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Were Ukrainian regions too different to start interregional confrontation: economic, social and ecological convergence aspects?

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ABSTRACT

This article deals with analysis of economic, social and ecological disparities of Ukrainian regions. Regional economic disparities are measured through the convergence concept and the article employs panel data analysis with fixed and random effects estimations. Our empirical results show the presence of economic convergence in Ukrainian regions. Initially it was found that poor regions do grow relatively faster than the rich. Moreover, the difference between poor and rich regions has been decreased 1.8 times during 1999 and 2010. In addition, it was found that the presence of ecological convergence in the Ukraine and initially 'clean' regions do increase pollution faster than initially 'dirty' regions. That is, Ukrainian regions were converging to some environmental steady state through the process of increasing pollution. Ukrainian regions were also experiencing health convergence with negative policy implications, since all regions do converge to some health levels through an increase in morbidity. The economic growth of Ukrainian regions was achieved through sacrificing environmental situations and increased morbidity. Therefore, there were no clear economic reasons to start interregional confrontation that has taken place in the Ukraine, since all regions were on the same track of development.

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1. Introduction

In the current global and interdependent world, the stability of state economic system depends on the stability of its regions. Historically, the development of the former USSR economy under central planning created major differences among regional economies. Even within boundaries of one country the regions were not equally developed. Eastern and Southern regions of the Ukraine were always much more economically developed than the Western and Northern regions of the country. Since Ukraine became independent in 1991 its economy has undergone a lot of reforms, but the gap between poor and rich regions is still substantial. Statistical data shows the significant regional economic disparities in the Ukraine during 1990–2000s, and on average the difference between poor and rich regions

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within one country was about two times in terms of per capita incomes. Considering the ecological indicators, such as per capita emissions, rich regions had 20 times higher air emissions levels compared to less developed regions. Also, the rates of pollution-related morbidity, like respiratory and cardiovascular disease (CVD), are much higher in more economically developed regions. It indicates that for a long time richer regions were developing their economies in terms of extensive use of natural resources, sacrificing environmental situation sand worsening population health. Major regional differences in terms of basic social living standards may cause serious economic, social and ecological problems. Therefore, development and transformation of regional economies should consider not only the structural reforms and increase in per capita incomes, but also the levelling of regional development.

The main objective of the article is to estimate economic, ecological and social regional convergence and to find whether there were any substantial regional development distortions that could provoke military interregional confrontation within Ukrainian territories.

The issue of whether or not poor regions tend to catch up with richer ones plays a significant role in regional growth theories. The convergence debate has originally arisen from neo-classical growth theory Baumol (1988), Barro and Sala-I-Martin (1991), Mankiw, Romer, and Weil (1992). Early theoretical growth models were based on aggregate production functions and explanatory factors such as quantity (and quality) of labour input, physical capital and technology. The empirical growth models were relying mostly on available data, such as real per capita income, savings and investments, government expenditure, exports, labour force and its structure within industries, education variables, etc. Those estimates were and still are useful for determining policy recommendations. For example, the savings rate was considered a critical parameter of development, however the effectiveness of investment (e.g., where to invest, in which region) is an even more important factor of regional development. A given level of investments in poorer regions is usually associated with relatively higher per capita income increases than investment in richer regions.

The concept of economic convergence according to Matkowski and Prochanik (2004) should be addressed in two aspects. First, a tendency towards levelling per capita incomes and growth rates among regions. Second, tendency towards an economic cycle convergence (that is ups and downs of economic cycles ideally should have high positive correlation). Both convergence concepts are independent and tested separately. An empirical research has four main approaches to study convergence processes: sigma convergence, absolute beta convergence, conditional beta convergence and stochastic convergence. Historically, according to Sala-i-Martin (1996), the first was the *sigma convergence approach*, which compares standard deviations, variances for the different economic indicators across time for specific groups of countries (regions). *Absolute convergence* means that if regions are fairly similar and under the same conditions (e.g., within one country or union) they should approach the same absolute level of steady state in all directions (economic, ecological, social). *Conditional beta convergence* means that it is not possible to achieve a unique steady state in all countries (regions), due to the differences in national, natural or historic achievements. And all separate territories have their own steady states. The last one, *stochastic convergence,* relies on time-series methodology.

