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METHODOLOGY OF TAX BURDEN DETERMINATION BASED ON PRODUCTION POTENTIAL

A B S T R A C T

The article deals with considering gross domestic product to be the result of economic potential in proportional gross economy and the model of economic balance is offered with excitement theory application. This model can use the development potential of the economy as an appropriate endogenous factor and provides an analytical expression for the coefficient and the development of the economy.

Keywords: excitement theory, production potential, economic potential, tax burden, proportional growth, MathWork Program MATLAB.

Introduction

In the systematic analysis of the activity of any economic system it is necessary to distinguish 3 main mega subjects: State, Society, Economy. Economic power of the state, welfare of the society and efficiency of economy depends on the mutual activity level of these three "players" among themselves.

Macroeconomic indicators such as Gross Domestic Product (GDP), Gross National Product (GNP), Gross Social Product (GSP), etc. are production potential results appeared on the bases of their balanced activity. In order to write a model of the equilibrium of an economic system, the production potential must first be assesses.

In this article we shall consider "state-economy" segment of the above-mentioned closed relations, or rather economic system and its economic (production) potential, the extend to which the state will use and develop this. On this basis, it is better to investigate the elements namely structural elements of which economic system production potential comprises.

When studying a country's production potential, the economic potential and its components, which is a more general concept, must first be assessed. Assessing the country's economic potential is one of the most difficult economic categories and is considered one of the unresolved problems. However, in modern research, the economic potential of the economic system means the aggregate capacity of its industries, production of industrial and agricultural products, substantial construction, transportation and services to the population.

The components of this opportunity are classified as followings:

- Amount of labour resources and their professional arrangement;
- The capacity of production power of industry and construction sector (organizations);
- Production opportunity of agriculture;
- Length of transport highways and number of vehicles;
- Development of non-manufacturing sector;
- Achievement of scientific and technical work;
- Discovered natural resources.

These elements which comprise total volume of country's productive forces characterize the country's economic potential from the viewpoint of national wealth.

In the country's National Accounts System (NSS) the structure and quality of the economic potential are classified as followings:

1. Economic potential;
2. Production potential;
3. Working capital potential;
4. Investment potential;
5. Value added potential;
6. Innovation potential;
7. Marketing potential;
8. Labour potential;
9. Incompatibility (avoidance);
10. Income potential.

As can be seen, it reflects the key phases of production chain income formation and income distribution adopted by world economists' society and the elements determined by economic potential structure in the NSS.

Similarly, the structure of production potential is defined as follows:

- Non-current items;
- Circulating funds;
- Investments.

It should be noted other structures of both economic and production potential are also found in the scientific literature.

- Production capital;
- Turnover capital;
- Human capital;
- Cash reserves;

or

- Human capital;
- Investment;
- Natural resources;
- Information and so on.

1. Defining the equilibrium model of the economy

1.1. Statement of the problem

Economic potential of a country is socio-economic activity of economic system and its branches, high-quality and competitive goods production, an opportunity to meet the requirements of population namely whole society for the necessary product and services and to ensure production growth and demand increase, to improve the structure of economy.

Production opportunity of the society is the highest possible income production amount using available resources completely and efficiently.

Let's imagine that the country's production potential is K_t – in the year of t, its utilization coefficient is ξ_t, real output is GDP:

$$GDP_t = \xi_t K_t$$

In this case,

$$K_t = noncurrent\ funds + current\ funds + investments$$

For the simplicity of the following mathematical expressions:

$$y(t) = GDP_t \tag{1}$$

To build an equilibrium model of the economic system, assume that the production potential of the economic system K_t and its utilization coefficient ξ_t are estimated by one of the above-mentioned approaches. At the same time, the only endogenous factor affecting the economic system is the tax regime. It is clear that the tax burden, which is an endogenous factor, disrupts the stability of the economic system, moving it from one state of stability to another as a result of excitement. If we express the result of the initial state of the economic system as $y(t)$ and the result of the subsequent state as $y_1(t)$ and take into account that $y_1(t)$ is formed as a result of the application of the tax regime from $y(t)$ which is the result of the initial state of the economic system we can write the equation:

$$y_1(t) = u(t)y(t) \tag{2}$$

here *t*- is financial (tax) year*u(t)*- is tax burden of the economic subject in the financial (tax) year of *t*.

