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STRUCTURAL CONVERGENCE OF THE LABOUR PRODUCTIVITY OF THE BULGARIAN ECONOMY WITH THE EURO AREA²

The study analyzes the process of convergence of labour productivity (LP) of the Bulgarian economy to the Eurozone for the period 2000-2022. With the help of descriptive and beta and sigma convergence analysis, the dynamics of this indicator are examined and it is compared with the CEE countries. The quantitative analysis of the convergence process was carried out using an index of difference and a divergence index, which were again compared with the values of the CEE countries and the Eurozone. The results show a slow process of convergence of the LP of the Bulgarian economy with that of the Eurozone, which continues throughout the period under review, although there are also moments of slight fluctuations. Keywords: convergence; labour productivity; Eurozone JEL: E24; E52; F02; F15; L16; O47

1. Introduction

According to neoclassical and endogenous growth theory, LP is a key factor in achieving economic growth and in improving living standards in the long term, and so tracking structural convergence in the LP is a particularly important point in this direction.

In recent years, there has been a slowdown in the global and European economy and a deepening of regional problems. These undesirable perspectives from the perspective of EU objectives and policy make the topic of convergence of LP even more challenging and responsible from both a theoretical and practical point of view.

The aim of the study is to present an up-to-date assessment of the structural convergence of the Strategic Partnership of the Bulgarian economy to the Eurozone, which is an important indicator of the synchronization of the business cycle, as well as of the country's readiness for the adoption of the single European currency.

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2. Theoretical Framework and Factors Influencing the Structural Convergence of LP

Whether one examines the convergence of LP for an economy or at the sectoral level, there are factors that influence it, such as institutions and national specificities. These include national psychology, cultural peculiarities and traditions, natural conditions, etc. Therefore, the existence of similarities between countries in relation to them can be seen as a factor facilitating convergence in their LP.

Among the factors influencing the convergence of LP, investments in research and development, innovation, education and human capital development can also be included. If R&D lead to the increase of LP in one sector and if new knowledge is transferred to the same sector of another country, this may lead to sectoral convergence in LP. At the same time, however, it is possible to transfer new knowledge from one to other sectors, which will increase LP in the economy as a whole. Therefore, one of the most important factors influencing the convergence of LP between a group of countries is the diffusion of technology between them (Barro, Sala-i-Martin, 1997; Wacziarg, 2004). In this case, similarity in technology appears to be a factor of convergence in both total LP and LP at the sectoral level. Moreover, more accelerated trade in intermediate goods between EU countries increases the coherence of production technologies between firms, and greater mobility of labour within the common market facilitates the transfer of new knowledge between countries.

Another factor influencing the change of LP is structural changes in employment by the economic sector (Ark, 1995; Naveed, Ahmad, 2016). According to Ark (1995), the movement of employees from low-to-high-LP sectors also leads to higher LP in the economy as a whole. It is pointed out that structural changes are a factor that influences the total LP in the economy to a greater extent than the sectoral LP. Therefore, if there are similar structural changes in two or more countries, it is possible that they will lead to a convergent trend in the LP total for the economy. The existing evidence according to (Doyle and O'Leary, 1999) of a higher degree of convergence in the LP total for the economy than at the sectoral level is explained by the existence of structural changes in economies. Consequently, when structural changes occur in two or more countries associated with a reduction in the relative share of lower productivity sectors, LP in the whole economy increases and there is a tendency towards convergence, but not so much at the sectoral level as for the economy as a whole.

A distinction between the factor determinants of convergence in LP in the industry sector and in the service sector in the context of European integration (Sondermann, 2012). He argues that European integration leads to a reduction in barriers to labour, capital and new knowledge, which in turn promotes convergence in LP in the industrial sector, where technology transfer between EU countries is easier. There is also evidence of the feedback, namely that the presence or absence of convergence in LP is a factor that influences the formation of convergent or divergent processes between a group of countries in terms of the share of employment in different sectors. Changes in the relative share of employees can be seen as the result of changes in LP at a sectoral level, the relationship between the two variables being negative, since when LP in a sector increases, employment in that sector usually decreases. Therefore, if two or more countries experience a rise in LP in a sector and a convergence process accordingly, it can be assumed that there is a convergence between

them and in employment. According to Höhenberger & Schmiedeberg (2008), the very process of LP growth leads to convergence of employment across sectors among a group of countries.

According to Palan & Schmiedeberg (2010), when LP in a sector of the economy differs substantially from the Eurozone average, their shares in employment will differ significantly from those in their value added. For example, it is slightly misleading when the share of employees for a sector is significantly higher than its share of value-added, as it will be characterized by low LP. It is for this reason that it is useful, along with the analysis of the distribution of employment, to examine the dynamics of the relative shares of convergence for the given sector on the basis of a complex analysis. Pigliaru (2003) sets out the view that changes in the technological level of individual economies are closely related to the overall level of production. As the technological level rises, the technological gaps between lagging and leading economies narrow, and hence the gap in LP is narrowed, as economies with lower initial GDP are more likely to innovate. This again suggests that structural and real convergence are linked, but no firm conclusion can be drawn from this analysis alone about which of the two is leading.

Bilenko, 2022 analyzes the convergence in the sectoral structure of LP and its impact on economic growth in 15 countries, some of which are EU members – Bulgaria, the Czech Republic, Estonia, Hungary, Poland, Lithuania, Latvia, Romania, Slovenia and Slovakia, as well as those that are not yet members of the EU, such as Ukraine, Moldova, Belarus, Russia and Albania, for the period 1996-2019. For this purpose, it uses models with fixed effects at the level of the main economic sectors – agriculture, industry and services and tries to determine the degree of differences in the level of LP in the CEE countries after the market reforms they have experienced and to assess the impact of these structural changes on their economic growth. According to this study, its results can be used to further develop effective economic policy in these countries, to identify structural changes in LP in different sectors of the economy before and after the financial crisis, to assess the level of convergence between different sectors of the economy, etc.

Diaz & Santillán-Salgado (2024) analysed the development of LP among the Eurozone member states in the period 1999-2019 using a model with panel data and came to the conclusion that the convergence between the countries has been decreasing since 2008, probably due to the global financial crisis, but this is not valid for the countries that have already adopted the euro, and also that at the end of the period under study the convergence of LP is not slow at all among the new member states. A major consequence of the poor convergence in LP in the Eurozone is the sub-optimal use of their potential production capacity, which also hampers their ability to innovate. The results of this study confirm the existence of a gradual convergence between all countries of the Eurozone, with convergence in the PT being lower in the old member states and higher in the new member states.

Ahmad, Naveed & Naz (2019) examined the effect of structural changes (change in the relative share of people employed in different activities, changes in demand and technological progress) on the convergence of LP in the EU from 1991 to 2009 at different levels of aggregation (by country, region, sector and activity) and found that convergence at

regional level is large, while at sectoral level it has been confirmed for some sectors (agriculture, construction, services) and not for others. This once again confirms the thesis that the convergence of LP differs at different levels of aggregation.

3. Methodology of Analysis

The analysis of structural convergence consists in assessing its existence and intensity precisely enough to give an overall picture of it. This can happen only with a proper selection of specific methods and approaches to its study. The aim is to obtain sufficiently reliable and accurate results on the degree and dynamics of convergence based on the chosen approaches and specific methodology. In order to ensure the reliability of the analysis, it is primarily necessary to choose research methods that meet the following conditions: to correspond to theoretical concepts, to take into account the possibilities of statistical and econometric methods and at the same time to be consistent with the specific objectives and objectives of the study.

