ANALYSIS OF THE DYNAMICS AND REGIONAL DISPERSION OF LABOR PRODUCTIVITY AS AN ALTERNATIVE METHOD OF MEASURING ECONOMIC AND SOCIAL COHESION ON THE EXAMPLE OF THE VISEGRAD GROUP

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Abstract

According to the paradigm of modern economics, the aim of national economies is to strive for sustainable economic development. Observation of economic reality allows to conclude that along with broadly understood economic development, there appear smaller or larger disproportions between the analyzed units, which also include the regions of countries. The evaluation of sustainable growth requires answering a few questions, including whether differences in economic potentials of individual regions do not arise at the expense of other regions and whether there is a correlation or a conflict between the economic growth of the whole country and the cohesion of individual regions.

The aim of the article is to present the labor productivity indicator (LPI) as a proposal of an alternative measure of social and economic development as well as social, economic and territorial cohesion. LPI is information about the ability of the economy to create good institutions. The economy is based on labor, and the productive work can be allowed by a properly developed institutional economic system. The analysis was extended by presenting the results of calculations of LPI for the countries and regions of the Visegrad Group (V4).

Keywords: labor productivity index (LPI), economic growth measurement, social and economic cohesion measurement, economic inequality.

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Introduction

Economic cohesion, sustainable growth and economic development are very broad concepts that overlap to a certain extent. From the perspective of the sustainable development paradigm, a level of country's development is not only reflected by a GDP and a standard of living, but also social and economic cohesion of a given country. In addition to some issues

with definitions, these concepts are primarily related to the problem of their measurement. Economic and social cohesion is an interdisciplinary concept. It integrates goals aimed at reducing market inefficiencies, sustainable growth, endogenous growth and well-being. These goals are implemented with the institutions, instruments, procedures that harmonize economic efficiency and social justice, they protect against the domination of the economic calculation over other criteria appropriate for individual spheres of human existence (Woźniak 2012).
The popular index of GDP dynamics has been created to measure the pace of economic growth or economic activity of the country. It does not take into account other aspects. This indicator is often equated with the level of development of a given country. In the literature and practice, many measures have been developed describing the state and rate of development of the socio-economic system. These indicators are largely based on the evaluation of selected institutions or effects to which they lead. Still they are unsatisfactory and indicate the need to develop more reliable and useful indicators (Costanza, Hart, Posner, & Talbert, 2009). One of the leading research trends is the search for life quality measures (Beslerova & Dziurickova, 2014). Also interesting is modern concept of inclusive growth, which means that it would focus on high productivity growth that can lead to productive jobs, social inclusion that can ensure equality of opportunity, and a social safety net that can reduce risk and act as a cushion for the most vulnerable groups (Xiaodi, Zengwen & Hetzler 2017).

The article presents the labor productivity index (LPI) as an alternative proposal of the cohesion measure. The research covered The Visegrad Group countries due to the fact that analysis shows that close integration, including the integrative currency area, is a good solution for countries with similar economic potential (Dobija, 2014).

1 LPI as a measure of economic and social cohesion

The useful result of the measurement of economic potential and efficiency should reflect the relationship between the output and the input. This remark also applies to the macroeconomic aspect (Klečka, 2014). Commonly practiced assessment of the country's economic condition on the basis of the size and dynamics of GDP is incomplete. It is limited to the analysis of economic effects while it ignores the aspect of input. GDP per capita indicators also do not meet this condition, as only part of the population contributes to GDP growth. The value, including GDP, is ultimately the effect of human work performed in a given institutional environment. The relation between GDP and labor input, measured by the amount of remuneration received by employees, is the index of institutional potential

assessment. It is worth citing interesting research (Nedomlelová & Kocourek, 2016) on the measurement of labor productivity using the GDP per employee indicator. The observed increase in labor productivity can largely be the result of an increase in the level of employees education. However, an increase in the level of education leads not only to an increase in employee productivity, but also results in an increase of wages. The question here is whether wage growth goes hand in hand with appropriate macroeconomic effects. The next part of the paper discusses the information structure of LPI.

For the purpose of this paper, the starting point is analytical production function which differs from the well - known econometric models. This is a function of seven variables, whose composition corresponds to the complexity of the product formation process and takes into account the sum of the production factors. Factors are measured in monetary units, which allows for the aggregation of their values in the product, in accordance with the cost accounting principles. This postulate can be represented by an equation:

$$P = (W + Km - Kr) \cdot (1 + r) \qquad (1)$$

$$Km = z \cdot A \quad Kr = s \cdot A \quad W = u \cdot H$$

where: Km - cost of assets use, Kr – costs of risk, W - wages (labor costs), A - value of assets, H - human capital of employees, u - level of human capital remuneration, z - turnover rate of assets against costs other than labor costs, s – random loss of assets value in production processes, r - adjustment of production costs to market prices.