Then we can write the equilibrium model expressing the economic potential of the economic system as follows:

$$\int_0^\tau [y(t) - u(t)y(t)]dt = K_\tau \tag{3}$$

Obviously economic system has a very complicated development law and it is either impossible to describe it mathematically or it leads to the most complex models in order to achieve result in this or other sense. A variety of classification of these types of models can be found in economic literature.

1.2. Economic growth model review

Mercantilist's (15-17th centuries) approaches should be first underlined from the historical viewpoint of economic growth theories. Collection of wealth (metals like gold) is presented as the main source of economic growth in mercantilism theory. (3) A new economic development theory was suggested by physiocrats in the second half of the 18th century which replaced mercantilist's approach. According to this theory agriculture is considered to be main source of economic growth and all other brunches are "non-productive". (4)

Classic economics founded by Adam Smith in the late 18th century connected the economic development under competitive condition with production factors (land, labour force, capital), labour productivity increase and technological innovations (5).

During further years David Ricardo (1772-1823), Thomas Malthus (1766-1834), Karl Marx (1818- 1883), John Stuart Mill (1808-1873), Jean-Baptiste Say (1767-1832) and many others developed the classic economic theory from different aspects (Sharipov, 2015).

"Economic growth theory" printed Schumpeter in 1911 is considered a serious stage in the economic growth theory and inovation factor and the role of owners are reflected in this book.

Keynes and new Keynes theories are of great importance in the theory of modern economic growth (7).

The main source for the economists including both of these groups is "The general theory of employment, interest and money" written by Keynes. According to Keynes approach common effective requirement increase was put forward the main factor to provide economic growth and using fiscal policy tools is described as the major way of sollution. (8)

Keynes"s followers (new Keynes) spread the model widely during further years. Economic growth theories suggested by American economist Evsey Domar and British economist Roy Harrot are presented as Harrot Domar theory in economic literature as they were very close to each other.

In his model, Domar shows that investment or capital accumulation stimulates both returns and aggregate supply, resulting in balanced economic growth [9]. The Harrod model emphasizes not only the importance of investment, but also the significant impact of entrepreneurs' expectations on balanced economic growth [10]. However, the Harrod-Domar model argues that economic growth is primarily a line of investment and this link, the main drawback is that it does not take into account the growth of labour force and technological development (Sharipov, 2015).

Later neoclassical economists who criticized the neo-Keynesians tried to explain the reason of economic growth not only in terms of unused factors of production, but also taking these factors into account including technological progress, innovation in production management, increasing productivity, and so on. The Neoclassicals believed that economic growth would be achieved under the condition of a free market economy. The theory based on the Cobb-Douglas production function proposed by Nobel laureate Robert Solow (Robert SoLower) also shows the link between the three main sources of economic growth - investment, labour, and technological progress [11]. According to this model, the savings rate plays a key role in the formation of capital reserves and increase production.

In the 80s and 90s of the last century, there was a significant development in theories of economic growth. This trend has been reflected in the so-called "new economic theory". Some of the weaknesses of the neoclassicals, especially the Solow model, have been criticized and it increased the opportunity relating to impact of the economic growth in the long term period of the state. According to Solow's model, the state's influence on economic growth

could be negligible. However, proponents of the theory of endogenous economic growth show that scientific and technological progress plays a crucial role in economic growth as endogenous factors. (12), (13) and (14). They claim that technological innovations mainly appear as the result of technological development and investment in human capital. In the theories of endogenous growth, technological progress is shown to be the only possible cause of economic growth in the long period of time. Here, the quality of human capital (which depends on investment in human capital (education, health)), the creation of an important legal framework for the protection of intellectual property rights in a competitive market and state support for the development of science and technology it is important to create a favourable investment climate and attract new technologies (Sharipov, 2015). Similar arguments have been put forward by Grossman and Helpman (15), Aghion and Hovitt (16) in their theories.