Many of the methods chosen are universal and make it possible to use them to explore various aspects of structural convergence, but a large part of them are designed to measure nominal and real convergence rather than structural ones, necessitating some transformation in them, but without changing their underlying logic. In order to ensure that the results of the analysis are sufficiently reliable, it is useful to track convergence in dynamics and to make comparisons with the structural convergence of other economies with similar characteristics. The benchmarking provides an opportunity to assess a country's position and readiness to deepen integration through the eyes of its vulnerability to external shocks and its reaction to specific supranational policies.

The presented approaches to the study of convergence are characterized by deriving their advantages and disadvantages. Each approach is in itself a broad topic, but the aim here is to follow up briefly on some of the most commonly used convergence/divergence research approaches.

In most of the studies to assess structural convergence one or two methods are used and their choice is not fully justified. The reason for this is that the problem is relatively new and has not yet been addressed by many authors. Another possible explanation of this is that the concept of structural convergence is not sufficiently clear and usually only some aspects of it are investigated. The measurement of structural convergence can be based on the following methodological approaches: the catching-up process ascertainment approach, the distributional approach and the time series approach.

The catching-up approach aims to describe the catching-up process in which low-income countries catch up with those with higher ones. The idea of this is rooted in the neoclassical model of Solow (1956), which assumes that economies with the same structural characteristics such as technological level, population growth rate, savings rate and depreciation, will approach the same long-term equilibrium. However, this model has a significant drawback, namely, the assumption that changes in the growth rate of the manufactured product per capita under the long-term sustainable equilibrium are due to the

changes in the growth rate of exogenously determined technological progress. First, the endogenous theory is one that tries to explicitly clarify technological progress. The idea of poorer countries catching up with richer countries is a reduction in the gap in technological development between them.

Under the unconditional β convergence method, poorer countries' variables progress faster than richer countries' variables and catch up with them, i.e. $\beta < 0$. This is explained by the understanding that individual economies differ from each other only in the original level of income per capita and therefore as they grow closer to the same long-term equilibrium. If the rate of increase in real GDP per capita in a lower-income country is significantly higher than that in a high-income country, convergence is relatively rapid while, if the difference is small, convergence is slower and longer. This perception of β convergence, which is characteristic of many empirical models, has, however, a significant drawback, namely that the economies are not identical but differ considerably in physical, human capital, institutional conditions, etc., and this prevents them from reaching the same equilibrium. It is therefore more realistic for each economy to have an individual long-term equilibrium, but then convergence is conditional. A consequence of conditionality is that low-income countries should be expected to approach their individual long-term equilibrium more quickly than high-income countries. Whether or not this will happen depends on the disposition of the different groups of countries relative to their equilibrium growth paths. This ambiguous relationship between the individual growth rates of different countries is one explanation for why structural convergence cannot be seen as an indicator of reducing income inequality between countries (for more information on this explanation, see Gluschenko, 2012).

The reason for this is that low-income economies are close to those with high in terms of their structural characteristics, which is expressed in reducing the difference between them in terms of the relative share of different elements in the respective economic population. As a basis for comparison, the structure of the more developed economies is taken rather than some optimal state, therefore beta convergence, in this case, can be defined as absolute or unconditional. Another reason in favour of this is the possible emergence of external shocks that can simultaneously affect different economies and cause one-way changes in their structure. However, if the structural characteristics of economies are mainly influenced by individual factors, each economy will aim for its own long-run equilibrium, which will lead to conditional convergence.

The distributional approach to measuring convergence provides insight into the narrowing of disparities between countries over time and, unlike the previous approach, does not follow a particular theoretical scheme, but relies primarily on the use of statistical methods. Central to it are the standard deviation, dispersion and coefficient of variation of per capita income across countries, by reducing them over time speaks of shortening deviations and proves the existence of convergence.

The distributional approach is known in theory as σ convergence and has been thoroughly demonstrated by Barro & Sala-i-Martin, with Sala-i-Martin (1996) making a clear distinction between this and the preceding approach, while also revealing the complex dependencies between them. According to Friedman (1992) and Quah (1993), this approach is preferable

in most empirical studies and mostly in those that are concentrated on income convergence, as it is easier to use. Another justification for its use is that it is much closer to the concept of convergence. This feature, however, is why Young & Higgins & Levy (2007) concluded that beta convergence is a necessary but not sufficient condition for σ convergence. The reason for this is that random shocks may arise in the catching-up process to move the economy away from its path of development and prevent the narrowing of the gap with the more advanced economies.

In essence, σ convergence reflects the trend of convergence or divergence between indicators in a sample of countries. In order to overcome these differences, it is necessary for countries with lagging indicators to grow faster than the rest with higher performance, i.e. there must be β -convergence. In particular, the name of the σ -convergence derives from the dispersion coefficient and is calculated using the following formula:

$$\sigma^2 = \frac{1}{n} \sum_{i=1}^{n} (y_i - y_{av.})^2 \tag{1}$$

where *yi* is the given level of the indicator in country *i* and *yav*. the average for the given community (e.g. the Eurozone);

$$y_{av} = \frac{1}{n} \sum_{i=1}^{n} y_i \tag{2}$$

Thus, the dispersion coefficient can be used to estimate σ convergence in the EU on the basis of the following formula:

$$Dt = \frac{\sigma^2}{y_{av.}}$$
(3)

The distributive approach helps to measure the level and dynamics of differences in the structure of individual indicators in the economy, and if they decrease, this is a sign of structural convergence. In this sense, Palan (2013) argues that σ convergence, like beta convergence, can also be absolute or conditional, and in both cases, it is measured in accordance with the long-term pattern of specialization of economies evidenced by Baumol (1986) and Galor (1996). Galor defines absolute and conditional convergence as convergence between economies, which is independent of the initial conditions in each of them, and for conditional convergence, it also sets an additional condition for the similarity of other basic characteristics of economies on the idea of growth models.

A third possible approach to measuring structural convergence is the application of *the methods of analysis of temporary series*. It is of relatively limited application and is used only in studies in which an econometric analysis has been made to model panel. Measuring structural convergence with it also has some drawbacks given that it stakes, according to Kane (2001), on convergence at the same rate and towards the same equilibrium for different countries, and also does not take into account the possibility of non-stationarity of data and there is the problem of shift ability of estimates.

Its most significant drawback is in fact that the data for the analysed variables are potentially non-stationary, which may adversely affect the accuracy of the results obtained. This is because in the presence of a single root, the system is exposed to continuous shocks and does

not return to a convergent long-term developmental path, but shows divergence. Such problems do not exist with data stationarity, where the long-term variances of country variables caused by exogenous shocks tend to be zero. All these arguments are the reason why the analysis of time series is used in certain empirical developments and is accepted as a stand-alone approach to the study of convergence processes. Although this transformation is relatively easy, the applicability of this approach depends on the length of the rows and the completeness of the data.

These approaches and methods are not the only possible ones, but are only the most general methodological framework for checking and assessing structural convergence or divergence in economies. This methodological framework can be changed and/or expanded by adding new approaches, by searching for common ground between existing ones, and by using different ways of classifying them. A vast area of research is the adaptation of other specialized methods of analysis of this problem, as there are already attempts.

The use of too large a set of methods and approaches allows alternative estimates of structural convergence to be obtained, but this can also dilute the analysis and even lead to a divergence or discrepancy between the estimates. Therefore, it is better to use a generalized methodology that combines only the most appropriate methods and indicators. Due to the lack of such a systematic methodology, attention is focused on the most commonly applied methods and approaches. Therefore, given the purpose and objectives of this publication, namely a study of the convergence of the Bulgarian economy towards the Eurozone, we believe that beta and σ convergence methods are best suited for analysis. The grounds for this choice are that these two approaches are closest to the understanding of convergence advocated in the main models for economic growth. From a practical point of view, these two methods have a fairly universal application and can be used both to analyse the convergence of production and the labour market.

