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ECONOMY STRUCTURE, PRODUCTIVITY AND ECONOMIC GROWTH: TOWARDS METHODOLOGICAL PERSPECTIVE

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Abstract. As economic sectors' performance targeted at country's economic growth through the prism of inputs to production can not be implied without productivity phenomenon in the context of sustainable development, this paper is purposed to provide one aspect of the relevant methodologies for productivity phenomenon evaluation in the structure of economy. Scrutinized scientific literature proposes the following possible perceptions of productivity targets: as labor moves from low to high productivity a sector, in such a way contributing to aggregate country's productivity growth, and as productivity increasement within sectors. Different variations of shift-share analysis methods have been provided to measure the impact of structural change on aggregate productivity growth.

Keywords: economy sectors' performance, productivity, aggregate productivity, economic growth, sustainable development.

JEL classification: O40, O47.

1. Introduction

Economic sectors' performance in the structure of economy targeted at country's economic growth through the prism of inputs to production can not be implied without productivity phenomenon in the context of sustainable development (Lankauskienė, Tvaronavičienė 2013). As researches, related with economy structure and economic growth, generally named as structural economics, is widespread in foreign scientific literature of development economics, this movement in Lithuania is especially young. As a result, the necessity arises to overview, systemize and group the methodologies of economic sectors' performance, productivity and economic growth for the further development of this theme. The purpose of this paper is to distinguish and present one group of all possible methodologies, researching this broad topicality.

2. Economic sectors' performance in the context of sustainable development

Sustainable development is a complex and differently treated notion. On the one hand, it is very broad as may be related to competitiveness of country (Balkytė, Tvaronavičienė 2010), and on the other hand, if to adopt very practical approach, sustainable development is being estimated by a broad array of indicators (Grybaitė, Tvaronavičienė 2008; Tvaronavičienė, Lankauskienė 2011; Mačiulis, Tvaronavičienė 2013). The term "sustainable development" emerged in the context of development and growing awareness of an imminent ecological crisis. This conception became rather widespread in the period around the end of the 20th century. It was realized that economic growth is of vital importance, but it has to be a different kind of growth, targeted to the combination of needs of the people and sensitive to the needs of the environment (Vosylius *et al.* 2013). Sufficiency should be the goal, not economic efficiency. A distinction has to be made between growth – quantitative change – and development – qualitative change (Du Pisani, Jacobus 2006). The concept of sustainable development is more profound and comprehensive than economic growth. The essence of sustainable development is clear enough- most generally it is perceived as economic development meeting human needs at present not reducing its wealth opportunities in the future (Čiegis, Ramanauskienė 2009; Lankauskienė, Tvaronavičienė 2012, Vosylius *et al.* 2013). According the World Bank's definition provided in 1992 year "sustainable development is development that continues". Another scientific article presents the expression "sustainable development is development that meets the needs at present without compromising the ability of future genera-

tions to meet their own needs" (Du Pisani, Jacobus 2006). Robert Allen (1980) defined sustainable development as "development that is likely to achieve lasting satisfaction of human needs and improvement of the quality of human life" (Tvaronavičienė, Lankauskienė 2011).

While talking about the expression of economic sectors' performance in the structure of economy the following their pecularities could be distinguished: structural change, structural transformation, structural growth, and structural development. It is important to mention that structural change and transformation are quite similar expressions, as well as structural growth and development (Lankauskienė, Tvaronavičienė 2013). Economy sectors' performance in the structure of economy most commonly is being defined as structural changes by foreign scientists (Lankauskienė, Tvaronavičienė 2013). Economic growth can not be perceived without role of economic sectors, as economies are consisted of them. Structural change is the central insight of development economics. Economic growth reflects in economic sectors' performance and entails structural change. Structural change, narrowly defined as the reallocation of labor across economy sectors, featured in the early literature on economic development by Kuznets (1966). As labor and the other resources move from traditional into modern economic activities, overall productivity rises and income expand. The nature and speed with which structural transformation takes place is considered one of the key factors that differentiate successful countries from unsuccessful ones. Therefore, the new structural economists argue that economy structures should be the starting point for comparative economic analysis and the design of appropriate policies. And for the process of sustainable development elaboration, it is especially important for economy sectors to perform in a sustainable manner (Lankauskienė, Tvaronavičienė 2013). Economy sectors' sustainable performance manner is associated as a target at the development of knowledge based and innovation susceptible sectors, but not with exploiting nonrenewable natural resources (Tvaronavičienė, Lankauskienė 2013).

