GDAŃSK UNIVERSITY OF TECHNOLOGY

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# GROWTH AND STRUCTURAL CHANGES IN TRANSITION COUNTRIES – THE CHICKEN OR THE EGG?

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**GUT Faculty of Management and Economics**

**Working Paper Series A (Economics, Management, Statistics)**

**No 3/2018 (49)**

**April 2018**

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***First draft***

## ABSTRACT

The theoretical analysis of structural changes in the context of economic growth has a long tradition. However, studies which analyze the empirical relationship between these two economic categories are still very rare. In the literature, whether growth causes structural changes or the other way round is still an open the question. This paper empirically tests the relationship between structural changes (changes in gross value added and employment) and economic growth by using a panel Granger causality analysis based on annual data for 8 transition countries, covering the period 1995-2011. The main finding is that the causality relations analyzed are heterogeneous processes and are identified more often when we measure structural changes by value added than by changes in employment. Among the countries analyzed, we separate a subgroup of economies with very strong bilateral causality (small countries like Latvia, Lithuania, Estonia), a subgroup where no causal relationships are observed (e.g. Hungary for the case of employment) and a group with a one-directional relationship (e.g. Poland, where GDP changes cause employment changes in the Granger sense, but not vice versa).

**JEL classification codes:** C12, C33, O14, O47, O57

**Keywords:** economic growth, structural changes, industries, panel data, Granger causality, CEE countries

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## 1. Introduction

Economies not only grow but also change their structure over time. The interconnection between economic growth and changes in the branch structure of an economy (often measured in terms of employment and value added) is widely accepted in economic theory, but the question of whether economic growth causes structural changes or changes in the economic structure cause aggregate growth is still unanswered (Dietrich, 2009).

So far, the literature related to economic growth and structural changes has been mostly theoretical. Based on the formulations of growth theories, it is generally hypothesised that economic growth leads to changes in the branch structure of an economy rather than the other way round. However, a few empirical studies show both that growth is important for structural changes and that structural changes are significant determinants of an economy's growth (for 13 developed OECD countries over 1970-1985 – Echevarria 1997, for seven developed OECD countries in the years 1960-2004 – Dietrich 2009, for India in the period 1988-2007 – Cortuk, Singh 2010). These studies indicate that the causality relationships between economic growth and structural changes are very heterogeneous across the countries investigated, i.e. sometimes only a one-way relationship can be observed; sometimes strong two-way ones can be found.

For the transition countries the empirical analyses of the impact of economic growth on structural changes and vice versa are still very scarce. Some evidence can be found in work by Havlik (2013) who examines the extent and patterns of structural changes and their impact on aggregate economic growth or in work by Białowąs (2016) who assesses the same relationship between phenomena for the Czech Republic, Hungary, Poland and Slovakia. In our article we hold that the evaluation of this impact for this group of countries is crucial for the identification of their development factors. Most of the transition countries that joined the European Union in the year 2004 reached a GDP per capita corresponding to 17,000 US dollars (at constant prices of 2005) in 2011 and have significantly slowed their pace of growth in the last few years. This may indicate that these countries could be in the middle income trap, the essence of which is a long-term economic slowdown coming after a period of relatively rapid growth (Felipe et al. 2010; Eichengreen et al. 2011).

The most famous victims of the average income trap have been various Latin American countries, but the most well-known examples of economies that have not fallen into this trap are South Korea and Taiwan. They have managed to maintain growth after reaching the average level of income and to catch up with highly developed economies (Wheatley 2010). The success of these Asian economies has been a consequence of structural changes in their economies, so that they were able to produce increasingly diverse goods and specialization moved the economies towards the production of increasingly sophisticated goods characterized by a high share of value added (Ohno 2009).

The aim of this paper is therefore to use a panel Granger causality test to verify the hypothesis of the existence (or not) of a causal relationship between economic growth and structural change in selected Central Eastern European economies which have been the subject of transformation processes. In these countries, the structural changes that have taken place are very significant and the dynamics of future structural changes may determine their future growth.

The paper is organized as follows. The next section outlines theoretical considerations for the definition of structural changes and the relationship between economic growth and structural changes in economic models. It contains discussion on the possible impact of structural changes on economic growth and vice versa. Section 3 opens up the methodological part of the paper by introducing the methodology used for structural change measurement and the panel Granger causality test. Section 4 presents the data and the results of the analysis, and the last section gives our conclusions.

## 2. Structural changes - definition and relation to economy growth

There are many uses of the concepts of structure and structural changes in economics. The best source for the various ways in which the terms have been used and abused in economics is the semantic analysis by Machlup (1967), who finds almost nine different meanings of "structure" and "structural changes" in the economic sciences.