 σ convergence is usually estimated by some of the variance measures such as the standard deviation or the coefficient of variation. When analysing divergences in the dynamics of convergence, convergence is present if the dispersion between the countries compared decreases over time. σ convergence is usually estimated by the standard deviation, which is the square root of the variance. In numerous empirical studies, the coefficient of variation is also used, which is a relationship between the standard deviation of the variable and its mean. When these indicators are used to assess the convergence of an economy towards the EU or the Eurozone, the deviation is calculated against the value of the Eurozone and not against its average.

Another way is to measure structural convergence by Krugman's specialization index, which shows the deviation in structural terms of the economy on LP, compared to the group average or for the Eurozone. It was originally developed by Krugman (1993) in a more elementary form, and subsequently used in various forms by Kallioras and Petrakos (2007), as well as by Stattev and Raleva (2006) to measure convergence in the production and expenditure structure of Bulgaria's GDP relative to the Eurozone.

$$I_{Krugman} = \sum_{i=1}^{n} \left| RSE_{y} - RSE_{\bar{y}} \right|$$
(4)

where: RSE_{v} is the relative share of the relevant structural element in the given country, RSE_{v}

is the reference value that is assumed to be equal to the relative share of the corresponding element in the Eurozone, and n is the number of elements in the given structure.

The index is designed to measure the specialisation of countries, but is also often used to assess the degree of convergence. Krieger-Boden & Traistaru-Siedschlag (2008) criticise it because one of its peculiarities is that it assumes the same weights of components regardless of their size. Its advantage is taken to be the possibility of using it both at the sectoral level and at lower levels of generalisation. Moreover, according to Palan (2013), the transition from a higher to a lower level of aggregation does not affect the results of specialization if the deviations from the reference values in the activities that make up them are in the same direction. However, if these deviations are in different directions, the level of specialization decreases, which speaks of an increase in structural convergence.

According to Von Hagen & Traistaru (2005), structural convergence should be calculated by means of a divergence index based on Krugman's original formula, and by tracing its evolution over time. The index is intended precisely to measure the structural convergence of a country to the Eurozone and is calculated using the following formula, in which the notations are analogous to those in the previous one:

$$I_{\text{DISSIM}} = -\sum_{i=1}^{n} \left| RSE_X - RSE_{EZ} \right|$$
(5)

The transformation of the specialization index into an index of difference is associated with adding a negative sign in front of the sum of deviations taken in absolute value for each of the sectors. This changes the way the index is interpreted, because the higher its value, i.e. the lower its absolute value, the less the difference and the greater the structural convergence.

Another indicator based again on Krugman's specialisation index is the divergence index proposed by Van de Coeving (2003). This index has been calculated by the author for the EU and the countries of South-Eastern Europe (excluding Bulgaria), the USA and Japan, the latter two countries being used for comparison. The index is calculated using the following formula:

$$I_{\text{DIV}} = -\sum_{i=1}^{n} \frac{(RSE_x - RSE_{EZ})^2}{RSE_{EZ}}$$
(6)

When the index is equal to zero, the relative share of the element changes like the one in the Eurozone, and when the index is different from zero, the relative share deviates from that of the Eurozone, and the higher the value of the index (the smaller it is in absolute terms), the greater the structural convergence of the country to the Eurozone. The index takes only negative values, and the closer they are to zero, the more similar the economic structures compared. Raising the second degree of the difference between the relative share of the given variable for the respective country and the Eurozone determines the much higher weight in the index of the element with the highest change. However, this makes the divergence index dependent on the element in the aggregate that has the greatest dynamics, which can be a

problem when its relative weight in the studied population is the lowest. Thus, on the one hand, the sensitivity of the index increases, but at the same time the disadvantage of the difference index is overcome, which makes the divergence index preferable for use by the two. When different conclusions are reached about the convergence processes (divergence) of the two indices, which is possible due to the methodological differences between them, the presence of convergence or divergence will be considered proven if confirmed by both indices.

Similarly, Angeloni, Flag and Mondelli (2005) measure σ convergence of the economies of the new EU member states by applying a distance index.

$$I_{\text{DIST}} = \sum_{i=1}^{n} \frac{|RSE_X - RSE_{EZ}|}{2}.100$$
(7)

It is also an index derived from the Krugman specialization index, whose value is positive and twice as low, and unlike the Krugman index, it is calculated as a percentage. If the value of the index is zero, this shows that the compared economies have the same structure, and if its value grows, it speaks of structural divergence and, conversely, if it decreases, of structural convergence.

The wide variety of indices for the assessment of convergence/divergence makes it necessary to select only those of them, which give a sufficiently clear picture of the process under analysis and at the same time have the least disadvantages. This is necessary because, if all of them are used, it will deconcentrate the analysis and shift the focus of the study. To avoid this, only the divergence index, the divergence index and the distance index will be used as complementary in the present study.

Together with these indices, the analysis of structural convergence will be complemented by a descriptive analysis based on graphical and tabular presentation of the data, and with its help the main trends in the changes in the indicators for the respective country and the Eurozone for the given period should be outlined. In order to be able to determine the development of convergence processes in a particular country, its data are compared with another country similar in characteristics. In this study, this has been done for Bulgaria and 10 other CEE countries³, and in part of the analysis, they are divided into two groups – those that have already adopted the euro and those that are about to introduce it.

All these methodological approaches to the analysis of convergence have different characteristics and, as we have seen, their advantages and disadvantages, which also determine their different applicability in the performance of the studies. It is therefore important to select appropriately those of them, that will support the achievement of the objectives and objectives set in the study. In this publication on the measurement of the degree of convergence, a descriptive analysis has been selected, divergence, divergence and distance indices as well as panel modelling. The combination of these methods allows to empirically verify the postulates of the underlying theoretical models of β and σ convergence

³ Lithuania, Latvia, Estonia, Slovenia, Slovakia, Croatia, Poland, Czech Republic, Hungary, Bulgaria and Romania.

and then compare them. Moreover, panel modelling makes it possible to clarify the country's position relative to the other CEE countries, and the simultaneous use of the indices helps to obtain a more comprehensive picture of the existence of σ convergence. The β -convergence approach establishes the convergence process, estimates its speed, and in combination with panel modelling, allows a comparative analysis of structural convergence across countries. The distributive method can be used to determine structural differences between countries over time, as well as to reveal the level and dynamics of these differences through indices. Time series analysis allows us to investigate the long-term dependencies and to endogenize variables, but there may also be some difficulties in choosing stationarity tests. The β -convergence approach used allows an econometric assessment of the convergence process according to the specified indicators of the Bulgarian economy towards the Eurozone. This approach has been widely used in assessing convergence processes not only in the area of structural characteristics of economies. For the estimation of β convergence, a panel model with fixed effects by the method of least squares is used by this equation:

 $\Delta Y_{ijt} = \alpha + \beta \cdot Y_{ijt-1} + \epsilon$

(8),

where Y_{ijt} is the difference between the relative share of a sector i in country j in year t and the relative share of the same sector in the Eurozone, i.e. $Y_{ijt} = RS_{ijt} - RS_{iEZt}$, and ΔY_{ijt} is the change of this difference in year t from the previous one, i.e. $\Delta Y_{ijt} = Y_{ijt} - Y_{ijt}$. The equation was estimated on the basis of annual panel data for the 11 countries, using a fixed effects model to characterise the process in each country.

