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**COMMONWEALTH OF INDEPENDENT STATES ECONOMIC DEVELOPMENT:
MULTIDIMENSIONAL COMPARISON OF STATES**

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Abstract

After the disintegration of the Soviet Union several new states were founded, and majority of them created the Commonwealth of Independent States (CIS) while three Baltic states decided about independent path of development so now they are member states of EU.

The aim of the paper is to evaluate the level of economic development of 10 countries, that previously were Soviet Union republic. The evaluation procedure is provided applying taxonomic indicators constructed on the basis of 12 variables observed for each country in years 1995–2009. Aggregated measure values are used to classify the investigated states into four classes containing countries with similar level of economic development.

Keywords: CIS (Commonwealth of Independent States), synthetic taxonomic measures, economic development, clusteing.

JEL classification: C10, O10, O50, O57.

Introduction

It is more than twenty years after the fall of the Berlin Wall and the beginning of transition in former socialist countries. When the post-communist countries in Central and Eastern Europe started their way toward market economy there was no preexisting theory of transition. Therefore from the beginning of transformation from centrally planned to market economies there have been a lot of controversies on¹:

- the speed of reforms,
- privatization methods,
- the role and organization of government,
- the kind of financial system needed, etc.

These controversies often have been treated as ideological however they have been mainly connected with the ignorance and unpreparedness of economists and politicians with respect to large-scale institutional changes implied by the transition. It is worth mentioning that these changes have influenced not only domestic condition in transformed states but also international situation, to mention breakup of Yugoslavia, Czechoslovakia and the Soviet Union.

Multidimensional comparable analysis is used for ranking, clustering and classification of complex objects, such as countries, that are described by many features. Quantitative evaluation of different regions or countries development allows us to determine the changes that have been taking place. They could take into consideration the major aspects of economic and social development, different directions of their change and significances².

The aim of the paper is to compare the level of economic development in 10 countries that were previously the Soviet Union republics. In the research taxonomic indicators are constructed on the basis of 12 variables observed for each country in years 1995–2009. Aggregated measure values are used to classify the investigated states into four classes containing countries characterized by similar level of economic development. Changes in the time of the states positioning is also provided.

1. Literature review

The transition from centrally planned to market-oriented economies has been attracting economists since the beginning of nineties of the previous century. Therefore many problems have been discussed in the literature, starting from the “general view” of transformation, via the opinions about the problems and goals that should be achieved, to many detailed aspects

of transition. In general, two ways of transformation of the economic system have been distinguished³:

- Type I, rapid reforms in “big bang” style also called “Washington Consensus”;
- Type II, gradual reforms also labeled as evolutionary-institutional perspective.

The former was dominant at the beginning of transformation in Central and Eastern Europe. Those reforms proved relatively sustainable and were associated with improving economic performance in Central Europe (except the Czech Republic) and in the Baltic states. However they were much less successful in Russia and other countries of the Commonwealth of Independent States (CIS) as well as in the Balkans.

The latter has had more support in academic environment than in international policy circles. It was a minority approach at the beginning of economic and political transformation but it has gained more and more support over time. The evolutionary reforms required from governments to have enough resources to enforce market-friendly laws and to avoid being captured or dominated by special interests. Although it is difficult to capture a full range of differences across the transition states in Type II reforms, it is possible to point out the differences across several areas: privatization, banking reform, labor allocation, legal system, etc.⁴

Roland⁵ argues that such classification of changes that were introduced in transition countries mainly emphasizes the speed of reforms while there are many dimensions that should be taken into account. He also names several “unexpected surprises” that were brought by transition, among them the economic decline in all the countries in the former socialist bloc, or the extent of the development of the “Mafia phenomenon”. Whereas Boeri and Terrel⁶ point out the situation on the labor market and distinguish two key patterns of the labor reallocation.

The first one created by the group of former Soviet Union republics (where relatively little decline in employment was observed) marked the decrease in labor productivity and real wages, large turnover of the unemployment pools, and the relatively small reallocation of jobs between the “old” and “new” sectors.

The second pattern is characteristic for the majority of the Central and Eastern European states with consequently lower declines in labor productivity. In these countries the economic recovery started earlier than in Russia and other countries belonging to the CIS. However, along with a fairly rapid degree of structural change, these countries have experienced stagnant unemployment⁷. There are two exceptions from the patterns described above: the Czech Republic that experienced a long period of low unemployment, and Estonia that have been experiencing significant labor reallocation since the beginning of the transformation process.

The countries in transition which formerly belonged to the Soviet Bloc have always differed much⁸ because of their different origins, natural resources, geographies and cultural developments over centuries. However, during the socialist era politicians tried to reduce differences in development levels among these states, and the convergence in economic and social outcomes was obtained to some extent. Therefore, due to these differences that appeared among the post-communist countries in the past and various patterns of the economic system reforms, the transition economies should be evaluated and classified into homogenous groups according to the variety of features that are characteristic of the investigated states. Thus development should be regarded as a multidimensional process involving the reorganization and reorientation of the entire economic and social systems. The improvement of socio-economic situation causes radical changes in institutional, social and administrative structures. Moreover, the changes in popular attitudes, and, in many cases, even customs and beliefs can be observed⁹. To conduct such a complicated analysis multidimensional evaluation methods have been used recently.