1.3. The solution to the problem in the case of proportional economic growth

Assume that the economic system has a proportional economic development, and for simplicity $u(t) = u = const$

$$\Delta y(t) = \lambda y(t)\Delta t \tag{4}$$

If $t = 0$, then we get the ordinary differential equation with the initial condition $y(0) = 1/y_0$:

$$\frac{dy(t)}{y(t)} = \lambda dt \tag{5}$$

We can easily solve the differential equation (4)

$$y(t) = \frac{1}{y_0} e^{\lambda t} \tag{6}$$

Considering equation (7) in terms of equilibrium of the economic system (3) we get the equation:

$$\int_0^\tau \left[\frac{1}{y_0} e^{\lambda t} - u \frac{1}{y_0} e^{\lambda t} \right] dt = \frac{1}{K_\tau} \tag{7}$$

or

$$\frac{1}{\lambda} \frac{1}{y_0} (1 - u) \int_0^\tau e^{\lambda t} d(\lambda t) = \frac{1}{K_\tau} \tag{8}$$

or

$$\frac{1}{\lambda} (1 - u)(e^{\lambda t} - 1) = \frac{y_0}{K_\tau} \tag{9}$$

or

$$u = 1 - \frac{y_0}{K_\tau} * \frac{\lambda}{e^{\lambda t} - 1} \tag{10}$$

Let us denote $\xi_\tau = \frac{y_0}{K_\tau}$ here. Then, the tax burden of the economy can be written as follows:

$$u = 1 - \xi_\tau \frac{\lambda}{e^{\lambda t} - 1} \tag{11}$$

For any tax year τ, λ economic growth rate, fixed capital utilization coefficient ξ, fixed capital $K_{\tau-1}$,, deflator $P_{\tau-1}$ and the tax burden u of the economy according to the price of GDP in the base year y_0 (11) can be calculated according to the equation.

2. Approximation on the example of the Azerbaijani economy on the proposed methodology

For this purpose, a mathematical apparatus was developed, software was created in the form of an M-file in the MathWork Software MATLAB 2017a environment for interval and point calculations using these relationships, and appropriate calculations were performed. The following is a fragment of the assessment of the tax burden on the proposed methodology:

Table 1.

Statistical estimates of macroeconomic indicators

Indicators are expressed in millions of manats									
1	2	3	4	5	6	7	8	9	10
Years	GDP	Tax revenues	Public expen-ditures	Invest-ment	Household expenditures	Export (StatKom)	Import (StatKom)	Xalis Ixrac (StatKom)	K-son potensial
2005	12522.5	1427.5	2140.7	6733.4	5210.5	7881.8	6624.5	1257.3	20252.3
2006	18746.2	2706.3	3790.1	7415.6	6873	12467	7265.7	5201.3	28595.7
2007	28360.5	4549.3	6086.2	10353.9	9374.6	19321.7	8086.4	11235.3	39717.2
2008	40137.2	5746.6	10774.2	13328.0	13286.2	26400.7	9418.9	16981.8	54446.6
2009	35601.5	4113.4	10503.9	10475	15048.9	18383.1	8226.9	10156.2	49066.7
2010	42465	4292.8	11765.9	14118.9	16528.3	23060.5	8782.3	14278.2	57797.5
2011	52082	5475.1	15397.5	17048.8	19216	29388.3	12541.9	16846.4	70361.3
2012	54743.7	6025.4	17416.5	20251.1	21389.9	29000.3	13843.8	15156.5	75756.6
2013	58182	6663.6	19143.5	21448.2	24150	28169.3	15278.6	12890.7	81166.8
2014	59014.1	7113.6	18709	21890.6	26582.6	25537.5	15467.4	10070.1	83311.4
2015	54380	7118.2	17784.5	20057.4	30595.3	20552.8	18927.9	1624.9	78991.1
2016	60425.2	7015.2	17751.3	22868.5	35196.7	28054	26375.4	1678.6	87715.2
2017	70135.1	6971.7	17594.5	24462.5	40505	34147.5	29439.5	4708	101963.2

The table was compiled by the author based on the data of the State Statistics Committee of the Republic of Azerbaijan.

