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# General Patterns and Drivers of Changes in Employment Structure: Evidence from Five European Countries

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**Abstract**

This paper seeks to answer whether the general patterns and drivers of the sectoral employment shifts depend on a country's level of development. To accomplish this, we examined employment in Germany, Hungary, Poland, Romania and Ukraine at the national level (1998-2018) using econometric analysis, and at the regional NUTS2 level (2009-2018) using shift-share analysis. We obtained evidence that the general trend is the service sector expansion. Using the ARDL approach and the Granger causality test, we identified long-run unidirectional causality running from income proxies to employment in services in all countries except Romania, where the opposite causality was found. We revealed that household income moderates the impact of urbanization on service sector growth in all countries except Poland. At the regional level, the change in the employment rate in services is explained by the national growth effect and slightly by the industry-mix effect if the active phase of structural changes is completed.

**Keywords:** sectoral employment; ARDL bounds test; Granger causality; moderation effect; shift-share analysis.

**JEL classification:** J21; O14; R11; R15; C32.

## 1. INTRODUCTION

It is a well-documented fact that over the past century, changes in the employment structure took place in the direction of expanding the service sector. Does this trend persist in modern European countries and does it depend on the level of their development, and are there general drivers of these sectoral shifts? These questions motivated our study, since a deep understanding of sectoral employment changes has important implications for both vocational training policies and social infrastructure planning.

Issues of employment shifts between different sectors and possible reasons for relocation of workers attracted the attention of researchers about a hundred years ago. The first to establish patterns of structural change was probably Allan G. B. Fisher. In an article

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“The Drift to the Towns”, published in 1929, he noted that “a community grew in wealth the proportion of farming to total population would steadily diminish” (as cited in Fisher, 1935). In his subsequent book, Fisher (1935) identified the primary (agriculture), secondary (industry) and tertiary (services) producing stages, and, based on data from 1920-1933, he concluded “It has been a well-known feature of modern economic development that the proportion of total population engaged in “tertiary” production has been rapidly growing”, even during the period of depression (Fisher, 1935, p. 29). Later, Kuznets (1973, p. 248) also found that “major aspects of structural change include the shift away from agriculture to nonagricultural pursuits and, recently, away from industry to services”. Furthermore, he noted that reducing the share of the agricultural sector in the labor force by 30-40 percentage points in any sizable country in the course of a single century (1850s–1960s) is “a strikingly fast structural change”.

Subsequent studies in this area focused on empirical evidence of the patterns found, as well as identifying their causal mechanisms. Overall, the scientific literature on sectoral reallocation of employment can be classified according to the following main criteria: (i) measures of structural changes used, (ii) identified factors that stimulate these changes, (iii) national or regional level of research on sectoral shifts, and (iv) an analysis of the evolution of the employment structure in the one country or cross-country comparative analysis. In addition, the researchers applied both qualitative analysis and quantitative methods to long and medium time series.

The three most common measures of structural change are employment shares, value added shares, and final consumption expenditure shares (Herrendorf *et al.*, 2013). An important difference between these measures is that the employment shares and the value added shares are related to production, while the final consumption expenditure shares are related to consumption. This difference can lead to different interpretations of structural change information. It should be noted that production measures may also contain various information. For example, Simon Kuznets showed for the early stage of U.S. development that the share of employed in services increased significantly, while the share of value added in services remained almost constant (Herrendorf *et al.*, 2013). Verma (2012), examining the sectoral growth of services observed in the Indian economy during 1980-2005, showed that the three-sector model “performs well in accounting for the evolution of value added shares and their growth rates, but is unable to capture sectoral employment share trends”.

As for the causal mechanisms of structural changes, the most attention in theoretical and empirical literature was received by (i) the demand-side approach, explaining the change in the employment structure by differences across sectors in income elasticity of demand, and (ii) the supply-side approach, explaining the change in the employment structure differences across sectors in the rates of labor productivity, technological growth, and capital intensity.

Fisher (1935) and Clark (1957) were the first to explain structural transformations with demand. The application of Engel’s laws to successive stages of a progressive economy, according to Fisher (1935, p. 24), gives a rough picture of the changes in the structure of production. The version of Engel’s law applied to employment shares is that as incomes rise, the labor force in agriculture shrinks due to the low income elasticity of demand for agricultural products (Dennis and İşcan, 2009). At the same time, Clark (1957) points that change in employment shares between the three sectors of economic activity are closely related to an increase in national income. He found a significant decrease in the proportion of workers employed in the first division (agriculture) during the period from 1850 to 1945; and notes that first employment in the manufacturing sector grows as national income grows, reaches a maximum, and then decreases as the service sector begins to expand. Later Herrendorf *et al.* (2013) find identical patterns by analyzing the dependence of sectoral shares of employment and value added on GDP per capita between 1880 and 2000.

Baumol (1967), in contrast to Clark's demand-driven explanation, explains the transition to services by structurally lower growth rates of labor productivity in services than in other sectors of the economy. In 2001, Baumol (2001) empirically confirms his theory, as well as the predicted, so-called cost disease in the service sector. Mattey (2001) also indicates that the United States has 'fallen ill' with a "cost disease" in the service sector. "Productivity growth in the service sector has been quite weak, boosting production costs and prices of services. Despite this, the service sector's share of real output has trended upward, and the service sector's share of employment and nominal output has increased even faster" (Mattey, 2001, p. 87). In particular, employment in the service sector increased from 19% in 1977 to 29% in 1996, and labor productivity declined by 0.5% at an annual rate in this period, while as labor productivity in manufacturing increased by 3.1 percent. Similar trends and relationship were found in the Canadian economy for the period 1962–1991 (Mohnen and Raa, 2001) and in the EU countries for the period 1990–2010 (Mitkova and Dawid, 2016).

Fuchs (1968) tested both demand-side and supply-side explanations of employment changes in the service sector. He found that (i) in the U.S., between 1929 and 1965, income growth and subsequent changes in demand were not the main source of relative employment growth in the service sector, and (ii) "the major explanation for the shift of employment is that output per man grew much more slowly in the Service sector than in the other sectors" (Fuchs, 1968, p. 4). However, Dennis and İşcan (2009) show that the Engel effect explains almost all the redistribution of labor until the 1950s, after which the Baumol effect becomes a key determining factor. Kehoe *et al.* (2018) also found that most of the decline in the share of goods-producing sectors (agriculture, mining, and manufacturing) in total employment from 1992 to 2012 is due to differential productivity growth.

In addition, their relationship and joint impact are likely. Boppart (2014), Gabardo *et al.* (2019), Comin *et al.* (2019) proposed models that allow us to analyze both explanations of structural changes – income and the relative prices (substitution) effects – simultaneously. For example, the Boppart (2014) model suggests that in 1946, 44 percent of observed structural changes are attributable to a relative price effects and 56 percent to the income effect; in 2011, the corresponding numbers are 53 percent and 47 percent, respectively; and the relative contribution of the substitution effect will asymptotically converge to 65 percent. However, Comin *et al.* (2019) found that more than 75% of the observed structural changes are explained by the influence of income (the authors used household-level data for the U.S. and India, and aggregate data for a panel of 39 countries during the post-war period).

Thus, we find empirical evidence of intertemporal and intercountry differences in the effects of supply and demand mechanisms on the employment structure. In this regard, the question arises: is there a cointegration relationship between incomes and the employment share of the service sector in modern European countries, and does it depend on the level of socio-economic development of the country? Obviously, the autoregressive distributed lag (ARDL) bounds testing approach is most suitable for studying both long-term and short-term relationships between these variables. The ARDL bounds testing approach to cointegration analysis developed by Pesaran and Shin (1999) and Pesaran *et al*. (2001) and is now widely used in economic research, but we could not find its application in studies on sectoral reallocation of employment, with the exception of some indirectly related studies. For example, the positive effects of globalization on employment in general in the long-run (Dogan, 2016) and the long-run relationship between unemployment, economic growth, export and foreign direct investment inflows (Bayar, 2014) have been found in Turkey using this technique. Therefore, we will try to apply the ARDL approach to cointegration analysis in our study, as well as the Granger causality tests.

Nevertheless, the set of structural change drivers is not limited to supply-side and demand-side reasons. For instance, the impact of human capital on changes in the employment structure is revealed. Caselli and Coleman (2001) showed how a reduction in education (training) costs led to a transition from an unskilled agricultural sector to a skilled non-agricultural sectors, which in turn contributed to regional convergence in the U.S. Buera and Kaboski (2012) explain the increase in the share of the service sector in value added from 60 percent in 1950 to 80 percent in 2000 due to the growth of skill-intensive services; at the same time, the share of low-skill industries was actually declining. Mitkova and Dawid (2016) examined the impact of total R&D expenditures on sectoral employment in EU countries. The authors found that (i) there is a negative correlation between the manufacturing share in employment and the total R&D expenditures, but (ii) in terms of absolute employment (rather than employment share), sector specific R&D have a positive effect on employment in both the manufacturing sector and the service sector.

In addition, Betts *et al*. (2013) showed that international trade and trade policies are a significant source of the reallocations of Korean labor from agriculture into industry and services from 1963 to 2000. At the same time, Kehoe *et al*. (2018) tested the effect of the trade deficit on declining employment in the goods-sector and found that only 15.1 percent was caused by the U.S. trade deficit.

Finally, as Kuznets (1973) highlighted, rapid changes in the economic structure are associated with rapid changes in conditions of life suggested by "urbanization"; the transition to urban life causes changes in the nature of participation in economic activity, in social values, and needs. Recent empirical studies in developing countries show that for the services sector, urbanization can be a major driver of sector growth. Data from 36 developing Asian countries indicate that in a more urbanized economy, the share of the services sector in employment and in GDP is higher (Noland et al, 2012). In addition, it should be emphasized here, the authors found that the services value added and the share of employment in services are positively correlated with GDP per capita (logs), but the share of services shows a significantly stronger correlation. This evidence once again emphasizes that these measures of the sectoral share can interpret structural changes differently, as we noted above. Cheng (2012) using econometric time series models (from 1978 to 2010) finds that urbanization is the driving force behind the growth of the service sector in China. Arouri *et al*. (2014) based on measures of urbanization (share of urban population) and employment structure (employment shares and value added shares) show that urbanization is shifting the Africa's economy from agriculture to the service sector. The question arises: is there a correlation between urbanization and the expansion of the services sector in modern European countries, and does it depend on the level of socio-economic development of the country?

As mentioned above, in addition to studies of structural changes at the national level, regional changes in the employment structure are also being studied. In regional studies, the shift-share method proposed by Dunn (1960) is most widely used to identify employment growth factors. This method assesses the contribution of national, sectoral and regional effects to employment changes; however, it is criticized for the static nature of the analysis, the so-called problems of weights and intertwined effects, etc. Therefore, in subsequent studies, the shift-share analysis is used both in the classical specification and in the revised form (Esteban-Marquillas, 1972; Herzog and Olsen, 1977; Patterson, 1991; Fernandez and Menéndez 2005; Brox *et al*., 2010; Artige and Neuss, 2014; Mitkova and Dawid, 2016; Uyarer and Volkan, 2016; Johnston and Huggins, 2018). In addition, the method was used to study changes in employment not only in the regions of one country, but also considered countries as regions of various aggregations of countries. For example, Ray and Harvey (1995) used shift-share analysis (the Esteban-Marquillas version) to disaggregate employment changes in the EU to isolate differential impacts on member countries; Bielik and Rajčániová (2008) analyzed employment in the Visegrád group countries.

