Evaluating the Significance of Structural Changes within National Economy for Economic Growth of Latvia using the Econometric Model

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***Abstract* – The paper focuses on the research of structural changes of national economy, which is stated as one of the structural reform features, and their evaluation of economic growth. As a result of examining the basic theoretical guidelines of structural changes of national economy in economic literature and applying an econometric approach, a model of Latvian economy is developed. The model is based on the statistical data of the Republic of Latvia for the last twenty years. It describes a correlation between the structural changes of national economy and economic growth of Latvia during the period under consideration. According to the results of the study, the economy of Latvia during the last twenty years was driven by the tertiary sector – the services had significant impact on the economic growth of Latvia.**

Keywords: economic growth, sectors of national economy, structure of national economy, structural changes of national economy

I. Introduction

In recent decades, the structures of global and national economies have significantly changed, exhibiting bothpositive and negative aspects. This is proven by the existence of the developed and less developed countries, as well as by the recent economic and financial problems. The economic crisis of 2008–2010 has shown that no state is protected in the contemporary globalized world. Therefore, economists increasingly devote their attention to the economic impact of structural changes of national economy on the economic growth. The aim of this paper is to evaluate the impact of the structural changes of national economy on the economic growth, by using the basic theoretical guidelines and applying the econometric approach.

II. The Basic Theoretical Aspects of Structural Changes of National Economy

A. The Structure of National Economy and Structural Changes of National Economy

The national economy forms a complex system, which consists of several related to each other macroeconomic elements. The relation among these elements also forms the structure of national economy. The analysis of the structure is associated with the processes of structural transformation in the long-term period that takes place along with the economic growth. In economics and economic history the term *structure* mostly is associated with sectors of national economy or the sectoral structure, which consists of three sectors of national economy – agriculture, industry and services or the primary, secondary and tertiary sectors. The primary sector comprises agriculture and activities related to it, which focus on the basic needs of the population, as well as on the use of natural resources; the secondary sector – industry and construction or activities that produce consumption and investment products; the tertiary – the services. There is also a separately distinguished sector nowadays, the fourth sector – the sector of information, technology and science, but in the framework of this research the fourth sector is included in the service sector. Economic changes during the long-term period or structural changes in the economy are frequently examined based on the mentioned macroeconomic division. The structural changes of national economy are mainly reflected as the changes of sectoral share in total GDP (or value added) and number of employees. H. Chenery and M. Sirquin [4], [3], [10] in several works have given a significant contribution to the study of structural changes of national economy in the long-term period. H. Chenery and M. Sirquin have used cross-country models of industrial states that nowadays are considered to be developed, the comparison of their historical data, as well as econometric estimation. A. Fisher, C. Clark, M. Wolfe, J. Furastie, and others have made a considerable contribution to the division of national economy.

A. Fisher in his work [7] has proposed the interpretation of the structure of national economy that is based on the consumer demand. Under the proposed framework: primary production is related to the economic activities that provide the basic consumer needs; secondary production includes all industrial activities for the manufacturing of products with more or less standardized or conventional demand, but which could not be described as essential; the tertiary production includes new or relatively new types of consumer demand, the production and distribution of which is possible due to the increase in technical efficiency, which releases resources from the primary and secondary sectors [9, p. 12-13]. Despite the similar names of the sectors in the economic structure that A. Fisher used, C. Clark in his work "The Conditions of Economic Progress" [1] has formed the sectoral structure of national economy based on the common features of industries: agriculture, forestry and fishing form the primary sector; the secondary sector includes industries that are engaged in the production and processing of goods; the tertiary sector – all the other industries that are related to transportation, communication, finance, government services, etc. Consequently, C. Clark has created the division and classification based on that what is produced, goods or services, but A. Fisher's approach is based on the demand factor.

M. Wolfe in his work "The Concept of Economic Sectors" [12] has proposed the division of economic sectors based on the key factor of industry, which contributes to its growth. Accordingly, industries that rely mainly on natural resources are assigned to the primary sector, industries that rely mainly on technical factors are assigned to the secondary sector, and industries that rely mainly on human skills are assigned to the tertiary sector. These dominant factors are assumed to be responsible for the limitation of the increase of labour productivity in the respective sectors [11, p. 335]. Accordingly, M. Wolfe's defined factors that determine the growth of the sectors will also affect the overall economic growth.

J. Fourastie relies on the level of technological progress, which determines the level of labour productivity growth. In this classification, industries with an average rate of technological progress form the primary sector, but industries with a relatively high rate of technological progress are assigned to the secondary sector, while the other industries with a relatively low rate of technological progress are considered to be part of the tertiary sector. [11, p. 335]

The share of the sectors of national economy changes in the long-term period, and economic science explains structural changes of national economy by the three-sector hypothesis. The hypothesis is based on the changes in the sector proportion. During the historical development, there occurs a shift from the society with a dominant primary sector, usually agriculture, to the industrially oriented society (the secondary sector dominance) and then consequently to the society with a dominant tertiary sector or services. Both A. Fisher and C. Clark have studied the changes in the structure of employment, and concerning the structural changes of national economy they have come to a conclusion that economic development can be characterized by three stages: primary economy, industrial economy and developed economy with a high income level that is based on services.