Another stream of literature (e.g., Barrell & Te Velde, 2000, Miller & Gench, 2005; Kosfeld, Eckey, and Dreger, 2007) focused on issues of economic convergence within the boundaries of one country. For example, Miller and Gench (2005) analysed convergence processes in US regions during 1969–1997 for almost all regional specifications of models.

The absolute beta convergence parameters appeared to be in range of 0.3–0.36, which proved the hypothesis of economic convergence between the states in the US. Kosfeld, Eckey, and Dreger (2007) investigated regional convergence in unified Germany for the period 1992–2000. A spatial econometric approach was applied on the extended Solow model. They found some presence of ß-convergence for unified Germany. Ukraine falls into a category of transition countries and therefore the analysis of papers on transition economies is more closely related to our research. Kocenda (2001) and Kutan and Yigit (2004) papers found between and interregional convergence within Central and Eastern European (CEE) economies in terms of growth rates of real output. In particular, Baltic States do converge with the highest degree in all macroeconomic fundamentals.

According to Varblane and Vahter (2005) transition countries converge in per capita incomes with developed ones. Thus, new EU members including Romania and Bulgaria managed to reduce their per capita income gap against old members by 10–20%. These remarkable results were achieved during one decade. Moreover, a growth differential between the 'old EU' and new accession countries during 2001–2004 was about 2.2%. Additionally, Iancu (2007) states that one of the poorest new EU countries, Romania, can catch up with leaders in 30–50 years depending on annual Romanian growth rates from 4% to 8% annually. It was found by Pop, Ingen, and Oorschot (2013) that a decrease in income inequality and an increase in wealth can improve health indicators in developing and poor countries. A group of 16 researchers from nine developed countries (Van Doorslaer, Wagstaff, et al. 1997). All is good here used data for their domestic countries and they found a strong correlation between inequalities in health and inequalities in income.

2. Theoretical basis and econometric model

According to Miller and Gench (2005), in the long-run all regions within a country should strive for a certain level of equilibrium (steady state) in economic, environmental and social spheres. Many of the fundamental questions related to economic convergence at the macroeconomic level were intensively developed by Barro and Sala-i-Martin (2003). According to their study, within a single country the process of economic convergence of regions is subject to the following pattern:

$$y_{it} = e^{-\beta_0 \tau} y_{it-1} + (1 - e^{-\beta_1 \tau}) y_{it}^{*} + u_{it}, \tag{1}$$

where y_{it} is per capita income in the *i-th* region in the *t-th* year; y_{it}^{*} is steady state levels; *e*– is a natural logarithm; u_{it} is standard error term; β_0 and β_1 are parameters to be estimated.

The log-linearised version of (1) in Sala-i-Martin (1996), Barro and Sala-i-Martin (2003) is presented as:

$$\ln(y_{i,T}/y_{i,0}) = \beta_0 + \beta_1 \ln(y_{i,0}) + \beta_1 \ln y^{*} + u_i \tag{2}$$

The problem with analysis model (1–2) on international level is that term $\beta_1 lny$ – is constant (because it is a steady state) and β_0 takes that effect into constant term. Due to the fact that different countries have different steady states the above mentioned model is mostly used for an economic convergence analysis within boundaries of one country.

The most widely used linearised version of (2), is discussed in Sala-i-Martin (1996), Manasan and Mercado (1999), Miller and Gench (2005) and presented as:

$$\ln(y_{i,T}/y_{i,0}) = \beta_0 + \beta_1 \ln(y_{i,0}) + u_i, \tag{3}$$

where subscript T means last period, while *0* means initial period. This linearised version includes only the influence of basic factors while ignoring the less relevant factors. On the other hand, the advantage of this specification is a possibility to evaluate the rate of convergence amongst regions. In model (3) an economic convergence is present and richer regions grow more slowly if $\beta_1 < 0$. Otherwise, if β_1 is positive then richer regions are developing faster. Furthermore, the results of the 'log-log' model should be treated as elasticity – one percentage change in independent variable leads to β_1 percentage change in the dependent variable.

