---
Δln RER_{it}	---	0.547 (7.05*)
D2009	-0.219 (-23.78*)	-0.452 (-14.71*)
Year dummies	Yes	Yes
Observations	174	174
Arellano-Bond Test (p-level)	0.33	0.99
Sargan test (p-level)	0.99	0.98

Notes: *t*-statistics in parenthesis: *, **, *** significant at the 1, 5 and 10 per cent levels respectively.

Source: own calculations.

As presented in Table 2, our regression results imply that the regional output growth is negatively related to the lagged output per capita (this relationship is significant at no less than a 5 per cent level of confidence), suggesting conditional convergence among the Ukrainian regions over the past

decade. The calculated parameter estimate of α_1 is much higher in Specification I with the full set of explanatory variables. The value of α_1 is rather small in Specification II with the relative prices (export variables are not included in this specification due to the implied correlation with the real exchange rate).

As expected, the parameter estimates of α_2 and α_3 respectively confirm positive growth effect of investments in physical capital and population growth. However, the magnitude and statistical significance of both coefficients are considerably lower in Specification II with the relative prices. A higher share of the rural population is likely to inhibit regional growth, as $\beta_1 < 0$ in both specifications, but this result becomes statistically insignificant when controlling for the relative prices.

Our estimates of parameter β_2 reveal an inverse relationship between export of services and regional growth. On the contrary, export of goods contributes to regional growth, as the estimate of parameter β_3 is positive and statistically significant at the 1 per cent level. Though the sign of β_3 is what to be expected, it is not so easy to explain a negative sign of β_2. It is possible to speculate that export of services reflects misallocation of resources or unfavourable external effects.

As expected, inflation is restrictionary, with a 1 per cent in the consumer price growth leading to a 0.47 per cent decrease in regional per capita growth. Using the real exchange rate instead of inflation, an improvement in relative prices becomes expansionary. In both cases, the estimate of parameter β_4 is statistically significant at the 1 per cent level. A highly significant impact of the 2009 financial crisis was found, with the regional growth rate declining by about one-fifth to one-half of one per cent.

In order to compare growth determinants between low- and high-income regions, as classified in Table 1, statistical model 2 has been re-estimated separately for the subsamples of both groups of Ukrainian regions. The results for alternative specifications of price effects are presented in Table 3. Because of the short sample length in both panels, the results should be interpreted with caution. For all specifications, there is no second order autocorrelation in the first difference errors. The Sargan statistics does not indicate correlation of instruments with residuals for three out of the four specifications, but the results are somewhat weaker if compared with the full sample of 26 regions (Table 2).

Table 3. Determinants of regional product per capita growth: regional differences

Variable	Low-income regions		High-income regions	
	III	IV	V	VI
Constant	0.378 (2.91*)	0.399 (2.73*)	0.699 (3.39*)	0.286 (2.07**)
ln $y_{i,t-1}$	-0.039 (-1.90***)	-0.032 (-1.93***)	-0.142 (-4.79*)	-0.070 (-3.46*)
Δln k_{it}	0.015 (1.43)	0.003 (0.23)	0.081 (4.63*)	0.063 (3.95*)
Δln L_t	-0.689 (-1.60)	-0.986 (-1.67***)	1.697 (1.59)	-0.511 (-0.67)
$LSTR_{it}$	-0.004 (-0.17)	-0.019 (-0.69)	-0.111 (-3.86*)	-0.077 (-2.46**)
ln $service_{it}$	-0.001 (-0.25)	---	-0.006 (-2.70*)	---
ln $goods_{it}$	-0.001 (-0.08)	---	0.015 (2.16**)	---
Δln P_{it}	-0.370 (-4.99*)	---	-0.465 (-3.49*)	---
Δln RER_{it}	---	0.431 (3.56*)	---	0.641 (3.48*)
D2009	-0.238 (-22.07*)	-0.392 (-8.66*)	-0.242 (-13.61*)	-0.515 (-7.12*)
Year dummies	Yes	Yes	Yes	Yes
Observations	119	119	80	70
Arellano-Bond Test (p-level)	0.43	0.21	0.27	0.25
Sargan test (p-level)	0.13	0.19	0.19	0.07

Source: own calculations.

Estimates of α_1 are statistically significant at the 1 per cent level for high-income regions, but those for low-income regions are much smaller in magnitude and statistically significant at the 10 per cent level. Taken at the face value, these findings suggest that conditional convergence is much stronger for high-income regions, with a growing gap between leading and lagging regions to be the case. However, it should be noted that at least two of the high-income regions, namely Donetsk and Luhansk, have been suffering heavily from a switch to non-subsidised prices for imported natural gas (since 2009) and stiffer competition on the world steel market, not to mention the recent devastations of industrial infrastructure in the wake of 2014 armed conflict. Coal production in the region is still subsidised, but this situation is likely to be changed starting in 2015, further weakening the economic situation of the Donetsk and Luhansk regions. At the same time, the growth potential of many regions in the Central and Southern Ukraine has been artificially constrained by insufficient investments into the agricultural sector, which is the source of their most profound competitive advantages.