Despite the fact that C. Clark and A. Fisher have based their analysis on data from various countries, J. Fourastie has used data only from two countries (USA and France); however, he has defined structural changes of national economy more broadly and completely than C. Clark and A. Fisher:

a. In economics, the agriculture sector dominates in the first phase of development, while the other two sectors play a relatively minor role in meeting the customers' demand and the number of persons in the labour force;
b. The next phase begins with industrialization, and the importance of industry increases as well. There is a massive movement of labour force from the primary to the secondary sector. The income level per capita rises, the demand for industrial goods increases, while there is no saturation for the demand. While incomes are continuing to grow, there is deviation of demand for the tertiary sector products. In order to produce the necessary amount of services, there is growth of the labour force in the tertiary sector. Technological progress in the primary sector permits the nutrition and supply of a still growing population. Fewer and fewer people are needed for primary production because the demand for primary goods is getting saturated. Simultaneously, labour requirements of the secondary sector increase so that large-scale labour reallocations from the primary to the secondary sector can take place. Higher real income per capita and higher standards of living lead to increasing demand for manufacturing products until saturation starts in the secondary sector as well. Further increase in real income per capita leads to the consumption shifts towards the products of the tertiary sector, which are assumed to be associated with the high income elasticity. To generate these products, the tertiary sector employs those workers who are set free by the secondary sector, and the share of the so-called white collar and brainworkers increases substantially;
c. This phase of intense inter-sectoral structural change is followed by a second stable phase with the tertiary sector dominance. [11, p. 336-337]

In the third phase, the tertiary sector accounts for a larger share in the structure of total employment and gross domestic product (GDP) than the primary and secondary sectors.

The three-sector hypothesis gives the theoretical explanation and essence of structural changes in national economy: in the long-term period the proportion of the primary sector decreases during the structural changes of national economy, in the tertiary sector – increases, but changes of the proportion of the secondary sector in the structure of national economy is similar to an inverse U-curve, when increase is followed by decrease.

Accordingly, there are changes in the proportion of the sectors or changes in relative shares of the sectors, or structural transformation – that is the process of changes in economy, which is associated with the structural changes of national economy, when there are changes in the share of the sectors in the composition of macroeconomic aggregate. Further, the structure of national economy according to C. Clark's division by three sectors will be used in this paper. This type of structure divided by the common features of industries is the most applicable in economics.

B. Preconditions and Causes of Structural Changes of National Economy

Examining the process of structural transformation, two groups of driving forces – demand-side factors and supply-side factors are usually found. On the supply side – technological progress is considered the major driving factor of the structural transformation process. Technological progress leads either to the technology improvement or to the production of new products. Thus, technology improvement provides a possibility to manufacture the same products, but at a lower cost, and this is associated with the productivity growth. New products usually satisfy consumers' expectations better than the existing products, and this is associated with ahigher quality of new products. During the process of transformation, the sectors with a higher level of technological progress become more significant, meanwhile the contribution of the sectors with a low rate of technological progress and

productivity reduces both in terms of employment and total value added. According to J. Fourastie's view, the demand for primary sector goods is saturated firstly, followed by the increasing demand for secondary sector goods as per capita income rises. The demand for secondary sector goods will finally be saturated as well. J. Fourastie has also assumed that the demand for tertiary sector products will never be saturated as per capita income rises. Nevertheless, as J. Kruger has pointed out: "The decline of the primary and the rise of the secondary and tertiary sectors are clearly evident. The final transition to a service society, however, requires that the secondary sector (i.e. manufacturing) accounts for only a minor share of employment and value added. The argument for saturation of demand for goods of the secondary sector in particular is not totally compelling since many manufacturing products (i.e. durable and investment goods) are intermediate inputs, which are used in all three sectors. Thus, even if there were saturation in final consumption goods of the secondary sector, this would not automatically imply a declining share of the secondary sector in total value added. The share of employment in the secondary sector may still decline because of the further increase in the mechanization and the comparatively high rate of technological progress in this sector [11, p. 337].

The interaction between the demand-side and supply-side factors shapes the process of structural changes within national economy that is reflected on the composition of output, employment and productivity among three sectors. According to Fourastie's theory, both elements interact in a way that technological progress with its effects on labour requirements of production and real income per capita is the driving force of structural change, whereas the direction of structural change is determined by the demand side [11, p. 336]. Respectively, in Fourastie's theory the interaction of the demand-side and supply-side factors, i. e. level of saturation and technological progress, occurs at a sectoral level during the process of transformation.