The earliest uses of structure refer to 'different arrangements of productive activity in the economy, especially to different distributions of productive factors among various sectors of the economy, various occupations, geographic regions, types of products, etc.' (Machlup 1967). Structure is also often described in economics as the 'composition of aggregate quantity that does not change easily', the 'distribution of inputs or output over time' or as 'a set of constant reaction coefficients which shows transformation of irregular shocks into cyclical swings' (Machlup, 1967). The term "structure" is often found in economic literature with connotations of notions: model, system or economy. The structure of the system mostly determines the set of outcome-determining conditions, the structure of a model is understood as a set of known numerical constants and coefficients in econometric analysis, and the structure of an economy describes the set of given and invariant conditions assumed for theoretical analysis.

The term "structural changes" is frequently related to the concept of "structure". As an example, a definition of structural changes proposed by Ishikawa can be given: structural changes are 'changes in the relative weight of significant components of the aggregative indicators of the economy, such as national product and expenditure, exports and imports, and the population and labour force (Ishikawa 1987).

Machlup perceives structural changes as 'permanent (not temporary), long-term alterations of the fundamental relationships in the economy' (Machlup 1967). They are alterations in real resources, preferences or technology and do not include monetary or policy changes. Thus, he treats structural changes as a function of time. The same approach is used by Syrquin, who defines structural changes as 'long-term persistent changes in the composition of an aggregate' (Syrquin 2010).

However, in the economic literature structural changes are often not described as a time function, but as a function of other economic categories, such as economic growth. In this way, Chenery et al. (1986) assert that structural changes are 'a set of changes in the composition of demand, trade, production and factor use that take place as per capita income increases'. To identify the connotations of structural changes for other economic categories, Silva (2008) analyses citations and papers published in the journal "Structural Change and Economic Dynamics" and all the abstracts and articles on structural changes published over 40 years in other economic journals. This bibliometric analysis shows that the most popular publications related to structural changes in economics pertain to the concepts of development, technological change and innovation, convergence and growth, foreign trade, employment, migration, and growth in industrial production. Among all the topics mentioned, "growth and convergence" remains the most relevant category. In addition, the theoretical essay "Structural change and economic growth" by Pasinetti (1981) is indicated as the most cited study in the literature of structural changes. Therefore, this paper will refer to the notion of structural changes which has roots in the classic tradition of economics and is strongly connected with economic growth theory. In this meaning, structural changes 'include the entire range of transformative processes that accompany economic growth, such as changes in the sectoral composition of production and employment, organization of the industry, financial system, income and wealth distribution, and demography' (Matsuyama 2008).

In the economic literature, the relationship between structural changes and economic growth is well recognized. Although classical economists like Turgot, Stuart, Smith, Quesnay, Marx and Ricardo did not use the notion of structural changes in their theory, they gave it much attention. Among neoclassical economists, only Schumpeter highlighted the fact that economic growth cannot proceed without structural changes (Schumpeter 1934), but the first significant contributions to the explanation of the relationship between structural changes and growth were made by Fisher and Clark (Fisher 1939; Clark 1940). Both analyzed the patterns of changes in sectoral employment and created the theory known as the "three sector hypothesis". Fisher and Clark believed that every economy will change the sector on which it is based as it progresses along its growth path. In countries with a low national income level, economic activity will focus on raw material production; in the middle stage of a country's development on manufacturing; and when the country reaches the highest level of development it will probably be a service economy. This leads to the conclusion that countries with a similar level of development will be characterized by a similar inter-sectoral structure. The three sector hypothesis has been the basis of many studies on structural changes, understood as shifts between sectors in the economy (Fourastié 1949; Kuznets 1959; Chenery 1960).

In the 1950s, parallel to research on the three sector hypothesis, interest grew in the perception of structural change as a factor of economic growth. Precursors of this trend were Rosenstein-Rodan and Nurkse. They stressed sectoral differences as a requirement for balanced growth (Rosenstein-Rodan 1943; Nurkse 1953). The balanced growth approach assumes inter-sectoral balance between the sectors in an economy to be necessary, i.e. that each sector provides a market for the products of the others, and in turn supplies the necessary raw materials for the development and growth of other sectors.