Thus, while studying the literature on employment shifts, we raised two questions about the effects incomes and urbanization in modern European countries and the dependence of these effects on the level of development of countries. In addition, the issues of the relationship between regional shifts and the sectoral structure of employment in this context motivate our study. The purpose of this empirical study is to identify common patterns and driving forces of structural changes in employment at the national and regional levels in European countries with different levels of socio-economic development. We conduct a comparative analysis of changes in the employment structure in countries that are included in different groups according to the World Bank Income Group Classification (World Bank, 2019a), namely: Germany (high income), Hungary, Poland (high income, since 2006 and 2008, respectively), Romania (upper middle income, since 2005), and Ukraine (lower middle income). Overall, our data cover the period between 1998 and 2018 and in the case of regional studies since 2009. At the national level, we use sectoral shares of employment as a measure of structural changes, and focus on two of change sources: income (measured by GDP per capita and household income) and urbanization; at the regional level, we use the employment rate and study the national, sectoral and regional sources of structural changes. From a methodological perspective, we combine the econometric analysis of time series data for selected countries, including cointegration and error correction models in the presence of structural breaks, with a shift-share analysis. Our main findings are as follows. We found evidence that a general pattern for selected European countries, regardless of their level of socio-economic development, is a decrease in the agricultural sector and an increase in the service sector in terms of employment. We also identified long-run unidirectional causality running from income proxies to employment in services in all countries except Romania, where the opposite causality was found. In addition to incomes, our empirical results showed a significant positive impact of urbanization on employment growth in the service sector in all countries except Poland, but household incomes moderate this relationship. Using the regional shift-share analysis, we found that the change in the service sector employment share is explained by the effect of national growth and, to a small extent, by the industry-mix effect if the active phase of structural changes is completed. Thus, this paper contributes to the literature on sectoral reallocation of employment by collecting empirical evidence regarding changes in employment between agriculture, industry and service sectors, and the significant role of incomes, urbanization and their interaction, as well as national growth and sectoral-regional effects in this process.

The rest of the paper is organized as follows. Section 2 describes the hypotheses, data set, and research methodology. Hypothesis testing results are discussed in section 3. Finally, section 4 presents our findings and issues for future research. Annex 1 and Annex 2 present the results of the cointegration and causality analysis, and the shift-share analysis in tabular form, respectively.

## 2. METHODOLOGY AND DATA

### 2.1 Hypotheses formation

Obviously, employment trajectories depend on national, regional, and sectoral characteristics of economies and labor markets. But are there general patterns and factors that do not depend on the level of development of the country? We put forward two groups of research hypotheses concerning European countries. The first group of hypotheses contains assumptions about the impact of population income growth and urbanization on changes in employment structure in the direction of expanding the service sector. To test hypotheses, as a measure of structural changes, we take sectoral employment shares (% of total employment) and use econometric analysis. Hypotheses are proposed as follows:

***H1a****: Regardless of the level of development and structure of the national economy, the general pattern is an increase in the share of employment in services and a decrease in agriculture and industry.*

***H1b****: The increase in incomes and the subsequent change in the structure of demand lead to an expansion of the service sector and, consequently, to an increase in employment in the service sector.*

***H1c****: Urbanization is a driving force for expanding the service sector and, consequently, increasing employment in services.*

***H1d****: The impact of urbanization on the service sector employment share varies depending on household income levels.*

It is important to emphasize that the H1b hypothesis is essentially the Clark hypothesis, which we want to test on the data of European countries for the period between 1998 and 2018. In addition, the H1d hypothesis is an assumption about the moderation effect of income on the relationship between urbanization and the expansion of the service sector in terms of employment.

The second group of hypotheses contains assumptions about national, sectoral and regional factors of changes in employment structure. In this case, to test hypotheses, we apply a shift-share analysis to regional data (NUTS2 level) and take the employment rate (the ratio of the employed to the working-age population, i.e., to the population aged 15 to 64) as a measure of employment. We also suggest that the shift-share analysis will provide additional evidence for hypotheses about the impact of national growth and urbanization on the expansion of the service sector. We thus propose the following hypotheses.

***H2a**: The change in the employment rate in the service sector is explained by the national growth effect and, to a small extent, by the sectoral effect if the active phase of structural changes is completed.*

***H2b**: The regions are heterogeneous in terms of employment trajectories, but the capital regions have better employment indicators than national averages, regardless of the level of development and structure of the national economy*.

***H2c**: Capital regions specialize in the service sector, even if they do not have a competitive advantage in this sector.*

### 2.2 Data

In this study, we analyze the patterns of national and regional employment based on the three-sector hypothesis, namely: agriculture, industry, and the service sector. Therefore, firstly, we use employment data for these three sectors and other variables at the national level from Germany, Poland, Hungary, Romania and Ukraine. Secondly, we use data on sectoral employment and other variables at the level of the European territorial units of NUTS 2, except for Germany and Ukraine. In Germany, regional statistics are presented for 16 federal states. Since NUTS classification is defined only for EU Members States, for Ukraine we use the territorial division of 24 regions (analogue of NUTS2-level regions), and also indicate 5 macro-regions (analogue of NUTS1-level regions). Data have been collected from national statistical offices of Germany (Statistisches Bundesamt, 2019), Poland (Statistics Poland, 2019), Hungary (Hungarian Central Statistical Office, 2019), Romania (National Institute of Statistics, 2019), and Ukraine (State Statistics Service of Ukraine, 2019). In addition, we use the World Bank data (Word Bank, 2019b) on GDP per capita and urban population in the analyzed countries. However, the availability of regional and sectoral statistics limited the time interval of our sample. At the national level, the period covered is from 1998 to 2018, and in the case of Ukraine, the period covered is 2000–2018. At the regional level, data has been available since 2009 and in Romania since 2010.

### 2.3 Methods

#### *2.3.1 Cointegration and causality tests*

To investigate the cointegration relationship between income growth and the expansion of the services sector in terms of employment, we use autoregressive distributed lag (ARDL) bounds testing approach developed by Pesaran and Shin (1999) and Pesaran *et al*. (2001). We use GDP per capita at PPP (current international $) and household incomes (in national currency) as proxies for income. The ARDL approach can be applied to study cointegration in small samples, but provided that the variables are stationary with orders I(0), I(1), or a mixture of both. In addition, due to the global financial and economic crisis of 2008-2009 (or due to other internal reasons), structural breaks in the data set are possible. Therefore, we pre-test the data sets (Log) using the Augmented Dickey-Fuller (ADF) unit root test and the Zivot-Andrews (Zivot and Andrews, 1992) unit root test with a single structural break.

The research interest lies in identifying both the impact of income on the services sector and the feedback, therefore, the empirical equations of the ARDL bounds testing approach in the presence of structural break are given as:

$$\Delta LES_t = \alpha_0 + \sum_{i=1}^{m} \beta_{1i} \Delta LES_{t-i} \sum_{i=0}^{m} \beta_{2i} \Delta LGDP_{t-i} + \gamma_1 LES_{t-1} + \gamma_2 LGDP_{t-1} + \gamma_3 D_{ES} + \varepsilon_t, \quad (1)$$

$$\Delta LGDP_t = \lambda_0 + \sum_{i=1}^{m} \mu_{1i} \Delta LGDP_{t-i} \sum_{i=0}^{m} \mu_{2i} \Delta LES_{t-i} + \nu_1 LGDP_{t-1} + \nu_2 LES_{t-1} + \nu_3 D_{GDP} + \xi_t, \quad (2)$$

where *LES* is the Log of employment in the services (% of total employment), *LGDP* is the Log of GDP per capita at PPP, $D_{ES}$ and $D_{GDP}$ are dummy variables associated with structural shifts in levels or trends, $\Delta$ is the first difference operator, *m* is the selected lag length, $\varepsilon$ and $\xi$ are random error terms, the subscript *t* is the year.

Formally, the dummy variable for the break in the level of the series takes a value of 0 before the break year ($t_B$) and a value of 1 after, while the trend shift variable takes the value $t-t_B$ after the break year. It should be noted that due to the small sample size, we do not include additional variables to control the *LES–LGDP* relationship. Similarly, an ARDL model is presented to study the *LES–LHI* (employment in services–household income) relationship.

In equations (1) and (2), $\beta$'s and $\mu$'s represent the short-term dynamics of the model, and $\gamma$'s and $\nu$'s are long-run coefficients. Therefore, the investigate the existence of a long-run relationship between variables consists in testing the hypothesis that the coefficients of the lagged levels of the variables (OLS estimates) are insignificant, i.e., $H_0$: $\gamma_1 = \gamma_2 = 0$ and $H_0$: $\nu_1 = \nu_2 = 0$ or not cointegration. The null hypothesis is tested using the F-statistics. Pesaran et al. (2001) tabulated upper bound and lower bound critical values of F-statistics, but due to small data sets, we will use the critical bounds provided by Narayan (2005).

If we confirm the existence of cointegration between variables, we will use the two-step procedure proposed by Engle and Granger (1987) to identify causation. An error correction model (ECM) that describes the behavior of the employment in services and GDP per capita in the short-run in accordance with long-run cointegration relationship is written as follows:

$$\Delta LES_t = \alpha_0 + \sum_{i=1}^{m} \beta_{1i} \Delta LES_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta LGDP_{t-i} + \gamma \Delta D_{ES} + \delta ECT_{t-1} + \varepsilon_t, \quad (3)$$

$$\Delta LGDP_t = \lambda_0 + \sum_{i=1}^{m} \mu_{1i} \Delta LGDP_{t-i} + \sum_{i=0}^{m} \mu_{2i} \Delta LSES_{t-i} + \nu \Delta D_{GDP} + \varphi ECT_{t-1} + \xi_t, \quad (4)$$

where $ECT_{t-1}$ is the lagged value of error correction term.

The short-term causality (GDP Granger-causes ES) is tested by $H_0$: $\beta_2 = 0$, and long-run causality is tested by $H_0$: $\delta = 0$. Other causal effects are tested similarly. In addition, ECT is a measure of the rate of convergence to long-term equilibrium after a short-term shock. For instance, significant negative estimate of $\delta$ means that the employment in services tends to converge towards a long-term equilibrium path.

If we do not confirm the existence of cointegration between the variables, then the specification of the Granger causality test will be vector autoregression in first difference form.