An alternative way to test convergence is a linear parametric model with per capita income growth rate as a dependent variable. Model (3) can be extended by a linear specification as follows:

$$y_{i,T}/y_{i,0} = a_0 + a_1 y_{i,0} + \varepsilon_i \tag{4}$$

Additionally, according to Lall and Yilmaz (1999) the economic convergence can be estimated as a modified Cobb-Douglass production function:

$$\log(y_{it}) = a_0 + b_1 \log(y_{i,t-1}) + c_k Z_{kit-1} + d_i D_i + e_i T_i + \varepsilon_i \tag{5}$$

where, Z – is a vector of k additional regional characteristics (human capital, public capital, etc.). D – is a vector of regional dummy variable. T – is a vector of dummy time variables.

We are interested in the sign of the b_1 coefficient, that is estimating 'difficulty' to overcome higher initial levels of income. The hypothesis of economic (ecological) convergence will be accepted if b_1 is negative. The special attention is paid to the coefficients of b_1, which has, following economic interpretation as one percent per capita income change in base year, lead to b_1 percent change next year.

Having per capita income growth rates as a dependent variable the above mentioned model (5) would be rewritten as following.

$$r_{it} = \beta_0 + \beta_1 y_{i(t-1)} + \beta_2 K_{it} + \beta_3 L_{it} + \beta_4 P_{it} + \beta_5 X_{it} + u_{it} \tag{6}$$

where r_{it} – growth rate of per capita income in a region i in year t;
$y_{i(t-1)}$ – per capita income in a region i in previous year to year t;
K_{it} – real capital stock in a region i in year t;
L_{it} – employment in a region i in year t;
P_{it} –pollution in a region i in year t;
X_{it} – time dummies from 1999 to 2010.
$y_{i(t-1)}$ – a crucial factor in this specification is a speed and direction of convergence/divergence. It is expected that higher initial per capita income leads to slower economic growth.

3. Data description and empirical results

The data was collected and processed from state regional statistical year books, medical statistics and WHO databases. The data set consists of variables on economic per capita incomes, air emissions (all pollutants), cardiovascular and cancer morbidity per 100,000 of

Table 1. Data descriptive statistics.*

Variable	Obs	Mean	Std. Dev.	Min	Max
id	275	13	7.22425	1	25
year	275	2005	3.168043	2000	2010
pollution_th_tonnes (total air emissions, th. tonnes)	275	251.5841	384.2739	32.7	1895.2
pollution_per_km2_ton	275	9.810984	13.8038	1.751244	70.90189
employment	275	954.6789	3280.081	290.9	54736
income_per_capita (UAH in 1999 prices)	275	3040.743	1221.479	669.6343	6132.75
pollut_laged_value (1 year lag)	275	250.0066	386.4753	31	1895.2
income_lag (1 year lag)	275	2703.119	1217.633	569.2	5733.491
grrate_ income_per_capita	275	1.168533	.1892991	.8947135	2.007393
real_assets	275	27692.81	37807.93	113.6276	497404.2
diabet diseases_per100th (morbidity)	425	2070.739	531.9013	1160.2	3683.6
Cardiovascular_diseases_ per100th (morbidity)	425	3186.992	768.6802	1545	5781.7
wage_nom	425	739.9035	715.6166	50	3063
wage_real (UAH in 1999 prices)	425	346.3259	168.4329	107.3132	844.6108
Ark (regional dummies)	275	.04	.1963164	0	1
vinnit	275	.04	.1963164	0	1
volyn	275	.04	.1963164	0	1
dnipro	275	.04	.1963164	0	1
Other regional dummies					
y2000	275	.0909091	.2880039	0	1
y2001	275	.0909091	.2880039	0	1
Other year dummies					
y2009	275	.0909091	.2880039	0	1
y2010	275	.0909091	.2880039	0	1

*Source: The Center of Ukrainian Medical Statistics (2013).

the population, regional employment, real assets (proxy for the capital variable) during the period 2000–2010. All economic variables, which are subject to inflation, were converted into the real variables. In total we have 275 observations during the 11-year period (Table 1). Depending on the parametric specification of the model it is possible to add thefollowing parameters: expenditures on innovation and research, expenditures on financing resource saving and environmentally friendly technologies, etc.