Note: K - LAST POTENTIAL Reserves of total output of products and services are taken at base prices (https://www.stat.gov.az/source/system_nat_accounts/en/026.xls)

Table 2.

Results of calculations

1	2	3	4	5
Years	Growth rate $\lambda = \dfrac{Y_t}{Y_{t-1}} - 1$	Ksi $\xi = \dfrac{Y_t}{K_t}$	$u, \%$	$TT = u * Y$
2005		0.618325		
2006	0.4970	0.65556	49.39	9258.90
2007	0.5129	0.714061	45.35	12860.48
2008	0.4153	0.737185	40.53	16268.04
2009	-0.1130	0.725574	23.27	8282.97
2010	0.1928	0.73472	33.38	14175.99
2011	0.2265	0.740208	34.04	17731.21
2012	0.0511	0.722626	29.57	16186.72
2013	0.0628	0.71682	30.55	17771.98
2014	0.0143	0.708356	29.67	17509.34
2015	-0.0785	0.688432	28.42	15453.96
2016	0.1112	0.688879	34.87	21070.34
2017	0.1607	0.687847	36.59	25665.20

Figure 1.

**Statistical estimates of GDP - Y and tax revenues-T during 2006-2017;
calculated (TT) prices of tax revenues**
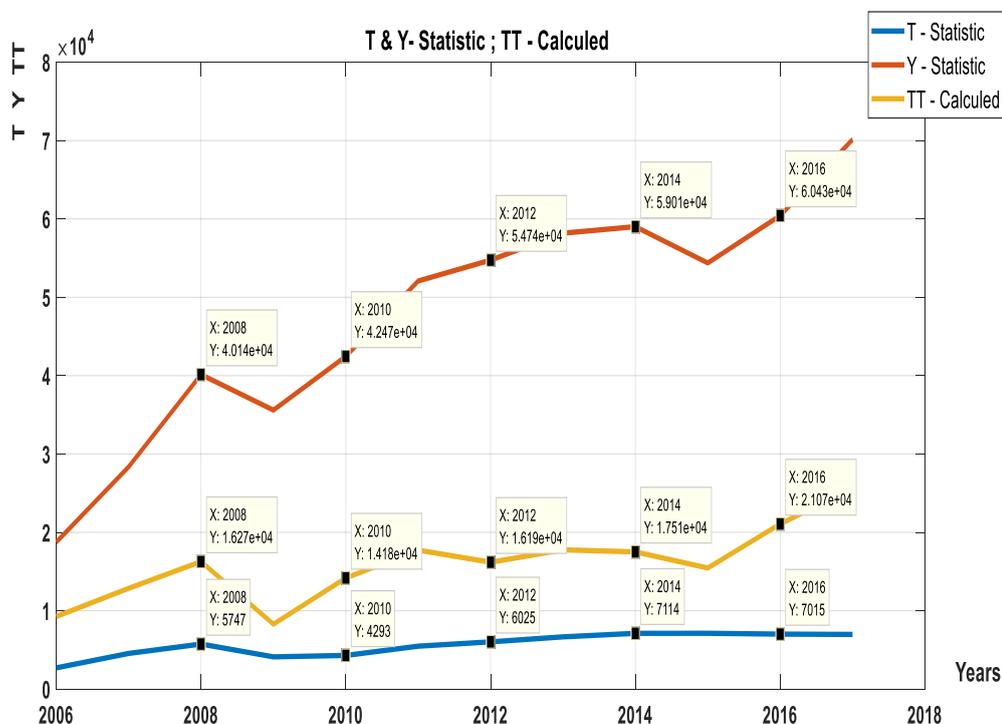
Figure 2.