From a methodological point of view, the analysis throughout the development is based on annual data. Annual data are preferred in such studies because they do not have cyclical problems. The descriptive analysis, based mostly on a tabular and graphical presentation of the statistical data, outlines the main trends in the dynamics of LP in different countries, as well as gives an idea of the existing correspondences and the links between them. In the framework of the descriptive analysis, the σ convergence method is also applied to measure heterogeneity in specific indicators at a sectoral level. Conclusions drawn through descriptive analysis about the presence or absence of divergence cannot be absolutized, and therefore it is complemented by an analysis using the β convergence method. A panel model is applied to calculate β convergence, for the construction of which annual data are also used. The time span of the analysis covers the period 2000-2022 and the geographical coverage includes data for the Eurozone, Bulgaria and the other CEE EU Member States. At the same time, CEE countries are divided into two groups: eurozone member states and those that are not yet part of it. This grouping of countries helps to clarify Bulgaria's relative position towards the CEE countries that are in the Eurozone and towards those that are yet to join the currency area.

The analyzed period 2000-2022 allows us to describe both the dynamics of the processes before Bulgaria's accession to the European Union in 2007 and the development of the process after that, in which the effects of EU membership could be outlined. Comparisons are also made with countries that are already members of the Eurozone (Lithuania, Latvia, Estonia, Slovenia, Slovakia and Croatia), as well as with those that have not yet joined it, such as Poland, the Czech Republic, Hungary and Romania. For the entire period of the analysis, a permanent composition of the Eurozone, including 19 countries, has been applied, as the changes in its actual composition that occurred during the period (the accession of Croatia) have a negligible impact on the values of the indicators used.

4. Descriptive and Σ-Convergent Analysis of LP in Bulgaria and the CEE Countries to the Eurozone

4.1. Descriptive analysis of LP

Individual countries in the community differ in their LP, the reasons for which are of a different nature – historical, geographical, cultural, etc. The assessment of LP should also take into account the different initial conditions in the individual countries. The Bulgarian economy during the studied period is trying to catch up with the average EU LP, but this is not so easy, as the right policy is needed here too. Without macroeconomic stability, LP cannot grow at the required rate. The relationship between macroeconomic stability and output growth is clearly established both theoretically and empirically.

LP is an important indicator of the level of economic development reached. The speed with which the economy absorbs new technologies also has an impact on LP in individual sectors. This is because differences in new technologies can explain much of the differences in the LP of individual countries. Innovation is also of particular importance. Less developed economies may increase their LP by applying existing technologies or gradually improving them, but this will not be enough to catch up with the LP of countries that have reached an innovation stage in their development.

Due to the relatively low initial value of LP in Bulgaria, it has the potential to grow at a faster pace, but not during the entire period this is a fact. Here a positive example can be given Romania, which in 2000 had the lowest LP in the EU (7.94% compared to 9.47% for Bulgaria, as for the EU-19 = 100), but by 2022 LP in Romania becomes 42.77% and in Bulgaria it reaches only 31%. Since 2005, LP in Bulgaria has been the lowest among the surveyed countries and almost four times lower than that of the group leader Slovenia. In 2022, LP in Bulgaria is three times smaller than in the Eurozone and again the lowest among the surveyed countries.

A comparison of the Bulgarian LP with the Eurozone average shows significant differences. Moreover, according to the data in Table 1, the absolute differences between them are deepening. This shows the lack of strong convergence, which, however, is crucial for Bulgaria's successful accession to the Eurozone. Bulgaria lags behind other Member States in terms of LP, although its value increases continuously between 2000 and 2022. Throughout the period studied, LP in the industrial sector was highest, while in the other two sectors it was lower. LP in the services sector fluctuates at about the same level as that for the whole economy, but is lower than that in the industry sector.

Indicators/ Years	2000	2007	2014	2022
Bulgaria	4,47	8,58	12,75	24,38
Euro area – 19 countries	47,21	58,10	64,80	78,64
Absolute differences	42,74	49,52	52,05	54,26
Bulgarian LP as % of the Eurozone average – 19	9,47	14,77	19,68	31,00

Table 1. LP in Bulgaria and the Eurozone for the survey period

Source: Eurostat and author's own calculations.

In the Eurozone, LP growth in the economy in the period 2000-2022 follows the same trend as Bulgaria. Only in 2009, there was a decline in the indicator due to the global economic crisis. The lowest LP in the Eurozone is characterised by the agricultural sector. The dynamics of this indicator in the industry and service sector show different trends than those registered in Bulgaria. Until 2009, LP in the industry sector was twice as high as in the service sector. In the following years, the gap between them decreased, and in 2021 the LP in the service sector is larger than that in the industry.



Figure 1. LP in the Eurozone on average and by sector in the period 2000-2022

Source: Eurostat and author's own calculations.

The agricultural sector has traditionally been characterized by lower LP than the other two sectors, due to its specifics in terms of the factors of production used, the technological principles applied and the organization of production. This is also reported for the Eurozone and for all EU countries, but in the period 2000-2022 this sector is significantly modernized in the Eurozone countries, with its LP increasing by about 133%, and in Bulgaria, this change is 2.5 times more. This is due to the low starting points of this indicator for Bulgaria, as well as to the traditions and natural conditions that our country has for the development of this sector, but all this speaks of the existence of divergent processes between Bulgaria and the Eurozone average.

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Figure 2. LP in Bulgaria in all three main sectors in the period 2000-2022

Source: Eurostat and author's own calculations.

A closer examination of the trends in the individual economic sectors shows that LP in the agricultural sector of the Bulgarian economy for most of the period has fluctuated significantly. In 10 years of the period under review, the indicator compared to the previous year decreased. As a consequence, the gap with LP in the other sectors is widening. In the Eurozone, the dynamics of the indicator are greater and it has many times higher values than in Bulgaria. Here only in 6 years of the period under review, there is a decline in LP in agriculture.

In Bulgaria, by 2019, LP in the industry sector is higher than in the other two sectors (agriculture and services). In both Bulgaria and the Eurozone, LP in the industry sector grew throughout the period under review, being higher than the corresponding value of the indicator in the service sector until 2017. At the end of the period, compared to its beginning, the reported growth rate of LP in the industry sector in Bulgaria was more than 17 times higher than in the Eurozone. Despite the reported positive trend compared to the other two sectors, the industrial sector has the largest absolute differences between the values for LP in the Eurozone and Bulgaria throughout the period under review. The average LP for the industry sector in the Eurozone for the period 2000-2022 is 81.4, while in Bulgaria it is 14.9, i.e. it is more than five times lower.

The LP in the service sector also rose during the period under review, being higher than that of agriculture but lower than that in industry and for the economy as a whole. The growth rate of this indicator in 2022 compared to 2000 is six times higher than in the Eurozone. This suggests that there is a process of convergence in this sector.

For the economy, Bulgaria and the Eurozone show similar trends in LP to those reported in the industry and service sectors. Figure 3 shows that the growth rate in Bulgaria is again higher than in the Eurozone. However, it should be noted that despite the processes of convergence, the differences between Bulgaria and the Eurozone remain significant both for the entire economy and for the different economic sectors, which indicates differences in the applied technologies. Moreover, despite the efforts made, in 2022 the Bulgarian economy is still in last place across the EU in terms of reported LP in the three main economic sectors and overall economy.

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Figure 3. Growth rate of LP in 2022 compared to 2000 in % in the Eurozone and in Bulgaria total and by sector











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Source: Eurostat and author's own calculations.

The comparative analysis of trends in LP between the Eurozone and the CEECs at the beginning of the period under review shows that the value of the indicator in the Eurozone is significantly higher than those reported by all CEE countries. Slovenia, the Czech Republic and Poland have the highest LP values, while Romania and Bulgaria have the lowest.