The paper by Foo and Witkowska¹⁰ discusses the progress achieved by the EC8 to accede to the European Union (EU) as well as the reforms, strategies and convergence goals necessary to achieve the EMU membership. Using synthetic taxonomic measure, the empirical study finds that most of the EC8 countries are on track to achieve the EMU membership but post-facto membership does not guarantee the maintenance of market restructuring. Another paper¹¹ analyzes the development and performance of the banking systems after two decades of transition. Using data from 1995–2006, a multidimensional statistical analysis is applied to investigate the current banking performance in ten EU transition countries, in particular – to what degree has banking sectors developed and performance improved for the new EU members since implementing reforms.

The paper discusses the progress in transitioning to a market economy by the emerging European countries and provides their business characteristics and environment¹². Using two classification methods – the discrimination analysis and taxonomic measure, the paper investigates the possibility of the South Eastern European and CIS transitional countries to develop an enterprise and business environment that is compatible with the new European Union members. What is more, Foo, Witkowska¹³ apply Granger causality tests to investigate what factors attract foreign banks penetration into the transition countries.

Cornia presents the comparison of the level of economic development in 25 transition countries in 2000–2007¹⁴. The analysis is provided by a clustering analysis employing 4 ratios evaluated as a share of GDP: (1) net manufacturing exports, (2) “other services” (3) net exports

of fuels and ores (4) the sum of Official Development Assistance. The result of the investigation are four homogenous groups of countries.

Construction of various aggregated measures, with a purpose to evaluate the level of the development on the basis of multidimensional analysis, is often discussed in the literature¹⁵. The best known development indicator is the Human Development Index (HDI) although its definition of the concept of human well-being is rather narrow. The HDI is a global measure that is evaluated for countries from all over the world, therefore it is characterized with low discrimination abilities¹⁶ when comparing states from one region (for instance the European Union members) or the ones at the similar stage of development (such as transition economies). Kompa and Witkowska¹⁷ evaluate the socio-economic level of development of the European Union member states in 1990–2006 by constructing indicators on the basis of 21 variables belonging to 6 groups: living conditions, education, medical care and health, environmental protection, technical and economic infrastructure and information society. Similar research including 87 variables for 24 distinguished criteria was conducted for Lithuania counties by Ginevicius and Podvezko, while Sojka compared the demographic growth of Polish voivodeships by means of 15 diagnostic features¹⁸. In the paper by¹⁹ the author compares the results of endowment level to technical infrastructure of 20 mountain communes in the Podkarpackie province (Poland) according to different aggregated measures. To construct synthetic taxonomic measures 8 diagnostic variable characterizing elements of technical infrastructure of country area are employed.

2. The Commonwealth of Independent States: Data description

After the collapse of the Soviet Union several new states were founded and the majority of them created the Commonwealth of Independent States (CIS). Three Baltic states decided about different path of development and now they are member states of the European Union. The Commonwealth of Independent States was founded on 8 December 1991 by the Republic of Belarus, the Russian Federation, and Ukraine. At present there are 9 official members of the CIS, i.e. Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan and Uzbekistan. Although Turkmenistan and Ukraine are not official members, they participate in the CIS. Georgia was a member until 2009 (stepped out in 2008). Our analysis covers the years of 1995–2009 and 10 CIS states, including Georgia, and excluding Uzbekistan and Turkmenistan since statistical data concerning these countries were not available.

Table 1. Gross Domestic Product (GDP) and GDP per-capita in the CIS

Country	GDP per-capita						GDP		
	2010			2009			2010		
	IMF spec.	Rank in		WB spec.	Rank in		WB spec.	Rank in	
CIS		World	CIS		World	CIS		World	
Armenia	2,846	5	118	2,826	6	104	9,265	7	126
Azerbaijan	6,008	3	77	4,899	4	80	51,092	5	72
Belarus	5,800	4	79	5,075	3	79	54,713	4	70
Georgia	2,448	7	115	2,315	7	103	11,667	6	120
Kazakhstan	7,019	2	66	6,708	2	55	142,987	2	52
Kyrgyzstan*	2,424	8		2,261	8		4,004	10	149
Moldova	1,514	10	125	1,159	10	119	5,809	8	141
Russia	8,694	1	59	9,115	1	44	1,479,819	1	11
Tajikistan**	2,190	9		2,104	9		5,640	9	143
Ukraine	2,542	6	112	3,029	5	91	137,928	3	53

* www.tradingeconomics.com/kyrgyzstan/gdp-per-capita-ppp-us-dollar-wb-data.html.

** www.tradingeconomics.com/tajikistan/gdp-based-on-purchasing-power-parity-ppp-per-capita-gdp-imf-data.html.

Note: IMF and WB specifications in [mio US\$].

Source: own elaboration on the basis of data from International Monetary Fund (IMF) and World Bank (WB), <http://siteresources.worldbank.org/DATASTATISTICS/Resources/GDP.pdf>.