Shows the values of u-tax burden calculated by the formula u = 1-λξ⁄((e ^ λτ-1))
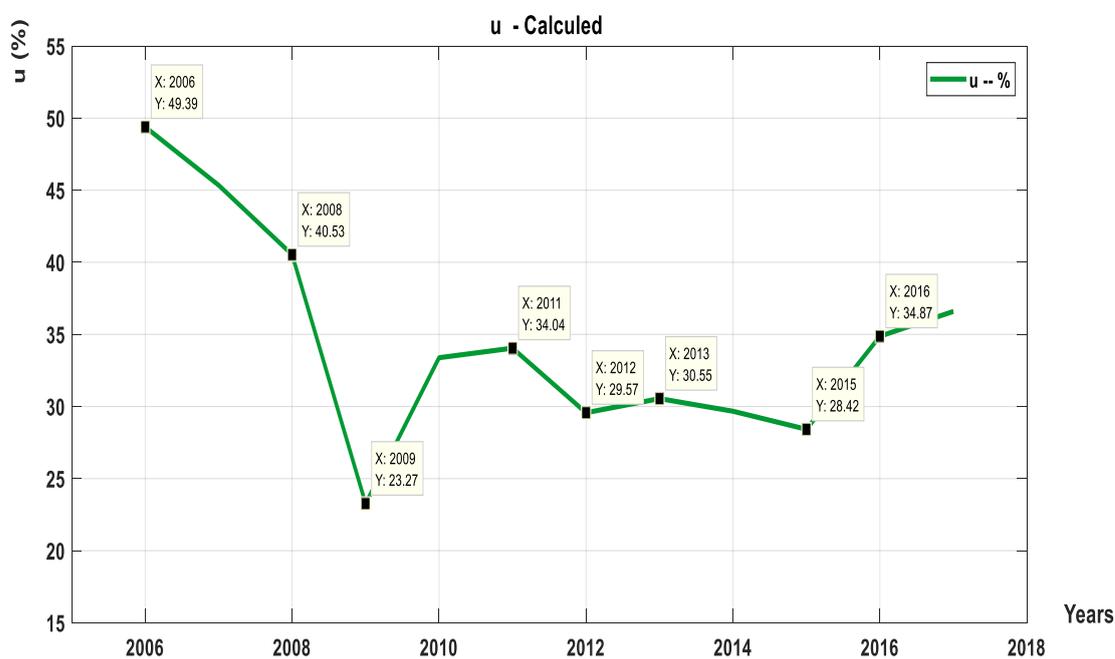
u - Calculed

Figure 3.

