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Internal Integration of the Transition Economy: Evidence from Ukraine

By Ihor Yaskal
Mzumbe University, Tanzania

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Internal Integration of the Transition Economy: Evidence from Ukraine

Ihor Yaskal

Abstract - Based on the methodology suggested by Bowen, Munandar, and Viaene (2010; 2011) I examine the quantitative measurement of internal economic integration. For this purpose the link between the region's share in total output and production factors was estimated, the pattern of distribution of these shares among the regions of Ukraine was assessed. Calculations demonstrated an increasing tendency to deepen the internal integration of the Ukrainian economy, although 2009-2010 were characterized by a reduction in intra-regional economic integration.

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I. Introduction

Globalization processes have a direct impact on the nature of economic relations, transforming the competition, making production factors, information and financial links more affordable. Therefore, location (i.e. regions, the regional environment) is the epicentre of origin of competitiveness. The region concentrates the natural resources, scientific and industrial potential, creates a competitive advantage and provides economic relations with other regions of the country. The presence integration links between regional segments of national economy creates a foundation for economic growth of the country, since it is based on the use of the specific characteristics of each region, the implementation of its competitive advantages.

The current development of economy dictates new priorities of Ukraine. In the process of deepening market reforms are more important becomes the issue of strengthening cooperation between Ukrainian regions as the main factor of sustainable economic growth in Ukraine, because only the integration development regions of the country can provide the efficiency advantages of the territorial division of labor, of natural resources, scientific and industrial potential of the regions and thus promote economic development of Ukraine as a whole.

In the study of integration as a modern tendency of regional development the question of its quantitative and qualitative measurements inevitably raises. In other words, the urgency is the formation of methodological and methodical basis for the assessment of regional integration processes.

Author : Yuriy Fedkovych Chernivtsi National University, Chernivtsi, Ukraine. E-mail : igoryaskal@gmail.com

This problem has to some extent covered in the scientific literature. Studies on regional convergence within or across countries have already been completed for a broad range of regions (Barro and Sala-i-Martin, 1995). Ghosh (2008) examines long-run growth performance and regional divergence in per capita income across 15 major Indian states during the pre- and post-reform periods. Frey and Wieslhuber (2011) did empirical analysis of the growth process on the regional level using annual gross regional product (GRP) data for the period 1998-2008 for the 16 Kazakh regions and shown that there were no evidence for regional convergence in Kazakhstan.

Storonyanska (2008; 2009) made some calculation using models of convergence on a number of parameters, and obtained important conclusions from factor analysis. Yevdokymenko and Yaskal (2008) used approach to the assessment of intra-regional economic integration based on indicators of trade in the region. Method of detecting approximate directions of interregional production and resource integration in industry and manufacturing industry using Euclidean distance, fuzzy clustering and gravity model was proposed by Yevdokymenko and Yaskal (2011; 2012). There were attempts to evaluate the effectiveness of the integration between regions (Plekhanova, 2008).

Bowen, Munandar, and Viaene (2011) assess the level of economic integration between the U.S. states and EU members, and in (Bowen, Munandar, and Viaene, 2010) – based on Regional Trade Agreements. Noteworthy, this approach is used for estimating the level of integration within the country (e.g. USA), and between countries within a particular group (e.g. EU, NAFTA, etc). I have utilised the methodology suggested by Bowen, Munandar, and Viaene (2010; 2011) to examine the quantitative measurement of internal economic integration in Ukraine.

Bowen, Munandar, and Viaene consider the distribution of output and factors of production among members of an integrated economic space (IES), within which goods and factors of production (resources) are mobile and policies are harmonized. They derive three theoretical propositions: 1) each member's share of total area output will equal its share of the total area stock of each productive factor; 2) the distribution of output and factor shares across IEA members will conform to a rank-share distribution that exhibits Zipf's law. Zipf's law specifies a particular relationship among member shares, namely, that the share of, for example, output of

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the largest member is twice that of the second largest member, three times that of the third largest member, etc.; and 3) given Zipf's law, the long-run distribution of output and factors across area members is unique and depends only on the number of IEA members (Bowen, Munandar, and Viaene, 2011). Thus, under the IES we will understand the national economy of Ukraine (set of regional economies), and by members of the IES – Ukrainian regions. Theoretical background for the distribution of output and factors of production among regions – equal-share relationship and rank-share distributions and Zipf's law – characterized and described in details in (Bowen, Munandar, and Viaene, 2010; 2011).