Eventually, summarizing this section, it can be stated that economic growth encompasses the growth of value added, created by economic sectors and their branches performance. Moreover, economy structure has to operate through all the possible capabilities of sustainability.

3. Lithuanian scientists' cultivation in the field of structural economics

The process of structural change has been widely discussed beginning from the factors, which determine the performance of economic sectors' and ending with the actual insights and various conclusions about relevant economy structure targeted for country's development in foreign scientific literature. Contrary, in relevant Lithuanian scientific literature the issue of economy structure fostering economic growth is rather vague. Scientists have used GDP structure in their researches: economic sectors, branches and their shares of employment. Stankevičius (2006) overviews Lithuanian economy structure and its change after the First World War. Balčiunas (2000) and Misiūnas; Kaminskienė (1999) researched Lithuanian economy structure when Baltic countries created market economy. In Matuzevičiūtė *et al.* (2010) article the economy structure is being analyzed. But the provided papers do not focus on economic sectors' performance targeted at economic growth. A. Vitas is the first Lithuanian scientist, who researched this topicality and in 2012 year has fended off PhD thesis, called "The economy structural changes analysis and evaluation in Baltic states". A. Vitas has proposed a macroeconomic model for structural changes evaluation, i. e. the effectiveness of structural changes:

$$\begin{aligned} Y_{evm}^{t} &= x_1 \times (\alpha_1 + \beta_1 + \#W - \#\mathrm{P}_{pr}) \times t + \\ & x_2 \times (\alpha_2 + \beta_2 + \#N + \#\mathrm{W}) \times t + \\ & x_3 \times (\alpha_3 + \beta_3 - \#\mathrm{r}_{\mathrm{EUR}} + \#W) \times t + \\ & x_4 \times (\alpha_4 + \beta_4 - \#\mathrm{P}_z) \times t + \\ & x_5 \times (\alpha_5 + \beta_5 + \#N + \#W - \#\mathrm{r}_{EUR}) \times t + \\ & x_6 \times (\alpha_6 + \beta_6 + \#N + \#\mathrm{W}) \times t, \end{aligned} \quad (1)$$

where:

Y_{evm}^{t} – GDP change at the moment of time *t*,

x_1 – industry sector part in the economy structure,

x_2 – service sector part in the economy structure,

x_3 – finance sector part in the economy structure,

x_4 – agriculture sector part in the economy structure,

x_5 – construction sector part in economy structure,

x_6 – other sector parts in economy structure,

α_i – productivity change in relevant *i*-th sector,

$ß_i$ – change of capital return in relevant *i*-th sector,

$\#\mathrm{P}_z$ – change of prices in agriculture production,

$\#P_{pr}$ – change of prices in industry production,

$\#N$ – change of population number,

$\#W$ – change of average wage level in the country,

$\#r_{EUR}$ – change of interest rate (EURIBOR),

T – number of years, used for forecasting economy, structure changes (Vitas 2012).

Some more publications have been performed in the field of this topicality (Lankauskienė, Tvaronavičienė 2012; Tvaronavičienė, Lankauskienė 2013; Lankauskienė, Tvaronavičienė 2013). Economic sectors' performance in economy structure – this competitive advantage is already recognized and well developed by scientists in advanced nations. Contrary, the attention to this issue in Lithuania is vague. Consequently, for this reason it is of vital importance for Lithuania to dedicate relevant attention to the structure of economy targeted for economic growth through the prism of sustainability.