In terms of territory Russia is the largest country in the CIS with 81% of the whole CIS territory, followed by Kazakhstan with 13% of the CIS territory. Ukraine is the third – 3% of whole CIS territory. In terms of population 58% of the CIS population lives in Russia, followed by Ukraine with 19% of population and Kazakhstan with 6%.

Table 1 contains data regarding GDP in millions of US dollars and GDP per capita in US\$ together with the ranking positions observed in the CIS and in the world. The Table shows that Russia has the strongest economy and a leading position among all the CIS states while Kazakhstan and Ukraine are the second and the third largest economies in terms of GDP. Belarus, which was the 4th in 2010, had GDP bigger than the total of GDPs generated by six states holding lower positions. The 5th GDP level was obtained by Azerbaijan and in 2010 it was similar to the one obtained by Belarus. One may also notice that Armenia and Ukraine together with Azerbaijan and Belarus changed their position in the CIS per capita ranking in 2009 and 2010.

In our investigation we attempt to evaluate the level of economic development of the CIS states. Therefore we have employed main economic indicators in percentage year to year since the variables so defined can be compared one to another in case of all the analyzed countries (Table 2). The source of the data that we use in our investigation is the Interstate Statistical Committee of the Commonwealth of Independent States²⁰. Missing observations are completed by introducing values generated by the trend function.

Table 2. Diagnostic variables

Type	Symbol	Description – annual rate of growth of
Stimulant	X_1	GDP
Stimulant	X_2	industrial production
Stimulant	X_3	agricultural production
Stimulant	X_4	capital investment
Stimulant	X_5	freight carried
Stimulant	X_6	retail trade turnover
De-stimulant	X_7	industrial producers price index
De-stimulant	X_8	consumer price index
Stimulant	X_9	export to Commonwealth of Independent States
Stimulant	X_{10}	export to other countries (than CIS states)
De-stimulant	X_{11}	import from CIS
De-stimulant	X_{12}	import from other countries (than CIS)

Source: own elaboration.

Four of the diagnostic variables are recognized as de-stimulants while the remaining ones – as stimulants. Please note that all variables are unit-free, thus the problems with national currencies have been avoided. In Table 7 in Appendix you can see that the variability coefficients are slightly smaller than 10% for the variables X_1 – X_3 , but we did not reject any of them since there were no other variables available that could be used for constructing the indicator. It is also worth mentioning that the correlation among all the variables is acceptable since the biggest value of Pearson coefficient is observed between price indexes X_8 and X_7 , and it equals 0.85.

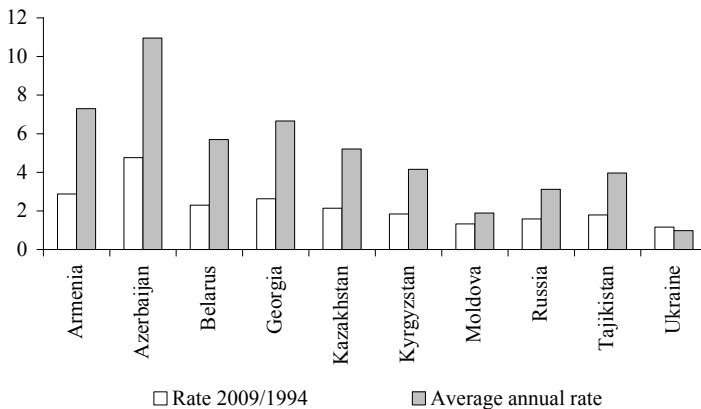


Fig. 1. The GDP growth rates

Source: own evaluation.

All macroeconomic parameters in majority of the CIS states were essentially increasing from 1995 to 2008 i.e. economic crisis (see Table 8 in Appendix where the GDP growth rate is presented). However, the rate of the growth differs in the analyzed countries (see Figure 1 that shows the GDP growth rate in 2009 in comparison to 1994 and the annual average growth rate in these years). One may notice that the development of Azerbaijan in terms of the GDP growth rates, capital investments, freight carried, export to and import from other than the CIS states is spectacular (see Tables 9–10) due to production of oil and natural gas.

3. Multidimensional statistical indicators

In our research we constructed multidimensional indicators to compare the level of economic development of 10 CIS countries in 1995–2009. We used four taxonomic measures: SMR_{it} , AMR_{it} , BMR_{it} , CMR_{it} , where i denotes the i -th country ($i = 1, 2, \dots, 10$) and t – the period of time ($t = 1995, 1996, \dots, 2008, 2009, T$) because we evaluated each indicator for every year separately and SMR_{it} , AMR_{it} , BMR_{it} , CMR_{it} were global measures regarding changes that took place in the whole analyzed period based on growth rates i.e. simple index numbers calculated for 2009 in comparison to 1994.