Table 2. LP in the CEECs for the three main economic sectors and for the economy as a
whole at the beginning and end of the period studied

Years		200	0			202	22	
Countries/sectors	Agriculture	Industry	Services	Common	Agriculture	Industry	Services	Common
Bulgaria	4,52	7,26	3,83	4,47	19,1	30,92	23,01	24,38
Romania	1,16	10,82	4,14	3,75	15,27	38,55	35,01	33,65
Slovenia	9,81	41,98	18,03	21,88	28,5	57,38	53,52	54,00
Slovakia	2,61	18,95	8,08	9,52	37,54	38,07	38,25	38,19
Poland	2,35	25,31	11,11	11,72	10,52	44,99	35,89	35,82
Czech Republic	9,14	26,99	10,27	13,22	45,55	50,3	49,89	49,89
Hungary	10,47	21,67	9,41	11,55	23,69	33,92	31,26	31,53
Croatia	6,36	25,14	11,99	13,32	18,03	30,98	35,42	33,59
Lithuania	2,17	17,75	7,63	8,02	37,09	59,1	42,14	44,81
Latvia	2,96	18,69	7,36	8,41	35,22	51,58	39,47	40,98
Estonia	5,5	17	8,32	9,66	54,96	51,59	49,45	50,02
Average	5,19	21,05	9,11	10,5	29,59	44,31	39,39	39,72
Coefficient of variation	61,47	41,53	40,93	44,6	44,39	22,25	21,67	21,94
Euro area – 19 countries	22,6	82,63	41,55	47,21	52,61	98,07	75,71	78,67

Source: Eurostat and author's own calculations.

At the beginning of the period, significant differences between the Eurozone and the CEECs are characteristic of LP in all three economic sectors. Hungary has the highest LP in the agriculture sector, followed by Slovenia, the Czech Republic and Croatia. Romania, Lithuania, Poland and Slovakia had the lowest LP values in 2000. In the industry sector, the highest figures were recorded in Slovenia, the Czech Republic and Poland, and the lowest in Bulgaria, Romania and Estonia. In the service sector, Slovenia, Croatia and Poland are closest to the value of the Eurozone, while Bulgaria and Romania have the lowest LP in this sector.

 Table 3. Ranking of CEECs by LP in the main sectors and for the economy as a whole at the beginning of the period studied

Place	Agriculture	Industry	Services	Total LP
First	Hungary	Slovenia	Slovenia	Slovenia
Second	Slovenia	Czech Republic	Croatia	Croatia
Third	Czech Republic	Poland	Poland	Czech Republic

Source: compiled by the author.

The comparison between the CEE countries and the Eurozone shows that Slovenia, Croatia and the Czech Republic have the most favourable starting positions, while Romania, Bulgaria and Lithuania have the largest distance from the Eurozone at the beginning of the period under review.

At the end of the period in 2022, the situation regarding the countries with the highest LP total in the economy is generally the same compared to that at the beginning of the period. Slovenia, Estonia and the Czech Republic retain their leading positions among the CEECs, with the following ranking of economies in terms of LP for individual sectors:

Table 4. Ranking of CEECs by LP in the main sectors and for the economy as a whole at the end of the period studied

Place	Agriculture	Industry	Services	Total LP
First	Czech Republic	Lithuania	Slovenia	Slovenia
Second	Slovakia	Slovenia	Czech Republic	Estonia
Third	Lithuania	Estonia	Estonia	Czech Republic

Source: compiled by the author.

Croatia and Poland did not make so much progress in increasing LP and at the end of the period compared to the beginning dropped out of the ranking. The growth rate of LP in 2022 compared to 2000 on average in the CEE countries is highest in the agriculture sector and the lowest in the industry sector, but this trend is not typical for all the countries under review. LP growth for the whole economy was highest in Romania, followed by Lithuania and Bulgaria. The highest growth rates of LP in the agriculture sector were observed in Lithuania, Latvia and Slovakia, while in the services sector Romania and Bulgaria showed the largest growth rate.

An interesting indicator concerning structural convergence is the relative LP. It is calculated as the relationship between the relative share of gross value added for the sector concerned and the relative share of persons employed in the same sector. The data show that this indicator does not show that the differences are not so large between countries, but it can also be judged on the level of structural convergence.

The biggest differences stand out in the agriculture sector. The different structure of production and employment in Bulgaria, Romania and the Eurozone at the beginning of the study period are particularly visible here. Then the relative share of production and employment in Bulgaria are approximately the same and therefore the relative LP in it is one. For the Euro-zone, the relative share of gross value added is twice that of persons employed, from which it follows that the relative LP is approximately 0.5. In Romania, however, the

relative share of employees in this sector is very high -39%, and the share of production is only 12%, whereby the relative LP becomes 0.3 and is the lowest of all surveyed countries.

RELATIVE LP IN AGRICULTURE 1.5 Eurozone (19 countries) Bulgaria Romania 1 0.5 0 2005 2006 2000 , ⁵00, 200* 2007 2010 2016 2017 2018 2019 2020 2002 2000 2009 200 · 2022 202 201 20) 2° 2° 20'

Figure 5. Relative LP in agriculture

Source: author's own calculations.

For the industry sector, the relative LP for Bulgaria, Romania and the Eurozone at the beginning and end of the survey period is greater than one, but for all three at the end of the period it decreases – for Bulgaria by 0.36, for the Eurozone by 0.5, for Romania the decrease is the largest – by 1.73. Thus, at the end of the period, relative LP values for them converged significantly – for the Eurozone 1.25, in Bulgaria – 1.27, Romania – 1.15. Hence, judging by this indicator, there has been a significant convergence in LP for this sector at the end of the period.





Source: author's own calculations.

Figure 7. Relative LP in the service sector for Bulgaria, Romania and the Eurozone



Source: author's own calculations.

In the service sector, the dynamics are different. For Bulgaria and the Eurozone the relative LP grew but was below one and at the beginning and end of the period studied, while for Romania the indicator decreased from 1.1 to 1.04 at the end of the period and in all years it was above one. After all, here too, one can talk about convergence on this indicator in the services sector for the economies examined. The relative LP in the service sector in Bulgaria during the period under review varied from 0.88 to 0.985, indicating that the relative shares of manufacturing and employment in this sector of the economy are roughly the same. Throughout the period considered, this indicator was below one, which means that the relative share of persons employed was greater than that of GVA.

In conclusion, we can say that LP is an indicator by which Bulgaria has traditionally lagged behind other EU Member States. During the analyzed period, its value in Bulgaria was the lowest and, despite its increase, remained so at the end of the period under review, and this is valid both for the economy as a whole and at a sectoral level. The other CEE countries also have lower LP values in total in the economy and in individual sectors compared to the Eurozone, and this is characteristic both at the beginning and at the end of the period analyzed.

4.2. σ -convergent analysis of LP in Bulgaria and CEE countries.

The analysis of the convergence of Bulgaria's LP towards the Eurozone in this paragraph is based on the calculation of a divergence index and a total divergence index in the economy in all three main economic sectors. They have been calculated for each year of the period under review and compared with those in the other CEE countries. The values of the divergence index, showing the difference in LP between Bulgaria and the Eurozone, indicate that it is the smallest in the agricultural sector, followed by the service sector, while the largest

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differences are in the LP in the industry sector. This finding is valid for the entire period considered. The difference between Bulgaria and the Eurozone, measured by this indicator, does not decrease for agriculture and services, while for industry and the economy as a whole, the decrease is insignificant. Therefore, we can conclude that for Bulgaria the formal criterion for the existence of σ convergence, namely that the index should decrease significantly at the end of the period considered compared to its beginning, is not available. In total, for the economy during the period under review, the difference between the LP in Bulgaria and the Eurozone remained at almost the same level – 117.5 in 2000 and 104 in 2022, i.e. the index in absolute value decreased by 13.5.