However, the first comprehensive model examining the relationship between structural change and economic growth was the unbalanced growth model, developed by Baumol (1967, 1985). Baumol divides the economy into two sectors: a progressive one that uses capital and new technology and grows at some constant rate; and a stagnant one that uses labour as the only input and produces services as its final output. In an economy so constructed, and due to factor mobility, structural changes (defined as changes in employment and expenditure) lead to a decrease in the growth rate and to potential stagnation. This is because in the stagnant sector production costs and prices grow (Baumol's cost disease), which results in wage increases and labour movements to this sector and consequently in a decrease in the growth rate in the long term. Thus, according to Baumol, there is a negative impact of structural change on growth in per-capita GDP, which is expressed in a shift of employment and expenditure toward "stagnant services" like health care and education. Baumol's model was, however, in contradiction with a very important neoclassical growth theory (Solow 1956, 1957) and with a new growth theory (Lucas 1988; Romer 1990; Grossmann, Helpman 1991). All these theories focus on technical or productivity progress as engines of economic growth and treat structural changes (sectoral composition) as a constant variable in their models.

In the most recent studies, structural changes again come to the fore. In 'neo-Schumpeterian' or 'evolutionary' approaches, structural changes become useful tools to explain a process of technology adoption in the economy and the path-dependent nature of economic changes. In the recent literature, two approaches can be distinguished. The first, called a demand-side approach, uses a homothetic utility function consistent with Engel's law (different income elasticities) to explain differences in the rate of economic growth (Echeverria 1997; Laitner 2000; Caselli, Coleman 2001; Kongsamut et al. 2001). The second, a supply-side approach, concentrates on explaining economic growth in terms of differences in total factor productivity growth across sectors (Ngai, Pissarides 2007) or of differences in factor proportions and capital deepening in the economy (Acemoglu, Guerrieri 2008).

In the economics literature related to the relationship between economic growth and structural changes, the hypothesis that economic growth promotes structural changes is dominant. There are two principal paths for economic growth to cause changes in economic structure. The first one is connected with the demand side. Economic growth means income growth. In each economy the products and services have different income elasticities – the lowest for primary sector products (agriculture) and the highest for the tertiary sector (services). This is why economic growth causes shifts in demand over time, i.e. decreasing demand in the primary sector and increasing demand for the products of the secondary and finally the tertiary sector. Economic growth via income growth causes changes in the importance of the sectors in the economy, measured by their output share or value added share.

The second way for economic growth to cause changes in the structural composition is associated with the supply side of the economy. Sectors are characterized by different levels of labour productivity due to different levels of technical progress. If a sector has high labour productivity, it can deliver products and services at lower prices and/or the wages in this sector can be higher. In both cases, either due to increasing wages or higher output, this sector becomes more and more important for the economy. In sum, the higher the economic growth rate in a period, the higher the income in this period, and the greater structural changes in the next periods.

We should also ask the question of whether an inverse relationship between growth and structural changes is possible, with structural changes affecting the economic growth rate. According to empirical studies by Stamer and Aiginger, structural changes can lead to changes in the economic growth rate (Stamer 1998, 1999; Aiginger 2001). This situation can arise when demand increases faster in a sector with low productivity than in a sector with high productivity, which forces a movement of employment from the second sector to the first, eventually leading to a slower rate of economic growth. Using sectoral data for Germany in the period 1970-1993, Stamer found a stronger influence of economic growth on structural changes than vice versa, while Aiginger, analysing sectoral data for 14 old European countries in the period 1985-1998, came to the conclusion that structural changes have a much larger impact on economic growth. Both Stamer and Aiginger used highly disaggregated data in their research. In this paper, we divide the economies of the transition countries chosen into 21 main sectors and test the direction and strength of the relationship between structural changes and economic growth within them.

## 3. Measuring structural changes and Granger's causality for panel data models

The most popular measure for comparing structural changes between countries and over time is the Structural Change Index (SCI), given as:

$$SCI_{st} = 0{,}5 \cdot \sum_{i=1}^{n} \left| x_{it} - x_{is} \right| \ , \tag{1}$$

where x denotes the relationship between the gross value added in sector i and the total gross value added, or the relationship between the number of persons engaged in sector i and the total number of persons engaged in the periods t and s.[3]

Another measure which allows structural changes to be compared is the Modified Lilien Index (MLI) (Stamer 1999), based on Lilien (1982), which is constructed as follows:

$$MLI_{st} = \sqrt{\sum_{i=1}^{n} x_{is} x_{it} \left( \ln \frac{x_{it}}{x_{is}} \right)^2} \ , \ x_{is} > 0 \ , \ x_{it} > 0 \, . \tag{2}$$

MLI measures the standard deviation of the sectoral growth rates between two periods, t and s, and over countries. The shares of the sectors in the two periods are used for weighting.

In our investigation we want to evaluate the causal relationship between structural changes, measured by SCI and MLI, and GDP growth.