L. Pasinetti also considers that technical progress is the major force of the structural changes of national economy. According to his point of view, the structural changes of national economy accompany the growth and development of economy – his works [5], [6] about the dynamics of economy have significantly contributed to the theory of structural changes and economic growth. L. Pasinetti argues that technological progress influences the dynamics of economic system through two major channels. The first one, defined as 'strictly technological', refers to the changes in the technological coefficients (productivity increases), as well as to the introduction of new techniques and new goods and services in economy. The second channel is related to the rise in per capita income and its influence on consumer demand, as described by Engel's Law. The increase in per capita income is reflected in differentiated increase in the demand for various goods and services, and, consequently, the composition of the total production of economy will also be different. [9, p. 24] According to L. Pasinetti's model, the prices depend on the changes in technology, but the output depends on the changes in the composition of consumers' demand, while different levels of productivity across sectors of national economy will contribute to different price levels among sectors.

In terms of economic growth, S. Kuznets has made an important contribution to the research and interpretation of the process of structural changes. He has discovered the relationship between the increase in GDP level per capita and shift in the consumption structure, and stated that the technological progress is the primary source for economic growth. S. Kuznets has marked out that: "Rapid changes in the production structure are inevitable as the technological innovations have a differential impact on the several production sectors, income elasticity of domestic demand for various consumer goods are different, and there are changes in comparative advantage in international trade" [14, p. 250]. In this statement S. Kuznets also emphasizes two main causes of structural changes mentioned above – the impact of technological progress on the sectors of national economy is different and different impact of the income elasticity of consumption. S. Kuznets has also noted that: "Advancing technology is the permissive source of the economic growth, but it is only a potential, a necessary condition, not sufficient by itself" [14, p. 247]. Correspondingly, it can be concluded that technological progress is a necessary factor for economic growth, but insufficient. Technological progress is also a necessary condition for structural transformation, but at the same time it is insufficient.

The collaborative research of P. Saviotti and A. Pika "Economic Development by the Creation of New Sectors" [13] also focuses on the technological nature of the source of structural changes of national economy. There is emphasized not only the technological progress as the basis of structural changes, but also competition among the firms inside the industry as well as between the industries. Competition forces promote the emergence of new niches or industries. In the analysis it is assumed that firms are engaged in the search activities that are related to growth of innovations. The increase ininnovations is associated with the increase in the quality of products, and the productive efficiency. P. Saviotti and A. Pika summarize that wider technological opportunities and a higher rate of learning accelerate structural changes and contribute to the emergence of new industries.

J. Shumpeter argue that entrepreneurs are a significant driving force for the economic development in the "creative destruction" way. According to J. Shumpeter, innovation, the major force behind the economic progress in capitalist economies, arises from the technological competition among firms [9, p. 9]. Conformably, if there is competition among firms, which is based on the technological basis, then innovations contribute to the structural changes of national economy.

Investments are also considered to be a significant factor for the transformation process in economics. For example, I. Svennilson stresses the role of investments for structural changes and overall economic growth. For instance, structural changes of national economy can be prevented if the necessary amount of investment is not available – that does not allow

replacing the existing equipment with new or more efficient types of equipment. A distinguished feature of Svennilson's model is that investments are considered to be the major driving force of technological changes, where the distribution of new equipment and rise in productivity depend on the rate of investments. N. Rosenberg also emphasizes the role of investments. According to N. Rosenberg, a high rate of investment may be of crucial importance since it leads to the establishment of capital goods sector of a sufficiently high dimension, one that allows economy to innovate and stimulate the technological change [9, p. 15]. This means that investments will also promote the structural transformation through the technological changes.

The change of economic system is considered to be an important factor, precondition, which contributes to the structural changes of national economy, for instance, the transition from a centrally planned economy to a market economy. Such changes in the economic system imply the reduction in the central government intervention in manufacturing processes, price liberalization and monetary reform, property, business and land privatization – that is transition to an economic system of private property and activation of market mechanisms. Institutional and ideological changes are assumed to be the features of the change of economic system, which also encourage the structural changes of national economy. S. Kuznets argues that institutional and ideological changes are also necessary for the conduction of effective use of innovations.

C. Interaction between Structural Changes of National Economy and Economic Growth

The structural changes of national economy and economic growth are interrelated processes that interact with each other. L. Pasinetti argues: "Increases in productivity and increases in income are two facets of the same phenomenon. Since the first implies the second, and the composition of the second determines the relevance of the first, one cannot be considered if the other is ignored" [11, p. 346].

Firstly, economic growth affects structural changes – a change in the composition of demand and output resulting from the increase in income. On the one hand, productivity growth contributes to economic growth, but, on the other hand, encourages the structural changes of national economy through reallocation of the labour force among the sectors. The productivity growth is also affected by the various factors. E. Denison in his study [2] has empirically determined the extent to which major factors impact the productivity growth: the contribution of scientific and technical progress to productivity growth is about 40%, capital investments – around 27%, change of the labour force quality, determined by knowledge and skills – around 20% [2, p. 299-300]. Consequently, the increase in productivity implies economic growth, but at the same time, economic growth suggests the increase in investments of national economy that is a necessary condition for scientific and technical progress, increase in capital (non-financial investments), and for the development of the skills and knowledge of the workforce, but with a certain delay as nothing happens immediately. Productivity growth ensures the changes in composition of the supply. The increase in income ensures the changes in the structure of demand as well. In turn, the changes in the structure of demand and supply induce the structural changes of national economy.