### *2.3.2 Moderation effect test*

Hypothesis H1d actually states that household income affect the nature of the relationship between urbanization and the expansion of the service sector in terms of employment. In other words, household income is the moderator of this relationship. As you know, a moderator is an independent variable that affects the direction and/or strength of the relationship between another independent variable and a dependent variable (Baron and Kenny, 1986). Typically, the moderator effect is indicated by the interaction of $x_1$ and $x_2$ when explaining $y$, so the terms "moderation effect" and "interaction effect" are often used synonymously. However, when the predictor and moderator variables are theoretically clearly distinguished, and it is interesting to see the effect of the predictor on the response under the influence of the moderator, this effect should be defined as the moderation effect. That is, we theoretically exclude the existence of the so-called reverse interaction effect (Andersson *et al*., 2014), in which the urbanization rate actually affects the relationship between the income and employment in services.

In this study, moderation effect is tested using hierarchical "moderated multiple regressions" (Saunders, 1956). In our case, the regression equation used to assess the effect of two independent variables, taking into account a possible structural break, is written as follows:

$$ES_t = \beta_0 + \beta_1 HI_t + \beta_2 UR_t + \gamma D_{ES} + \varepsilon_{1t}\,, \tag{5}$$

where $ES_t$ is employment in services (% of total employment) at $t$, $HI_t$ is household income at $t$, $UR_t$ is urbanization rate at $t$, $D_{ES}$ is dummy variable associated with structural shifts in national level or trend of the employment in services, $\varepsilon_{1t}$ is random error term at $t$.

To incorporate interaction in regression (5) we add the explanatory variable $HI_t \cdot UR_t$

$$ES_t = \beta_0 + \beta_1 HI_t + \beta_2 UR_t + \beta_3 HI_t UR_t + \gamma D_{ES} + \varepsilon_{2t}\,. \tag{6}$$

Further, in accordance with Carte and Russell (2003), to identify the moderation effect, we test the null hypothesis $H_0$: $\Delta R^2 = R^2_{mult} - R^2_{add} = 0$ against the alternative hypothesis $H_A$: $\Delta R^2 \neq 0$, where $R^2_{add}$ and $R^2_{mult}$ are coefficients of determination for additive regression (5) and multiplicative regression (6). To do this, we use $F$-statistic calculated by the formula

$$F_{(df_{mult}-df_{add},N-df_{mult}-1)} = \frac{\Delta R^2}{df_{mult}-df_{add}} \cdot \frac{N-df_{mult}-1}{1-R^2_{mult}}\,, \tag{7}$$

where $df_{add}$ and $df_{mult}$ are degrees of freedom for additive regression (5) and multiplicative regression (6), $N$ is sample size.

If the calculated $F$-value is greater than $F$-critical value, the null hypothesis is rejected, and it is concluded that income moderates the urbanization → employment-in-services relationship. It is important to emphasize that using $\beta_3$ instead of $\Delta R^2$ as an index of moderator effect size is an error (Carte and Russell, 2003). We use OLS for estimating the unknown parameters in regression models (5) and (6). In addition, given the purpose of this study, we preliminary normalize the data in order to obtain comparable model parameters and correctly conduct cross-country comparisons of the effects of incomes, urbanization, and their interaction on employment in the service sector.

### *2.3.3 Shift-share analysis*

We use shift-share analysis for cross-country comparisons of national, sectoral and regional effects on employment and its main tendency–increased employment in services. The "classical" shift-share equation is designed to decompose the growth of a regional variable into three "effects" (Dunn, 1960; Herzog and Olsen, 1977; Fernandez and Menéndez 2005): national growth (national effect), industry-mix (sectoral or structural effect), and competitive position (regional effect). Note that shift-share literature differs in terminology; therefore, we give some alternative terms in brackets. In addition, given that the standard definitions of all terms have not yet been established, it is helpful to present the mathematical formulas and terms we use. In this paper, we follow approaches to the shift-share analysis of Dunn (1960), Esteban-Marquillas (1972), and Herzog and Olsen (1977); we use the employment rate as a regional variable and examine its change over the analyzed period, i.e.

$$d_{ijk} = E^{n}_{ijk} - E^{o}_{ijk}\,, \tag{8}$$

where $E^{o}_{ijk}$, $E^{n}_{ijk}$ are employment rates in the *i*-th sector of the *j*-th region of the *k*-th country; the superscripts "0" and "*n*" denote employment rate in a base year and in the terminal year of the analysis, respectively.

In accordance with the classical shift-share specification (Dunn, 1960), we decompose the growth of the employment rate into three "effects"

$$d_{ijk} = g_{ijk} + m_{ijk} + c_{ijk}\,, \tag{9}$$

where $g_{ijk} = E^{o}_{ijk} \cdot r_k$ is national growth effect; $m_{ijk} = E^{o}_{ijk} \cdot \left(r_{ik} - r_k\right)$ is industry-mix effect; $c_{ijk} = E^{o}_{ijk} \cdot \left(r_{ijk} - r_{ik}\right)$ is competitive effect; $r_{k}$, $r_{ik}$, $r_{ijk}$ are growth of national and regional employment rates that are defined as follows:

$$r_{ijk} = \frac{E^{n}_{ijk} - E^{o}_{ijk}}{E^{o}_{ijk}} \quad r_{ik} = \frac{E^{n}_{ik} - E^{o}_{ik}}{E^{o}_{ik}} \quad r_{k} = \frac{E^{n}_{k} - E^{o}_{k}}{E^{o}_{k}}\,. \tag{10}$$

The national growth effect shows how much the change in the employment rate in the region can be explained by overall national growth. The difference between the actual change in the employment rate ($d_{ijk}$) and the national growth effect ($g_{ijk}$) is called the "net shift" of the *i*-th sector in the *j*-th region of the *k*-th country; from equation (9) it can be seen that the net shift is also equal to the sum $m_{ijk} + c_{ijk}$. The sign of the total regional net shift indicates the direction of the change in the share of the *j*-th region in total employment in the *k*-th country. The industry-mix effect shows how much the change in the employment rate in the region can be explained by the employment growth in this sector at the national level. The competitive position effect should show how much the change in the employment rate in the region can be explained by the unique advantages of this region in this sector. However, according to equation (9), the competitive position effect of the *j*-th region in the

$k$-th country ($c_{ijk}$) depends both on the nature of the dynamics of the $i$-th sector ($r_{ijk} - r_{ik}$) and the regional employment rate $E^o_{ijk}$ in this sector. Consequently, sectoral and regional competitive effects are intertwined, and competitive position is an unclean measure of regional advantage (disadvantage). To avoid this problem, the so-called intertwined effect, we will use the Esteban-Marquillas shift-share model. Esteban-Marquillas (1972) proposed the decomposition of the regional effect (in our case–$c_{ijk}$) into two components: the effect of the competitive position, cleared of all regional structural influences using the so-called homothetic employment

$$c'_{ijk} = \hat{E}^o_{ijk} \cdot \left(r_{ijk} - r_{ik}\right) \tag{11}$$

and the allocation effect

$$a_{ijk} = \left(E^o_{ijk} - \hat{E}^o_{ijk}\right) \cdot \left(r_{ijk} - r_{ik}\right), \tag{12}$$

where $\hat{E}^0_{ijk} = E^0_{jk} \frac{E^0_{ik}}{E^o_k}$ is homothetic employment rate in the $i$-th sector of the $j$-th region of the $k$-th country, $E^o_{ijk} - \hat{E}^o_{ijk}$ is a measure of regional specialization, and $r_{ijk} - r_{ik}$ is a measure of the competitive advantage of the $j$-th region in the $i$-th sector.

According to the definition of Esteban-Marquillas (1972, p. 251), homothetic employment is "the employment that sector $i$ of region $j$ would have if the structure of the employment in such region were equal to the national structure". The allocation effect shows whether the region specializes in those sectors in which it has the best competitive advantages (Esteban-Marquillas, 1972). Table no. 1 demonstrates how the allocation effect (code number) is identified depending on the combination of signs of regional specialization and competitive advantage.

**Table no. 1 – Possible allocation effects**

| Code | Definition | Allocation effect | Components | |
|---|---|---|---|---|
| | | | Regional specialization | Competitive advantage |
| 1 | Competitive disadvantage, specialized | - | + | - |
| 2 | Competitive disadvantage, not specialized | + | - | - |
| 3 | Competitive advantage, not specialized | - | - | + |
| 4 | Competitive advantage, specialized | + | + | + |

*Source:* *Herzog and Olsen (1977, p. 10)*

Thus, in our study, we use the Esteban-Marquillas model in this form

$$d_{ijk} = g_{ijk} + m_{ijk} + c'_{ijk} + a_{ijk}\,. \tag{13}$$

The components of model (13) are calculated for all sectors in all regions of the analyzed countries, and then, taking into account the purpose of our study, are summarized over all sectors and evaluated for the entire region. However, as noted by Herzog and Olsen (1977), as well as Artige and Neuss (2014), the Esteban-Marquillas transformation does not solve the problems of classical shift-share analysis. In particular, in both the classical model (9) and the revised Esteban-Marquillas model (13), weights are determined in the base year values and structural changes are not taken into account during the analysis period (Herzog and Olsen, 1977). At the same time, a sector defined as "not specialized" in the base year ( $E^{o}_{ijk} - \hat{E}^{o}_{ijk} < 0$) may become "specialized" in the terminal year ( $E^{n}_{ijk} - \hat{E}^{n}_{ijk} > 0$ ). Therefore, as in (Herzog and Olsen, 1977), in order to assess the sensitivity of the sign of the allocation effect to changes in the regional employment structure, we calculate the allocation effect (12) with base year and terminal year specialization weights.

## 3. EMPIRICAL RESULTS AND DISCUSSION

To test the H1a hypothesis, we carried out a cross-country comparative analysis of the dynamics of sectoral employment in selected countries between 1998 and 2018 (in the case of Ukraine, since 2000). As an indicator of the level of economic development and standards of living, we use GDP at Purchasing Power Parity (PPP) per capita. Our calculations for the analysis are reported in Tables no. 2 and no. 3, as well as in Figure no. 1. We find convincing evidence that in all countries, regardless of their level of development and the initial employment structure, the employment share in the service sector has increased, while in agriculture it has decreased. Note that in Ukraine, the employment share in the service sector is similar to developed countries in the sample. The initial structures of the German (2:30:68) and Romanian (40:30:30) labor markets are boundary in our sample, but over the past two decades, Romania has been most active in the inter-industry reallocation of employment. In 2018, the Romanian employment structure already had parameters (20:30:50), which indicates a rapid deagrarianization and, possibly, a direct "transition" of employment to the service sector. Probably, we can assume that the structure of the Romanian labor market is striving for a conditionally optimal post-industrial structure, in the limit to the German one.