A paper published by Granger (1969) became the starting point in the development of the methodology for testing causality. According to Granger's definition of causality, a series x can be said to cause a series y if and only if the expectation of y given the history of x differs from the unconditional expectation of y:

$$E(y \mid y_{y-k}, x_{t-k}) \neq E(y \mid y_{t-k}) \, . \tag{3}$$

[3] It should be remembered that SCI is very sensitive to a number of factors. The most important ones which can influence the index are: the level of data aggregation, price changes, and the selection of periods used for comparison. A higher level of disaggregation causes a higher level of the index. Depending on the classification used for measurement we can obtain different results. This means the more detailed data, the more structural change can be observed.

In other words, in the conditional distribution lagged values of series x give additional information to explain series y. If causality between series y and x exists (x→y), current values of y can be predicted better using lagged values of x and y than using past values of y only.

Granger's procedure for testing causality requires datasets which are stationary. This means that before the estimation is started, a test for the presence of unit roots is needed. In the case of a relatively short size of the panel, there can be a problem with distortion of panel unit-root tests connected with their power and size. Regarding the first generation tests, in small samples Monte Carlo simulations suggest using the Breitung test rather than the LLC test, the power of which is too low in such cases (Breitung 2001). Following Baltagi (2008), when the structure of the lags in the tested regression is chosen correctly, then the Im, Pesaran and Shin test (Im et al. 2003) also performs well. For second generation panel unit-root tests, Monte Carlo experiments (Pesaran 2003; Moon and Perron 2004) confirm the good properties of the CADF test (Pesaran 2003) in terms of both size and power in relatively small samples. In order to evaluate Granger's causality properly, all the tests mentioned above will be used to assess the stationarity of the data first.

After stationarity testing, we go to a 3-step procedure for testing causality based on Granger's definition. The procedure extended for panel data was proposed by Hurlin and Venet (2001).

Let us focus on a time-stationary VAR model adapted to a panel data context. For T periods and N individuals the model is as follows (Hurlin, Venet 2001):

$$y_{i,t} = \sum_{k=1}^{p} \gamma^{(k)} y_{i,t-k} + \sum_{k=0}^{p} \beta_i^{(k)} x_{i,t-k} + \nu_{i,t} \,, \tag{4}$$

where νit is the sum of individual effects αi, assumed to be fixed, and normally distributed disturbances εit. This means that we use a one-way error component model. Following Hurlin and Venet, we impose the following assumptions on νit:

$$\alpha_i \sim IID(0,\sigma_\alpha^2)\,,\ \varepsilon_{it} \sim IID(0,\sigma_\varepsilon^2)\,, \tag{5}$$

$$E(\alpha_i \varepsilon_{it}) = 0\,, \tag{6}$$

$$E(\alpha_i \alpha_j) = E(\varepsilon_{it}\varepsilon_{js}) = 0 \text{ for } i \neq j \text{ and } t \neq s\,, \tag{7}$$

$$E(\alpha_i x_{it}) = E(\varepsilon_{it} x_{it}) = 0\,, \tag{8}$$

and make these assumptions concerning the model coefficients:

- the autoregressive coefficients γ(k) and the coefficients associated with variables x – βi(k) are constant for all lags,
- the autoregressive coefficients γ(k) are identical for all individuals but the regression coefficient slopes βi(k) may have an individual dimension.

In panel data models we can expect heterogeneity between individuals for two reasons. Firstly, we can observe natural permanent cross-sectional differences between individuals. This kind of heterogeneity is taken into consideration by introducing individual fixed parameters αi. Secondly, there are heterogeneous coefficients associated with the exogenous variable x. In a whole group of individuals we can find a subgroup where causality between x and y exists (βi(k)≠0) and a subgroup where the causal relationship is not observed (βi(k)=0).
This means that the analysis of causality must take this problem into consideration to avoid mistakes in the evaluation of causality. The details of the procedure are shown in Figure 1 and Table 1.