Let us define the synthetic measure of development SMR_{it}^{21} :

$$SMR_{it} = 1 - \frac{q_{it}}{\bar{q}_t + 2 \cdot S_{qt}}; \quad i = 1, 2, \dots, n; t = 1, 2, \dots, T \quad (1)$$

where q_{it} is the distance of the i -th object from the benchmark z_{jt}^0 :

$$q_{it} = \sqrt{\sum_{j=1}^k (z_{jt}^i - z_{jt}^0)^2}, \quad z_{jt}^0 = \begin{cases} \min_{i=1, 2, \dots, n} \{z_{jt}^i\} & \text{for } x_{jt}^i \in D \\ \max_{i=1, 2, \dots, n} \{z_{jt}^i\} & \text{for } x_{jt}^i \in S \end{cases} \quad (2)$$

where z_{jt}^i – standardized variable obtained from x_{jt}^i , j -th discriminant variable, D, S – sets of destimulants and stimulants, respectively, and \bar{q}_t, S_{qt} – the average and the standard deviation of distances q_{it} , respectively:

$$\bar{q}_t = \frac{1}{n} \sum_{i=1}^n q_{it}, \quad S_{qt} = \sqrt{\frac{1}{n} \sum_{i=1}^n (q_{it} - \bar{q}_t)^2} \quad (3)$$

Three other measures are called “absolute” since they do not require any benchmark:

$$ASM_{it} = \sum_{j=1}^k \frac{x_{jt}^i}{S_{jt}^x} \quad (4)$$

$$BSM_{it} = \frac{1}{k} \sum_{j=1}^k \frac{x_{jt}^i - \min(x_{jt}^i)}{\max(x_{jt}^i) - \min(x_{jt}^i)} \quad (5)$$

$$CSM_{it} = \frac{1}{k} \sum_{j=1}^k \frac{x_{jt}^i}{\max(x_{jt}^i)} \quad (6)$$

where $\max(x_{jt}^i)$, $\min(x_{jt}^i) \pm$ maximal and minimal values of $\{x_{jt}^i\}$.

Measures (4) and (6) were introduced by Cieślak, Zeliaś and Malina²² respectively, and (5) is the same type of indicator as the Human Development Index (HDI). On the basis of the measure $MR_{it} = \{SMR_{it}, AMR_{it}, BMR_{it}, CMR_{it}\}$ values it was possible to classify all the countries into homogenous groups in terms of the level of economic development. We distinguished four classes of states that were characterized by mean and standard deviations of the measures evaluated for each year separately:

$$\text{class 1 – very high level of development if } MR_{it} \geq MR_t + S_{MRt} \quad (7a)$$

$$\text{class 2 – high level of development if } MR_t + S_{MRt} > MR_{it} \geq MR_t \quad (7b)$$

$$\text{class 3 – average level of development if } MR_t > MR_{it} \geq MR_t - S_{MRt} \quad (7c)$$

$$\text{class 4 – low level of development if } MR_{it} < MR_t - S_{MRt} \quad (7d)$$

where MR_{it} ; MR_t ; S_{MRt} – value of the aggregated measure evaluated for the i -th country in the t -the period of time, average and standard deviation of indicators, respectively.

Dynamic analysis is provided applying trend function:

$$MR_{it} = \alpha + \beta \cdot t + \varepsilon_t \quad (8)$$

where: α , β , ε_t – trend parameters and random component.

4. Results

The results of the country classification due to values of taxonomic measures refer to 10 states, 4 methods and 15 years of analysis therefore there are 60 classifications for each country. So, in order to decide about the class that each country belongs to, we used a majority rule recognizing the state as a member of the group where it was classified the most often, and we employed global measures SMR_{it} , AMR_{it} , BMR_{it} , CMR_{it} .

Table 3 contains the numbers of classes that are defined for each investigated state by means of all the constructed taxonomic measures. The presented results confirm relative stability of classification of 10 former Soviet Union republics due to the employed measures and significant changes in time. The reason of such essential changes in classification in the subsequent years is the definition of variables that describe the rate of increase of main economic indicators.

Table 3. Classification of countries

Country	MR_i	Year														
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Armenia	SMR	1	2	4	1	2	2	2	1	1	2	2	2	3	4	3
	AMR	1	1	4	2	2	3	2	1	2	4	2	3	2	3	3
	BMR	1	2	3	1	2	2	1	1	1	3	1	2	2	3	3
	CMR	2	2	3	1	2	2	1	1	1	3	1	2	2	4	3
Azerbaijan	SMR	3	2	2	3	1	1	2	2	3	2	1	2	1	1	1
	AMR	3	2	2	1	1	1	1	2	2	2	1	1	2	3	1
	BMR	3	2	2	2	1	1	2	2	3	2	1	2	1	1	1
	CMR	2	2	1	2	1	1	2	2	2	1	1	1	2	2	1
Belarus	SMR	3	2	2	2	4	4	4	4	4	2	2	2	2	2	3
	AMR	4	2	2	2	4	4	4	3	3	2	2	2	3	3	3
	BMR	4	2	3	2	3	4	4	4	4	2	2	2	2	1	3
	CMR	4	2	3	2	4	4	4	4	4	3	2	2	2	2	3
Georgia	SMR	1	1	1	1	2	3	3	2	1	4	1	4	2	1	2
	AMR	1	2	1	2	2	3	4	3	1	4	2	2	1	1	2
	BMR	1	1	1	1	2	3	3	2	1	4	1	3	1	1	2
	CMR	1	1	1	1	2	2	3	2	1	4	1	3	1	1	2
Kazakhstan	SMR	3	2	2	2	1	2	1	2	2	3	3	2	3	2	2
	AMR	3	2	2	3	1	1	1	2	2	3	2	2	2	3	3
	BMR	3	2	2	3	1	1	1	2	2	2	3	2	3	3	2
	CMR	3	2	2	2	2	2	2	2	2	2	3	2	2	3	2
Kyrgyzstan	SMR	3	2	1	3	2	2	3	4	2	3	4	4	2	4	2
	AMR	3	1	1	2	2	3	4	4	3	4	4	4	2	3	2
	BMR	3	2	1	3	2	2	3	4	2	3	4	4	2	4	2
	CMR	2	2	1	3	2	2	3	4	3	3	4	4	2	3	2