 Table 5. Aggregate LP structural divergence indices for the CEECs that have adopted the euro and on average for the period 2000-2022

							1
Years	Lithuania	Latvia	Estonia	Slovenia	Slovakia	Croatia	Average
2000	-97,1	-94,7	-91,6	-40,5	-93,7	-72,7	-81,72
2001	-95,2	-93,3	-87,6	-40,7	-93,5	-70,6	-80,15
2002	-96,4	-92,1	-84,8	-39,4	-90,9	-66,9	-78,42
2003	-93,3	-93,3	-76,2	-31,1	-83,8	-61,7	-73,23
2004	-92,4	-92,3	-73,9	-36,2	-77,1	-62,3	-72,37
2005	-87,3	-87,9	-67,5	-34,5	-73,4	-56,9	-67,92
2006	-81,7	-80,6	-60,5	-32,7	-67,4	-52,7	-62,6
2007	-75	-69,1	-52	-30,7	-59,9	-59,4	-57,68
2008	-63,9	-63,2	-49,8	-26,2	-49,4	-55	-51,25
2009	-75,8	-82,3	-64,1	-31,1	-51,7	-57,1	-60,35
2010	-74,7	-89,9	-62,7	-33,8	-49,3	-60,9	-61,88
2011	-67,6	-86,9	-58,5	-36,6	-51,1	-64,1	-60,8
2012	-64,1	-77,1	-55,9	-40,8	-48,6	-69,6	-59,35
2013	-60,2	-74,7	-51,8	-41,3	-50,9	-69,1	-58
2014	-62	-72,4	-47,1	-41,7	-48,7	-76	-57,98
2015	-66,5	-74,9	-54	-41,4	-54,9	-78,1	-61,63
2016	-66,7	-76,9	-55,9	-38,7	-56,9	-74,3	-61,57
2017	-63,3	-73,9	-51,6	-47,5	-62,1	-79,4	-62,97
2018	-64,2	-72	-48,5	-40,4	-55,9	-77,9	-59,82
2019	-55,9	-65	-43,5	-40,8	-59,1	-78,2	-57,08
2020	-46,1	-59,1	-39,5	-39,9	-55,6	-81,7	-53,65
2021	-45,3	-51,6	-33,1	-37	-56,1	-85,4	-51,42
2022	-34,9	-45,1	-31,2	-34,4	-59,6	-90,1	-49,22
Average:	-70,85	-76,88	-58,32	-37,28	-63,03	-69,57	-62,65

Source: author's own calculations on Eurostat data.

The dynamics of the divergence index by sector are as follows: in agriculture, the index in absolute value rose by 6.88 and in the service sector by 2.44, while in industry it decreased by 22.77. Therefore, one cannot talk about the existence of significant convergence, but also of a strong divergence in LP between Bulgaria and the Eurozone.

An analysis of the divergence indices between the individual CEECs and the Eurozone shows that the difference in LP relative to the Eurozone for most countries has decreased. This is valid for Lithuania, Latvia, Estonia, Slovenia and Slovakia, i.e. for all of the groups that have already adopted the euro, with the exception of Croatia (see Table 5). For countries that have not yet adopted the euro, the divergence index decreases for Bulgaria, Romania and the Czech Republic, but not for Poland and Hungary (see Table 6).

Figure 8. Structural convergence of LP in the Bulgarian economy as a whole and in the three main economic sectors relative to the Eurozone according to the divergence index



Source: author's own calculations.

 Table 6. Aggregate LP structural divergence indices for CEECs not yet adopting the euro and average for the period 2000-2022

Years	Bulgaria	Romania	Poland	Czech Republic	Hungary	Average
2000	-117,5	-116,4	-80,2	-69	-76,3	-91,88
2001	-114	-116,6	-75,1	-63,7	-70,4	-87,96
2002	-114,7	-116,3	-76	-57,8	-61,5	-85,26
2003	-112	-112,3	-80	-54,7	-57,8	-83,36
2004	-115,2	-113,5	-81,3	-54,1	-55,1	-83,84
2005	-112,5	-104	-76	-46,7	-51,9	-78,22
2006	-110,7	-98,4	-74,3	-40	-52,8	-75,24
2007	-110,9	-89,8	-74,3	-37	-48,3	-72,06
2008	-103	-81,5	-66,8	-28,2	-44,8	-64,86
2009	-101,6	-91,6	-76,8	-31,9	-52,7	-70,92
2010	-104,2	-94,6	-74,1	-30,3	-50,5	-70,74
2011	-100,3	-94,9	-74,8	-30,5	-53,7	-70,84
2012	-102,5	-98,5	-77,2	-37,3	-61,4	-75,38
2013	-109,2	-97,2	-78,8	-45,4	-64,2	-78,96
2014	-111,6	-97,7	-79,4	-46,5	-67,3	-80,5
2015	-115,1	-100,1	-81,8	-48,1	-70	-83,02
2016	-112,5	-99,9	-85,2	-49,1	-72,5	-83,84
2017	-118,6	-101,7	-86,7	-47,8	-75,2	-86
2018	-119,8	-97,6	-86,4	-45,2	-74,4	-84,68
2019	-118,7	-94,2	-81,8	-40	-71,4	-81,22
2020	-112,3	-92,6	-78,9	-38,6	-71,8	-78,84
2021	-107,6	-86,9	-81,9	-39,3	-73,9	-77,92
2022	-104	-84,5	-83,3	-33	-84	-77,76
Average:	-110,80	-99,17	-78,74	-44,10	-63,56	-79,27

Source: author's own calculations on Eurostat data.

Only in Croatia, Poland and Hungary are the differences with the Eurozone increasing in total for the economy. In the industry sector, divergence is observed only in Croatia, and in

the agriculture sector in Bulgaria, Romania, Slovenia, Poland, Hungary and Croatia. For the service sector, there is divergence in Bulgaria, Hungary and Croatia.

It should be noted that divergence in LP is observed in some of the sectors or in total for the economy, especially in countries that have not yet adopted the euro. The only exceptions are Slovenia, where differences with the Eurozone are increasing in the agriculture sector and Croatia, where differences are growing in all sectors and in the economy as a whole, but it last adopted the euro, so this is somewhat expected for it. This shows that the introduction of the euro is a factor facilitating convergence in LP for the CEECs. Among other things, the countries that have not yet joined the Eurozone have the highest differences with it, both at the beginning and at the end of the study period.

Countries	Year 2000			Year 2022		
Countries	Agriculture	Industry	Services	Agriculture	Industry	Services
Bulgaria	-14,46	-68,7	-34,2	-21,34	-46,0	-36,7
Romania	-20,34	-62,4	-33,7	-26,50	-36,1	-21,9
Slovenia	-7,24	-20,0	-13,3	-11,05	-16,9	-6,5
Slovakia	-17,68	-49,1	-27,0	-4,32	-36,7	-18,5
Poland	-18,14	-39,8	-22,3	-33,67	-28,7	-20,9
Czech Republic	-8,02	-37,5	-23,5	-0,95	-23,3	-8,8
Hungary	-6,51	-45,0	-24,9	-15,89	-42,0	-26,1
Croatia	-11,67	-40,0	-21,0	-22,73	-45,9	-21,4
Lithuania	-18,47	-50,9	-27,7	-4,58	-15,5	-14,9
Latvia	-17,07	-49,5	-28,1	-5,75	-22,0	-17,3
Estonia	-12,94	-52,1	-26,6	-0,10	-22,0	-9,1
Average	-13,87	-46,82	-25,66	-13,35	-30,46	-18,37
Coefficient of variation	33,99	26,43	21,71	81,26	35,53	45,10

 Table 7. Structural convergence of LP in the main economic sectors of the CEEC economies relative to the Eurozone according to the divergence index

Source: Eurostat and author's own calculations.