With this intention, in order to get deeper insight into this topicality, in depth- coverage scientific literature will be overviewed accentuating on economy structure, productivity and economic growth. Hereinafter, we will concentrate on different methodologies, researched by foreign scientists in relevant scientific literature, distinguish and present one group of all possible methodologies set.

4. Productivity phenomenon performance possibilities in the context of economy structure

What is the impact of structural change on productivity growth? In response to this question many authors use an empirical methodology designed to analyze such issues, often called 'shift-share analysis'. It has been used frequently by among others economic geographers, economic historians, industrial economists and trade analysts. Essentially, it is a purely descriptive technique that attempts to decompose the change of an aggregate into a structural component, reflecting changes in the composition of the aggregate, and changes within the individual units that make up the aggregate. As such it is closely related to analysis of variance. There are many versions of this methodology, the main difference being the choice of base year or "weights": initial year, final year, some kind of "average", linked, etc., and each version usually has its critics as well as defenders. The reason for this state of affairs is the well known result in index number theory that if, say, initial or final year weights are applied throughout in decomposition, a residual will occur necessarily. So what many versions of this methodology do is to try to reduce this residual as much as possible (Tanuwidjaja, Thangavelu 2007).

Authors examine the effects of recent structural changes on the growth of labor productivity. The traditional assumption of the growth accounting literature is that structural change is an important source of growth and overall productivity improvements. The standard hypothesis assumes a surplus of labor in some (less productive) parts of the economy (such as agriculture), thus shifts towards higher productivity sectors (industry) are beneficial for aggregate productivity growth. Even within industry, shifts towards more productive branches should boost aggregate productivity. On the other hand, structural change may have a negative impact on aggregate productivity growth if labor shifts to industries with slower productivity growth. The 'structural bonus and burden' hypotheses were examined by the example of Asian economies by Timmer and Szirmai (2000), a large sample of OECD and developing countries (Fagerberg 2000), and more recently by Peneder and DG Employment for the USA, Japan and EU Member States (Peneder 2009). The overall developments regarding output, employment and productivity described above mask substantial structural changes within economies and their individual sectors. Structural changes reflect inter alia different speeds of restructuring and resulting efficiency gains or losses at branch level. The impact of structural change on aggregate productivity growth in is evaluated by the frequently applied shift-share analysis in analogy with Timmer and Szirmai (2000), Fagerberg (2000), Peneder (2003) and others. The shift-share analysis provides a convenient tool for investigating how aggregate growth is linked to differential growth of labor productivity at the sectorial level and to the reallocation of labor between industries. It is particularly useful for the analysis of productivity developments in countries where data limitations prevent us from using more sophisticated econometric approaches (Havlik 2005).

Using the same notation as presented in Peneder (2003), authors decompose the aggregate growth of labor productivity into three separate effects:

$$growth(LP_T) = \frac{LP_{T,fy} - LP_{T,by}}{LP_{T,by}} =$$

$$\frac{\underbrace{\sum_{i=1}^{n} LP_{i,by} \cdot (S_{i,fy} - S_{i,by})}_{I:static.shift.effect} + \underbrace{\sum_{i=1}^{n} (LP_{i,fy} - LP_{i,by}) \cdot (S_{i,fy} - S_{i,by})}_{II:dynamic.shift.effect} + \underbrace{\sum_{i=1}^{n} (LP_{i,fy} - LP_{i,by}) \cdot S_{i,by}}_{III:within.growth.effect}}{LP_{T,by}}, \quad (2)$$

where:

LP – labor productivity,
by – base year,
fy – final year,
T–S over industries i,
S_i – share of industry in the total employment.

First, the structural component is calculated as the sum of relative changes in the allocation of labor across industries between the final year and the base year, weighted by the value of the sector's labor productivity in the base year. This component is called the static shift effect. It is positive/negative if industries with high levels of productivity (and usually also high capital intensity) attract more/less labor resources and hence increase/decrease their share of total employment. The standard structural bonus hypothesis of industrial growth postulates a positive relationship between structural change and economic growth as economies are upgrading from low- to higher-productivity industries. The structural bonus hypothesis thus corresponds to an expected positive contribution of the static shift effect to aggregate growth of labor productivity (Havlik 2005).