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Moldova	SMR	2	3	3	4	4	4	2	2	4	2	4	3	4	2	4
	AMR	2	3	3	4	4	4	2	2	4	3	3	4	4	3	3
	BMR	1	3	3	4	4	4	2	2	3	3	4	4	4	2	4
	CMR	2	3	3	4	4	4	2	2	3	3	4	4	4	3	4
Russia	SMR	3	3	3	4	2	2	3	3	3	3	3	2	3	2	3
	AMR	3	3	3	4	2	2	3	3	4	3	3	3	3	3	3
	BMR	2	3	3	4	2	2	3	3	3	4	3	2	4	2	3
	CMR	3	3	3	4	2	2	3	3	3	3	3	2	4	2	3
Tajikistan	SMR	3	4	4	2	2	2	4	2	3	1	2	1	2	3	2
	AMR	4	4	3	2	2	3	3	2	2	1	3	2	2	3	2
	BMR	4	4	4	2	3	2	4	2	3	1	2	2	3	3	2
	CMR	3	4	4	2	2	3	4	2	4	1	2	1	3	3	2
Ukraine	SMR	4	4	3	3	3	2	2	3	2	1	4	2	2	3	4
	AMR	3	3	3	3	3	2	2	3	2	1	3	3	2	3	3
	BMR	3	4	3	3	3	2	2	3	2	1	4	2	2	4	4
	CMR	3	3	3	3	3	2	2	3	2	1	4	2	2	3	4

Source: own evaluation.

In Table 4 we present the proposed classes that should group the investigated states according to their economic development in 1995–2009. The best developed state is Georgia, while the second class contains 6 countries: Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan and Tajikistan. Russia and Ukraine belong to the third class, and Moldova seems to be the least developed state. It is worth mentioning that two biggest economies i.e. Russia and Ukraine might be under-evaluated since the country ranking bases on the growth rate.

Table 4. Number of the classifications of countries

Class	Armenia	Azerbaijan	Belarus	Georgia	Kazakhstan
1	18	26	1	28	8
2	24	27	26	17	36
3	13	7	13	9	16
4	5	0	20	6	0
	Kyrgyzstan	Moldova	Russia	Tajikistan	Ukraine
1	5	1	0	5	4
2	22	14	15	26	19
3	17	18	37	16	27
4	16	27	8	13	10

Source: own evaluation.

In Table 5 we compare the position of all the states taking into account all years of the study. It can be seen that the ranking of countries made according to all four measures is stable

for such states as: Georgia and Azerbaijan (always in the first class), Ukraine, Tajikistan and Kyrgyzstan (always in the third class), as well as Moldova – always at the last position

Table 5. Comparison of the states positions obtained by global measures 2009/1994

Class	Rank	SMR	ASM	BSM	CSM
1.	1	Belarus	Georgia	Georgia	Georgia
	2	Georgia	Azerbaijan	Azerbaijan	Azerbaijan
	3	Azerbaijan	Kazakhstan	Belarus	Belarus
2.	4	Kazakhstan	Armenia	Kazakhstan	Kazakhstan
	5	Armenia	Tajikistan	Armenia	Armenia
3.	6	Kyrgyzstan	Russia	Tajikistan	Tajikistan
	7	Tajikistan	Kyrgyzstan	Kyrgyzstan	Kyrgyzstan
	8	Ukraine	Ukraine	Russia	Russia
4.	9	Russia	Belarus	Ukraine	Ukraine
	10	Moldova	Moldova	Moldova	Moldova

Source: own evaluation.

At the last stage of our investigation we estimated the trend function (8) for each state and measure. Table 6 contains the results of the trend model OLS estimation. The statistical significance of a beta coefficient informs about essential changes over time. At the significance level 0.05 such situation occurs only in case of the composite measure CMR. One may also notice that the determination coefficients for this measure are essentially bigger than for other measures.

Table 6. Trend parameters evaluated for each aggregated measure

State	Measure							
	SMR		AMR		BMR		CMR	
	R ²	$\hat{\beta}$	R ²	$\hat{\beta}$	R ²	$\hat{\beta}$	R ²	$\hat{\beta}$
Armenia	0.162	0.50	0.160	0.470	0.140	22.77	0.35	18.09
Azerbaijan	0.072	-0.35	0.080	-0.380	0.010	-2.59	0.25	11.07
Belarus	0.027	-0.19	0.040	-0.240	0.030	-8.01	0.00	0.44
Georgia	0.191	0.67	0.080	0.490	0.220	24.51	0.69	23.45
Kazakhstan	0.047	0.23	0.040	0.190	0.130	17.08	0.40	15.93
Kyrgyzstan	0.179	0.63	0.170	0.630	0.250	26.43	0.47	18.31
Moldova	0.072	0.31	0.070	0.310	0.230	25.94	0.59	18.57
Russia	0.004	0.05	0.001	0.030	0.140	14.44	0.35	13.45
Tajikistan	0.186	-0.55	0.220	-0.600	0.090	-17.49	0.00	1.05
Ukraine	0.004	0.06	0.003	0.050	0.030	9.83	0.14	10.66
Average	0.072	0.14	0.033	0.096	0.295	11.29	0.47	13.10

Note: numbers in bold denote significance at $\alpha = 0.05$.