We get similar information from the difference index. Here, both indices are used simultaneously to confirm each other's results, but if there is a discrepancy between them, the values of the divergence index are taken into account, which more accurately captures the convergence/divergence processes. The aggregate divergence index for Bulgaria shows quite fluctuating values over the period under review and also a process of divergence of LP towards the Eurozone. This is because, the LP in Bulgaria is very low compared to that in the Eurozone and despite its increase according to this index, it continues to move away from the average for the Eurozone, as it is also growing there.

Within the period considered, the changes in the divergence index are significantly greater than for the divergence index and show opposite trends for a large part of the economies considered. At the beginning of the studied period, the value of the index increases, which speaks of structural convergence. In the following years until 2008, the index fluctuated around the value reached, but without a clear direction. This is the main difference to the observed dynamics of the divergence index, where the period up to 2009 is almost without exception characterized by a sharp increase in values, while during the rest of the period up to its end, the dynamics of the two indicators move differently.

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The dynamics of the index are also interesting for the other countries. In more detail, if we compare with them, we will see that Bulgaria is in a relatively unfavourable situation in terms of structural convergence of LP with the Eurozone. This index puts our country in the bottom half of the ranking in similarity with the Eurozone among the surveyed countries, and from 2009 to 2022 it is the last in similarity country with the Eurozone. For its part, Romania is the next most remote from the Eurozone. The reasons for this are similar to those for Bulgaria. After 2020, differences between countries as measured by the divergence index tend to increase, which is an indication of the impact of the Covid pandemic and the remaining structural differences between them, which are projected on LP as well.

The LP analysis presented in this paragraph for Bulgaria and the CEE countries helped to bring out the main trends in its development and to make comparisons between it and the Eurozone. Certain positive trends in some sectors can be identified, as well as negative processes in others. Due to the complexity of the factors forming and influencing LP, it is impossible to draw firm conclusions about the existence of structural convergence only on the basis of descriptive analysis. The analysis was therefore complemented by the divergence and divergence indices, which allow for a more aggregated comparison at the sectoral level and stronger conclusions on the extent of the convergence processes taking place. Ultimately, in general, these two indices support the main trends described through the descriptive analysis. In particular, according to the values of the divergence index for the Bulgarian economy, convergence processes have been reported for most of the period under review, but in the last two years the value of the index is lower, i.e. the differences are greater than in 2020. Compared to the beginning of the period according to the divergence index, convergent processes are present. If we compare only with the results of Romania and then for the period after the accession of the two countries to the EU it turns out that Romania has a much greater convergence of LP with the Eurozone than Bulgaria. In recent years, the index of divergence has been decreasing in absolute terms. The two countries show a relatively similar degree of structural convergence of LP, but this is smaller than the other observed CEE countries.

The application of the σ methodology shows that the only sector that has seen Bulgaria's convergence towards the Eurozone is the industry. In the other sectors and in general for the economy, the formal criterion for the presence of σ convergence is not met, as the differences between Bulgaria and the Eurozone, as measured by the divergence index, did not decrease at the end of the period under review compared to the beginning.

The analysis of the calculated indices of divergence between the individual countries of CEE and the Eurozone shows that the differences in LP compared to the Eurozone are decreasing. For the economy as a whole, the gap with the Eurozone is widening in Croatia, Poland and Hungary, and for agriculture – in Bulgaria, Romania, Slovenia, Hungary, Poland and Croatia. For the industry sector, the differences are increasing only in Croatia, and for the service sector – in Bulgaria, Hungary and Croatia. Therefore, divergence in the LP is reported both in the countries that have not yet switched to the euro and in those that have already introduced it. This proves once again that this is not a significant factor in increasing convergence.

4.3. β -convergent analysis of LP

The analysis of the β convergence of LP with respect to the Eurozone for the three economic sectors in the CEE countries was carried out in order to trace the presence of β -convergence for the CEE countries with respect to the Eurozone by applying a panel model with fixed effects through the method of least the small squares, separately for the three economic sectors. The adequacy of fixed effects models was confirmed by the Hausman test.

If the coefficient β is negative and statistically significant, this proves the existence of β convergence between the CEECs and the Eurozone. This negative value indicates that changes in disparities between LP in the country concerned and the Eurozone are inverse to the size of this gap in the previous year.

	Agriculture	Industry	Services
α	-1.325*	-1.987*	-3.956 *
β	-0.166*	-0.047**	-0.275*
Fixed effects			
Bulgaria	-0,725	-0,653	-1,479
Romania	-0,587	-0,237	-0,826
Slovenia	-0,175	0,596	1,812
Slovakia	1,246	0,546	0,584
Poland	-0,689	-0,148	-0,277
Czech Republic	0,456	0,246	0,584
Hungary	0,139	-0,091	-0,168
Croatia	-0,014	-0,231	0,137
Lithuania	-0,268	0,085	-0,438
Latvia	-0,123	-1,417	0,875
Estonia	0,697	0,036	0,014
Adj. R2	0.096	0.088	0.076
F-stat.	2,697	1,248	3,047

Table 8. β convergence of LP at a sectoral level for CEECs towards the Eurozone

* and ** denote statistically significant values at 1% and 5% levels, respectively. Source: Eurostat and author's calculations.

The survey results show the existence of β -convergence of LP in the three main economic sectors of the CEE countries towards the Eurozone. This is evidenced by the negative sign of the coefficient β , which is statistically significant. In the industrial sector, however, the value of the coefficient is too low to indicate a substantial convergence process. The strongest β -convergence of LP for the CEECs compared to the Eurozone is in the service sector, which also corresponds to the conclusions regarding the strength of structural convergence according to the results of the σ -methodology.

In Bulgaria and in the three economic sectors, negative fixed effects are reported, which indicates the existence of a convergence process with the Eurozone. The values generally follow the same trend as those obtained on the basis of β -coefficients for the CEECs, with the highest absolute values in the service sector, followed by agriculture, and the lowest in industry. The analysis of signs over fixed effects in the three economic sectors shows that there is no significant difference in the number of countries reporting negative signs. Seven countries report negative fixed effects in the agricultural sector, while in the services sector

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and industry, there are six. On the other hand, the application of the sigma approach leads to different conclusions about the existence of convergence between CEE and the Eurozone in the services sector and the existence of divergence with the Eurozone in six countries in the agricultural and industrial sectors. The application of the β methodology to LP data shows the existence of β convergence of CEECs with the Eurozone in all three economic sectors. Divergence in LP exists only in some sectors or total for the economy only in countries that have not yet adopted the euro and also in Slovenia. Moreover, both at the beginning and at the end of the period, the countries outside the Eurozone have the highest differences with it. In 2022, Bulgaria has the largest differences compared to the Eurozone in terms of LP, both overall for the economy and by sectors.

Conclusion

The convergence of EU economies' LP is a lengthy process that helps synchronise their business cycles, reduce differences in the impact of external shocks on each of them, and increase the effectiveness of common policy. That is why it is seen as a desirable phenomenon. At the same time, given the dynamic nature of the productive structures of the economies and the various factors affecting them, it is not realistic to expect perfect convergence and this should not be a fundamental objective of economic policy.