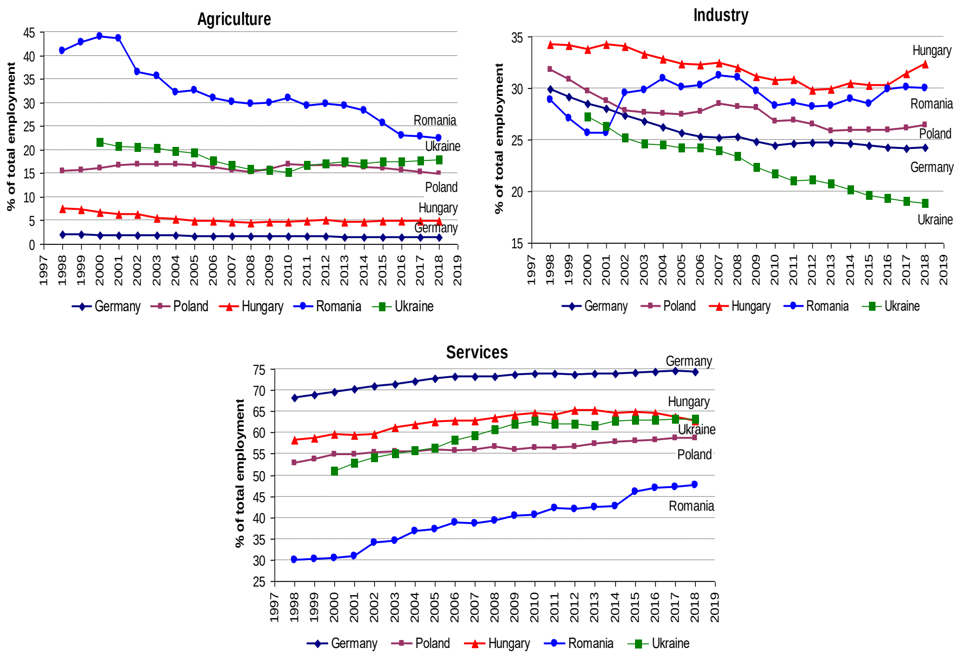
As can be observed in Figure no. 1, regardless of the level of development of the country and the initial structure of employment, all trajectories tend to a certain attractor. The most compelling in this sense is the service sector. In addition, over the past two decades, in all selected countries, the employment share of the service sector has increased, and the share of agriculture has decreased. These trends are consistent with those described in previous studies, but we emphasize that there is no dependence on the level of development of the country. However, with regard to industry, in the last 5-7 years the trend has been reversed in all countries except Ukraine (probably due to military operations in industrial eastern regions). Future studies will show us whether this trend is long-term. Thus, due to a change in the direction of the industry share trends in recent years, we cannot accept the hypothesis H1a in this part. At the same time, in connection with the revealed increase in the employment share of the service sector, our subsequent hypotheses focus on the possible causes of this pattern in selected countries.

**Table no. 2 – The relationship between income growth and changes in employment structure, 1998-2018**

| Country | GDP per capita, PPP (current international $)[a] | | Sectoral employment shares, per cent | | | | | | Correlation between sectoral employment shares and household income,[c] and GDP per capita PPP | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1998[b] | | | 2018 | | | | | |
| | 1998 | 2018 | Agr. | Industr. | Serv. | Agr. | Industr. | Serv. | Agr. | Industr. | Serv. |
| Germany | 25392.6 | 53735.2 | 2.0 | 29.9 | 68.1 | 1.4 | 24.2 | 74.4 | -.959**<br>-.958** | -.813**<br>-.860** | .833**<br>.873** |
| Poland | 9471.5 | 31343.0 | 15.4 | 31.8 | 52.8 | 14.9 | 26.4 | 58.7 | -.350<br>-.328 | -.806**<br>-.816** | .942**<br>.943** |
| Hungary | 10411.5 | 30673.1 | 7.4 | 34.3 | 58.3 | 4.8 | 32.4 | 62.8 | -.842**<br>-.774** | -.796**<br>-.810** | .858**<br>.839** |
| Romania | 5544.3 | 28206.4 | 41.0 | 28.9 | 30.1 | 22.3 | 30.0 | 47.7 | -.931**<br>-.921** | .280<br>.308 | .969**<br>.968** |
| Ukraine | 3415.6 | 9233.2 | 21.6 | 27.3 | 51.1 | 18.0 | 18.9 | 63.1 | -.462*<br>-.825** | -.917**<br>-.876** | .803**<br>.946** |

*Note:* [a] Data are in current international dollars based on the 2011 ICP round (The World Bank, 2019b); [b] For Ukraine, data on sectoral employment are only available since 2000; [c] Average amount per household and month in national currency; *significant at the .05 level; **significant at the .0001 level (2-tailed)

*Source: author's computations*




*Note: For Ukraine, data are only available since 2000*

*Source: author's computations*

**Figure no. 1 – Sectoral employment shares for selected countries between 1998 and 2018**

To test the H1b hypothesis about the impact of income on employment growth in the service sector, as income measures, we used household income in national currency and per capita GDP (PPP). In this study, we consider the first measure to be important, since we assume that the change in the structure of demand depends on income in the national currency, while in cross-country comparisons, of course, per capita GDP (PPP) is used. Nevertheless, the calculation results shown in Table no. 2 lead to the same conclusions; a significant difference between the Pearson correlation coefficients is observed only for the employment share of the agriculture in Ukraine. The significant (at the .0001 level) correlation coefficients values in the range (.803; .969) confirm that there is a very strong positive correlation between household incomes and the service employment share in all selected countries throughout the sample period. Moreover, there is a negative correlation between household incomes and the agriculture employment share in all countries (not significant in Poland), as well as a negative correlation with the industry employment share in all countries except Romania.

However, for a deeper study of causality between income indicators and the expansion of the services sector in terms of employment, we used the ARDL approach. We report results in Annex 1. First of all, in accordance with the methodology, we investigated the stationarity of time series (LES, LGDP, and LHI) using the ADF unit root test. From the results in Panel A of Annex 1, all variables in the selected countries either demonstrate stationary properties at the level, or are stationary at the first difference. It should be noted that, based on the type of time series, we tested various null hypotheses about nonstationarity around the mean and / or linear trend.

Our time series includes the years of the global financial and economic crisis, but the ADF test does not allow for the possibility of structural break, that is, a sharp change associated with a change in the mean or trend. Therefore, we applied the Zivot-Andrews (1992) (Z-A) unit root test with one structural break, using three models that allow either a one-time change in the level of the series (A), or a one-time change in the slope of the trend function (B), or both changes (C). Test results are presented in Panel B of Annex 1. In contrast to the ADF test, the Z-A test suggests that the shares of employment in services in Germany and Ukraine show stationary properties at the level when the possible break in the time series is taken into account (in 2006 and 2010, respectively). It is noteworthy that for all countries the test showed a structural break in GDP per capita in 2009, while in employment in the service sector, possible breaks were identified in different years and not always due to the global crisis.

Thus, the findings of the ADF and Z-A tests showed it to be appropriate to apply the ARDL approach to study the existence of a cointegration relationship between variables, but taking into account the structural breaks. Panel C of Annex 1 shows the results of the ARDL bounds test. The F-statistic values less than the critical value of the lower bound at 10 percent do not allow us to reject the null hypothesis of the absence of cointegration between the employment in services and GDP per capita in Germany and Romania, as well as household income in Romania, when the employment in services is a dependent variable. When employment in services is used as an explanatory variable, the findings show a lack of cointegration with both income proxies in Ukraine and Poland.

In other cases, the test confirmed the existence of long-term relationships among the variables, so we estimated the long-term ARDL coefficients of models (1) and (2), as well as similar models for household income. The estimation results, presented in Panel D of Annex 1, show that in all countries except Germany, GDP per capita and household income have a positive and significant impact on the employment in services in the long-run. The finding for Germany is consistent with a decline in the growth rate of the employment in services (see Figure 1), with high growth rates of GDP per capita and household income. It is noteworthy that Ukraine and Poland showed the same long-run estimates, namely: an increase in GDP per capita by 1 percent in the long-run increases the employment in services by .0521 percent in Poland and by .0509 percent in Ukraine; for household incomes these values are .0491 percent and .0488 percent, respectively. In Hungary, the impact of GDP per capita is significantly greater than the impact of household incomes .081 percent versus .037 percent. In addition, as expected, we received negative significant estimates of the dummy variables, which indicates the negative impact of the identified structural breaks (but in model (1) this estimate is not significant for Ukraine).

Regarding the impact of the expansion of the service sector on income proxies in the long-run, despite the established cointegration, we obtained significant estimates only for household income in Hungary and GDP per capita in Romania. The estimated long-run coefficients for Hungary show a negative long-run impact of employment in the service sector on both income proxies, which is likely due to the steady decline in the employment in services since 2015. At the same time, a 1 percent increase in the employment in services in the long-run increases GDP per capita by 1.05 percent.

The existence of a long-run relationship between indicators of employment and income suggests that there must be Granger causation in at least one direction. Panel E of Annex 1 presents the results of Granger causality tests using equations of the form (3) and (4); in the absence of cointegration, we estimated these equations without the error correction term ($ECT_{t\text{-}1}$). Negative and significant (at the level of 10% and lower) $ECT_{t\text{-}1}$ coefficients indicate that in the long-run (i) in Poland, Hungary, and Ukraine, GDP per capita Granger cause ES, (ii) in Germany, Poland, and Hungary, household incomes Granger cause employment in services, and (iii) only in Romania, employment in services Granger cause both GDP per capita and household income (moreover, in Romania, we found that employment in services Granger cause household incomes also in the short-run).

In addition, as we noted above, the value of the $ECT_{t\text{-}1}$ coefficient is a measure of the rate of convergence to long-term equilibrium after a short-term shock. In this context, Poland looks most preferable. A value of -.4733 explains that approximately 47.33 percent of the disequilibrium from last year has been adjusted for the present year, i.e., possible deviations between the service employment and GDP per capita series will disappear in about 2 years (1/0.4733). At the same time in Germany, possible deviations between employment and household income will disappear in more than 7 years (1/0.1363).

Analysis of short-run coefficients leads to the following conclusions: (i) the value of the long-run positive effect is significantly higher than the value of the short-run effect (sometimes even negative) of both income proxies on the expansion of the service sector in terms of employment, with the exception of Ukraine, where a significant short-run negative effect of GDP per capita slightly exceeds the long-run positive effect, (ii) on the contrary, for feedback, the estimated long-run and short-run coefficients do not show the same excess across countries, in particular, our results show a significant negative effect of the employment in services on GDP per capita in Germany and a significant positive effect of the employment in services on household incomes in Romania in the short-run.

Thus, we conclude our testing of hypothesis H1b with the following conclusion: for all countries except Romania, estimated results confirmed a long-run unidirectional causality running from income proxies (GDP per capita and/or household income) to employment in the service sector. However, the data for Romania confirmed the hypothesis of inverse long-run causality, i.e., the impact of the expansion of the service sector in terms of employment on both indicators of household income, but the data for Romania showed long-run causality in the opposite direction. To this it should be added that for all countries except Romania, our results show the negative impact of employment in the service sector on GDP per capita in the short-run (although a significant estimate only for Germany). This finding is consistent with previous evidence that relative expansion of services tends to have a negative impact on economic growth (eg, Dutt and Lee, 1993), but only in the short-run.