Source: own evaluation.

Conclusions

The evaluation results of the CIS countries economic development level show essential differences among the former Soviet Union republics. Thus it is possible to distinguish the leaders of transformation such as Georgia, Azerbaijan and Kazakhstan and laggards as Moldova, Ukraine and Belarus. Leading positions were obtained mostly by a significant increase of export, capital investment and freight carried. In addition, Georgia enjoyed the highest rate of retail trade turnover growth. Low position in ranking was obtained by Moldova mostly because of decreased industrial and agricultural production, capital investment and freight. Ukraine was characterized by the slowest (but positive except for the rate of freight carried) growth of the majority of macroeconomic parameters that are regarded as a development stimulant. While Belarus suffered from huge inflation, especially in 1995 (the inflation rate was 461% and 709% for variables X_7 and X_8), 1999 (with the inflation of, respectively, 356% and 294%) and 2000 (186% and 169% for both variables respectively).

It is also worth noting that the two biggest states (in terms of population) i.e. Russia and Ukraine belong to the third class, which may result from the applied diagnostic variables that are defined as the growth rates of main macroeconomic indicators. It let us omit the scale of the analyzed states. However, one should also realize that in such analysis larger organizations (countries) may be evaluated as worse than they actually are because it is easier to report higher dynamics of development for smaller than for bigger objects.

It is worth mentioning that all synthetic measures classify the CIS states in a similar way in each year, however the positions of individual countries were changing in the subsequent years. It means that country ranking is not sensitive to the measure construction while changes in time are mostly visible in case of the CMR measure.

Appendix

Table 7. Diagnostic variables and Pearson coefficients

Variables	Variability [%]	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁
X ₁	6.8	1.00										
X ₂	7.7	0.54	1.00									
X ₃	7.7	0.69	0.09	1.00								
X ₄	22.1	0.39	-0.50	0.53	1.00							
X ₅	12.1	0.72	0.46	0.73	0.08	1.00						
X ₆	10.6	0.72	0.13	0.69	0.46	0.72	1.00					
X ₇	22.3	-0.24	0.32	-0.28	-0.50	-0.36	-0.45	1.00				
X ₈	21.2	-0.41	0.05	-0.21	-0.38	-0.44	-0.30	0.85	1.00			
X ₉	19.8	-0.57	-0.10	-0.58	-0.32	-0.63	-0.53	0.65	0.71	1.00		
X ₁₀	28.8	0.48	0.73	0.12	-0.31	0.19	0.19	0.35	0.26	0.04	1.00	
X ₁₁	18.0	-0.13	0.16	-0.31	-0.04	-0.57	-0.54	0.67	0.54	0.70	0.25	1.00
X ₁₂	18.8	0.45	-0.12	0.81	0.48	0.54	0.83	-0.24	0.05	-0.41	0.08	-0.44

Source: own evaluation.

Table 8. GDP growth as a percentage of the previous year

Year	Country									
	Armenia	Azerbaijan	Belarus	Georgia	Kazakhstan	Kyrgyzstan	Moldova	Russia	Tajikistan	Ukraine
1995	106.9	88.2	89.6	102.6	91.8	94.6	98.6	95.9	87.6	87.8
1996	105.9	101.3	102.8	111.2	100.5	107.1	94.1	96.4	83.3	90.0
1997	103.3	105.8	111.4	110.5	101.7	109.9	101.6	101.4	101.7	97.0
1998	107.3	110.0	108.4	103.1	98.1	102.1	93.5	94.7	105.3	98.1
1999	103.3	107.4	103.4	102.9	102.7	103.7	96.6	106.4	103.7	99.8
2000	105.9	111.1	105.8	101.8	109.8	105.4	102.1	110.0	108.3	105.9
2001	109.6	109.9	104.7	104.8	113.5	105.3	106.1	105.1	109.6	109.2
2002	113.2	110.6	105.0	105.5	109.8	100.0	107.8	104.7	110.8	105.2
2003	114.0	111.2	107.0	111.1	109.3	107.0	106.6	107.3	111.0	109.6
2004	110.5	110.2	111.4	105.9	109.6	107.0	107.4	107.2	110.3	112.1
2005	113.9	126.4	109.4	109.6	109.7	99.8	107.5	106.4	106.7	102.7
2006	113.2	134.5	110.0	109.4	110.7	103.1	104.8	107.7	107.0	107.3
2007	113.8	125.0	108.6	112.3	108.9	108.5	103.0	108.1	107.8	107.9
2008	106.8	110.8	110.0	102.1	103.3	107.6	107.2	105.6	107.9	102.1
2009	85.6	109.3	100.2	108.0	101.2	102.3	93.5	92.1	103.4	85.0
Rate 2009/1994	287.8	475.6	229.7	263.0	214.2	184.1	132.4	158.4	179.2	115.7
Geom. mean	7.30	10.96	5.70	6.66	5.21	4.15	1.89	3.12	3.96	0.98

Note: Geometric mean is calculated from the growth rates evaluated for the years from 1994 to 2009.