Secondly, the structure of the economy affects the economic growth, as well: in countries with a low income level, agriculture has a larger share in the aggregate structure; in developed countries with relatively high income levels, the tertiary sector has a larger share in the aggregate structure.

C. Echevarria has studied the relationship between the sectoral composition and economic growth [8], and considered that the sectoral structure is of significant importance to the contribution to GDP growth. Thus, on the one hand, in poor countries there are the lowest growth rates of GDP per capita. The less developed countries are followed by the developed countries, while the middle-income countries have the highest growth rates of GDP per capita. On the other hand, based on the data on 65 countries in 1990 provided by the World Bank, C. Echevarria has concluded that in the low-income countries the agricultural sector has a larger portion in the aggregate structure of GDP and labour force, but in the developed countries with relatively high income levels – the service sector.

III. Evaluating the Significance of Structural Changes of National Economy for Economic Growth in Latvia

According to the subject of the article, the main task is to evaluate Latvian structural changes of national economy in economic growth, by applying an econometric approach. To evaluate the relationship between the economic growth and structural changes and to create the model, data of the Central Statistical Bureau (CSB) of the Republic of Latvia has been used for the period of the last twenty years. Statistical data from CSB that was in current prices was converted to prices of the year 2000 in order to reduce the influence caused by inflation. Annual growth rates were calculated for all indicators, generating a time series from 1991 to 2010., The growth rate of the total value added (changes in the value added with respect to the previous year) has been selected as the factor, which reflects economic growth of Latvia. In turn, the growth rates of value added in the three sectors of national economy (agriculture, industry and services) have been selected as the factors, which describe the changes in the structure of economics. The above-mentioned factors can be written as the function (1):

$$TVA = f(A_{VA}, I_{VA}, S_{va}) \quad (1),$$

where TVA – the growth rate of total value added;

A_{VA} – the growth rate of the value added in the sector of agriculture;

I_{VA} – the growth rate of the value added in the sector of industry;

S_{VA}– the growth rate of the value added in the sector of services.

To create a model based on (1), at first it is necessary to identify the factors that have an impact on the growth rate of value added in the sectors of national economy and to build relationships that will describe the changes of the growth rate of value added in the sectors. The relationships that describe value added of each sector can be based on production function (2):

$$Y = f(C, L) \quad (2),$$

where Y – the quantity of output;
C – the quantity of capital input;
L – the quantity of labour input.

Using (2) and adjusting it to the purpose of the paper, as well as applying the research of the theoretical aspects of structural changes in a national economy, we assume that the value added of each sector of national economy depends on the number of employees, nonfinancial investment or fixed capital, as well as on the labour productivity. Taking into consideration that we examine the relationship between the economic growth and the structural changes and both factors are expressed as growth rates, respectively, factors that affect sectors' value added are measured as growth rates, as well. Accordingly, the relationship between the changes in the value added and the changes in input factors for each sector of national economy can be written as follows:

$$VA = f(In, E, Pr) \quad (3),$$

where VA – the growth rate of value added;
In – the growth rate of nonfinancial investment;
E – the growth rate of number of employees;
Pr – the growth rate of labour productivity.

To create the macroeconomic model and to estimate the correlation, EViews software was used. Econometric estimation of the regression functions was made using the least square method, applying the major indicators – the coefficient of determination, the adjusted coefficient of determination, and statistical tests: Student's t-distribution, Fisher's exact test and Durbin-Watson test. During the process of estimation of the econometric functions, three relationships were chosen that reflect the best correlation between the growth rate of the value added and the growth rates of nonfinancial investment, number of employees and labour productivity in each corresponding sector. These correlations (relationships) and the results of econometric estimation are presented below.

The agricultural sector is characterized by the relationship (4) and its econometric evaluation is reflected in Table I:

$$A\_VA = 0.009513 * A\_In(t-1) + 0.751684 * A\_E + 0.926842 * A\_PR - 0.032026 \quad (4),$$

where A_VA – the growth rate of value added in the agricultural sector;
$A\_In(t-1)$ – the growth rate of nonfinancial investment in the agricultural sector, with one year delay;
A_E – the growth rate of number of employees in the agricultural sector;
A_PR – the growth rate of labour productivity in the agricultural sector.