More on the applied analytical production function is presented in the work of M. Dobija (2016). According to the above model, market value of production can be presented as a function of the sum of expenditures incurred for its production. Appropriate transformation of the production function formula, leads to a developed form of function:

$$P = (W + z \cdot A - s \cdot A) \cdot (1 + r) \qquad (2)$$

By transforming the formula in order to present the production effect (P) as a function of labor costs, the following form of production function is obtained:

$$P = W \cdot [1 + \frac{A}{W} \cdot (z - s)] \cdot (1 + r) \qquad (3)$$

Using the concept of human capital in the analytical model allows us to express the amount of labour costs (W = u · H) as a derivative of the value of human capital[1], resulting in:

$$P = W \cdot [1 + \frac{A}{H} \cdot \frac{z-s}{u}] \cdot (1 + r) \qquad (4)$$

In turn, the transformation of the above formula from the point of view of labour productivity leads to the following form:

[1] More information on human capital measurement and remuneration presents (Koziol et.al, 2014)

$$LPI = \frac{P}{W} = \left[1 + \frac{A}{H} \cdot \frac{z-s}{u}\right] \cdot (1 + r) \qquad (5)$$

The formula above shows that productivity is a function of technical equipment of work, asset turnover, profitability of assets, level of work remuneration.

LPI on a macroeconomic field can be represented by the following formula:

$$LPI = \frac{GDPR}{W} \qquad (6)$$

Where: GDPR – real gross domestic product, W – salaries in economy.

In the macroeconomic account, GDP is mainly calculated according to few methods. The starting point for the interpretation of the LPI is the analysis of the structure of real GDPR calculated using the income approach. It assumes that GDPR is the sum of the income of all owners of the production factors. This means that the structure of GDP may be presented as the sum of labour income (GDPR (W)), capital income (GDPR (C)), state income (GDPR (G)) and depreciation (GDPR (D)) (Hall & Taylor, 2002):

$$GDPR = GDPR(W) + GDPR(C) + GDPR(G) + GDPR(D) \qquad (7)$$

These two formulas can be transformed into a form:

$$GDPR = W \cdot LPI = W+(LPI-1) \cdot W = GDPR(W) + GDPR(A) \qquad (8)$$

$$GDPR(A) = GDPR(C) + GDPR(G) + GDPR(D) \qquad (9)$$

The above analysis shows that the (GDPR) can be divided into two main components, the part of the remuneration (payroll related) (GDPR (W)) and the non-payroll part (GDPR (A)). Thus, the higher the level of LPI, the greater part of the GDP is intended to finance social benefits such as capital income, public goods and infrastructure. For this reason, a higher level of LPI means a higher standard of living. This statement largely overlaps with the concept and objectives of social and economic cohesion policy, thanks to which the LPI can be an alternative to numerous other indicators used for measuring economic and social cohesion. In addition, broadening of the analysis of the country's LPI by a regional dimension allows for the assessment of territorial cohesion. The above analyzes indicate that LPI can be a basic indicator of the level of economic development and the efficiency of the national economy.

According to Woźniak (2012), in the convergence approach, cohesion is assessed by comparing the results obtained for a given country with the results of most developed country or by referring to the average in a given integration group. The author states that the basic barrier to development are too high differences, what justifies intervention policy. Therefore, the political goal of the countries and unions governments, should be the growth of LPI.

Calculating the value of the LPI requires an adequate data on the real GDP and the wages in economy. Data on GDP are usually available, however there is a need to differentiate the

method of growth accounting depending on industry or country development level (Lankauskiene 2016). Due to the lack of sufficient standardization of data on wages in the economy published statistical information requires appropriate adjustments to determine the disposable wages income. Analysis of the regional LPI requires the same data in a regional dimension. The starting point for determining wages may be the result of the average wage multiplied by the number of employees in the analyzed period. This amount requires an add-on of social security contributions paid by employers. Part-time and self-employed workers should also be included if the percentage of those people on the labour market is significant.

Tab. 1: Labor productivity in selected countries.