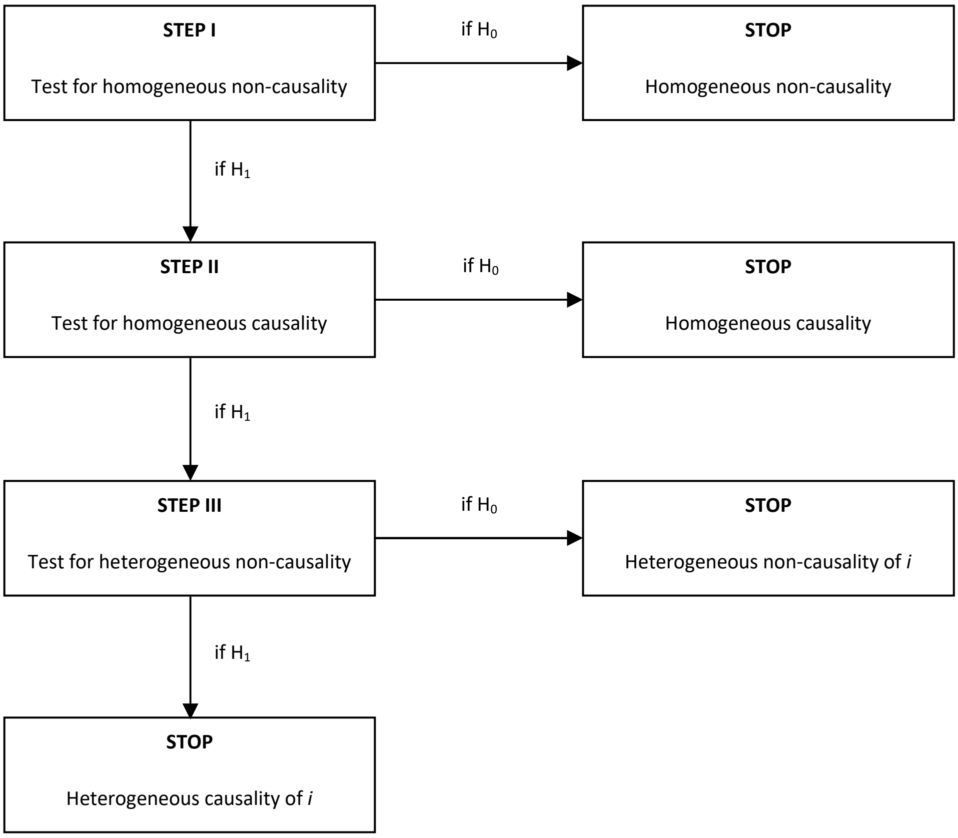


Fig. 1. Test for Granger's causality in panel data models

In the first step of the procedure we check whether the coefficients βi(k) for all panel groups i and all lags k are statistically significant or not. Testing the slope coefficients for all i at once and all k means that we treat the panel as homogeneous. A lack of significance means that a causality relationship for all the individuals does not exist. If we reject the hypothesis, then the second step of the procedure allows the question of whether the slope coefficients are identical or not to be to answered. Rejecting the hypothesis implies differences among βi(k) and lets us treat the panel as heterogeneous where the causality is observed. The last step identifies a subgroup of individuals for which the causality relationship exists and a subgroup for which such a relationship is not observed.

Table 1. Hypotheses and test statistics in Granger's causality test for panel data models

| Hypotheses | Test statistics |
|---|---|
| STEP I | |
| $H_0 : \beta_i^{(k)} = 0 \ \forall i = 1,..., N \ \forall k = 1,..., p$<br>$H_1 : \exists (i,k) \ \beta_i^{(k)} \neq 0$ | $F_{HNC} = \dfrac{(RSS_2 - RSS_1)/Np}{RSS_1/(NT - N(1+p) - p)}$ |
| STEP II | |
| $H_0 : \forall k = 1,..., p / \beta_i^k = \beta_i \ \ \forall i = 1,..., N$<br>$H_1 : \exists k \in [1, p], \exists (i, j) \in [1, N] / \beta_i^k \neq \beta_j^k$ | $F_{HC} = \dfrac{(RSS_3 - RSS_1)/(N-1)p}{RSS_1/(NT - N(1+p) - p)}$ |
| STEP III | |
| $H_0 : \exists i \in [1, N] / \forall k \in [1, p] \beta_i^k = 0$<br>$H_1 : \forall i = 1,..., N \exists k \in [1, p] / \beta_i^k \neq 0$ | $F_{HENC} = \dfrac{(RSS_{2,i} - RSS_1)/p}{RSS_1/(NT - N(1+2p) + p)}$ |

Source: Own elaboration based on Hurlin and Venet (2001).

## 4. Data and Empirical Results

Granger's procedure for testing causal relationships is implemented to examine a panel of Central Eastern European transition countries which accessed the European Union in 2004 – the Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Slovakia and Slovenia – using annual data from 1995 to 2011.

In order to obtain a higher level of disaggregation, the total economy is divided into 21 branches, according to the NACE revision 2. The sectoral data for gross value added (GVA), the number of persons employed (EMP)[4] and the growth rate of GDP are taken from the Eurostat database and the WIOD database. The measures of structural changes for GVA and EMP are calculated on the basis of the Structural Change Index and the Modified Lilien Index.

[4] For Latvia, Lithuania and Poland, and for employment only we were forced to use NACE rev.1.1, because of a lack of corresponding data at the beginning of the period analysed. It also forced us to limit time range of our analysis to 1995-2011.