TABLE I

THE ECONOMETRIC EVALUATION OF THE FUNCTION OF VALUE ADDED IN THE AGRICULTURAL SECTOR

Variable	Coefficient	Std. Error	t-Statistic	Probability
A_In(t-1)	0.009513	0.018072	0.526421	0.6063
A_E	0.751684	0.112722	6.668450	0.0000
A_PR	0.926842	0.049060	18.89214	0.0000
C	-0.032026	0.010272	-3.117878	0.0071
R-squared		0.969482		
Adjusted R-squared		0.963379		
S.E. of regression		0.037029		
F-statistic		158.8390		
Durbin-Watson stat.		1.847663		
F (critical)		3.343888		
t (critical)		2.131449		
d(L)		0.967		
d(U)		1.685		

According to Table I, indicators of statistical estimation such as the coefficient of determination (R^2) and the adjusted coefficient of determination (Adjusted R^2) are high enough. It indicates that the relationship (4) explains about 96-97% of the variations of the value added in the agricultural sector.

According to the research of theoretical aspects of structural changes, investments have a positive effect on structural changes of national economy – on the total value added and value added of each corresponding sector. Therefore, as seen from Table I, changes in the growth rate of nonfinancial investments have a positive impact on the value added of the primary sector with one period delay.

Estimation of the independent factors, which are included in the relationship (4), shows that the growth rates of number of employees and of labour productivity are statistically significant at least at 5% level. In turn, the growth rates of nonfinancial investments have a relatively minor impact on the value added – this follows from the comparison of the t-statistic and t-critical values (t-stat. < t-crit.). In addition, the value of the probability also proves this fact ($p > \alpha$, $\alpha = 0.05$). Therefore, the null hypothesis that the coefficient at the factor of nonfinancial investments is equal to null cannot be rejected. Nevertheless, variable of nonfinancial investment was included in the relationships as there was a minor increase in the variations of the dependent variable, which was explained by the variations of the independent variables (proven by the values of R^2 and Adjusted R^2).

Fisher statistic, comparing the values of F-statistic with F-critical, indicates that regression function (4) is a statistically significant relationship (158.8390 > 3.343888).

Estimation with the Durbin-Watson statistic at the 5% level of significance, which means the probability of making a mistake by rejecting the hypothesis of the absence of autocorrelation in the residuals, indicates that there is no autocorrelation ($d_{(L)} < 1.847663 < 4 - d_{(U)}$) in the regression residuals in the relationship (4). Conformably, this indicates that independent factors, which are included in the relationship (4), are of high importance for the interpretation of endogenous factor – the growth rate of value added in the agricultural sector.

Reviewing the coefficients of the independent variables $A\_I_{(t-1)}$, $A_E$and A_PR, which were predicted by the econometric estimation (Table I), it is obvious that the growth rates of value added of the agricultural sector (A_VA) was most affected by the changes in the growth rate of labour productivity (A_PR) in the corresponding sector, but the least impact was caused by the changes in the growth rate of nonfinancial investments ($A\_In(t-1)$) during the period under consideration. Accordingly, the derived coefficient (0.926842) of variable A_PR indicates that if the growth rate of labour productivity in the agriculture increases (decreases) by 1 point, all other variables being invariable, the growth rate of value added of the corresponding sector will increase (decrease) by 0.926842 points.

The industrial sector is characterized by the relationship (5) and its econometric evaluation is reflected in Table II:

$$I\_VA = 0.015292 * I\_In + 1.003718 * I\_E + 0.872900 * I\_PR + 0.002509 \quad (5),$$

where I_VA – the growth rate of value added in the industrial sector;

I_In – the growth rate of nonfinancial investments in the industrial sector;

I_E – the growth rate of number of employees in the industrial sector;

I_PR – the growth rate of labour productivity in the industrial sector.

Reviewing the coefficients of the independent variables I_I, I_E and I_PR from the relationship (5), it is obvious that during the period under analysis the growth rates of value added of the industrial sector (I_VA) were most affected by the changes in the growth rate of number of employees (I_E) in the corresponding sector, but the changes in the growth rate of nonfinancial investments had the least impact on the value added (I_In). Accordingly, the derived coefficient (1.003718) of variable I_N indicates that if the growth rate of number of employees in the industrial sector increases (decreases) by 1 point, all other variables being invariable, the growth rate of value added of the corresponding sector will increase (decrease) by 1.003718 points. During the period under analysis, the growth rate of labour productivity also had a major impact on the growth rate of value added in the industrial sector – if the growth rate of labour productivity changes by 1 point, the growth rate of value added in the industrial sector will change by 0.872900 points.

According to Table II, indicators of statistical estimation, such as the coefficient of determination (R^2) and the adjusted coefficient of determination (Adjusted R^2), are high enough – around 99.7% of variations of the growth rate of value added in the corresponding sector are explained by the relationship (5).