For the West Ukrainian regions, a relatively weak economic performance could be explained by a combination of the collapse of Soviet-style manufacturing in the 1990s, large-scale labour migration abroad and the lack of policies towards successful attraction of FDI. However, there is a recent boom in IT services in several regions classified as low-income ones, especially in the Lviv region, which bodes well for the future of their regional growth. At this point, somewhat better estimates of parameters on ln $service_{i,t-1}$ for low-income regions compared with high-income ones support this explanation. It is worth noting that the estimate of β_2 for high-income regions

is unambiguously negative and statistically significant at the 1 per cent level. Export of goods has a positive growth effect for high-income regions, which is intuitively appealing as they dominate the ranking of exporting regions (Table 1). However, the benefits of merchandise exports are lacking for low-income regions.

Among the other results, it was confirmed that investments in physical capital contribute to regional growth, but only for high-income regions. It was found that, in contrast to the sample of all regions (Table 2), population growth does not show any evident positive statistical relationship with the dependent variable. Moreover, the coefficient on $\Delta \ln L_t$ is negative and statistically significant at the 10 per cent level in specification IV for the sample of low-income regions. Urbanisation, as measured by a lower value of $LSTR_{it}$, at least does not hinder regional growth in both sub-samples of Ukrainian regions.

Inflation has a significant negative effect on regional growth, regardless of whether low-income or high-income regions are included into the sample. The coefficient for the inflation variable is larger for high-income regions. A favourable effect of relative prices is more pronounced for high-income regions, too. If it is controlled for relative prices, the financial crisis of 2009 seems to take a heavier toll on high-income regions.

Our results correspond to those obtained by Ledyaeva and Linden (2008: 87-105) that conditional convergence in Russian regions is slower than that expected from growth theory. As the results for Russia do not differ much between low-income and high-income regions, this is clearly not the case in Ukraine. There is no difference in that domestic investment and export are both important factors of regional economic growth.

5. CONCLUSIONS

Based on the dynamic panel data estimates for 26 Ukrainian regions over the period 2002 to 2012, regional per capita growth clearly appears to be driven by investments in physical capital and the export of goods, both being standard growth factors. However, this finding of statistically significant growth effects by investments and merchandise exports is due to the relationships in high-income regions. When the sample includes either low-income or high-income regions, there is no stable and significant "*textbook*" pro-growth effect, even though that kind of impact is somewhat evident in the sample of all regions. Higher inflation is a negative growth factor, while the improvement in relative prices has an opposite pro-growth impact (both are standard macroeconomic relationships). Export of services has a negative effect on regional growth

in high-income regions, while there is no significant impact on low-income regions.

The results imply that conditional income convergence is a feature of output growth across Ukrainian regions, but this process is rather slow. As suggested by the lagged output coefficients, convergence among high-income regions is much faster than for low-income ones. The results are robust to the choice of regression model specifications. The paper also finds evidence that the 2009 financial crisis had exerted a stronger negative growth effect on high-income regions.

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ABSTRACT

In this paper, determinants of real regional per capita growth were estimated using a balanced panel data set consisting of 26 Ukrainian regions for the period from 2002 to 2012. The Arellano-Bond dynamic panel data estimation technique was applied.

Among the traditional factors of economic growth, positive effects of investments in physical capital and population growth (for the high-income regions only) were found. Higher inflation and a larger share of rural population are negative regional growth factors, while the depreciation of the real exchange rate and increase in the export of goods has an opposite pro-growth impact. As suggested by the lagged level of the output coefficients, conditional convergence is faster among the high-income regions. The results are robust to the choice of estimators and regression model specifications.

CZYNNIKI WZROSTU REGIONALNEGO NA UKRAINIE: OSZACOWANIE NA PODSTAWIE DANYCH PANELOWYCH

ABSTRAKT

Wykorzystując zbilansowany zbiór danych panelowych 26 regionów Ukrainy w okresie lat 2002–2012, oszacowano czynniki regionalnego wzrostu regionalnego w ujęciu realnym. Zastosowano estymatory z efektami stałymi (fixed effects) oraz Arellano-Bonda. Spośród standardowych czynników wzrostu gospodarczego, stwierdzono pozytywne oddziaływanie inwestycji w zasoby kapitału fizycznego oraz wzrostu liczby ludności. Wyższa inflacja jest negatywnym czynnikiem wzrostu gospodarczego, w tym jak deprecjacja realnego kursu walutowego ma pozytywne oddziaływanie na ten wskaźnik (oba te rezultaty są standardowymi relacjami makroekonomicznymi). Pozytywny wpływ poziomu eksportu otrzymano wyłącznie dla regionów Wschodniej i Południowej Ukrainy z wyższym poziomem produktu regionalnego (dochodu) na mieszkańca.

Według podejścia D'Costa et al. (2013), zbadano zależność otrzymanych wyników od luki dochodu pomiędzy poszczególnymi regionami a regionem granicznym – z najwyższym poziomem dochodu, tzn. stolicznym miastem Kijowem. Podobnie do innych badan (Crespo Cuaresma et al. 2009; Ledyaeva, Inden 2008), otrzymano świadczenia na korzyść konwergencji warunkowej jak to uwyraźnia negatywna relacja między początkowym poziomem produktu na mieszkańca a stopa wzrostu dochodu w następnych latach. Jak to sugerują odpowiednie współczynniki regresyjne, konwergencja warunkowa jest mocniejszą wśród regionów z wyższym poziomem dochodu niż wśród regionów z niższym poziomem dochodu. Rezultaty są odporne na wybór estymatorów oraz specyfikacji modelu regresyjnego.