Growth rate

Lamda

*Figure 4.*

Load ratio
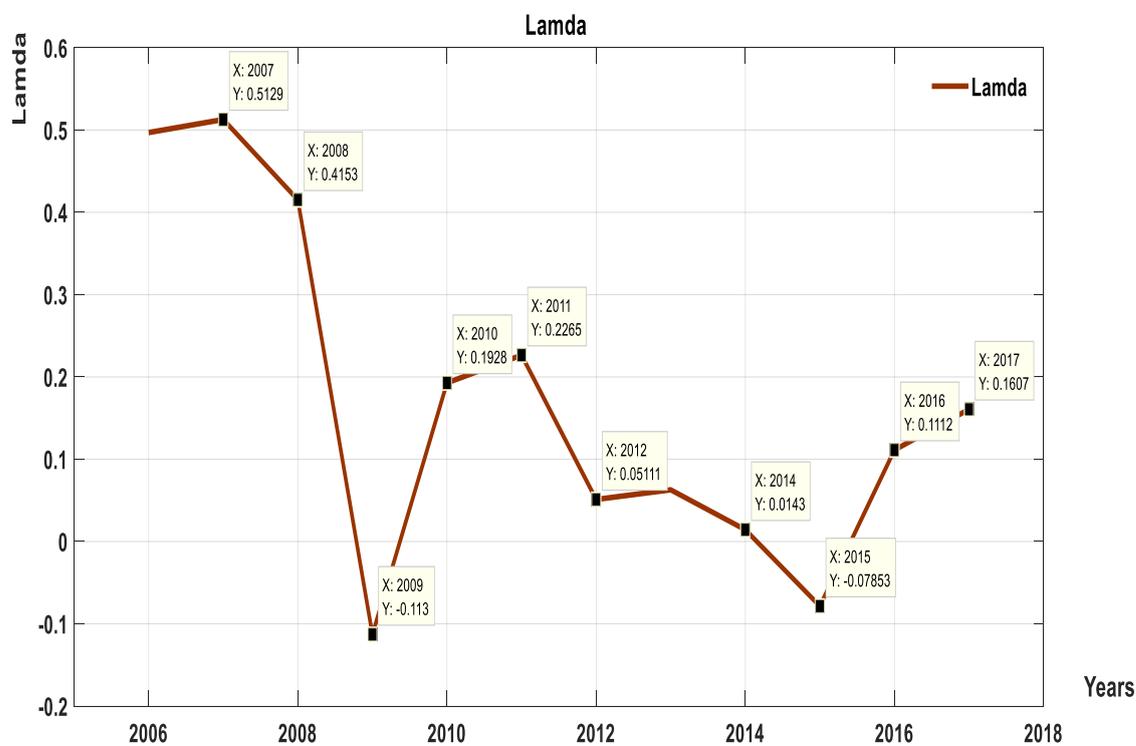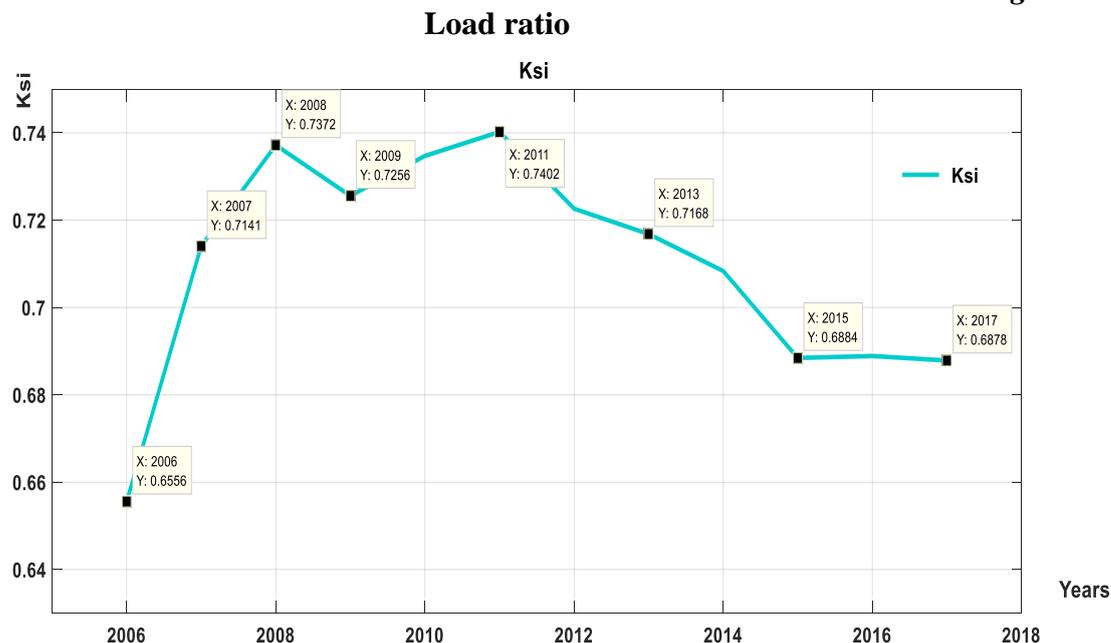
Figure 5 shows the dependence of GDP and tax revenues on the values of the tax burden u calculated by the formula u = 1-λξ⁄((e ^ λτ-1)).

Figure 5.