TABLE II

THE ECONOMETRIC EVALUATION OF THE FUNCTION OF VALUE ADDED IN THE INDUSTRIAL SECTOR

Variable	Coefficient	Std. Error	t-Statistic	Probability
I_In	0.015292	0.011650	1.312596	0.2078
I_E	1.003718	0.029010	34.59886	0.0000
I_PR	0.872900	0.017528	49.80060	0.0000
C	0.002509	0.001925	1.303592	0.2108
R-squared		0.997834		
Adjusted R-squared		0.997428		
S.E. of regression		0.007515		
F-statistic		2457.486		
Durbin-Watson stat.		2.059114		
F (critical)		3.287382		
t (critical)		2.119905		
d(L)		0.967		
d(U)		1.685		

Estimation of the independent variables, which are included in the relationship (5), shows that the growth rates of number of employees and of labour productivity are statistically significant at least at 5% level. In turn, the growth rates of nonfinancial investments have a relatively minor impact on the value added – this follows from the comparison of the t-statistic and t-critical values (t-stat. < t-crit.), and the probability also proves this fact ($p > \alpha$, $\alpha = 0.05$). Therefore, the null hypothesis that the coefficient at the factor of nonfinancial investments is equal to null cannot be rejected. Nevertheless, this variable was included in the relationships because there was a minor increase in the variations of the dependent variable, which was explained by the variations of the independent variables (proven by the values of R^2 and Adjusted R^2).

Estimation of the Durbin-Watson statistic for relationship (5) from Table II and its comparison with the lower border $d_{(L)}$ and the upper border $d_{(U)}$ for 20 observations and for three variables indicate that there is no autocorrelation in the regression residuals of the (5) relationship ($d_{(L)} < 2.059114 < 4 - d_{(U)}$).

Comparing the values of F-statistic with F-critical from Table II, Fisher statistic indicates that regression function (5) is a statistically significant relationship 2457.486 > 3.287382).

The service sector is characterized by the relationship (6) and its econometric evaluation is reflected in Table III:

$$S\_VA = 0.001673 * S\_In(t-1) + 1.067158 * S\_E + 0.960893 * S\_PR + 0.001515 \quad (6),$$

where S_VA – the growth rate of value added in the service sector;

$S\_In(t-1)$ – the growth rate of nonfinancial investments in the service sector;

S_E – the growth rate of number of employees in the service sector;

S_PR – the growth rate of labour productivity in the service sector.

TABLE III

THE ECONOMETRIC EVALUATION OF THE FUNCTION OF VALUE ADDED IN THE SERVICE SECTOR

Variable	Coefficient	Std. Error	t-Statistic	Probability
$S\_In\ (t-1)$	0.001673	0.003367	0.496954	0.6264
S_E	1.067158	0.020099	53.09616	0.0000
S_PR	0.960893	0.012591	76.31603	0.0000
C	0.001515	0.001139	1.330239	0.2033
R-squared		0.998181		
Adjusted R-squared		0.997817		
S.E. of regression		0.004031		
F-statistic		2744.107		
Durbin-Watson stat.		2.380544		
F (critical)		3.343888		
t (critical)		2.131449		
d(L)		0.967		
d(U)		1.685		

Reviewing the coefficients of the independent variables $S\_In\ (t-1)$, S_E and S_PR from the relationship (6), it is obvious that during the period under analysis the growth rates of value added of the service sector (S_VA) was most affected by the changes in the growth rate of number of employees (S_E) in the corresponding sector, but changes in the growth rate of nonfinancial investments had the least impact on the value added ($S\_In\ (t-1)$). Accordingly, the derived coefficient (1.067158) of variable S_N indicates that if the growth rate of number of employees in the service sector changes by 1 point, all other variables being invariable, the growth rate of value added of the corresponding sector will change by 1.067158 points. During the period under analysis, the growth rate of labour productivity also had a major impact on the growth rate of value added in the service sector – if the growth rate of labour productivity changes by 1 point, the growth rate of value added in the service sector will change by 0.960893 points.

According to Table III, indicators of statistical estimation, such as the coefficient of determination (R^2) and the adjusted coefficient of determination (Adjusted R^2), are high enough – around 99.8% of variations of the growth rate of value added in the service sector are explained by the relationship (6).

Estimation of the independent variables, which are included in the relationship (6), shows that the growth rates of labour productivity and of number of employees are statistically significant at least at the level of 5%. In turn, the growth rates of nonfinancial investments have a relatively minor impact on the value added, as in the relationship (4) and (5). Nevertheless, this variable was included in the relationships because there was an increase in the variations of the dependent variable, which was explained by the variations of the independent variables (proven by the values of R^2 and Adjusted R^2). In addition, likewise the primary sector, changes in the growth rate of nonfinancial investments have a positive impact on the value added of the tertiary sector with one period delay (index (t-1)).

Using the estimation of the Durbin-Watson statistic for relationship (6) from Table III and its comparison with the lower border d(L) and the upper border d(U) for 19 observations and three variables at the level of 5% significance, it is not possible to conclude about the presence or absence of autocorrelation in the regression residuals of the relationship (6) as $4 - d(U) < 2.380544 < 4 - d(L)$. However, at the level of 1% significance, when the lower border is equal to $d(L) = 0.742$, and the upper border $d(U) = 1.416$, it can be concluded that there is no autocorrelation in the regression residuals of the (6) relationship ($0.742 < 2.380544 < 4 - 1.416$).