For the purpose of evaluating unit-root presence, we use the three panel unit-root tests listed in the previous section: the Breitung test, the IPS test and the CADF test. The results of the tests are presented in Table 2.

For all the panel series mentioned, the unit-root tests reject the null hypothesis that the series contain a unit root. Both the structural change measures – SCI and MLI for value added and employment – and the GDP growth rate are stationary and can be used in further calculations.

Table 2. Panel unit-root tests

| | Breitung test | | IPS test | | CADF test | |
|---|---|---|---|---|---|---|
| ΔGDP | -3.6183 | *** | -2.0659 | ** | -1.4000 | * |
| SCI_GVA | -4.2872 | *** | -5.3029 | *** | -4.5160 | *** |
| SCI_EMP | -3.8836 | *** | -7.7696 | *** | -6.8620 | *** |
| MLI_GVA | -4.7322 | *** | -5.5160 | *** | -5.3100 | *** |
| MLI_EMP | -4.6155 | *** | -6.3933 | *** | -7.1620 | *** |

Note: significant at 0.1%, ** significant at 0.05%, *** significant at 0.01%

Source: Own calculations

Table 3 and Table 4 present the results for the Homogeneous Non-Causality (HNC) hypothesis. All the test statistics are significant. For all lags and both the structural change indices for GVA and EMP, the HNC hypothesis can be strongly rejected. This means that structural changes measured by gross value added and number of persons employed cause GDP changes in Granger's sense and vice versa. We can confirm that there is a two-way casual relationship between the phenomena analyzed for all the countries.

Table 3. Results for Homogeneous Non-Causality for Gross Value Added

| | structural changes in GVA → ΔGDP | | | | ΔGDP → structural changes in GVA | | | |
|---|---|---|---|---|---|---|---|---|
| lags | SCI | | MLI | | SCI | | MLI | |
| 1 | 13.5794 | *** | 11.8914 | *** | 14.2928 | *** | 13.8217 | *** |
| 2 | 6.3117 | *** | 5.5971 | *** | 8.6568 | *** | 8.5464 | *** |
| 3 | 6.6828 | *** | 6.0752 | *** | 9.8994 | *** | 10.8811 | *** |

Note: significant at 0.1%, ** significant at 0.05%, *** significant at 0.01%

Source: Own calculations.

Table 4. Results for Homogeneous Non-Causality for employment

| | structural changes in EMP → ΔGDP | | | | ΔGDP → structural changes in EMP | | | |
|---|---|---|---|---|---|---|---|---|
| lags | SCI | | MLI | | SCI | | MLI | |
| 1 | 3.9365 | *** | 4.2787 | *** | 8.9305 | *** | 8.4625 | *** |
| 2 | 3.3721 | *** | 4.3890 | *** | 5.0197 | *** | 4.8434 | *** |
| 3 | 3.3037 | *** | 3.6046 | *** | 3.8152 | *** | 3.6487 | *** |

Note: significant at 0.1%, ** significant at 0.05%, *** significant at 0.01%

Source: Own calculations.

The next step is to determine whether the relationship investigated is homogeneous. The results for testing Homogeneous Causality (HC) hypothesis are shown in Table 5 and Table 6. We cannot observe the influence of structural changes in GVA on the GDP growth rate for only two lags, and the influence of structural changes in EMP on GDP only for the first lag and SCI. For the rest, the HC hypothesis can be rejected and we can confirm that both structural changes cause GDP growth and GDP growth causes structural changes for at least one economy. This indicates that the causality process is not homogeneous.

Table 5. Results for Homogeneous Causality for Gross Value Added

| | structural changes in GVA → ΔGDP | | | | ΔGDP → structural changes in GVA | | | |
|---|---|---|---|---|---|---|---|---|
| lags | SCI | | MLI | | SCI | | MLI | |
| 1 | 3.4108 | *** | 2.8416 | *** | 2.3809 | ** | 2.4047 | ** |
| 2 | 1.4914 | | 1.2096 | | 1.5889 | * | 1.7914 | * |
| 3 | 2.4472 | *** | 1.8568 | ** | 2.9145 | *** | 3.1562 | *** |

Note: significant at 0.1%, ** significant at 0.05%, *** significant at 0.01%

Source: Own calculations

Table 6. Results for Homogeneous Causality for employment

| | structural changes in EMP → ΔGDP | | | | ΔGDP → structural changes in EMP | | | |
|---|---|---|---|---|---|---|---|---|
| lags | SCI | | MLI | | SCI | | MLI | |
| 1 | 1.7105 | | 2.0399 | ** | 4.3629 | *** | 4.2183 | *** |
| 2 | 1.5444 | * | 2.3812 | *** | 2.6073 | *** | 2.4214 | *** |
| 3 | 2.0036 | *** | 2.2204 | *** | 2.1624 | *** | 1.9309 | ** |

Note: significant at 0.1%, ** significant at 0.05%, *** significant at 0.01%

Source: Own calculations

Rejection of the HC hypothesis allows us to ask the question of which countries belong to the subgroup where Granger's causality is observed. The Heterogeneous Non-Causality (HENC) hypothesis needs to be tested. The results are presented in Table 7 and Table 8.