We estimated that model (3), described in the methodology section, found a statistically significant coefficient $\beta_1 = -0.526$ with $R^2 = 0.87$. Economic interpretation of this result is as follows: an increase in regional Ukrainian per capita income in base levels above its average by 1% has caused a 0.53% decrease in a specific region's growth rate. It means that rich regions have grown slower than poor regions, which is evidence of economic convergence in the Ukraine. Comparing Ukrainian and US convergence coefficients (0.53 vs. 0.3) it is seen that the speed of regional convergence development in the Ukraine is about 1.77 times faster than in the US.

According to Statistics of Ukraine, the highest per capita income in 2010 was 6132 UAH while the lowest was 3527 UAH in 1999 prices. It means that the ratio of the highest to lowest per capita income in the Ukraine has decreased from 2.91 in 2000 to 1.7 in 2010. That is, the difference between rich and poor regions decreased 1.8 times over the 2000–2010 period. Our models described above produced the same result. Model (6) uses a growth rate as a dependent variable which also confirmed our hypothesis on economic convergence. The advantage of using a growth rate over logarithmic functional form comes from the fact that it has a larger number of observations and the possibility of including more explanatory factors. The estimation results are based on explanatory variables of the World Bank in apaper by Lall and Yilmaz (1999) and are presented in Table 2

Table 2. Modelling regional economic convergence with economic and ecological factors.

	(1)	(2)	(3)	(4)
	Growth rates of per capita income	Growth rates of per capita income	Growth rates of per capita income	Growth rates of per capita income
income lagged	-0.0000481 (.000)***	-0.0000462 (.000)***	-0.0000485 (.001)***	-0.0000806 (.001)***
pollution lagged		-2.07e-06 (.91)		
employment			-1.15e-06 (.518)	-1.64e-06 (.58)
assets (capital)			5.56e-08 (.76)	-1.92e-07 (.51)
pollution			-3.93e-06 (.83)	.0000298 (.31)
year2000	0.0152 (.270)	0.019 (.770)	0.5232 (.000)***	
…all	The rest	time	2001-2009	…
Year 2010	0.22 (.000)***	.2234812 (.000)***	0.216(.009)***	
constant	1.134(.000)***	1.12(.000)***	1.14 (.000)***	1.38 (.000)***
number of observations	275	275	275	275
number of groups	25	25	25	25
R-sq overall, %	77	76	78	53

Note:p-values are given in parentheses;
*significant at 10%;
**significant at 5%;
***significant at 1%
Source: Authors.

In order to interpret Table 1 coefficients, let us take a closer look at results presented in column 3:

$$r_{it} = 1.12 - 0.0005y_{i(t-1)} - 1.15e\text{-}06L + 5.56e\text{-}08K - 3.93e\text{-}06P \quad (7)$$

This result means that on average every additional 100 UAH in per capita income reduces regional growth rates of the next year by 5%.

The current study also supports 'ecological convergence' (see Appendix A), and estimation of model (3) produced the statistically significant coefficient $\beta_{1=}$ – 0.1 for an ecological situation. Model (7) supports evidence of ecological convergence within the Ukraine, and pollution in 'clean' regions increases faster than in initially 'dirty' regions.

In order to check the health convergence hypothesis, model (3) has also been estimated, yielding the following results:

$$Ln\left(H_{CVD2011}/H_{CVD1990}\right) = 2.08 - 0.22 \ln H_{CVD1990} \quad (8)$$

where, $H_{CVD2011} / H_{CVD1990}$ – is a CVD ratio during the period of 2011 and 1990.

Economic interpretation of this result is as follows: an increase in regional CVD morbidity in 1990 by 1% has caused a 0.22% decrease in a specific region's CVD illness, which means that initially (in 1990) more sacrificed regions in terms of CVD have shown slower rates of morbidity growth than initially healthier regions.

The average CVD morbidity in 1990 was 2863 people per 100,000 (with a minimal level of 2099 and maximum level of 3885). The average CVD morbidity in 2011 was 3994 (with a minimal level of 3065 and maximum level of 5780). It is clearly seen that CVD levels increase from time to time. That is, regions with higher initial CVD morbidity do increase their levels at lower rates. Actually what is happening in the Ukraine is a health convergence with negative policy implications, since all regions do converge to some 'steady state' through the processes of morbidity increase. More preferable would be a situation

of health convergence with positive policy implications, when regional health indicators do converge to some 'steady state' through the processes of morbidity decrease (initially more affected regions would become healthier with higher rates than regions with initially lower rates of illness).