Country	2010	2011	2012	2013	Country	2010	2011	2012	2013
Ukraine	1,71	1,76	1,64	1,51	Czech Republic	2,21	2,13	2,36	2,25
Russia	2,05	1,89	1,70	1,54	Great Britain	3,1	3,22	3,28	3,31
China	1,77	1,78	1,89	1,97	Germany	3,17	3,16	3,35	3,37
Poland	1,9	1,94	1,96	1,99	USA	3,45	3,65	3,62	3,66

Source: (Dobija 2014)

Data from Table 1 on LPI in selected countries confirms the possibility to analyze the LPI dynamics and to conduct comparative analysis between countries. There is some regularity that well developed countries have a LPI above 3 and economically poor countries score below 2. For example, the LPI obtained by Ukraine in 2013 (1.51) means that 2/3 of GDP is spent on wages and only 1/3 of GDP is spent on other purposes such as infrastructure or public product. This results in low living standards of people. In contrast, LPI in Germany and the US in 2013 equaled 3.37 and 3.66, respectively, which means that only 30% of GDP is spent on wages and 70% is spent on public goods, infrastructure and capital incomes.

2 Results

The research covered V4 countries during 2013-2016 period. On the basis of statistical data from national statistical institutions, LPI in each country was calculated. Regional statistical data were used to calculate the LPI in individual regions. The dispersion of labor productivity between the regions of each of the analyzed countries was measured using two basic measures: standard deviation and coefficient of variation. The analysis was supported by

providing the relation between minimum and maximum regional LPI (LPI_{Rmin}/LPI_{Rmax}). The analysis of relation between regional LPI and the value of this indicator for a given country as well as the analysis the change in LPI between 2013 and 2016 were conducted.

Tab. 2: Labor productivity in Hungary (HU).

	2013	2014	2015	2016	Dynamics 2016/2013	Region (2016)/ Country
Budapest	**3,36**	**3,27**	**3,19**	**2,92**	**86,9%**	**141,7%**
Győr-Moson-Sopron	2,35	2,5	2,54	2,48	105,5%	120,4%
Komárom-Esztergom	2,15	2,12	2,13	2,12	98,6%	102,9%
Fejér	2,02	2,07	2,06	2,04	101,0%	99,0%
Vas	2,19	2,16	2,03	2,02	92,2%	98,1%
Borsod-Abaúj-Zemplén	1,96	2,07	2,14	2	102,0%	97,1%
Zala	2,01	2,13	2,13	1,9	94,5%	92,2%
Hajdú-Bihar	2,08	2,11	2,06	1,88	90,4%	91,3%
Bács-Kiskun	1,99	2,05	2,02	1,85	93,0%	89,8%
Szabolcs-Szatmár-Bereg	1,79	1,89	1,86	1,79	100,0%	86,9%
Somogy	2,04	1,91	1,89	1,78	87,3%	86,4%
Tolna	1,92	1,84	1,77	1,77	92,2%	85,9%
Csongrád	1,96	1,96	1,94	1,76	89,8%	85,4%
Jász-Nagykun-Szolnok	1,91	1,82	1,79	1,74	91,1%	84,5%
Békés	1,83	1,89	1,84	1,73	94,5%	84,0%
Heves	1,82	1,83	1,82	1,72	94,5%	83,5%
Baranya	1,79	1,82	1,74	1,71	95,5%	83,0%
Pest	1,81	1,82	1,83	1,7	93,9%	82,5%
Veszprém	1,78	1,81	1,73	1,69	94,9%	82,0%
Nógrád	1,44	1,4	1,35	1,33	92,4%	64,6%
Hungary	**2,23**	**2,22**	**2,2**	**2,06**	**92,4%**	**100,0%**
Standard deviation	0,370	0,364	0,366	0,330	89,1%	
Variation coef.	0,18	0,18	0,18	0,17	94,4%	
LPI_{Rmin}/LPI_{Rmax}	0,43	0,43	0,42	0,46	106%	
Skewness	2,615	2,129	1,844	1,731		

Source: own calculation using statistical data Hungarian Central Statistical Office

Tab. 3: Labor productivity in Poland (PL).

	2013	2014	2015	2016	Dynamics 2016/2013	Region (2016)/ Country
Mazowieckie	2,47	2,29	2,22	2,48	100,5%	119,8%