For five countries – Estonia, Latvia, Lithuania, Slovakia and Slovenia – the HENC hypothesis is strongly rejected for all lags and both relationships. These countries belong to the subgroup where a causal bi-directional relationship is observed. In Hungary and the Czech Republic, the relationship analysed in not so strong as in the above-mentioned countries and depends on the lag length. Poland is the only country where we cannot observe any relationship – neither structural changes cause GDP changes and nor do GDP changes cause structural changes.

Table 7. Results for Heterogeneous Non-Causality for Gross Value Added

| | | structural changes in GVA → ΔGDP | | | | ΔGDP → structural changes in GVA | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | SCI | | MLI | | SCI | | MLI | |
| Czech Republic | 1 | 7.1813 | *** | 6.8567 | *** | 6.7359 | ** | 5.7345 | ** |
| | 2 | 2.9095 | * | 2.6869 | * | 3.1757 | ** | 2.6809 | * |
| | 3 | 2.2010 | * | 2.1560 | * | 3.6265 | ** | 2.8897 | ** |
| Estonia | 1 | 41.5627 | *** | 32.8637 | *** | 26.8335 | *** | 14.4604 | *** |
| | 2 | 15.3294 | *** | 11.2433 | *** | 14.6384 | *** | 9.0787 | *** |
| | 3 | 14.7637 | *** | 13.5407 | *** | 14.4542 | *** | 10.1329 | *** |
| Hungary | 1 | 2.8104 | * | 2.6299 | | 3.1673 | ** | 3.8441 | ** |
| | 2 | 2.5764 | * | 2.3548 | | 1.6363 | | 2.3469 | |
| | 3 | 3.0705 | ** | 2.7362 | ** | 2.0778 | | 2.4335 | |
| Latvia | 1 | 20.4352 | *** | 15.9699 | *** | 16.6710 | *** | 15.7459 | *** |
| | 2 | 8.7601 | *** | 6.9492 | *** | 11.6139 | *** | 11.6521 | *** |
| | 3 | 12.1623 | *** | 10.5321 | *** | 13.9608 | *** | 15.8033 | *** |
| Lithuania | 1 | 26.1617 | *** | 24.6239 | *** | 35.0953 | *** | 28.5297 | *** |
| | 2 | 12.3923 | *** | 12.1096 | *** | 19.6672 | *** | 16.8533 | *** |
| | 3 | 11.2079 | *** | 10.5734 | *** | 18.4953 | *** | 17.4797 | *** |
| Poland | 1 | 0.6238 | | 0.5213 | | 0.6383 | | 0.7190 | |
| | 2 | 0.4704 | | 0.4493 | | 0.5008 | | 0.7240 | |
| | 3 | 0.5406 | | 0.7231 | | 0.8832 | | 1.2832 | |
| Slovakia | 1 | 7.1171 | *** | 7.1612 | *** | 20.1787 | *** | 25.6592 | *** |
| | 2 | 4.0669 | ** | 4.5004 | ** | 11.5583 | *** | 16.8434 | *** |
| | 3 | 4.1757 | *** | 4.1843 | *** | 12.5566 | *** | 18.5470 | *** |
| Slovenia | 1 | 9.0477 | *** | 9.9437 | *** | 5.0007 | ** | 7.4897 | *** |
| | 2 | 5.0471 | *** | 5.0620 | *** | 3.1525 | ** | 5.2594 | *** |
| | 3 | 3.9080 | ** | 4.0418 | *** | 3.1595 | ** | 5.3277 | *** |

Note: significant at 0.1%, ** significant at 0.05%, *** significant at 0.01%

Source: Own calculations

For two countries – Latvia and Lithuania – independently of the lag length chosen we find a strong bidirectional causality relation between structural changes in employment and economic growth. Unlike Table 7, for Poland the direction of strong causality is only from GDP growth to employment. In the Czech Republic and Slovakia the opposite direction is found (but only when we use MLI) and if only one lag is included we can hold that growth causes structural changes in employment in these countries. For Estonia, we are able to reject the HNCH for employment vs. growth when two or three lags are included. The inverse relationship, where economic growth causes structural changes in employment, can be confirmed for a lag length of only one and two. For the remaining countries – Hungary, Slovenia – the test statistics never exceed their critical values and therefore employment neither causes growth nor vice versa.