To test the H1c hypothesis about the impact of urbanization on expanding the service sector and increasing the service employment share, we have envisaged a measure of urbanization as a percentage of the urban population. Table no. 3 exhibits that in all countries except Poland, there are: (i) a positive correlation between urbanization and service employment share, and (ii) a negative correlation between urbanization and the employment share in agriculture and industry. However, Romanian data show no significant correlations. In Poland, unlike other countries, the share of urban population has declined by 2.69 percent during the analyzed period (since 2002 there has been a steady decline) while the share of people employed in agriculture decreased by 8.23 percent. This paradox is probably due in part to the labor migration of a more skilled urban population. Unfortunately, we did not find convincing confirmation of this assumption. However, we give information that indirectly supports our assumption. Korys (2004) provides data on a population temporarily absent for 2 months or more due to residence abroad: the number of urban migrants increased from 11.6 thousand in 1998 to 12.2 thousand in 2001, and the number of rural migrants increased from 2.6 thousand to 3.2 thousand, that is, the ratio is on average 4:1. Kaczmarczyk and Okólski (2008) argue that since 2004 (May 1, 2004 Poland joined the EU) labor migration from Poland has become one of the most impressive migration movements in modern European history. In addition, they provide data on migrants from Poland by type of residence (category of settlement) before migration: before EU accession, migrants from cities accounted for 56.8 percent, and after EU accession – 60.4 percent. Therefore, we accept the H1c hypothesis for Germany, Hungary and Ukraine at the 0.01 percent significance level. In the case of Romania, we reject the H1c hypothesis at the 5 percent significance level. In the case of Poland, we categorically reject the H1c hypothesis about the impact of urbanization on the expansion of the service sector due to the decline in the urban population from 1998 to 2018.

However, as we hypothesized in H1d hypothesis, the impact of urbanization on employment in services varies depending on household income. Table no. 4 shows the results of testing the moderation effect, as well as the results of the OLS assessment of multiplicative regression (6). Hypothesis has been tested with ANOVA. As Table no. 4 reports, we fail to reject the null hypothesis that $\Delta R^2 = 0$ only for Poland. Thus, for the other four countries, our results support the hypothesis that household incomes moderates the impact of urbanization on expansion of the service sector in terms of employment at a significance level of at least 1 percent. In addition, the results of the OLS multiplicative regression estimation (5) show that (i) in all countries except Poland, household incomes, the urbanization rate and their interaction affect employment in services, (ii) in all countries except Poland, the significant negative interaction effect confirms the assumption that the higher household incomes, the less the impact of urbanization on increased employment in the service sector, and (iii) adjusted $R^2$ values indicate a good fit of the models. Moreover, the estimated structural break parameters are significant only for Poland and Romania. The significant negative estimate for Poland is consistent with the significant long-run and short-run coefficients (-0.013 and -0.005) obtained using the corresponding ARDL models. For Romania, the urbanization impact model reflects a significant positive effect of the 2013 structural break on employment growth in the service sector, while the ARDL model showed an insignificant negative effect in the short-run.

**Table no. 3 – The relationship between urbanization and changes in employment structure, 1998-2018**

| Country | Change in urbanization rate and sectoral employment shares, per cent | | | | Correlation between sectoral employment shares and urbanization rate | | |
|---|---|---|---|---|---|---|---|
| | Urbanization rate | Agr. | Industr. | Serv. | Agr. | Industr. | Serv. |
| Germany | 3.70 | -32.27 | -18.84 | 9.22 | -.9497** | -.9684** | .9715** |
| Poland | -2.69 | -8.23 | -10.95 | 7.01 | .5299* | .8394** | -.9707** |
| Hungary | 10.90 | -35.33 | -5.66 | 7.84 | -.7451** | -.8771** | .8717** |
| Romania | 2.29 | -45.63 | 3.93 | 58.45 | -.2927 | -.1514 | .3167 |
| Ukraine[a] | 2.73 | -16.86 | -30.69 | 23.63 | -.6877* | -.9623** | .9380** |

*Note:* [a] For Ukraine, data since 2000; *significant at the .05 level; **significant at the .0001 level (2-tailed)

*Source: author's computations*

Thus, evaluating the regression parameters (6), we find confirmation of the H1b and H1c hypotheses for all countries except Poland: the proportion of the total variation in the employment share of the service sector that is accounted for by variation in the household income, urbanization rate, their interaction, and structural break, is more than 95 percent.

**Table no. 4 – Test results of the moderation effect and regression results**

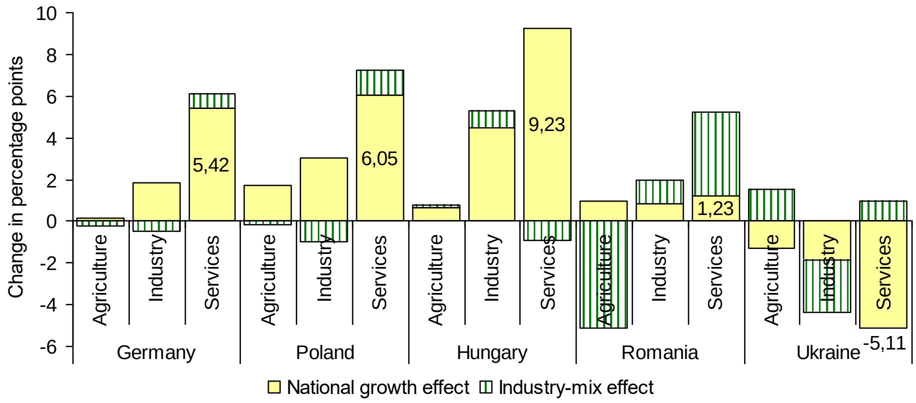
| | Germany | Poland | Hungary | Romania | Ukraine |
|---|---|---|---|---|---|
| F-statistic (moderation effect) | 9.617** | .156 | 77.721**** | 29.748**** | 22.146*** |
| Intercept | .145 | .657** | .212** | -.213 | -.026 |
| Household income (*HI*) | 79.277** | -2.438 | 15.702**** | 52.314**** | 89.545*** |
| Urbanization rate (*UR*) | 8.166** | .099 | 2.835**** | .866**** | .672** |
| Interaction (*HI·UR*) | -85.724** | 3.821 | -17.644**** | -52.385**** | -89.378*** |
| Dummy variable ($D_{ES}$) | .218 | -.773* | .235 | .108** | .055 |
| Adj. $R^2$ | .953 | .901 | .972 | .977 | .952 |

*Note*: *$p < .05$, **$p < .01$, ***$p < .001$, ****$p < .0001$

*Source: author's computations*

Next, to test the hypotheses of the second group, we used a shift-share analysis. Results from shift-share analysis are reported in Figure no. 2, Table no. 5, Figure no. 3 and Annex. Figure no. 2 shows the summary results of the decomposition of changes in the employment rate by sector. In all countries, with the exception of Romania, the national effect has a decisive role in changing the employment rate in the service sector, both its increase and decrease (in the case of Ukraine). For instance, in Germany, the employment rate in the service sector increased by 6.14 percentage points, of which, due to the national effect, by 5.42 percentage points (i.e., 88.3 percent) and due to the industry-mix effect, by .72 percentage points (i.e., 11.7 percent). In the case of Poland, a similar result was obtained. In Hungary, the industry-mix effect is even negative (-.92 percentage points out of

8.23 percentage points of employment growth). In Hungary, a negative (small) sectoral effect indicates that employment in the service sector has grown more slowly than total employment, measured at the national level. This is explained by the redistribution of employment between sectors and the new trend identified above – an increase in the employment share of industry (see Figure no. 1). In Ukraine, the employment rate in the service sector decreased by 4.14 percentage points, of which, due to the national effect, by 5.11 percentage points and increased due to the industry-mix effect by 0.97 percentage points. Note that in Ukraine as a whole, the employment rate decreased by 8.29 percentage points. As for Romania, sectoral changes are not over yet, and therefore the increase in the employment rate in the service sector is determined by the sectoral effect (4.01 percentage points out of 5.24 percentage points). Therefore, the results of the shift-share analysis support hypothesis H2a for all countries analyzed, namely: the change in the employment rate in the service sector is explained by the national growth effect and, to a small extent, by the sectoral effect if the active phase of structural changes is completed.




*Note*: Decomposition of sectoral employment changes in Poland between 2009 and 2017, in Romania between 2010 and 2017

*Source: author's computations*

**Figure no. 2 – Decomposition of changes in the employment rate by sectors, 2009-2018**

It is obvious, however, that the regions are heterogeneous in terms of employment trajectories, so we will focus further on identifying the general patterns of the European capital regions. Our last two hypotheses concern the capital regions, i.e., regions of the NUTS2 level (or federal land for Germany and the region for Ukraine) in which the national capitals are located. The capital regions are the financial and economic centers of countries and, as Fratesi and Rodríguez-Pose (2016) showed, are more open economies than the average region in their country, which contributes to growth and employment generation in periods of economic recovery. In addition, the income level and demand structure predetermine the specialization of the capital regions in the service sector. To test these hypotheses, we used a shift-share analysis of changes in the employment rate in the capital regions between 2009 and 2018. Table no. 5 shows the results of a shift-share analysis of changes in employment rates in the capital regions of the analyzed countries; allocation codes defined in Table no. 1 are also given.

**Table no. 5 – Shift-share analysis of changes in employment rates in the capital NUTS2-level regions (in percentage points), 2009-2018**

| Sector name | Employment rate | | Effects of employment change | | | | Code[a] |
|---|---|---|---|---|---|---|---|
| | $E^n$ | *d* | *G* | *m* | *c′* | *a* | |
| **Berlin (Germany)**[b] | | | | | | | |
| Agriculture | .03 (1.14)[c] | .00 | .00 | .00 | .24 | -.24 | 3 |
| Industry | 9.31 (18.78) | .38 | .87 | -.24 | -.49 | .24 | 2 |
| Services | 73.00 (63.09) | 11.33 (6.22 ) | 5.99 | .79 | 3.83 | .72 | 4 |
| Regional economy | 82.34 (83.01) | 11.71 (7.51) | 6.86 (7.34) | .55 (.06) | 3.58 (-.04) | .72 (.15) | |
| **Masovian**[d] **(Poland)**[e] | | | | | | | |
| Agriculture | 9.38 (10.84) | -.21 | 1.89 | -.21 | -2.12 | .23 | 2 |
| Industry | 15.41 (16.73) | 1.62 | 2.72 | -.90 | -.28 | .08 | 2 |
| Services | 56.11 (34.88) | 11.71 (6.25 ) | 8.77 | 1.73 | 1.03 | .17 | 4 |
| Regional economy | 80.91 (62.45) | 13.12 (9.78) | 13.39 (10.40) | .62 (-.05) | -1.37 (-.33) | .48 (-.24) | |
| **Budapest (Hungary)** | | | | | | | |
| Agriculture | .11 (3.49) | -.07 | .05 | .01 | -2.04 | 1.92 | 2 |
| Industry | 12.74 (23.10) | 1.53 | 2.97 | .55 | -3.42 | 1.44 | 2 |
| Services | 58.92 (41.97) | 8.24 (7.98) | 13.41 | -1.34 | -3.01 | -.82 | 1 |
| Regional economy | 71.76 (68.56) | 9.70 (14.43) | 16.43 (14.33) | -.79 (.06) | -8.48 (-.28) | 2.53 (.32) | |
| **Bucharest-Ilfov (Romania)**[e] | | | | | | | |
| Agriculture | .57 (13.14) | -.13 | .04 | -.19 | .83 | -.81 | 3 |
| Industry | 13.08 (19.39) | -2.01 | .77 | 1.01 | -4.50 | .72 | 2 |
| Services | 57.43 (30.02) | 9.81 (5.40) | 2.41 | 7.87 | -.25 | -.22 | 1 |
| Regional economy | 71.08 (62.54) | 7.67 (2.99) | 3.22 (3.02) | 8.68 (.29) | -3.92 (-.93) | -.31 (.61) | |
| **Kyiv (Ukraine)**[b] | | | | | | | |
| Agriculture | 1.86 (14.53) | -.75 | -.30 | .35 | -3.68 | 2.87 | 2 |
| Industry | 10.84 (11.92) | -4.67 | -1.76 | -2.34 | -.64 | .07 | 2 |
| Services | 61.80 (40.10) | 3.69 (-3.27) | -6.60 | 1.25 | 7.32 | 1.73 | 4 |
| Regional economy | 74.49 (66.54) | -1.73 (-5.75) | -8.66 (-8.21) | -.73 (.54) | 3.00 (1.94) | 4.67(-.02) | |