Source: www.cisstat.com/eng/frame_macro.htm and own evaluation.

Table 9. Annual percentage average rates

Variables	Country										
	Armenia	Azerbaijan	Belarus	Georgia	Kazakhstan	Kyrgyzstan	Moldova	Russia	Tajikistan	Ukraine	median %
X_1	7.30	10.96	5.70	6.66	5.21	4.15	1.89	3.12	3.96	0.98	4.68
X_2	3.46	6.82	7.36	8.31	4.96	1.34	-0.60	1.75	2.56	2.20	3.01
X_3	4.52	4.23	2.33	2.28	0.89	4.17	-1.33	1.36	4.49	0.39	2.30
X_4	12.28	24.90	8.55	24.80	10.60	8.88	-2.15	3.01	16.98	1.09	9.74
X_5	2.75	9.89	0.51	33.22	4.80	1.95	-5.99	-3.59	2.92	-3.78	2.35
X_6	12.21	11.61	13.31	18.61	11.86	7.88	4.98	5.85	4.95	7.61	9.75
X_7	16.80	13.76	68.01	6.93	18.55	18.86	17.02	27.87	42.34	24.21	18.71
X_8	12.45	6.34	66.72	14.15	18.33	14.70	15.10	25.24	45.32	29.05	16.71
X_9	1.22	12.57	13.01	12.69	9.05	3.82	1.43	8.31	5.53	6.16	7.24
X_{10}	15.83	26.88	17.92	26.6	24.54	14.95	11.27	11.63	4.73	12.18	15.39
X_{11}	11.83	9.32	15.51	17.03	12.08	15.22	6.12	5.14	12.63	6.44	11.96
X_{12}	17.99	19.49	17.06	12.79	17.86	15.47	17.80	11.58	8.80	15.65	16.35

Source: own evaluation on the basis of www.cisstat.com/eng/frame_macro.htm and own evaluation.

Table 10. Rates of growth 2009/1994

Variables	Country										
	Armenia	Azerbaijan	Belarus	Georgia	Kazakhstan	Kyrgyzstan	Moldova	Russia	Tajikistan	Ukraine	median
X_1	287	475	229	262	214	184	132	158	179	115	199
X_2	166	269	290	331	206	122	91	129	146	138	156
X_3	194	186	141	140	114	184	81	122	193	105	140
X_4	568	2,809	342	2,774	453	358	72	155	1,050	117	405
X_5	150	411	107	7,390	201	133	39	57	153	56	141
X_6	562	519	651	1,294	537	311	207	234	206	300	415
X_7	1,027	691	239,868	273	1,283	1,335	1,056	3,994	19,939	2,583	1,309
X_8	581	251	213,800	728	1,248	782	823	2,923	27,220	4,584	1,036
X_9	119	590	626	599	366	175	123	331	224	245	288
X_{10}	906	3,556	1,184	3,458	2,688	808	496	520	199	560	857
X_{11}	535	380	869	1,058	553	837	243	212	595	255	544
X_{12}	1,196	1,444	1,062	608	1,176	865	1,167	517	354	885	973

Source: own evaluation on the basis of www.cisstat.com/eng/frame_macro.htm and own calculations.

Notes

- ¹ See Roland (2001).
- ² Ginevicius, Podvezko (2009). There are numerous examples of the application of multidimensional statistical analysis to compare countries or regions, see Nijkamp (1986); Nijkamp, Vindigni (2000) among others.
- ³ See Svejnar (2002); Roland (2001).
- ⁴ Svejnar (2002); Boeri, Terrel (2002).
- ⁵ Roland (2001).
- ⁶ Boeri, Terrel (2002).
- ⁷ See Rutkowski (2003) who discusses in detail the case of Lithuania.
- ⁸ See Cornia (2010).
- ⁹ Todaro, Smith (2003), p. 110.
- ¹⁰ Foo, Witkowska (2008a).
- ¹¹ Witkowska, Foo (2009).
- ¹² Foo, Witkowska (2008b).
- ¹³ Foo, Witkowska (2009).
- ¹⁴ Cornia (2010).
- ¹⁵ Alkire, Sarwar (2009).
- ¹⁶ Kompa, Witkowska (2010a).
- ¹⁷ Kompa, Witkowska (2009; 2010b).
- ¹⁸ Ginevicius, Podvezko (2009); Sojka (2008).
- ¹⁹ Krakowiak-Bal (2005).
- ²⁰ www.cisstat.com/eng/frame_macro.htm.
- ²¹ Hellwig (1968).
- ²² Cieślak (1974); Zeliaś, Malina (1997).