Table 8. Results for Heterogeneous Non-Causality for employment

| | | structural changes in EMP → ΔGDP | | | | ΔGDP → structural changes in EMP | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | SCI | | MLI | | SCI | | MLI | |
| Czech Republic | 1 | 3.8816 | * | 5.2480 | ** | 1.5104 | | 23.7815 | *** |
| | 2 | 2.5961 | * | 3.9476 | ** | 0.4356 | | 1.3155 | |
| | 3 | 1.8988 | | 2.3183 | * | 0.3715 | | 0.9650 | |
| Estonia | 1 | 1.0645 | | 1.7375 | | 3.2245 | * | 45.1784 | *** |
| | 2 | 5.3409 | *** | 9.4487 | *** | 2.5398 | * | 2.5218 | * |
| | 3 | 7.6931 | *** | 8.0186 | *** | 1.2527 | | 1.2910 | |
| Hungary | 1 | 1.3147 | | 0.7930 | | 1.3044 | | 0.6934 | |
| | 2 | 1.2786 | | 0.7564 | | 0.6609 | | 0.3411 | |
| | 3 | 0.9301 | | 0.5819 | | 0.6046 | | 0.3188 | |
| Latvia | 1 | 17.4098 | *** | 13.5913 | *** | 48.2462 | *** | 32.9323 | *** |
| | 2 | 13.5986 | *** | 13.5211 | *** | 25.4048 | *** | 18.0013 | *** |
| | 3 | 9.3889 | *** | 8.5817 | *** | 15.8997 | *** | 11.8156 | *** |
| Lithuania | 1 | 4.8055 | ** | 7.3186 | *** | 9.8166 | *** | 9.1076 | *** |
| | 2 | 4.1196 | ** | 5.4552 | *** | 4.2954 | ** | 4.8785 | *** |
| | 3 | 3.2276 | ** | 3.2243 | ** | 2.4056 | * | 3.5322 | ** |
| Poland | 1 | 1.0901 | | 1.0911 | | 18.7034 | *** | 26.5343 | *** |
| | 2 | 0.6858 | | 0.7148 | | 10.1796 | *** | 14.1865 | *** |
| | 3 | 0.4637 | | 0.4758 | | 7.0364 | *** | 9.0548 | *** |
| Slovakia | 1 | 3.7874 | * | 6.2247 | ** | 1.3275 | | 2.8520 | * |
| | 2 | 1.1946 | | 2.7196 | * | 0.9113 | | 1.5485 | |
| | 3 | 1.4972 | | 3.4743 | ** | 0.7295 | | 1.0862 | |
| Slovenia | 1 | 1.5144 | | 2.7107 | | 0.3813 | | 1.4198 | |
| | 2 | 0.1339 | | 2.8522 | * | 0.3380 | | 0.8456 | |
| | 3 | 1.6278 | | 1.9707 | | 0.6714 | | 0.9833 | |

Note: significant at 0.1%, ** significant at 0.05%, *** significant at 0.01%

Source: Own calculations

## 5. Conclusions

This article has examined whether or not a causal relationship exists among important economic processes. We have asked the question whether economic growth causes structural changes or whether it is the other way round, and have employed Granger's causality test extended to panel data in the investigation. We used two different measures of structural changes – the Structural Change Index and the Modified Lilien Index – to calculate changes in gross value added and employment. We found that in general causality in our sample of 8 transformed EU countries is a very heterogeneous process.

We found that a casual relationship between economic growth and structural changes occurs more frequently when we measure structural changes by value added than by changes in employment. The exception is Poland, the largest economy among the countries surveyed, for which in the case of gross value added we found no significant influence on economic growth and vice versa, but we did indentify a very strong causal one-way relationship between economic growth and employment.

For very small countries like Latvia, Lithuania and Estonia, bidirectional causality was observed, irrespective of whether structural changes are measured in terms of employment or in terms of gross value added.

Of course, the results require more detailed explanations of the channel through which economic growth affects structural changes and vice versa in the major sectors of the economy.

Due to the shortness of the time series, we used a year-to-year comparison, in which temporary factors can strongly influence structural measures in some cases and thus they can hide the real long term changes. For this reason we recommend re-estimating the relationships analyzed when the time series available is longer and the data can be divided into sub-periods.

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**Original citation**:
Olczyk, M., Kordalska A. (2018). Growth and structural changes in transition countries – the chicken or the egg? GUT FME Working Paper Series A, No 3/2018(49). Gdansk (Poland): Gdansk University of Technology, Faculty of Management and Economics.

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