*Note*: [a] Allocation codes: 1 – Competitive disadvantage, specialized; 2 – Competitive disadvantage, not specialized; 3 – Competitive advantage, not specialized; 4 – Competitive advantage, specialized; [b] In the case of Germany, the results for the federal state Berlin, and in the case of Ukraine, the total results for Kyiv and the Kyiv region; [c] In brackets are national averages; [d] In accordance with the NUTS 2016 revision, Masovian Voivodship has been divided into two statistical units: PL91 (Warsaw capital) and PL92 (Masovian regional); [e] Decomposition of employment changes in Poland between 2009 and 2017, and in Romania between 2010 and 2017.

*Source: author's computations*

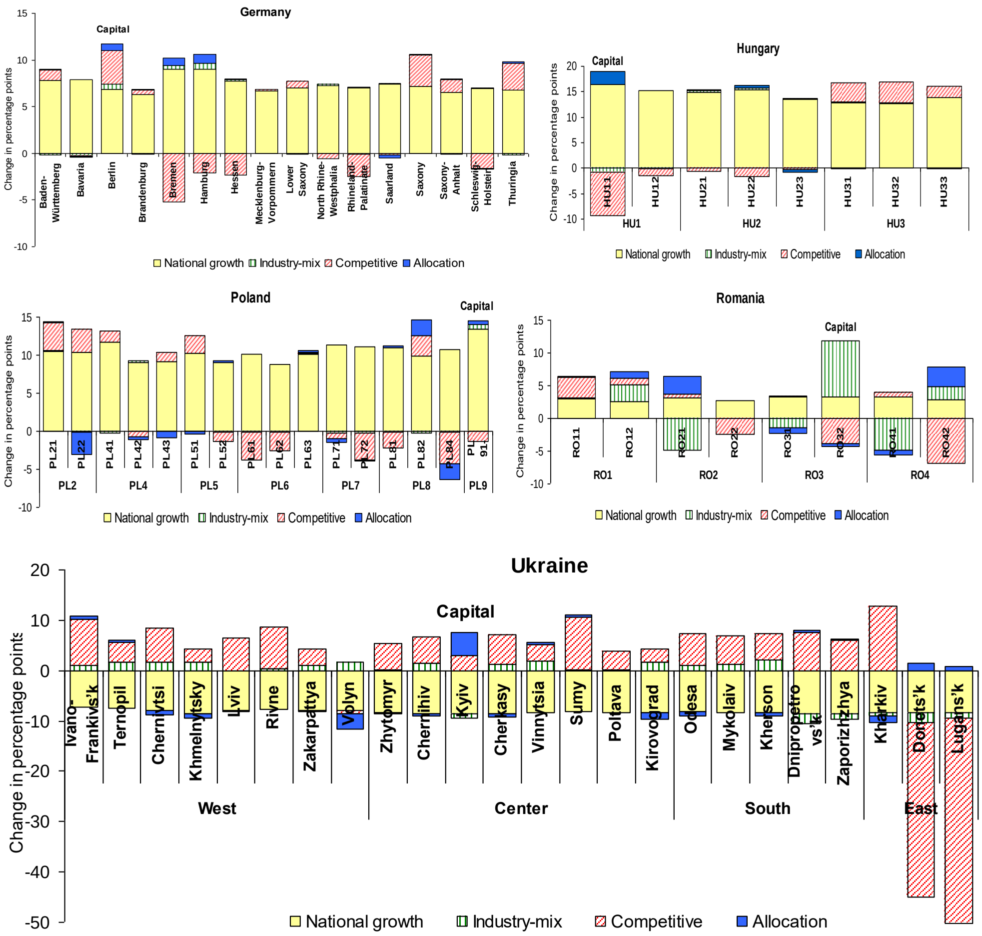
The analysis results allow us to draw two groups of conclusions: (i) by the value of the employment rate and its change, and (ii) by the components of the change in the regional employment rate. The values of employment rates and their changes lead to such conclusions. First, in the terminal year of the analysis (2017 or 2018), the employment rate in the capital regions takes on values in a fairly narrow range from 71.08 percent (Romania) to 82.34 percent (Germany), i.e. we do not observe a significant dependence on the level of development of the country. Secondly, in the capital regions of all countries except Germany, the employment rate is higher than the national average. In the case of Germany, the negative deviation is explained as follows. The employment rate in all the so-called new states of Germany is lower than the national average, although this gap has narrowed over the period 2009–2018. At the same time, the issue of Berlin's membership in the new or old states is controversial, since the federal state of Berlin was formed by the merger of East Berlin (the former capital of the German Democratic Republic) and West Berlin (state of the Federal Republic of Germany). Nevertheless, this fact continues to affect socio-economic indicators, including employment. We found that in 2018, the employment rate in Berlin (82.34 percent) is higher than the average for new states (77.04 percent).

Thirdly, in the capital regions of all countries except Hungary, the growth of the employment rate in the analyzed period is significantly higher than the national average; in Ukraine there was a decrease in the employment rate, but in the capital region it is significantly less than the national average. This conclusion is consistent with the evidence of Fratesi and Rodríguez-Pose (2016) about the impact of economic openness on the employment trajectory in European regions after the crisis. However, for the Hungarian capital region, we reject the H2b hypothesis, but below we give an explanation.

Fourth, regardless of the level of development of the country, the economy of all capital regions is a "service economy", the employment rate in the service sector ranges from 56.11 percent (Poland) to 73.00 percent (Germany); the value of the employment rate in services ($E^n$) and its change ($d$) in all capital regions is significantly higher than national averages. In addition to Table no. 5, Figure no. 3 visualizes the decomposition of the changes in the employment rate for all analyzed regions.

Based on the values of the components of changes in regional employment rate, we draw the following conclusions. In all capital regions except Romanian, the effect of national growth is the maximum share of changes in the employment rate. For instance, in Berlin, the share of the national effect is 58.6 percent (we cannot specify the percentage in other countries, since the values of the effects have different signs). Note that a similar situation is observed at the level of national averages, but in the capital regions, with the exception of Berlin, the value of the national effect is more than average (in Ukraine, a negative value). However, these differences can probably be neglected in all countries except Poland, where the deviation is 28.7 percent. In the case of Romania, employment has grown the most due to the structural effect. In the case of Romania, employment has grown most due to the structural effect; this result confirms the above conclusion.

The net shift in the employment rate ($d - g$ or $m + c' + a$) in all capital regions is significantly different from the average for countries (for example, the smallest deviation of 56.14 percent was recorded in Poland). This is due to the fact that in all capital regions changes in the employment rate are significantly different from the average, while the effects of national growth are close in their values. However, in the Hungarian capital region, a negative net shift was obtained with a positive average (-6.73 versus .10 percentage points). This result indicates that in this region, employment grew more slowly than in the country, and its share in total employment in the country decreased. Indeed, the region's share in 2009 was 19.6 percent, and in 2018 – 18.7 percent. Below we explain this fact with negative values of sectoral and regional effects. The share of all other capital regions in total employment has increased, regardless of the level of development of countries.




*Note*: Decomposition of sectoral employment changes in Poland between 2009 and 2017, and in Romania between 2010 and 2017

*Source: author's computations*

**Figure no. 3 – Decomposition of changes in the employment rate by regions, 2009-2018**

In the capital regions of Germany, Poland and Romania, the total industry-mix effects are positive, while in Hungary and Ukraine they are negative. Negative total industry-mix effects indicate that in the Hungarian and Ukrainian capital regions, employment in sectors with subnormal growth (negative or zero growth) was above national average. Indeed, in the Ukrainian capital region, the service employment rate is higher than the regional average (61.8 percent versus 40.1 percent), but at the national level, the service sector showed a negative growth (-9.2 percent), while the employment rate in agriculture increased by 2.2 percent. The situation is similar in the Hungarian capital region: employment in the service sector is higher than the national average, but at the national level, the growth of employment rates in services (24.2 percent) is less than in agriculture (25.0 percent) and in industry (31.5 percent).

The total competitive effect ($c = c' + a$) is positive only in the German and Ukrainian capital regions, and in Ukraine its value is greater. According to the classical shift-share analysis, this means that in these regions, employment grew faster than its industry-mix or employment structure would suggest (Herzog and Olsen, 1977). The Hungarian capital region has no competitive advantage in any of the sectors and, as a result, its total competitive effect ($c$) is negative, while the national average is positive (-5.94 and .04 percentage points, respectively). The German and Romanian capital regions showed a slight competitive advantage in agriculture. The German, Polish and Ukrainian capital regions demonstrate a competitive advantage in the service sector. To answer the question whether the regions used their competitive advantages, we evaluated the allocation codes. The last column of Table no. 5 shows the allocation codes calculated with base year specialization weights (12). We also calculated with terminal year specialization weights; in this case, the values of the components of the allocation effect have changed, but their signs and, consequently, the codes have not changed. Therefore, we can conclude that, regardless of the level of development of the country, (i) no capital region has changed employment specialization during the analyzed period; (ii) no capital region specialized in agriculture, although in Germany and Romania these regions had slight competitive advantages; (iii) no capital region specialized in industry and all showed a competitive disadvantage in this sector; (iv) all capital regions specialized in the service sector, although Hungarian and Romanian did not have a competitive advantage in this sector. Therefore, our estimates for the Hungarian and Romanian capital regions do not allow us to accept the H2c hypothesis regarding competitive advantages in the service sector. In addition, the patterns established for the capital regions are an indirect confirmation of the hypotheses H1a, H1b and H1c about the general trend, and the impact of income and urbanization on the expansion of the service sector in terms of employment.