Wielkopolskie	2,58	2,69	2,81	2,35	91,2%	113,5%
Dolnośląskie	2,66	2,55	2,47	2,22	83,5%	107,3%
Śląskie	2,08	2,17	2,32	2,21	106,0%	106,8%
Kujawsko-pomorskie	2,26	2,19	2,07	2,04	90,1%	98,5%
Zachodniopomorskie	2,36	2,38	2,49	2,02	85,7%	97,5%
Łódzkie	1,79	1,76	1,80	2,01	112,4%	97,0%
Lubuskie	2,13	2,15	2,09	2,00	94,1%	96,9%
Małopolskie	2,11	2,13	2,22	2,00	94,8%	96,6%
Pomorskie	2,14	2,09	1,95	1,99	92,9%	96,0%
Warmińsko - mazurskie	2,00	2,00	1,91	1,94	97,0%	93,6%
Opolskie	2,25	2,11	1,97	1,91	85,1%	92,4%
Podkarpackie	1,92	1,97	1,94	1,85	96,4%	89,3%
Świętokrzyskie	1,66	1,61	1,57	1,79	107,5%	86,4%
Podlaskie	1,87	1,81	1,74	1,74	93,2%	84,1%
Lubelskie	1,52	1,46	1,40	1,67	109,5%	80,6%
Poland	**2,12**	**2,10**	**2,09**	**2,07**	**97,4%**	**100,0%**
Standard deviation	0,307	0,312	0,347	0,209	68,3%	
Variation coef.	0,145	0,150	0,169	0,104	71,5%	
LPI_{Rmin}/LPI_{Rmax}	0,573	0,541	0,499	0,673	117,5%	
Skewness	-0,051	-0,123	0,215	0,581		

Source: own calculation using statistical data Polish Central Statistical Office – Local Data Bank.

Tab. 4: Labor productivity in Slovakia (SK).

	2013	2014	2015	2016	Dynamics 2016/2013	Region (2016)/ Country
Region of Bratislava	**3,38**	**3,19**	**3,26**	**3,07**	**90,8%**	**159,1%**
Region of Trnava	2,3	2,3	2,12	2,05	89,1%	106,2%
Region of Nitra	2,16	2,02	1,95	1,87	86,6%	96,9%
Region of Žilina	2,05	2,01	1,89	1,81	88,3%	93,8%
Region of Košice	1,95	1,85	1,85	1,79	91,8%	92,7%
Region of Trenčín	2,01	1,89	1,85	1,72	85,6%	89,1%
Region of Banská Bystrica	1,84	1,74	1,7	1,66	90,2%	86,0%
Region of Prešov	1,72	1,67	1,66	1,62	94,2%	83,9%
Slovak Republic	**2,16**	**2,06**	**2,01**	**1,93**	**89,4%**	**100,0%**
Standard deviation	0,518	0,487	0,515	0,472	91,1%	
Variation coef.	0,238	0,234	0,253	0,242	101,7%	
LPI_{Rmin}/LPI_{Rmax}	0,509	0,524	0,509	0,528	103,7%	
Skewness	2,182	2,029	2,414	2,407		

Source: own calculation using statistical data Statistical Office of the Slovak Republic

Tab. 5: Labor productivity in the Czech Republic (CR).

	2013	2014	2015	2016	Dynamics 2016/2013	Region (2016)/ Country
Prague	2,59	2,68	2,84	2,83	109,2%	117,5%
Central Bohemia Region	2,53	2,73	2,73	2,69	106,5%	111,7%
The Hradec Kralove Region	2,46	2,52	2,46	2,45	99,7%	101,8%
The South Moravian Region	2,40	2,40	2,40	2,38	99,0%	98,9%
The Zlin Region	2,37	2,52	2,35	2,38	100,6%	99,0%
The Moravian-Silesian Region	2,28	2,29	2,32	2,33	102,1%	96,8%
The Plzen Region	2,21	2,35	2,27	2,31	104,7%	96,1%
South Bohemia Region	2,40	2,29	2,30	2,27	94,8%	94,5%
The Vysocina Region	2,33	2,31	2,29	2,23	95,8%	92,6%
The Usti Region	2,33	2,30	2,39	2,21	94,7%	91,9%
The Liberec Region	2,18	2,16	2,19	2,16	98,9%	89,7%
The Pardubice Region	2,18	2,13	2,19	2,15	98,9%	89,5%
The Olomouc Region	2,25	2,18	2,18	2,14	95,0%	88,9%
The Karlovy Vary Region	2,05	2,00	1,94	1,94	94,9%	80,7%
The Czech Republic	**2,37**	**2,40**	**2,43**	**2,41**	101,5%	100,0%
Standard deviation	0,148	0,207	0,227	0,227	154,1%	
Variation coef.	0,063	0,088	0,097	0,098	154,5%	
LPI_{Rmin}/LPI_{Rmax}	0,790	0,734	0,682	0,686	86,9%	
Skewness	-0,002	0,368	0,781	0,865		

Source: own calculation using statistical data Czech Statistical Office

The calculations in tables 2-5 are flowing conclusions:

1. In all V4 countries, a similar level of LPI was recorded slightly above 2. This is a characteristic value for developing countries.
2. Between 2013 – 2016 years, LPI in SK and HU fell by 10.6% and 7.4% respectively. In PL (-2.6%) and CR (increase by 1.5%), the LPI remains at a relatively constant level.
3. In all countries, the highest LPI was recorded in the capital regions. This is particularly evident in SK and HU, where LPI in the capital region exceeds the national average by 60% and over 40% respectively. This may indicate an excessive concentration of economic activity in the capital regions. This countries have also the lowest relation between minimum and maximum regional LPI among researched countries. It indicates that this concentration is at the expense of marginalization of other regions.
4. In three of the researched countries a decrease in the regional dispersion of LPI was observed, especially in the case of PL. Only in the CR did regional differences increase,

but this increase starts from the low level of standard deviation (0.148) in 2013 and in subsequent years stabilized at just over 0.2.

Conclusion

The presented LPI uses macroeconomic data expressed in monetary units that can be measured in a reliable and standardized manner. These data concern both the expenditure area (remuneration) and the area of effects (GDP) and cover the same period. The structure of this index confirms that it is a good and reliable measure of both the development of a given country and the degree of cohesion in the economic, social and territorial aspects. This indicator integrates economic data on technical labor equipment, asset turnover, asset profitability and the level of remuneration.

Including the measurement of LPI in the national statistics system can give economists and policy makers an easy-to-interpret tool that ensures full comparability in time and space. The implementation of this postulate requires clarification and unification of the method of measuring its components. This remark in particular concerns the measurement of labor cost.

The political goal should be to strive for a steady LPI increase, but an additional goal must be to reduce regional differences. Analysis of LPI in the regional cross-section allows for an in-depth analysis of the country's economic situation. It enables identification of economically weaker regions that require the design and introduction of an appropriate regional policy.

Among the surveyed countries of the V4 group, the Czech Republic has the highest level of cohesion. This is evidenced by both the highest level of the national LPI (2.37 - 2.43) and the lowest regional dispersion. Slovakia, on the other hand, has the lowest LPI (1.93 - 2.16) and relatively high regional diversification. Unfortunately, none of the countries surveyed reported a satisfactory increase in LPI during the period under consideration.

References

Beslerova, S. & Dzurickova, J. (2014). Quality of life measurements in EU countries, Procedia Economics and Finance 12, 37-47, doi: 10.1016/S2212-5671(14)00318-9

Costanza, R., Hart, M., Posner, S., & Talbert, J. (2009). *Beyond GDP: The Need for New Measures of Progress*. Boston: Trustees of Boston University, 3-5.

Dobija, M. (2016). Ekonomia pracy, wynagrodzeń i racjonalnych nierówności – laboryzm, *Nierówności Społeczne a Wzrost Gospodarczy*, *47*(3/2016), 25-53. doi:10.15584/nsawg.2016.3.2

Dobija, M. (2014). Formation of the Integrative Currency Area, *SOP Transactions on Economic Research*, vol. 1, no. 1, Jan. 2014, 1-9, https://doi.org/10.15764/er.2014.01001

Hall, R. & Taylor, J. (2002). *Makroekonomia*, Warszawa: WN PWN, 42.

Klečka, J. (2014). Indicators measuring the level and development of enterprise productivity, *8th International Days of Statistics and Economics.* Praha, Slaný: Melandrium, 668 - 677.

Koziol, L. Koziol, W. Wojtowicz, A. & Pyrek, R. (2014). An outline of compensation system based on human capital theory, *Procedia-Social and Behavioral Sciences* vol. 148, 551-558, doi: 10.1016/j.sbspro.2014.07.078

Lankauskiene, T. (2016). Application of the growth accounting method for the construction industry, Journal of Business Economics and Management vol.17(3), 430-443 doi:10.3846/16111699.2016.1173580

Nedomlelová, I. Kocourek, A. (2016). Human capital: relationship between education and labor productivity in the European countries, *10th International Days of Statistics and Economics.* Praha, Slaný: Melandrium, 1090–1099.

Woźniak, M.G. (2012). Spójność społeczno – ekonomiczna w kontekście tendencji do upowszechniania się kryzysu finansów publicznych w Unii Europejskiej, *Nierówności Społeczne a Wzrost Gospodarczy*, 25 (2/2012), 6-29.

Xiaodi, L. Wang, Z. Hetzler A. (2017). HFMADM method based on nondimensionalization and its application in the evaluation of inclusive growth, Journal of Business Economics and Management vol. 18(4), 726-744, doi:10.3846/16111699.2017.1341848

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