Current studies on health convergence results are in contradiction with Van Doorslaer et al. (1997) for developed countries, where a decrease in economic inequality was associated with a decrease in health inequality. Probably for developing and transition countries there exist inverted U-shape relationships between economic growth and health indicators. That is, early economic achievements are combined with a deterioration of the environment and worsening health indicators, but later, when the population becomes richer, people start paying more attention to their health.

Health Kuznets curve (HKC) is a new hypothesis and there are few publications about it. This is probably due to the fact that an inverted HKC could only be observed in transition and developing countries and smaller scientific interest is devoted to this group. The first and currently only paper known to the authors on HKC is by the London School of Economics scientific team, published at the end of 2013 (Costa-Font, Hernandez-Quevedo, & Sato, 2013). The HKC appeared following the Environmental Kuznets Curve (EKC), the last was discussed by Grossman and Krueger (1995) on the basis of cross-country analysis and the idea of an inverted U-shape relationship between pollution and per capita income was introduced. Due to the form of the relationship the curve was named EKC, after Simon Kuznets, who in 1955 showed that at the early stages of a country's development the gap between poor and rich increases, then when the country becomes wealthier the inequality gap decreases. Grossman and Krueger (1995) tested different pollutants, and found that in countries with low GDP per capita, the concentration of dangerous chemical substances initially increased but then, after a specific level of income (which was different for different pollutants), concentration was decreasing. Dasgupta et al. (2002) proposed to consider following assumptions to explain the 'bell-shaped' relationship between income and pollution: with rising income, marginal propensity to consume should decline or at least be constant; marginal disutility of polluted environment should increase; marginal economic cost of pollution should increase. These assumptions are quite reasonable and moreover they are indirect assumptions for the HKC. According to Yevdokimov, Melnyk, and Kubatko (2011) the Ukraine follows the EKC for sulphur dioxide and nitrogen dioxide measured in terms of concentrations. On the other hand, there is a strictly increasing pattern for dust and carbon dioxide.

Having estimated HKC for CVDs in the Ukraine a positive evidence of inverted HKC was found (Appendix B). The main explanatory variables were the real regional wages. The breakeven point for CVD appeared to be at level of 900 UAH in 1999 prices, which is 3285 UAH in 2011 prices. The average wage in 2011 was 2633 UAH that is some time is needed to achieve the critical point. Figure 1 gives a graphical representation of HKC for CVD.

The Ukraine is probably at the edge of the 'cardiovascular revolution' that has taken place in the West in recent years. According to Smith and Nguyen (2013) better control of hypertension and cholesterol – in part through anti-hypertensive drugs and statins, respectively – has played a major role in the 'cardiovascular revolution' achieved in the West. In general, the cardiovascular revolution means that cardiovascular morbidity and mortality should start to decrease (people would live longer and would die from other factors).

It should be admitted that more research is needed in this direction, since it is not a rise in wages itself that stimulates improvement in health indicators, but people with higher incomes

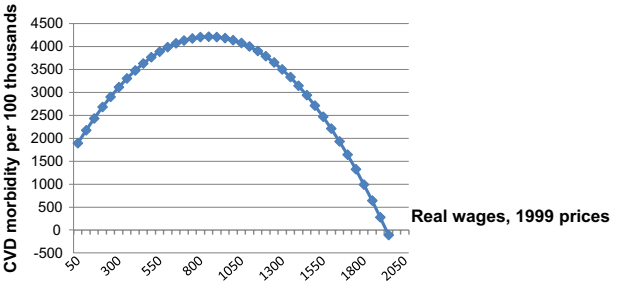

Figure 1. Health Kuznets curve for CVD morbidity in the Ukraine. Source: Authors.

prefer a safer environment and better conditions, so some changes in the structure of consumption are observed. It was tested also the HKC hypothesis for diabetes and it appeared the richer the population the more diabetes incidents are happening per 100,000 (Appendix B). Those diseases are probably more related to the lifestyles of rich urbanised territories.