II. Data and Empirical Approach

a) Data

The basis was taken data structure for which statistical information published by the State Statistics Service of Ukraine, i.e. the Autonomous Republic of Crimea, 24 administrative regions (oblast), cities of Kyiv and Sevastopol. Thus, the number of observations is 27. We start from assumption that the long-term distribution of shares among the regions of the integrated economic space exhibits Zipf's law. This means that the theoretical share value of each region could be calculated on the basis of a number of members. In our case it is 27, so theoretical shares values for the regions of Ukraine will be: 0,2569; 0,1284; 0,0856; 0,0642; 0,0514; 0,0428; 0,0367; 0,0321; 0,0285; 0,0257; 0,0234; 0,0214; 0,0198; 0,0183; 0,0171; 0,0161; 0,0151; 0,0143; 0,0135; 0,0128; 0,0122; 0,0117; 0,0112; 0,0107; 0,0103; 0,0099; 0,0095. To calculate the actual share values of regions in total IES I used the following statistical information. For each of the regions output was measured by gross regional product (GRP), which is calculated by State Statistics Service of Ukraine. Suppose, that ratio between fixed and working capital remained constant during the period. Therefore, under the factor "capital" I mean fixed assets. Difficulty in assets evaluating is that national statistics suggests two types of value: the actual and residual. In our calculations I have used the residual value for two reasons. First, the actual cost varies not only by input and/or output of fixed assets, but also the revaluation (indexation). This means that this parameter can be changed without physical changes that would affect the result. Second, the residual value shows a higher statistical relationship with GRP than actual (the correlation coefficient is 0.96 and 0.89 respectively). Factor "labor" for each region measured by the number of employed working-age population. Study period covers the years 2000-2010.

Table 1 describes the distribution of output shares and their ranking for Ukrainian regions. Table 1 shows the sharp increase of the capital position, the city of Kyiv, which was the clear leader of ranking during the analyzed period. The dominance of the capital – a trend that is peculiar not only for Ukraine but also for other post-Soviet countries. This is explained by the fact that Kyiv is the largest city in the country and its industrial, scientific and cultural center. It attracts central offices of large companies location in Kyiv. Another reason is that most companies registered in Kiev have subsidiaries in the regions, and report and pay taxes at the place of registration, i.e. in the capital.

The second feature is that the role of some old industrial regions has gradually reduced. For example, Donetsk region for 2000-2010 years, lost the first place in the rankings, with the dropped its share of total output. Especially significant was the decline during 2005-2010 – by 1.29. The same can be said about Zaporizhzhya region which has lost four positions in the rankings and decreased its share to 1.53 over the period. Other industrial regions, Dnipropetrovsk and Kharkiv, kept their places in the rankings, and their share in total output even increased: at 1.19 and 0.04 respectively.

Overall, in 2000-2005 years 7 regions improved their position in the ranking, 13 – did not change, and 7 – reduced. During the years 2005-2010 6 regions improved position, 12 – did not change and 9 – reduced. This was due to increased concentration of economic activity in Kiev. It means that capital's production share increasing for 2000-2010 was due to reduction of 22 region's shares. However, the speed of this "capital" concentration slowed down: during 2000-2005 only 4 regions has increased their share of total output and in 2005-2010 – 11 regions has improved the output share.

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Table 1 : Distribution and rank of Ukrainian region output shares during 2000-2010 years