Dependence of GDP and tax revenues on the tax burden u
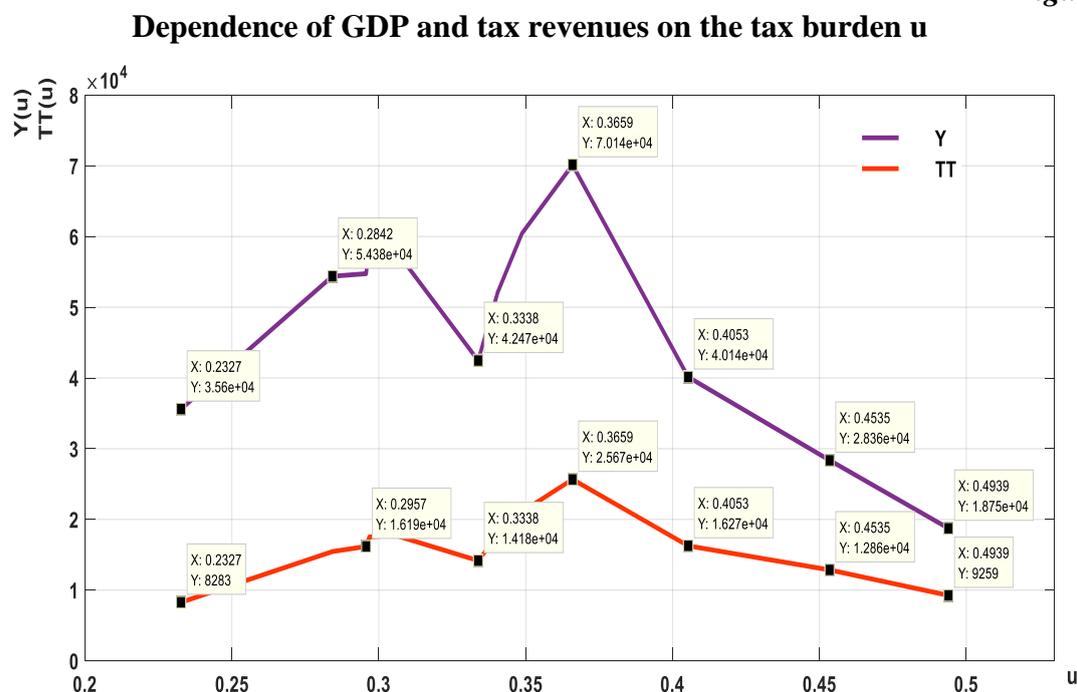
Figure 5 shows that a tax burden greater than u = 0.3659 (u = 36.59%) does not lead to an increase in tax revenues and GDP, in other words, the value of the tax burden u = 0.3659 can be considered optimal for the Republic of Azerbaijan.

Conclusion

- Using the theory of excitement for the calculation of the tax burden production potential using analytic ratio ξ, is given depending on economic growth rate λ.

- MathWork Software. The results of experiments with M-file software in the MATLAB 2017a environment show that as the tax burden increases in theory, tax revenues increase initially, and after a certain threshold, tax revenues decrease as the tax burden increases, including limiting economic development.

- As the level of utilization of production potential increases, the tax burden on the economy decreases.

It should be noted that these results can be used by government economic policy institutions in the formulation stage of economic policy.

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МЕТОДОЛОГИЯ ОПРЕДЕЛЕНИЯ НАЛОГООБЛОЖЕНИЯ НА ОСНОВЕ ПРОИЗВОДСТВЕННОГО ПОТЕНЦИАЛА

Р Е З Ю М Е

Статья посвящена рассмотрению валового внутреннего продукта как результата экономического потенциала в пропорциональной валовой экономике. Предложена модель экономического баланса с применением теории возбуждения. Эта модель может использовать потенциал развития экономики в качестве соответствующего эндогенного фактора и обеспечивает аналитическое выражение для коэффициента и развития экономики.

Ключевые слова: теория возбуждения, производственный потенциал, экономический потенциал, налоговая нагрузка, пропорциональный рост, программа MathWork MATLAB.

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İSTEHSAL POTENSİALINA ƏSASLANAN VERGİ BORCU ÜZRƏ MÜƏYYƏNLƏŞDİRMƏ METODOLOGİYASI

X Ü L A S Ə

Məqalədə müvafiq olaraq ümumi iqtisadiyyatda iqtisadi potensialın nəticəsi kimi ümumi daxili məhsulun və həyəcan nəzəriyyəsinin tətbiqi ilə təklif olunan iqtisadi tarazlıq modelinin nəzərə alınmasından bəhs olunur. Məhz bu model iqtisadiyyatın inkişaf potensialını müvafiq olaraq onun daxili amili kimi istifadə edə bilir və bu model vasitəsilə iqtisadiyyatın inkişaf əmsalı ilə təhlil aparmaq mümkündür.

Açar sözlər: həyəcan nəzəriyyəsi, istehsal potensialı, iqtisadi potensial, vergi yükü, mütənasib artım, MathWork Proqramı MATLAB.