The structural bonus hypothesis:

$$\sum_{i=1}^{n} LP_{i,by} (S_{i,fy} - S_{i,by}) > 0 . \quad (3)$$

Second, dynamic shift effects are captured by the sum of interactions of changes in employment shares and changes in labor productivity of individual sectors/industries. If industries increase both labor productivity and their share of total employment, the combined effect is a positive contribution to overall productivity growth. In other words, the interaction term becomes larger, the more labor resources move toward industries with fast productivity growth. The interaction effect is, however, negative if industries with fast growing labor productivity cannot maintain their shares in total employment. Thus, the interaction term can be used to evaluate Baumol's hypothesis of a structural burden of labor reallocation which predicts that employment shares shift away from progressive industries towards those with lower growth of labor productivity (Baumol 1967; Havlik 2005). We would expect to confirm the validity of the structural burden hypothesis in the NMS due to the above-sketched shifts from industry to services (with lower productivity levels) at the macro level, and due to shifts from heavy (and capital-intensive) to light industries within manufacturing, respectively (Havlik 2005).

The structural burden hypothesis:

$$\sum_{i=1}^{n} (LP_{i,fy} - LP_{i,by})(S_{i,fy} - S_{i,by}) < 0 . \quad (4)$$

Third, the 'within-growth' effect corresponds to growth in aggregate labor productivity under the assumption that no structural shifts in labor have ever taken place and each industry (sector) has maintained the same share in total employment as in the base year. Authors, however, recall that the frequently observed near equivalence of the within-growth effect and aggregate productivity growth cannot be used as evidence against differential growth between industries. Even in case all positive and negative structural effects net out, much variation in productivity growth can be present at the more detailed level of activities (Havlik 2005).

As productivity has a robust tendency to grow, the within-growth effect is practically a summation over positive contributions only. Conversely, for each industry the sign of the contribution to both shift effects depends on whether labor shares have increased or decreased. The shift effects therefore capture only that comparatively small increment to aggregate growth which is generated by the net difference in productivity performance of the shifting share of the labor resources. Even that increment can either be positive (structural bonus) or negative (structural burden). In short, offsetting effects of shifts in employment shares of industries with high and low levels of labor productivity, as well as high and low productivity increases, explain why shift-share analyses regularly fail to reveal substantial direct contributions of structural change to aggregate growth (Havlik 2005).

Decomposition method could be found in scientific research "Structural Change in the Centrope Region" (Hurber, Mayerhofer 2006) and in "Is growth of services an obstacle to productivity growth? A comparative analysis" (Maroto-Sanchez,

Cuadrado-Roura 2009). In this research there has been stated that the relationship between economy structure and productivity growth has been a subject of increasing interest over recent decades. The innovative focus of this paper concerns the role of the service sector in this relationship. Services play a core role in advanced economies, both from a quantitative and a strategic point of view. However, empirical research in this area lies considerably behind the research into the agricultural and manufacturing sectors. This paper focuses on the impact of tertiarisation on overall productivity growth, using a sample of 37 OECD countries in the period between 1980 and 2005. The results partially refute traditional knowledge on the productivity of services. Contrary to what conventional theories suggest, this research demonstrates that several tertiary activities have shown dynamic productivity growth rates, while their contribution to overall productivity growth plays a more important role than was historically believed (Maroto-Sanchez, Cuadrado-Roura 2009).

As it has been stated above, Fagerberg (2000) also tries to answer the question "what is the impact of structural change and productivity growth?" and uses 'shift-share analysis' as well. Formally, the method applied is similar to the one, presented above, but there is a difference in the sequence of variables. He uses the method as follows:

$$P = \frac{Q}{N} = \frac{\sum Q_i}{\sum_i N_i} = \sum_i \left[\frac{Q_i}{N_i} \times \frac{N_i}{\sum_i N_i} \right], \quad (5)$$

where:

P – labor productivity,

Q – value added,

N – labor input,

I – industry.