At the same time, however, in some non-capital regions, the sign of the allocation effect has changed from negative to positive in some sectors, i.e., there was a transition $1 \rightarrow 2$ or $3 \rightarrow 4$, which means the "correct" redistribution of employment specialization consistent with regional competitive advantage and disadvantage (Herzog and Olsen, 1977). In Germany there is only one such region. In 2009, the state of Lower Saxony specialized in the service sector, in which the region did not have a competitive advantage, but in 2018 the region no longer specialized in service, i.e. there was a transition $1 \rightarrow 2$. In Poland, we have established 4 regions with a transition of $1 \rightarrow 2$, of which three regions (PL61 (Kuyavian-Pomeranian), PL52 (Opole), PL41 (Greater Poland)) with a change in agriculture and PL81 (Lublin) with a change in the service sector; also, PL42 (West Pomeranian) showed a $3 \rightarrow 4$ transition in industry. In Ukraine, we found 3 regions with a transition of $3 \rightarrow 4$, of which in two regions (Volyn and Dnepropetrovsk regions) a change in the service sector and in the Zhytomyr region in industry. But in Hungary and Romania, our estimates showed regions with "incorrect" redistribution of employment specialization. In HU32 (Northern Great Plain), the allocation code changed $4 \rightarrow 3$ in industry, i.e., the region ceased to specialize in a sector in which it had a competitive advantage. In RO22 (South-East), the allocation code has changed $2 \rightarrow 1$ in the service, i.e., the region began to specialize in a sector in which it has no competitive advantage.

In conclusion, it should be noted that despite the fact that the shift-share analysis has been criticized, it gives correctly interpreted estimates. For instance, as can be seen from the Annex 2, the smallest and greatest values of the regional competitive effect ($c = c' + a$) were obtained from Ukrainian data. Indeed, these estimates reflect employment changes that were not expected, but were caused by external aggression in eastern Ukraine: (i) the smallest values $c_{Lugans'k}$ = -40.06 and $c_{Donets'k}$ = -33.11 reflect the unexpected decline in employment in the border regions of Lugans'k and Donets'k regions; (ii) the highest values $c_{Kharkiv}$ = 11.47 and $c_{Sumy}$ = 10.91 reflect the unexpected growth in employment in the Kharkiv region and in the neighboring Sumy region (central macro-region) caused by internal migration from the Lugans'k and Donets'k regions.

## 4. CONCLUSIONS AND PERSPECTIVES

Previous studies examined demand-side and supply-side explanations of changes in the employment structure, as well as other indirectly related causal factors. In addition, studies of changes in the employment structure have focused either at the national or regional level. In this paper, we tried to identify general patterns and driving forces of structural changes in employment at the national and regional levels in European countries with different level of socio-economic development. We tested a set of hypotheses based on data from five European countries (Germany, Poland, Hungary, Romania, Ukraine) for the period 1998-2018 and concluded that the general trend is a decrease in the agricultural sector and an increase in the service sector in terms of employment. This evidence is consistent with previous literature. But in recent years, the employment trajectory in industry has changed its direction in all countries except Ukraine. We attribute the Ukrainian phenomenon to conflict in eastern industrial regions. Thus, we can formulate the first issue of future research: an increase in the employment share of the industry is a new trend or is it a post-crisis recovery of industry.

In connection with the revealed increase in employment in services, our study focused on the possible causes and consequences of this pattern. In all countries except Romania, the study found a long-run unidirectional causality running from income proxies (GDP per capita and/or household income) to employment in services in the presence of structural breaks, but the data for Romania showed long-run causality in the opposite direction. In addition, in all countries except Romania, we found the negative impact of employment in the service sector on GDP per capita in the short-run (although a significant estimate only for Germany). Thus, our study confirms previous evidence that relative expansion of services tends to have a negative impact on economic growth, but only in the short-run. These findings mean that Romanian politicians should pay more attention to the development of the service sector in order to stimulate both economic growth and the economic well-being of the population. However, politicians should be prepared for the fact that in the future, Romania is likely to also face the detrimental impact of the expansion of the service sector on economic growth, as well as more developed countries or countries that started with more employment in the service sector and less in agriculture (such as Ukraine).

In addition to incomes, our empirical results showed a significant positive impact of urbanization on employment growth in the service sector in all countries except Poland, but household incomes moderate this relationship (i.e., the higher household incomes, the less the impact of urbanization on increased employment in the service sector). One of the reasons is that with the growth of household incomes, including agricultural ones, the service sector expands significantly in rural areas due to changing needs and increasing demand for its services. With regard to the Polish phenomenon, we found evidence of labor migration in the majority of the urban population, but this is the second issue that requires additional research.

At the regional level, using a shift-share analysis, we found that the change in the employment rate in the services sector is explained by the effect of national growth and, to a small extent, by the sectoral effect if the active phase of structural changes is completed. We found that the last condition applies to Romania and this is consistent with the above conclusion. Finally, realizing that the regions are heterogeneous in terms of employment trajectories, we focused on identifying general patterns in the capital regions. We hypothesized that the capital regions as more open economies will have better employment indicators than the average region in their country, especially in the analyzed post-crisis period from 2009 to 2018. However, for the Hungarian capital region, we rejected this hypothesis. At the same time, we found strong evidence that all capital regions specialize in the services sector, even if they do not have a competitive advantage, like the Hungarian and Romanian capital regions. We believe that focusing on the capital regions is probably overly restrictive, so the regional aspect should be considered more broadly. However, the shift-share model, even in the revised version that we used, is an identity, not a behavioral equation, which is also a research flaw that needs to be improved.

Finally, we must emphasize that the results of both econometric and shift-share analyzes of the data sets in Romania and Ukraine confirm that the initial structure of employment influences the current trends and long-term relationships in the sectoral reallocation of employment more than the level of socio-economic development. Thus, while the results showed that most of our hypotheses were correct, they also showed the need to take into account broader factors and measures of employment change at both the national and regional levels.

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## ANNEX 1 – COINTEGRATION AND CAUSALITY ANALYSIS

**Panel A: Augmented Dickey-Fuller (ADF) unit root test results**

| Variables | Germany | | Poland | | Hungary | | Romania | | Ukraine | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Level** | **FD**[a] | **Level** | **FD** | **Level** | **FD** | **Level** | **FD** | **Level** | **FD** |
| *LES* | -1.897 (2) | -3.448* | -3.292* (2) | -4.741*** | .727 (2) | -3.782** | -1.365 (1) | -2.727* | 1.069 (0) | -1.823* |
| *LGDP* | -4.313** (2) | | -.805 (1) | -2.643* | -2.784* (1) | | 2.677** (0) | | 1.437 (0) | -1.864* |
| *LHI* | -2.421 (2) | -3.265* | -.562 (1) | -2.666* | -3.269* (2) | | 1.324 (0) | -1.904* | -1.694* (2) | |

| Critical values for ADF test | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Number of obs. | Model 0 | | | Model 1 | | | Model 2 | | |
| | 1% | 5% | 10% | 1% | 5% | 10% | 1% | 5% | 10% |
| 21 | -2.680 | -1.958 | -1.608 | -3.788 | -3.013 | -2.646 | -4.469 | -3.645 | -3.261 |
| 19 | -2.693 | -1.960 | -1.607 | -3.833 | -3.031 | -2.656 | -4.534 | -3.673 | -3.277 |

**Panel B: Zivot-Andrews (Z-A) single structural break test results**

| Variables | Germany | | Poland | | Hungary | | Romania | | Ukraine | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Tα** | **Break** | **Tα** | **Break** | **Tα** | **Break** | **Tα** | **Break** | **Tα** | **Break** |
| *LES* | -4.128* (B) | 2006 | -7.086*** (C) | 2009 | -2.382 (B) | 2013 | -3.815 (C) | 2007 | -5.076*** (B) | 2010 |
| *LGDP* | -4.153* (B) | 2009 | -3,397 (C) | 2009 | -4.579* (A) | 2009 | -3.894 (B) | 2009 | -4.865* (C) | 2009 |
| *LHI* | -3.431 (A) | 2006 | -4.809* (C) | 2006 | -4.408 (B) | 2009 | -3.830 (B) | 2010 | -3.757 (B) | 2009 |

| Asymptotic critical values of the Zivot-Andrews test | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Alternative models | Model A | | | Model B | | | Model C | | |
| | 1% | 5% | 10% | 1% | 5% | 10% | 1% | 5% | 10% |
| | -5.34 | -4.80 | -4.58 | -4.93 | -4.42 | -4.11 | -5.57 | -5.08 | -4.82 |

**Panel C: ARDL cointegration test results**

| | Germany | Poland | Hungary | Romania | Ukraine | |
|---|---|---|---|---|---|---|
| $F_{LES}(LES\|LGDP)$ | 2.871 | 9.826*** | 17.336*** | 1.147 | 9.178** | |
| $F_{LGDP}(LGDP\|LES)$ | 7.358** | 1.945 | 20.709*** | 6.111* | 2.843 | |
| $F_{LES}(LES\|LHI)$ | 7.859** | 11.749*** | 9.367*** | 2.357 | 8.843** | |
| $F_{LHI}(LHI\|LES)$ | 8.434** | 2.072 | 6.401** | 6.396** | 1.477 | |
| Critical value bounds of the F-statistics: intercept and no trend | | | | | | |
| | 10% | | 5% | | 1% | |
| T | I(0) | I(1) | I(0) | I(1) | I(0) | I(1) |
| 30 | 4.290 | 5.080 | 5.395 | 6.350 | 8.170 | 9.285 |

**Panel D: Estimated long-run coefficients**

| Regressor | Germany | | Poland | | Hungary | | Romania | | Ukraine | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Dependent variable: *LES*** | | | | | |
| *LGDP* | | | .052*** | | .081*** | | | | .051* | |
| *LHI* | | .005 | | .049** | | .037* | | | | .049*** |
| $D_{ES}$ | | -.005* | -.014** | -.013* | -.007*** | -.004*** | | | -.0004 | -.004*** |
| Constant | | .296* | 1.969*** | 1.862*** | 1.700*** | 1.156** | | | .821*** | 2.229*** |
| | | | | | **Dependent variables: *LGDP* and *LHI*** | | | | | |
| | *LGDP* | *LHI* | *LGDP* | *LHI* | *LGDP* | *LHI* | *LGDP* | *LHI* | *LGDP* | *LHI* |
| *LES* | .837 | .209 | | | -.288 | -1.264*** | 1.050** | .254 | | |
| $D_{ES}$ | .009 | -.003 | | | -.023 | .006*** | -.007 | .005 | | |
| Constant | -2.150 | -1.096 | | | 1.039 | 5.308*** | -1.283* | 1.698 | | |