Region*	Share Rank (1 = largest share)						Share Value**					
	2000	2005	2010	Change***			2000	2005	2010	Change****		
				2000-2005	2005-2010	2000-2010				2000-2005	2005-2010	2000-2010
Donetsk	1	2	2	-1	0	-1	12,52	13,2	11,91	0,68	-1,29	-0,61
City of Kyiv	2	1	1	1	0	1	11,39	17,5	18,16	6,11	0,66	6,77
Dnipropetrovsk	3	3	3	0	0	0	9,54	9,34	10,73	-0,2	1,39	1,19
Kharkiv	4	4	4	0	0	0	5,99	5,8	6,03	-0,19	0,23	0,04
Zaporizhzhya	5	6	9	-1	-3	-4	5,48	4,52	3,95	-0,96	-0,57	-1,53
Odesa	6	5	5	1	0	1	5,12	4,7	4,98	-0,42	0,28	-0,14
Luhansk	7	7	6	0	1	1	4,64	4,47	4,21	-0,17	-0,26	-0,43
Kyiv	8	10	7	-2	3	1	4,29	3,48	4,15	-0,81	0,67	-0,14
Lviv	9	9	10	0	-1	-1	4,24	3,89	3,85	-0,35	-0,04	-0,39
Poltava	10	8	8	2	0	2	4,14	4,1	4,09	-0,04	-0,01	-0,05
Autonomous Republic of Crimea	11	11	11	0	0	0	2,96	2,91	3	-0,05	0,09	0,04
Vinnytsya	12	12	13	0	-1	-1	2,76	2,31	2,18	-0,45	-0,13	-0,58
Sumy	13	16	17	-3	-1	-4	2,53	1,82	1,69	-0,71	-0,13	-0,84
Mykolayiv	14	14	12	0	2	2	2,4	2,16	2,22	-0,24	0,06	-0,18
Cherkasy	15	15	14	0	1	1	2,3	2,04	2,06	-0,26	0,02	-0,24
Ivano-Frankivsk	16	13	15	3	-2	1	2,26	2,18	1,89	-0,08	-0,29	-0,37
Chernihiv	17	18	19	-1	-1	-2	2,23	1,73	1,57	-0,5	-0,16	-0,66
Khmelnytskiy	18	17	18	1	-1	0	2,14	1,8	1,67	-0,34	-0,13	-0,47
Zhytomyr	19	19	16	0	3	3	2,05	1,68	1,73	-0,37	0,05	-0,32
Rivne	20	20	20	0	0	0	1,82	1,65	1,47	-0,17	-0,18	-0,35
Kherson	21	24	21	-3	3	0	1,7	1,47	1,45	-0,23	-0,02	-0,25
Volyn	22	23	24	-1	-1	-2	1,59	1,48	1,33	-0,11	-0,15	-0,26
Zakarpattya	23	22	23	1	-1	0	1,56	1,52	1,41	-0,04	-0,11	-0,15
Kirovohrad	23	21	21	2	0	2	1,56	1,56	1,45	0	-0,11	-0,11
Ternopil	25	25	25	0	0	0	1,34	1,16	1,18	-0,18	0,02	-0,16
Chernivtsi	26	26	26	0	0	0	0,95	0,96	0,91	0,01	-0,05	-0,04
City of Sevastopol	27	27	27	0	0	0	0,47	0,64	0,72	0,17	0,08	0,25

* Sorted by rank in 2000

** Share values in percent

*** A positive change indicates a higher rank in end year relative to start year

**** A positive value indicates a higher share value in end year relative to start year

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An interesting question in Ukraine is how processes of inter-regional economic integration are interrelated with concentrations of business activity. I consider the concentration of economic activity the primary with respect to integration, because a kind of business activity is formed initially, and then there is a need to collaborate (not always) with someone. Increasing the concentration of economic activity in the capital over time intensifies regional labor division and, consequently, there is a need to cooperate with other entities. Hence, I assume that the increase in the concentration of economic activity would have to strengthen inter-regional economic integration within the country. Further calculations partially confirm this assumption.

b) Empirical Approach

To check the potential empirical validity of the equal-share relationship, we can check the "weak" form of this relationship, namely whether that there will be conformity between (pair-wise) rankings of the output and factor shares across regions of Ukraine. Table 2 contains the confirmation of this assumption by calculating Spearman rank correlation coefficient for pair-wise rankings of the shares for each region for the period 2000-2010.