Define

$$P_i = \frac{Q_i}{N_i}; \quad (6)$$

$$S_i = \frac{N_i}{\sum_i N_i}, \quad (7)$$

where:

P_i – labor productivity in industry I,

S_i – the share of industry i in total em ployment.

Then, by substituting eq. (6) and (7) into eq. (8):

$$P_i = \sum \left[P_i \cdot S_i \right]$$

$$Assume \quad (8)$$

$$\Delta P = P_i - P_0; \Delta S = S_i - S_0, etc.$$

Then, using Eq. (8), authors give "in growth rate form":

$$\Delta P = \sum_i \left[\frac{\overset{I}{P_{i0} \cdot S_i}}{P_0} + \frac{\overset{II}{\Delta P_i \cdot \Delta S_i}}{P_0} + \frac{\overset{III}{S_{i0} \cdot \Delta P_i}}{P_0} \right]. \quad (9)$$

The first term (I) is the contribution to productivity growth from changes in the allocation of labor between industries. It will be positive if the share of high productivity industries in total employment increases at the expense of industries with low productivity. Thus, it reflects the ability of a country to move resources from low to high productivity activities. The second term (II) measures the interaction between changes in productivity in individual industries and changes in the allocation of labor across industries. This effect will be positive if the fast growing sectors in terms of productivity also increase their share of total employment. Hence, it reflects the ability of a country to reallocate its resources towards industries with rapid productivity growth. The third (III) is the contribution from productivity growth within individual industries (weighted by the share of these industries in total employment) (Fagerberg 2000). The same methods are being provided by Jalava (2006) and Van Ark, Hann (1997).

One more scientific article also implies that labor productivity growth in an economy can be achieved in one of two ways. First, productivity can grow *within* economic sectors through capital accumulation, technological change, or reduction of misallocation across plants. Second, labor can move *across* sectors, from low-productivity sectors to high-productivity sectors, increasing overall labor productivity in the economy. This can be expressed using the following decomposition:

$$\Delta Y_t = \sum_{i=n} O_{i,t-k} \cdot \Delta y_{i,t} + \sum_{i=n} y_{i,t} \cdot \Delta O_{i,t}, \quad (10)$$

where:

Y_t, $y_{i,t}$ – economy-wide and sectorial labor productivity levels,

$O_{i,t}$ – the share of employment in sector i,

Δ – the change in productivity or employment shares between $t–k$ and t.

The first term in the decomposition is the weighted sum of productivity growth within individual sectors, where the weights are the employment share of each sector at the beginning of the time period. Authors call this the "within" component of productivity growth. The second term captures the productivity effect of labor reallocations

across different sectors. It is essentially the inner product of productivity levels (at the end of the time period) with the change in employment shares across sectors. Authors call this second term the "structural change" term. When changes in employment shares are positively correlated with productivity levels, this term will be positive, and structural change will increase economy-wide productivity growth (McMillan, Rodrij 2011).

The article "Deconstructing the BRICs: Structural Transformation and Aggregate Productivity Growth" studies structural transformation and its implications for productivity growth in the BRIC countries based on a new database that provides trends in value added and employment at a detailed 35-sector level. Authors Vries *et al.* (2012) find that for China, India and Russia reallocation of labor across sectors is contributing to aggregate productivity growth, whereas in Brazil it is not. However, this result is overturned when a distinction is made between formal and informal activities. Increasing formalization of the Brazilian economy since 2000 appears to be growth-enhancing, while in India the increase in informality after the reforms is growth-reducing (Vries *et al.* 2012).