Fisher statistic, comparing the values of F-statistic with F-critical from Table III, indicates that regression function (6) is a statistically significant relationship ($2744.107 > 3.343888$).

As mentioned above, the model of the total value added for the Latvian economy is based on the function (1) that also contains three relationships of the value added in the corresponding sectors of national economy: (4) – for the primary sector, (5) – for the secondary sector, (6) – for the tertiary sector. Accordingly, the model of the total value added contains four endogenous factors and nine exogenous factors (Fig. 1.):

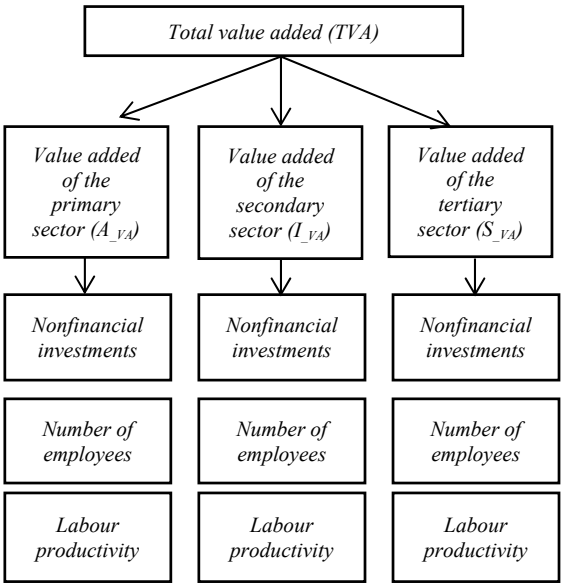

Fig. 1. The abstract model of the total value added of the national economy.

According to Fig. 1, in the model of the growth rate of total value added the endogenous factors are the following: the growth rate of the total value added (TVA), the growth rate of value added in the agricultural sector (A_VA), the growth rate of value added in the industrial sector (I_VA) and the growth rate of value added in the service sector (S_VA). Exogenous factors in the model are the following: the growth rate of nonfinancial investments, the growth rate of number of employees and the

growth rate of labour productivity of each corresponding sector of national economy. The econometric model of the total value added looks like this:

$$TVA = 0.129588 * A_{\_VA} + 0.458743 * I_{\_VA} + 0.548578 * S_{\_VA} - 0.000609 \quad (7),$$

where TVA – the growth rate of the total value added;

$A_{\_VA}$ – the growth rate of value added in the primary sector;

$I_{\_VA}$ – the growth rate of value added in the secondary sector;

$S_{\_VA}$ – the growth rate of value added in the tertiary sector.

The econometric evaluation of the relationship (7) is reflected in Table IV:

TABLE IV

THE ECONOMETRIC EVALUATION OF THE RELATIONSHIP OF THE TOTAL VALUE ADDED IN THE NATIONAL ECONOMY

Variable	Coefficient	Std. Error	t-Statistic	Probability
$A_{\_VA}$	0.129588	4.90E-08	2642559.	0.0000
$I_{\_VA}$	0.458743	7.71E-08	5953828.	0.0000
$S_{\_VA}$	0.548578	1.09E-07	5034281.	0.0000
C	-0.000609	9.47E-09	-64247.51	0.0000
R-squared		1.000000		
Adjusted R-squared		1.000000		
S.E. of regression		4.09E-08		
F-statistic		8.67+13		

According to Table IV, indicators of statistical estimation, such as the coefficient of determination (R^2) and the adjusted coefficient of determination (Adjusted R^2), are high – the relationship (7) explains all variations of the growth rate of the total value added of the national economy during the last 20 years.

According to the relationship (7), the growth rate of the total value added is most dependent on the tertiary sector – services. If the growth rate of value added in the service sector changes by 1 point, all other variables being invariable, the growth rate of the total value added will change by 0.548578 points.

The least impact on the total value added is caused by the growth rate of value added in the agricultural sector, because if the growth rate of value added changes by 1 point, the growth rate of the total value added will change by 0.129588 points.

The industrial sector has a major impact on the growth rate of the total value added, as well. If the growth rate of value added in the industrial sector changes by 1 point, all other variables being invariable, the growth rate of the total value added will change by 0.458743points, which is only about 0.09 points less than the impact of the secondary sector. According to the results of the analysis, the growth of the Latvian economy during the last 20 years was based on the growth of the service sector being the major driving force of the total growth.

IV. CONCLUSION

After developing the econometric model and applying statistical estimation, it can be concluded that the created model of the relationship between the growth rate of the total value added in the Latvian economy and the growth rates of value added in the corresponding sectors of national economy is statistically significant, and factors included in the model explain most variations of the growth rates of value added.

The results of the analysis are the following: the growth rate of value added in the primary sector is most affected by the changes in the growth rate of labour productivity; the growth rate of value added in the secondary sector as well as in the tertiary sector is most affected by the growth rate of number of employees; changes in the growth rate of labour productivity in the corresponding sectors are of high importance. In addition, changes in number of employees and labour productivity have a major effect on the value added in the service sector compared to other sectors of national economy. While, the changes in the growth rate of nonfinancial investments have a major effect on the primary sector, rather than on other sectors.