References

- Alkire, S. & Sarwar, M. (2009). Multidimensional Measures of Poverty and Well-Being. *Report Working Paper for the European Commission*, www.ophi.org.uk/wpcontent/uploads/OPHI-RP-6a.pdf.
- Brauers, W.K., Ginevicius, M.R., Zavadskas, E.K. & Antucheviciene, J. (2007). The European Union in a Transition Economy. *Transformations in Business and Economics*, 6 (2), 21–37.
- Boeri, T. & Terrel, K. (2002). Institutional Determinants of Labor Reallocation in Transition. *Journal of Economic Perspectives*, Vol. 16, No. 1, 51–76.
- Cieślak, M. (1974). Taksonomiczna procedura prognozowania rozwoju gospodarczego i określenia potrzeb na kadry kwalifikowane. *Przegląd Statystyczny* 21.01.1974.

- Cornia, G.A. (2010). Transition, Structural Divergence, and Performance. *United Nations University UNU-WIDER World Institute for Development Economics research*. Working Paper No. 2010/32.
- Foo, J. & Witkowska, D. (2008a). EMU Convergence Prospects and Transition Countries. *International Journal of Business*, ISSN:1083-4346, 2008, Vol. 13, No. 2, 119–139.
- Foo, J. & Witkowska, D. (2008b). Transitional Progress and Business Challenges. *International Advances in Economic Research*, 215–227.
- Foo, J. & Witkowska, D. (2009). *Foreign Presence and Financial Development in Emerging Countries*. In: D. Witkowska, M. Łatuszyńska (Eds.), *Quantitative Methods in Regional and Sectoral Analysis*. Szczecin: University of Szczecin, Faculty of Economics and management, 13–32.
- Ginevicius, R. & Podvezko, V. (2009). Evaluating the Changes in Economic and Social Development of Lithuanian Counties by Multiple Criteria Methods. *Technological and Economic Development of Economy*. Vilnius Gediminas Technical University 2009, No. 3, 418–436.
- Hellwig, Z. (1968). Zastosowanie metody taksonomicznej do typologicznego podziału krajów ze względu na poziom ich rozwoju oraz zasoby i strukturę kwalifikowanych kadr, *Przegląd Statystyczny*, nr 4, 324.
- Kompa, K. & Witkowska, D. (2009). Comparison of the Socio-Economic Development Level of European Union States: the Distance Measures Application. *Polish Journal of Environmental Studies*, Vol. 18, No. 3B, 391–397.
- Kompa, K. & Witkowska, D. (2010a). *Application of Selected Synthetic Measures to Compare the Socio-Economic Development in European Union State*. In: K. Jajuga, M. Waleśiak (Eds.), *Taksonomia 17*. Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, 71–80 (in Polish).
- Kompa, K. & Witkowska, D. (2010b). *Evaluation of the Development Level of the European Union States in Years 1990–2006*. In: W. Starzyńska, W. Roszko (Eds.), *Macroeconomic Aspects of European Integration*. Acta Universitatis Lodzianis, *Folia Oeconomica* 241, 123–135.
- Krakowiak-Bal, A. (2005). The Implementation of Chosen Synthetic Measures for Construction of Development's Measure of Technical Infrastructure. *Infrastruktura i Ekologia Terenów Wiejskich*, nr 3/2005, PAN, Oddział w Krakowie, 71–82 (in Polish).
- Nijkamp, P. (1986). *Infrastructure and Regional Development: A Multidimensional Policy Analysis, Empirical Economics*. Amsterdam: Free University Press, 1–21.
- Nijkamp, P. & Vindigni, G. (2000). Multidimensional Comparative Assessment Methodology for Policy Analysis: A Multi-Country Study of the Agricultural Sector. *Journal of Environmental Systems*, Vol. 28 71–90.

- Roland, G. (2001). Ten Years After Transition and Economics. *IMF Staff Papers*, Vol. 48, Special Issue.
- Rutkowski, J. (2003). Rapid Labor Reallocation with a Stagnant Unemployment Pool: The Puzzle of the Labor Market in Lithuania. *World Bank Policy Research Working Paper 2946*, www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2003/03/07/000094946_03012304282754/additional/103503322_20041117164006.pdf.
- Sojka, E. (2008). Multidimensional Comparative Analysis of Demographic Growth of Voivodeships in Poland. *Bulletin of Geography, Socio-Economic Series*, No. 9, 5–19.
- Svejnar, J. (2002). Transition Economies: Performance and Challenges. *Journal of Economic Perspectives*, Vol. 16, No. 1, 3–28.
- Todaro, M.P. & Smith, S.C. (2003). *Economic Development*, Addison-Wesley Higher Education Group.
- Witkowska, W. & Foo, J. (2009). Application of Multidimensional Analysis to Banking Development Evaluation. *Polish Journal of Environmental Studies*, Vol. 18, No. 5B, 209–216. www.cisstat.com/eng/frame_macro.htm.
- Zeliaś, A. & Malina, A. (1997). *O budowie taksonomicznej miary jakości życia. Syntetyczna miara rozwoju jest narzędziem statystycznej analizy porównawczej*. In: K. Jajuga, M. Walesiak (Eds.), *Taksonomia 4*. Wrocław: Wydawnictwo Akademii Ekonomicznej we Wrocławiu.