**Panel E: Granger causality tests results**

| Regressor | Germany | | Poland | | Hungary | | Romania | | Ukraine | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Dependent variable: *ΔLES*** | | | | | |
| *ΔLGDP* | .027 | | -.070 | | -.008 | | .007 | | -.080** | |
| *ΔLHI* | | .109* | | .005 | | .034 | | -.030 | | -.008 |
| $\Delta D_{ES}$ | -.003*** | -.001*** | -.006** | -.005* | .0002 | .0004 | -.022 | -.027 | -.011* | -.015* |
| $ECT_{t-1}$ | | -.136*** | -.473*** | -.448*** | -.404** | -.342* | | | -.336*** | -.199 |
| Constant | .004 | .007*** | .013** | .007* | .005 | .003 | .045* | .053** | .018** | .019* |
| | | | | | **Dependent variables: *ΔLGDP* and *ΔLHI*** | | | | | |
| | *LGDP* | *LHI* | *LGDP* | *LHI* | *LGDP* | *LHI* | *LGDP* | *LHI* | *LGDP* | *LHI* |
| *ΔLES* | -8.776*** | 1.373 | -.333 | .513 | -1.320 | -.085 | .483 | 1.007* | -1.442 | -2.854 |
| $\Delta D_{GDP}$ | -.051** | | -.013 | | -.025* | | -.032 | | -.057 | |
| $\Delta D_{HI}$ | | .023 | | -.016 | | -.023 | | -.098* | | -.111 |
| $ECT_{t-1}$ | -.071 | -.048 | | | .070 | .013 | -.244** | -.272*** | | |
| Constant | .128*** | .001* | .062*** | .038* | .079*** | .071*** | .086*** | .129* | .086 | .215** |

*Note*: *, **, and *** significance at 10%, 5%, and 1%, respectively. In Panel A, FD denotes the first difference of variables; figures in parentheses are models selected for testing: model 0 – no constant, no trend; model 1 – constant, no trend; model 2 – constant, trend; critical values for ADF test are calculated by the author based on MacKinnon (2010). In Panel B, letters figures in parentheses are models selected for testing: model A – trend stationarity under a level shift; model B – trend stationarity under a trend shift; model C – trend stationarity under level and trend shifts; critical values for Z-A test are extracted from Zivot and Andrews (1992); if the calculated value of the Z-A test statistics is less than its critical value at the chosen significance level, the null hypothesis of a unit root with drift against the alternative model is rejected. In Panel C, critical value bounds of the F-statistics are extracted from Narayan (2005)

*Source: author's computations*

## ANNEX 2 – DECOMPOSITION OF CHANGES IN THE EMPLOYMENT RATE BY REGIONS (IN PERCENTAGE POINTS)

**Panel A: NUTS2 regions of Poland, Hungary and Romania**

| Region name | Code NUTS2 | Change in employment rate | Effects of employment change | | | |
|---|---|---|---|---|---|---|
| | | | national growth | industry-mix | competitive | allocation |
| **Poland** | | | | | | |
| Lesser Poland | PL21 | 14.39 | 10.54 | .06 | 3.70 | .09 |
| Silesian | PL22 | 10.35 | 10.36 | -.17 | 3.05 | -2.89 |
| Greater Poland | PL41 | 12.88 | 11.69 | -.25 | 1.43 | .02 |
| West Pomeranian | PL42 | 8.14 | 9.00 | .23 | -.77 | -.32 |
| Lubusz | PL43 | 9.52 | 9.19 | -.03 | 1.20 | -.85 |
| Lower Silesian | PL51 | 12.15 | 10.23 | .05 | 2.27 | -.39 |
| Opole | PL52 | 7.87 | 9.04 | -.17 | -1.18 | .17 |
| Kuyavian-Pomeranian | PL61 | 6.32 | 10.13 | -.14 | -3.59 | -.09 |
| Warmian-Masurian | PL62 | 6.21 | 8.75 | -.08 | -2.52 | .07 |
| Pomerania | PL63 | 10.59 | 10.11 | .08 | .16 | .23 |
| Łódź | PL71 | 9.93 | 11.39 | -.23 | -.70 | -.54 |
| Holy Cross | PL72 | 7.20 | 11.05 | -.29 | -3.50 | -.06 |
| Lublin | PL81 | 9.06 | 11.02 | -.15 | -2.04 | .23 |
| Subcarpathian | PL82 | 14.40 | 9.82 | -.22 | 2.69 | 2.11 |
| Podlaskie | PL84 | 4.42 | 10.71 | -.13 | -4.13 | -2.03 |
| Masovian[b] | PL91-92 | 13.12 | 13.39 | .62 | -1.37 | .48 |
| National average | | 9.78 | 10.40 | -.05 | -.33 | -.24 |
| **Hungary** | | | | | | |
| Budapest | HU11 | 9.70 | 16.43 | -.79 | -8.48 | 2.53 |
| Pest | HU12 | 13.78 | 15.15 | -.12 | -1.40 | .15 |
| Central Transdanubia | HU21 | 14.73 | 14.82 | .49 | -.65 | .07 |
| Western Transdanubia | HU22 | 14.62 | 15.43 | .36 | -1.63 | .45 |
| Southern Transdanubia | HU23 | 12.86 | 13.49 | .19 | -.26 | -.56 |
| Northern Hungary | HU31 | 16.70 | 12.76 | .16 | 3.86 | -.09 |
| Northern Great Plain | HU32 | 16.99 | 12.74 | .07 | 4.06 | .12 |
| Southern Great Plain | HU33 | 16.05 | 13.80 | .08 | 2.26 | -.09 |
| National average | | 14.43 | 14.33 | .06 | -.28 | .32 |
| **Romania** | | | | | | |
| North-West | RO11 | 6.42 | 3.07 | .10 | 3.13 | .11 |
| Center | RO12 | 7.21 | 2.61 | 2.57 | .99 | 1.04 |
| North-East | RO21 | 1.61 | 3.11 | -4.79 | .65 | 2.64 |
| South-East | RO22 | 0.32 | 2.73 | .02 | -2.36 | -.06 |
| South-Muntenia | RO31 | 1.18 | 3.27 | -1.45 | .19 | -.82 |
| Bucharest-Ilfov | RO32 | 7.67 | 3.22 | 8.68 | -3.92 | -.30 |
| South-West Oltenia | RO41 | -1.53 | 3.28 | -4.86 | .72 | -.67 |
| West | RO42 | 1.01 | 2.89 | 2.01 | -6.86 | 2.97 |
| National average | | 2.99 | 3.02 | .29 | -.93 | .61 |

*Note*: [a]Decomposition of sectoral employment changes in Poland between 2009 and 2017, in Hungaria between 2009 and 2018, and in Romania between 2010 and 2017; [b]In accordance with the NUTS 2016 revision, Masovian Voivodship has been divided into two statistical units: PL91 (Warsaw capital) and PL92 (Masovian regional).

*Source: author's computations*

**Panel B: The federal states of Germany, 2009-2018**

| Region name | Change in employment rate | Effects of employment change | | | |
|---|---|---|---|---|---|
| | | national growth | industry-mix | competitive | allocation |
| Baden-Württemberg | 8.81 | 7.81 | -.17 | 1.12 | .06 |
| Bavaria | 7.47 | 7.88 | -.23 | -.08 | -.11 |
| Berlin | 11.71 | 6.86 | .55 | 3.58 | .72 |
| Brandenburg | 6.74 | 6.30 | -.08 | .49 | .04 |
| Bremen | 5.00 | 9.00 | .41 | -5.19 | .78 |
| Hamburg | 8.53 | 9.01 | .65 | -2.08 | .95 |
| Hessen | 5.57 | 7.70 | .19 | -2.37 | .06 |
| Mecklenburg-Vorpommern | 6.85 | 6.66 | -.01 | .23 | -.02 |
| Lower Saxony | 7.65 | 7.04 | -.11 | .68 | .04 |
| North Rhine-Westphalia | 6.85 | 7.27 | .13 | -.54 | .00 |
| Rhineland-Palatinate | 4.57 | 7.03 | -.13 | -2.37 | .03 |
| Saarland | 7.02 | 7.45 | .06 | -.16 | -.33 |
| Saxony | 10.59 | 7.13 | -.04 | 3.43 | .07 |
| Saxony-Anhalt | 7.90 | 6.50 | -.08 | 1.40 | .08 |
| Schleswig-Holstein | 5.30 | 6.96 | .02 | -1.60 | -.08 |
| Thuringia | 9.66 | 6.79 | -.18 | 2.88 | .17 |
| National average | 7.51 | 7.34 | .06 | -.04 | .15 |

**Panel C: The regions of Ukraine, 2009-2018**

| Region name | Macro-region name | Change in employment rate | Effects of employment change | | | |
|---|---|---|---|---|---|---|
| | | | national growth | industry-mix | competitive | allocation |
| Ivano-Frankivs'k | West | 3.63 | -7.21 | 1.02 | 9.10 | .72 |
| Ternopil | | -1.36 | -7.46 | 1.68 | 3.83 | .59 |
| Chernivtsi | | -0.46 | -7.90 | 1.76 | 6.60 | -.92 |
| Khmelnytsky | | -5.05 | -8.48 | 1.72 | 2.61 | -.89 |
| Lviv | | -1.50 | -8.00 | -.02 | 6.49 | .04 |
| Rivne | | .85 | -7.66 | .33 | 8.27 | -.10 |
| Zakarpattya | | -3.89 | -7.86 | 1.12 | 3.17 | -.32 |
| Volyn | | -9.96 | -7.92 | 1.59 | -0.70 | -2.93 |
| Zhytomyr | Center | -3.18 | -8.43 | .15 | 5.15 | -.05 |
| Chernihiv | | -2.46 | -8.64 | 1.42 | 5.23 | -.47 |
| Kyiv | | -1.73 | -8.66 | -.73 | 3.00 | 4.67 |
| Cherkasy | | -1.98 | -8.49 | 1.34 | 5.87 | -.69 |
| Vinnytsia | | -2.63 | -8.32 | 1.98 | 3.24 | .46 |
| Sumy | | 2.93 | -8.11 | .14 | 10.43 | .48 |
| Poltava | | -4.41 | -8.33 | .10 | 3.77 | .04 |
| Kirovograd | | -5.29 | -8.37 | 1.71 | 2.56 | -1.20 |
| Odesa | South | -1.67 | -8.16 | 1.04 | 6.23 | -.77 |
| Mykolaiv | | -1.48 | -8.44 | 1.28 | 5.57 | .11 |
| Kherson | | -1.73 | -8.38 | 2.19 | 5.11 | -.66 |
| Dnipropetrovs'k | | -2.62 | -8.61 | -1.95 | 7.51 | .44 |
| Zaporizhzhya | | -3.34 | -8.55 | -1.01 | 6.06 | .16 |
| Kharkiv | East | 2.46 | -8.44 | -.57 | 12.76 | -1.29 |
| Donets'k | | -43.52 | -8.38 | -2.02 | -34.63 | 1.52 |
| Lugans'k | | -49.53 | -8.28 | -1.19 | -40.77 | .71 |
| National average | | -5.75 | -8.21 | .54 | 1.94 | -.02 |