Having analysed the development of the Ukrainian regions during 2000–2010 we have found that economic, ecological and population health regional distortions were shrinking, and all regions were striving for the same 'steady state' points. Our results do not find any regional economic, social or ecological reason for interregional confrontation. The core of conflict according to Zhukov (2016) could be related to the economic structure of Eastern industrial regions, the 'big three' industries: metals, coal and machine-building were differentially vulnerable to trade disruptions with Russia (machine-building being most vulnerable). Thus, the Donetsk region accumulated up to 45% of the Ukrainian machine-building sector and 60% of its production was exported to Russia. Moreover, Zhukov (2016) states that neither ethnicity nor economics contribute much explanatory power, while military geographic factors, like roads or distance to the border, do most of the heavy lifting.

4. Conclusion

Our research found a presence of economic regional convergence in the Ukraine. That is, with time, poor regions catch up with richer ones. The speed of economic convergence in the Ukraine is about two times higher than regional convergence in developed countries. The last point is due to higher initial differences between regions in the Ukraine and developed countries. Also we found presence of ecological convergence of Ukrainian regions. During 1999–2010, nearly every region in the Ukraine has shown an increase in pollution, with only a few exemptions.

Ukrainian regions are experiencing health convergence with negative policy implications, since all regions converge to some 'steady state' through the processes of morbidity increase. An increase in regional health CVD morbidity in 1990 by 1% is related to 0.22% decrease in a specific region's CVD growth rate, which means that initially (in 1990) more sacrificed regions in terms of CVD illness have shown slower rates of illness growth than initially healthier regions. A presence was found on the HKC in the Ukraine for CVDs, while diabetes shows an increasing pattern against real wage growth.

The higher the rates of economic development, the higher the illness growth rates in the Ukraine. It means that economic achievements are made through sacrifice of environmental situation and health quality. The latter suggests that all regions are on the same track of

development and there was no economic reason during 1990–2010 to start the interregional confrontation that takes place today in the Ukraine nowadays. The economics of rebellion in eastern Ukraine has other roots than disparity and was described by Zhukov (2016). In terms of practical application, it is recommended to develop regional equality in order to increase economic and social safety.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Barrell, R., & Te Velde, D. W. (2000). Catching-up of east german labour productivity in the 1990. *German Economic Review, 1*, 271–297.

Barro, R. J., & Sala-I-Martin, X. (1991). Convergence across states and regions. *Brookings Papers on Economic Activity,* 107–182.

Barro, R., & Sala-i-Martin, X. (2003). *Economic growth* (2nd ed.). Cambridge, MA: MIT Press.

Baumol, W. (1988). Productivity growth, convergence and welfare: What the long run data show. *American Economic Review, 76*, 1072–1085.

Center of Ukrainian medical statistics. (2013) Ukrainian base of medical and statistical information. "Health for all". Retrieved from http://medstat.gov.ua/ukr/normdoc/vooz.html

Costa-Font, J., Hernandez-Quevedo, C., & Sato, A. (2013). A health kuznets' curve'? Cross-country and longitudinal evidence. *CESifo Working Paper, 4446*, 49p.

Dasgupta, S., Laplante, B., Wang, H., & Wheeler, D. (2002). Confronting the environmental kuznets curve. *Journal of Economic Perspectives, 16*, 147–168.

Grossman, G., & Krueger, A. (1995). Economic growth and the environment. *The Quarterly Journal of Economics, 110*, 353–377.

Iancu, A. (2007). Economic convergence. *Applications. Romanian Journal of economic forecasting, 4*, 24–48.

Kocenda, E. (2001). Macroeconomic convergence in transition countries. *Journal of Comparative Economics, 29*, 1–23.

Kosfeld, R., Eckey, H. -F., & Dreger C. (2007). Regional convergence in unified Germany. *A Spatial Econometric Perspective*, 26. Retrieved from http://www.uni-kassel.de/fb07/fileadmin/datas/fb07/5-Institute/IVWL/Forschungskolloquium/diskussionen/papier3902.pdf

Kutan, A., & Yigit, T. M. (2004). Nominal and real stochastic convergence of transition economies. *Journal of Comparative Economics, 32*, 23–36.