To measure the contribution of structural change to growth, authors start with the canonical decomposition originating from Fabricant (1942). The change in aggregate labor productivity levels (ΔP) can be written as:

$$\Delta P = \sum \Delta P_i L_i + R, \qquad (11)$$

where:

L_i – the average share of sector i in overall employment,

R – the reallocation term.

In Eq. (11), the change in aggregate productivity is decomposed into within-sector productivity changes (the first term on the right-hand side which authors call the "within-effect" (also known as 'intra-effect'), and the effect of changes in the sectorial allocation of labor which authors call the "reallocation-effect", (the second term, also known as the "shift-effect" or "structural-change effect"). The within-effect is positive (negative) when the weighted change in labor productivity levels in sectors is positive (negative). The reallocation-effect is a residual term, which measures the contribution of labor reallocation across sectors, being positive (negative) when labor moves from less (more) to more (less) productive sectors. One advantage of this approach above partial analyses of productivity performance within individual sectors is that it accounts for aggregate effects. For example, a high rate of productivity growth within say manufacturing can have ambiguous implications for overall economic performance if manufacturing's share of employment shrinks rather than expands. If the displaced labor ends up in activities with lower productivity, economy-wide growth will suffer. It should be noted that this reallocation term is only a static measure of the allocation effect as it depends on differences in productivity levels across sectors, not growth rates. Growth and levels are often, but not necessarily, correlated. The reallocation term is often used as an indicator for the success of structural transformation (Bosworth, Collins 2008; IADB 2010; McMillan, Rodrik 2011; Vries *et al.* 2012). Paper investigates whether the reallocation term is affected by a change in the level of aggregation used in the decomposition. Typically, decompositions are carried out at the level of broad sectors. This paper uses a more detailed dataset finding different decomposition results. For example, aggregate trends in manufacturing might hide considerable variation at a lower level. Aggregate manufacturing productivity growth might be the result of a shrinking formal sector, outsourcing labor-intensive activities to small informal firms. This effect is picked up as a negative reallocation effect in our more detailed decomposition analysis, but not by an analysis based on aggregate manufacturing data. Structural change will be growth-reducing when the shift of labor from formal to informal activities is properly accounted for. In the following sections authors show that this is indeed the case for India after the reforms. More formally, let each sector i consists of a number of subsectors j. As before, for each sector i the change in labor productivity is given by a weighted growth of subsectors j, with share of j in i employment as weights, and a residual term measuring the reallocation across industries in a sector i (R_i):

$$\Delta P = \sum \Delta P_i L_i + R_i \qquad (12)$$

where:

$L_{i,j}$ is the average share of subsector j in sector i employment.

Substituting Eq. (12) in Eq. (11), it is easily shown that them change in aggregate productivity can be decomposed in an employment weighted change of productivity levels in all subsectors j plus a new reallocation term:

$$\Delta P = \sum_j \Delta \left(P_j L_j \right) + \left(\sum P_i L_i + R \right), \qquad (13)$$

where:

L_j is the average share of subsector j in overall employment.

Formula 13 shows that the new overall reallocation effect consists of the reallocation of labor between sectors *i* (the old R), and the reallocation effects between subsectors *j* within each sector *i* (R_i summed over all sectors). In the example above, R_i is negative for manufacturing bringing down the overall reallocation effect. This indicates the importance of having a detailed sector database to analyze the role of structural change in economic growth, not only in theory but also empirically as authors argue in the next sections (Vries *et al.* 2011, 2012).

5. Conclusions

Productivity most generally is perceived as a measure of output or value added per labor input (hour worked). Scrutinized relevant scientific literature in this topicality had provided the following possible productivity performance possibilities. Productivity, as a phenomenon in the context of economy structure, gains more forms. From one point of view it can be perceived as labor move from low productivity to high productivity sectors and in such a manner contributing to aggregate country's productivity growth. And from another point of view- as productivity increase within sectors through capital accumulation, technological change, innovation, etc.

In this paper possible aggregate productivity accounting methods had been provided. Authors use different variations of "shift-share analysis". This is only one methodological aspect, others will be provided in the further development of this topicality.

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