According to the developed relationship of the growth rate of the total value added of national economy, during the last twenty years the growth rate of the total value added was most affected by the changes in the growth rate of value added in the service sector. The changes in the growth rate of value added in the industrial sector also had a high impact. While, the least impact on the total value added was caused by the changes in the growth rate of value added in the agricultural sector. The conducted research confirms that the increase in significance of the service sector in the economic growth of Latvia was the distinctive feature of national economy in the period under analysis.

The conducted research could have been used to forecast changes in the growth rate of value added of the Latvian economy.

Despite the fact that the research indicates that the economic growth of Latvia during the period under analysis was based on the growth of the service sector, it is necessary to conduct further research to determine the effectiveness of the existing structure of national economy and its sustainability, and to identify whether any changes are necessary in the structure of national economy.

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Aleksandra Mihņenoka, Juris Saulītis. Tautsaimniecības struktūrizmaiņu nozares novērtējums Latvijas ekonomikas izaugsmē, izmantojot ekonometrisko modeli

2008.-2010. gadu ekonomiskā krīze parādīja, ka mūsdienu globalizētajā pasaulē neviena valsts nav aizsargāta. Tāpēc ekonomisti aizvien vairāk akcentē savu uzmanību uz tautsaimniecības struktūru. Mūsdienās ar tautsaimniecības struktūru saprot trīs sektorus – lauksaimniecību, rūpniecību un pakalpojumu sektoru, pie kura mēdz pieskaitīt arī ceturto sektoru, informācijas tehnoloģijas un zinātni. Savukārt tautsaimniecības struktūrizmaiņas visbiežāk atspoguļo kā tautsaimniecības sektoru īpatsvara izmaiņas tādos ekonomikas koprādītājos kā IKP un nodarbināto skaits.

Rakstā uzmanība tika pievērsta tautsaimniecības struktūrizmaiņu izpētei un to novērtēšanai Latvijas ekonomikas izaugsmē. Izpētot tautsaimniecības struktūrizmaiņu teorētiskos pamataspektus ekonomikas literatūrā un pielietojot ekonometrisko pieeju, tika izveidots modelis. Ekonometriskā modeļa veidošanai tika izmantoti LR CSP dati par pēdējiem 20 gadiem. Izveidotās sakarības novērtē tautsaimniecības struktūrizmaiņu ietekmi uz Latvijas ekonomikas izaugsmi analizētajā periodā. Pirmkārt, sakarības parāda, kā nefinanšu investīciju, nodarbināto skaita un darbaspēka produktivitātes pieauguma tempi katrā no tautsaimniecības sektoriem ietekmēja attiecīgā sektora pievienotās vērtības pieauguma tempu. Un, otrkārt, kā tautsaimniecības sektoru pievienotās vērtības pieauguma tempu izmaiņas ietekmēja kopējās pievienotās vērtības pieauguma tempu. Saskaņā ar veiktā pētījuma rezultātiem Latvijas ekonomikas izaugsme analizētajā periodā balstījās galvenokārt uz pakalpojumu sektora izaugsmi.

Александра Михненока, Юрис Саулитис. Оценивание значения структурных изменений национальной экономики в экономическом росте Латвии, используя эконометрическую модель

Экономический кризис 2008-2010-х годов показал, что в сегодняшнем мире с высоким уровнем глобализации ни одна страна не защищена. Таким образом, экономисты все больше и больше акцентируют своё внимание на структуре национальной экономики. В настоящее время под структурой национальной экономики подразумевают три сектора - сельское хозяйство, промышленность и сферу услуг, которая включает в себя и т. н. четвертичный сектор, сферы информации, технологий и науку. В свою очередь, структурные изменения в экономике, как правило, отображают как изменение удельного веса секторов в структуре макроэкономических показателей, как например, ВВП и количество занятого населения. В данной статье внимание сосредоточено на исследовании структурных изменений в экономике и их оценке в росте Латвийской экономики. Исследовав основные теоретические аспекты структурных изменений в экономической литературе, и применив эконометрический подход, была разработана эконометрическая модель. Эконометрическая модель была создана на основе статистических данных Латвийской Республики за последние 20 лет. Созданные эконометрические взаимосвязи отображают влияние структурных изменений на рост экономики Латвии за исследуемый период. Во-первых, взаимосвязи показывают, как темпы роста нефинансовых инвестиций, занятости и производительности труда в каждом из секторов экономики влияли на темпы роста добавленной стоимости соответствующего сектора экономики. Во-вторых, взаимосвязи показывают, как темпы роста добавленной стоимости в каждом секторе влияли на темпы роста общей добавленной стоимости экономики. Согласно результатам исследования, в исследуемом периоде рост экономики Латвии в основном обеспечивался за счёт роста сферы услуг.