Lall, S., & Yilmaz, S. (1999). *Regional Economic convergence: Do policy instruments make difference*. International Bank for reconstruction and development, World Bank, 18. Stock No. 37161, Retrieved from http://siteresources.worldbank.org/WBI/Resources/wbi37161.pdf

Manasan, R., & Mercado, R. G. (1999). Regional economic growth and convergence in the Philippines: 1975–1997. *Discussion paper series*, 99–13.

Mankiw, N., Romer, D., & Weil, D. (1992). A contribution to the empirics of growth. *The Quarterly Journal of Economics, 107*, 407–437.

Matkowski, Z., & Prochanik, M. (2004). Real economic convergence in the EU accession countries. *International Journal of Applied Econometrics and Quantitative Studies, 1*, 5–38.

Miller, J., & Gench, I. (2005). Alternative regional specification and convergence of U.S. regional growth rates. *The Annals of Regional Science, 39*, 241–252.

Pop, I., Ingen, E., & Oorschot, W. (2013). Inequality, wealth and health: Is decreasing income inequality the key to create healthier societies? *Social Indicators Research, 113*, 1025–1043.

Sala-i-Martin, X. (1996). Regional cohesion: Evidence and theories of regional growth and convergence. *European Economic Review, 40*, 1325–1352.

Smith, O., & Nguyen, S. N. (2013). Getting better: Improving health system outcomes in Europe and Central Asia. *World Bank publications*, No 13832 Washington, DC, 192p.

Van Doorslaer, E., Wagstaff, A., Bleichrodt, H., Calonge, S., Gerdtham, U. G., Gerfin, M., ... Winkelhake, O. (1997). Income-related inequalities in health: Some international comparisons. *Journal of Health Economics, 16*, 93–112.

Varblane, U., & Vahter, P. (2005). *An analysis of the Economic convergence process in the transition countries*. Tartu (Estonia): University of Tartu. 47p.

Yevdokimov, Y. V., Melnyk, L. G., & Kubatko, O. V. (2011). The environmental kuznets curve and regional convergence in ukraine. *International Journal of Ecological economics and Statistics, 22*, 72–86.

Zhukov, Y. M. (2016). Trading hardhats for combat helmets: The economic s of rebellion in eastern Ukraine. *Journal of Comparative Economics, 44*, 1–15.

Appendix A. Modeling regional ecological convergence

Source	SS	df	MS		Number of obs = 25	
					F(1, 23) = 8.94	
Model	.281616824	1	.281616824		Prob > F = 0.0065	
Residual	.724362723	23	.031494031		R-squared = 0.2799	
					Adj R-squared = 0.2486	
Total	1.00597955	24	.041915814		Root MSE = .17747	
lngrpoll	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
lnpollut2000	-.1070456	.0357976	-2.99	0.007	-.1810985	-.0329927
_cons	.7520613	.175006	4.30	0.000	.3900339	1.114

Source: Authors.

Appendix B. Estimation of health Kuznets curve hypothesis: the case of CVD

Fixed-effects (within) regression					Number of obs = 425	
Group variable (i): id					Number of groups = 25	
R-sq: within = 0.8208					Obs per group: min = 17	
between = 0.0567					avg = 17.0	
overall = 0.4265					max = 17	
					F(2,398) = 911.29	
corr(u_i, Xb) = -0.1442					Prob > F = 0.0000	
CVD_per1~h	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
wage_real	6.146799	.3876566	15.86	0.000	5.384689	6.90891
wage2	-.0035998	.0004976	-7.23	0.000	-.004578	-.0026216
_cons	1591.847	65.29891	24.38	0.000	1463.473	1720.221

Source: Authors.

Appendix C. Estimation of health Kuznets curve hypothesis: the case of diabetes

Fixed-effects (within) regression					Number of obs = 425	
Group variable (i): id					Number of groups = 25	
R-sq: within = 0.6538					Obs per group: min = 17	
between = 0.0105					avg = 17.0	
overall = 0.3025					max = 17	
					F(2,398) = 375.80	
corr(u_i, Xb) = -0.0458					Prob > F = 0.0000	
CVD_per1~h	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
wage_real	.6502278	.3207571	2.03	0.043	.0196378	1.280818
wage2	.001533	.0004117	3.72	0.000	.0007236	.0023424
_cons	1618.288	54.03002	29.95	0.000	1512.068	1724.508

Source: Authors.