Table 2 : Spearman rank correlations for years 2000-2010*

Year	Output-Fixed assets	Output-Human capital	Fixed assets-Human capital
2000	0,979	0,934	0,923
2001	0,971	0,957	0,951
2002	0,969	0,960	0,933
2003	0,978	0,940	0,920
2004	0,977	0,937	0,919
2005	0,964	0,933	0,915
2006	0,972	0,928	0,919
2007	0,957	0,929	0,908
2008	0,940	0,939	0,910
2009	0,947	0,927	0,913
2010	0,949	0,934	0,910

* Correlation coeficients are significant from null-hypothesis at the level 0,01

Rank correlation with human capital are generally lower and is demonstrating weaker confirmation the relationship of equal shares. This may indicate both of the smaller "contribution" of human capital in GRP of Ukrainian regions compared to the "contribution" of capital (which partly confirms the conclusion made in (Yaskal, 2011), and a poorly functioning labor market. In addition, a lower correlation with the share of human capital caused by lower (compared to capital) mobility of this factor.

Despite the volatility, these results confirm the "weak" form of the equal shares relationship. This fact may indicate that the equalization of marginal returns between regions is not perfect. Although speaking about obtained result, we most likely will talk about excessive centralization than the coordination policy areas. It is known that regional governments and local authorities in Ukraine do not have sufficient financial resources, which is a necessary precondition of its regional policy.

c) Measures of internal economic integration

Next, we try to assess the level of economic integration between Ukrainian regions. The question is to choose a parameter that demonstrated to the distance between the distribution of the actual and theoretical specific weights. In probability theory, Kullback-Leibler divergence (KLD) is used to measure the difference between two probability distributions (Bowen et al., 2010; Kullback and Leibler, 1951). By analogy, KLD can be applied in our context to measure the distance between actual and theoretical share distributions. KLD is defined as:

$$KLD\left(\overline{S} : S_t\right) = \frac{1}{3} \sum_{j=Y,K,L} \left(\sum_{m=1}^{M} \overline{S}_{mj} \ln\left(\frac{\overline{S}_{mj}}{S_{mjt}} \right) \right) \quad (1)$$

where S_{mjt} – observed proportion at the time t; $\overline{S}_{mj}$ – independent of time the theoretical part. Values of KLD range between zero and infinity. It is equal to zero (which is interpreted as the full integration) when the proportions are pair-wise equal, i.e. $\overline{S}_{mj} = S_{mjt}$ as of

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the date t and for all m and j. Otherwise, detected deviations indicate how far the group of investigated regions is from complete integration. According to Bowen et al. (2010) formalization (1) has one drawback: "...it is not symmetric, in the sense that a deviation between an actual and theoretical share can be negative or positive. This means that a zero value of KLD could arise either because the distance between the shares is zero, or because the shares are equidistant around a common mean."

For this reason Bowen et al. prefer symmetrical version Kulbaka-Leibler divergence (SKLD):

$$SKLD(\bar{S} : S_t) = \frac{1}{3} \sum_{j=Y,K,L} \left(\sum_{m=1}^{M} (\bar{S}_{mj} - S_{mjt}) \ln \left(\frac{\bar{S}_{mj}}{S_{mjt}} \right) \right) \quad (2)$$

SKLD values is usually higher for the respective KLD, since all deviations between actual and theoretical shares in the index SKLD are positive Bowen et al. (2010).

Table 3 presents the calculated indicators (1) and (2) for Ukrainian regions for the period 2000-2010.

Since the parameters (1) and (2) showing the extent of divergence, we consider appropriate to calculate the inverse indicators to obtain of integration level, the inverse of the KLD and SKLD marked as I-KLD and I-SKLD respectively.

Table 3 : Kullback-Leibler indicators for 2000-2010

Years	Kullback-Leibler divergence		Indicator of integration*	
	KLD	SKLD	I-KLD	I-SKLD
2000	0,1068	0,2070	9,3652	4,8304
2001	0,0898	0,1746	11,1355	5,7287
2002	0,0924	0,1784	10,8270	5,6040
2003	0,0851	0,1661	11,7447	6,0188
2004	0,0763	0,1527	13,1145	6,5487
2005	0,0741	0,1498	13,4929	6,6775
2006	0,0707	0,1401	14,1480	7,1397
2007	0,0645	0,1268	15,5028	7,8879
2008	0,0610	0,1222	16,4057	8,1800
2009	0,0612	0,1181	16,3404	8,4667
2010	0,0636	0,1212	15,7229	8,2497

* Inverse of (symmetric) Kullback-Leibler divergence

To better study the dynamics of integration for the period in Fig. 1 the value I-KLD and I-SKLD represented graphically.