At the beginning of the period, the production structure of the different sectors in the Bulgarian economy differed significantly from that of the Eurozone. During this period, there were structural changes in Bulgaria, and so at the end of the period, the sectoral distribution of value added approached that of the Eurozone. This process proceeds faster in the first half of the study period, while in the second half of it, the changes are more moderate. The process is not uniform across sectors, with the greatest convergence occurring in the sector with the largest differences in starting positions – agriculture. In the services sector, convergence is relatively stable but more moderate in absolute terms, and the process is most controversial in the industry sector. On the one hand, the share of this sector increased above that in the Eurozone, contributing to a faster increase in overall LP, but on the other hand, over most of the period, the gap in sectoral shares was larger than at the beginning.

It should also be noted that Bulgaria has more favourable convergence indicators than Latvia, which is already a member of the Eurozone, and the most favourable is the position of Estonia and Croatia, which are also part of it. Compared to Romania, Bulgaria is slightly less convincing at the end of the period and shows a lower degree of convergence. Overall, compared to the other countries under review, the results for Bulgaria show a relatively lower degree of convergence with the Eurozone, and despite the positive developments during the period, at its end, our country is ahead of only Latvia.

The general conclusion that can be drawn on the basis of this analysis is that there is a gradual convergence of the production structure of the Bulgarian economy with that of the Eurozone, which does not exclude individual opposing trends. In addition to reporting significantly greater convergence with the Eurozone, at the end of the period, Bulgaria is much closer to the values typical of the other countries analyzed. In this sense, no significant differences in the effects of the ECB's monetary policy on the Bulgarian economy compared to the other

Euro area countries should be expected. Under the Treaty on the Functioning of the EU, Bulgaria has committed to adopting the euro, which implies that it must strive to meet all convergence criteria.⁴

Structural convergence is particularly important for Bulgaria, which is not yet a member of the Eurozone and has not joined the common monetary policy. The effectiveness of this common policy is directly related to the degree of synchronization of countries' business cycles and to reducing differences in their reactions to external shocks to the economy. This efficiency is important for the Bulgarian economy, especially in times of crisis, which further determines the need for targeted actions to stimulate structural convergence.

References

- Ahmad, N., Naveed, A., Naz, A. (2019). A hierarchical analysis of structural change and labor productivity convergence across regions, countries and industries within the EU. – Labor & Industry: A Journal of the Social and Economic Relations of Work, 29(2), pp. 181-198.
- Angeloni, I., Flad. M., Mongelli, F. (2005). Economic and Monetary Integration of the New Member States. Helping to Chart the Route. – European Central Bank Occasional Paper Series, No 36.
- Ark, B. (1995). Sectoral Growth Accounting and Structural Change in Postwar Europe. Default Journal, University of Groningen.
- Barro, R. T., Mankiw, G., Sala-i-Martin, X. (1997). Technological Diffusion, Convergence, and Growth. Journal of Economic Growth, Vol. 2, N1, 26 p.
- Baumol, W. (1986). Productivity Growth, Convergence, and Welfare, What the Long-Run Data Show. American Economic Review, 76(5), pp. 1072-1085.
- Bilenko, Y. (2022). Economic Growth And Total Factor Productivity In Central And Eastern European Countries Between Two Global Crises And Beyond. – Baltic Journal of Economic Studies, Publishing house "Baltija Publishing", Vol. 8(4).
- Diaz, A., Santillán–Salgado, R. (2024). Labor Productivity Convergence among Eurozone Member Countries, Revista Mexicana de Economía y Finanzas, Nueva Época Vol. 19, N 2, Abril – Junio 2024, pp. 1-19.
- Doyle, E., O'Leary, E. (1999). The Role of Structural Change in Labour Productivity Convergence among European Union Countries: 1970-1990. – Journal of Economic Studies, Vol. 26, N 2, pp. 106-122.
- Friedman, M. (1992). Do Old Fallacies Ever Die?. Journal of Economics Literature, 30, pp. 2129-2132.
- Galor, O. (1996). Convergence? Inferences from Theoretical Models. Economic Journal, 106, pp. 1056-1069.
- Gluschenko, K. (2012). Myths about Beta-Convergence. MPRA Paper 66823, [online] Available at: https://mpra.ub.uni-muenchen.de/id/oeprint/66823.
- Höhenberger, N., Schmiedeberg, C. (2008). Structural Convergence of European Countries, Center for European. Governance and economic development research, discussion papers. No. 75, July. CeGE Discussion Paper, Available from: https://www.econstor.eu/handle/10419/32002
- Kallioras, D., Petrakos, G. (2007). Industrial Growth, Integration and Structural Change: Evidence from the European Union New Member States' Regions. – Discussion Paper Series, 13(4), March, pp. 93-114.
- Kane, R. (2001). Investigating Convergence of the U.S. Regions: A Time-Series Analysis. The Journal of Regional Analysis and Policy, 31(1).
- Krieger-Boden, Ch., Traistaru-Siedschlag, I. (2008). Regional Structural Change and Cohesion in the Enlarged European Union: An Introduction. – In: Krieger-Boden, Ch., Morgenroth, E., Petrakos, G. (eds.) The Impact of European Integration on Regional Structural Change and Cohesion, London: Routledge.
- Krugman, P. (1993). Lessons of Massachusetts for EMU. In: Torres, F., Giavazzi, F. (eds.). Adjustment and Growth in the European Monetary Union. Cambridge University Press, pp. 241-261.
- Naveed, A., Ahmad, N. (2016). Labour Productivity Convergence and Structural Changes: Simultaneous Analysis at Country, Regional and Industry Levels. Journal of Economic Structures, 5:1.

⁴ https://www.ecb.europa.eu/press/other-

publications/convergence/pdf/ecb.cr202406~475c2172bc.bg.pdf, Convergence Report, June 2024 p. 3

- Palan, N., Schmiedeberg, C. (2010). Structural convergence of European countries. Structural Change and Economic Dynamics, 21(2), pp. 85-100.
- Palan, N. (2013). Structural Change and Convergence: An Empirical Analysis of Production Structures in Europe, Frankfurt am Main: Peter Lang Economic Research, 3433.
- Pigliaru, F. (2003). Detecting Technological Catch-Up in Economic Convergence. Metroeconomica, 54 (2-3), pp. 161-178.
- Quah, D. (1993). Galton's Fallacy and the Convergence Hypothesis. Scandinavian Journal of Economics, 95, pp. 427-443.
- Sala-i-Martin, X. (1996). The Classical Approach to Convergence Analysis. The Economic Journal, pp. 1019-1036.
- Solow, R. (1956). A Contribution to the Theory of Economic Growth. The Quarterly Journal of Economics, 70(1), pp. 65-94.
- Sondermann, D. (2012). Productivity in the Euro Area: Any Evidence of Convergence?. Working Paper Series 1431, European Central Bank.
- Stattev, St., Raleva, St. (2006) Bulgarian GDP Structures Convergence with the EU. South-Eastern Europe Journal of Economics, 4(2), pp. 193-207.
- Van de Coevering, C. (2003). Structural convergence and monetary integration in Europe. MEB Series 2003-20, December.
- Von Hagen, J., Traistaru, J. (2005). Macroeconomic Adjustment in the New EU Member States. ZEI Working Paper, B 01.
- Wacziarg, R. (2004). Structural convergence. Stanford University. CDDRL Working Paper No 8. Retrieved from http://cddrl.fsi.stanford.edu/.
- Young, A., Higgins, M., Levy, D. (2007). Sigma Convergence versus Beta Convergence: Evidence from U.S. Country-Level Data, MPRA Paper 2714, [online] Available at: https://mpra.ub.uni-muenchen.de/2714/1/ MPRA_paper_2714.pdf.
- https://www.ecb.europa.eu/press/other-publications/convergence/pdf/ecb.cr202406~475c2172bc.bg.pdf, Convergence Report, June 2024 p. 3