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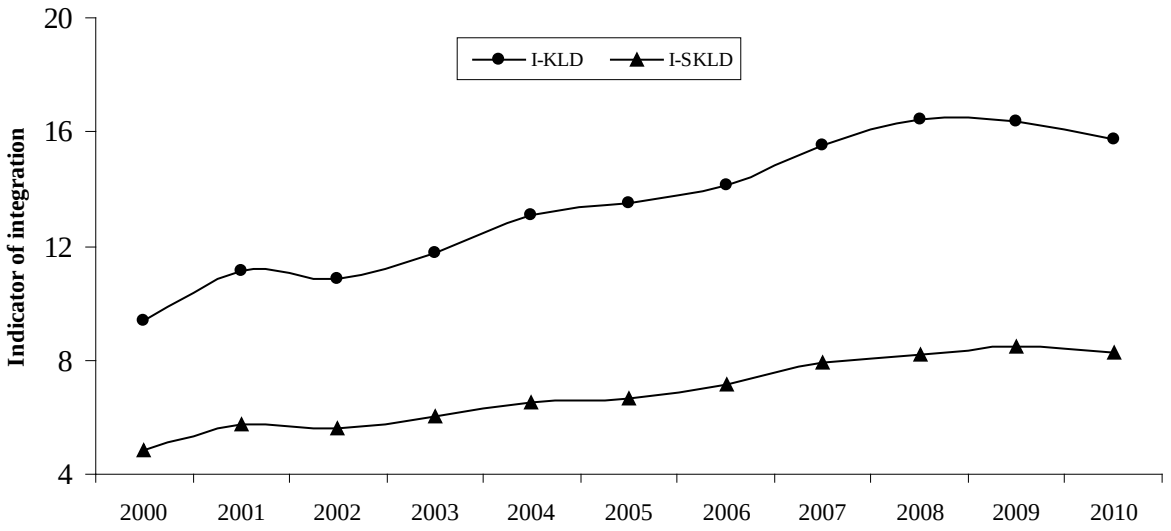

Fig. 1 : Dynamics of intra-regional integration in Ukraine during 2000-2010

From Table. 3 and Fig. 1 evident that the level of economic integration between regions in Ukraine is gradually increasing since 2000, despite some changes in the direction of reduction. Decreasing of I-SKLD value in 2010 can be explained by the negative impact of the financial crisis. Deterioration of economic environment in 2009-2010 obviously has led to nonuniform changes in specific weights of output and production factors of regions in total, and thus increased the discrepancy between the theoretical and actual distribution of shares. In general, we can assume the hypothesis about the close relationship between economic development and the deepening of inter-regional economic integration (one proof of this is the high correlation between I-SKLD and GRP – 0.96), but this suggestion requires further detailed studies.

III. Conclusion

The study received a number of specific interactions that emerge between the economies that make up an integrated economic space. In our case, the integrated economic space is the national economy of Ukraine and units – regions. So, the level of intra-regional economic integration has been evaluated as the relationship between the regions. First, we tested the relationship of equal shares. Calculation of Spearman's rank correlation showed a significant relationship between the presence of specific weights of regions in total production and production factors. Conclusions about the dominant role of capital in Ukrainian economic growth and a relatively smaller role of human capital in it have been confirmed.

The level of intra-regional economic integration estimated using Kullback-Leibler divergence and inverse parameters. Calculations demonstrated an increasing tendency to deepen the internal integration of the Ukrainian economy, although 2009-2010 were characterized by a reduction in intra-regional economic integration.

In addition to the quantitative measurement of intra-regional economic integration, the advantage of this approach is that it confirms the idea: increased mobility of production factors and reducing of barriers to flows between regions means strengthening the equal shares relationship. However, we recognize that differences between countries are not identical to inter-regional differences within the same country. The state has a number of characteristics that are inherent to all of its territory, in particular: the only macroeconomic area, currency zone, the absence (or their lower) barriers between regions for the movement of people, capital, goods, services and information, the relative unity of the institutional system.

Promising areas for further research can be regarded as the evaluation of sector-level economic integration between regions that would characterize as fully as possible the level of integration interaction regions of Ukraine.

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