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SAMUELSON-HICKS BUSINESS CYCLE MODEL TESTING ON THE EXAMPLE OF INVESTMENT FUNCTION OF THE RUSSIAN FEDERATION

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Abstract. In this paper there is an analysis of Samuelson-Hicks business cycle model and solution on an example of Russian Federations investment function over a period from 1989 to 2017. The analysis is conducted within the framework of considering the relationship between investment and gross domestic product in the Russian Federation. The regression analysis technique is used to accomplish the tasks set by the author. The data obtained are tested for adequacy using such tools as the Fisher Criteria, the Durbin-Watson test and the Goldfeld-Quandt test. The author's study is carried out in several directions: determination of the presence of heteroskedasticity; identifying positive or negative correlations, as well as determining the significance of the model and the relationship between statistical data that were analyzed. At the end of the article, there is an author's vision on the results of model testing for its adequacy in a given country.

Keywords: Samuelson-Hicks model; business cycle model; data analysis; least square method; investment.

JEL codes: C 51; C 58.

Introduction

First scientific research in the area of business cycles raised in thirties. It was productive period in the context of economic cycles and shocks which became a basis for the new theories of business cycles. The example of this statement is Great Depression causing huge damage to all advanced countries and leading international economic community to explain the reason and consequences of the damaging influence of Great Depression. There were several numbers of renowned economists who

tried to create a model for the movements of the economic activities but Samuelson – Hicks model [1] became the main and the only one model which explain the movement from boom to depression and back. The reason for success was its great accessibility. It was a straight dynamization of the Keynesian model and it was easy to understand. Samuelson's initial model is written as follow [2; 3]:

$$Y_t = C_t + I_t + G_t$$
$$C_t = \alpha Y_{t-1}$$
$$I_t = \beta(C_t - C_{t-1}$$
$$G_t = G_0$$

General specification for Samuelson-Hicks looks like [4]:

$$\begin{cases} C_t = a_0 + a_1 Y_{t-1} + u_t \\ I_t = a_2(Y_{t-1} - Y_{t-2}) + v_t \\ G_t = a_3 G_{t-1} + w_t \\ Y_t = C_t + I_t + G_t \\ 0 < a_1 < 1, a_2 > 0, a_3 > 0 \\ E(u_t) = 0, \ E(v_t) = 0, E(w_t) = 0 \\ \sigma(u_t) = const, \sigma(v_t) = const, \sigma(w_t) = const, \end{cases} \quad (1)$$

Where:

C – Private Final Consumption expenditure – expenditures spent on final consumption of goods and services by residents of a particular country or non-profit organizations which serve households.

I – Gross Capital Formation is a macroeconomic concept used in official national accounts. Statistically it measures the value of acquisitions of new or existing fixed assets by the business sector, governments and "pure" households (excluding their unincorporated enterprises) *less* disposals of fixed assets;

G – Government Final Consumption Expenditure - final expenditure which consists of amount of aggregate transaction on national income account of a country. Basically, it means government expenditures on goods and services which are used for the satisfaction of needs of individual consumption or collective needs of members of community;

Y – Gross Domestic Product – total amount of money which measure the total production of goods and services on the territory of a particular country by residents and non-residents.

The task of this research is to estimate the influence of gross capital formation on this model and analyze if Samuelson-Hicks model is appropriate for the business cycle of the Russian Federation.

Similar studies have been conducted previously in some countries [5; 6]. Russia is a representative of mixed and transition economy with the situation when strategic areas of the economy are under the ownership of a state. Russia has 11th place in the GDP rank but 62th in GDP per capita rank, level

of inflation is on the level of 2,5% and population below poverty line – 13,4%. Most of the population occupied in Services (63%), then in Industry (27,6%). Unemployment rate is 4,5%. Main Russian industries are petroleum and gas, mining, coal, metals, chemicals, machine building, defense equipment. Russian credit rating is following: Standard & Poor – BB+; Moody's – Ba1; Fitch – BBB-.

Regression analysis

Initially, the analysis was based on data array from 1989 to 2017, but regression analysis showed that this model absolutely not adequate for Russian Federation. Then data was reduced from 2007-2017 in the sake of testing investment and GDP connection after period of financial crisis. However, model was still inadequate. In order to build adequate model and test it for the realities of Russia I upgraded investment function and added one more variable Y_{t-1}.

The test is based on the statistical data of the Gross Capital Formation and GDP of the Russian Federation over the period from 2007 to 2017.

Specification form of investment function looks like that below:

$$I_t = b_1(Y_{t-1} - Y_{t-2}) + b_2 Y_{t-1} + v_t \qquad (2)$$

For the estimation of coefficients, I used linear function.

R Square is 0,94 which means that 94% in change of dependent variable may be explained by changes in independent variables according to linear regression model. Using correlation matrix, it was proved that there is no multicollinearity in this model.

F test

Test this model for F-test [7]. Fcrit is 4,46. It is less than F calculated which is 59,91, so R Square is not random, and quality of specification and econometric model is high.

As soon as our function does not have constant coefficient, we need to include it in regression model.

Calculated function of investment in Russia looks as following:

$$I_t = 0{,}08(Y_{t-1} - Y_{t-2}) + 0{,}22(Y_{t-1}) + v_t \quad (3)$$

This function gives us information that if $Y_{t-1} - Y_{t-2}$ experiences increase on 1 bln. dollars, amount of investment will also increase on 0,08 bln. dollars. If Y_{t-1} will increase on 1 bln. dollars, investment will increase on 0,22 bln. dollars as well.

The main task of this research is to test this model for adequacy. The main data for the analysis given below (Table 1).

Table 1: Estimated coefficients[1]

	b_1	b_2
Coefficient	0,08	*0,22*
t Stat	0,86	10,49
P-value	0,41	0,0000059

This regression analysis was fulfilled using such tool as “Data analysis”.

T test shows us that variable $Y_{t-1} - Y_{t-2}$ is not significant when Y_{t-1} is significant as soon as tcrit = 2,3 which is less than t calculated for Y_{t-1} (10,49) and more than t calculated for $Y_{t-1} - Y_{t-2}$ which is 0,86. It means that we should not put a lot attention on variable $Y_{t-1} - Y_{t-2}$ but we cannot withdraw it as soon as it is part of our initial model.

P-value test shows us the same results. As soon as we compare P-value calculated with H0: 0,01;0,05;0,1 we can see that variable Y_{t-1} is significant whether variable $Y_{t-1} - Y_{t-2}$ is not.

Major test for understanding the expediency of applying this model is Durbin-Watson test [9]. In present model DW coefficient is equal to 1,37 (4) which is in the sector of no autocorrelation. Autocorrelation means data that is correlated with itself, as opposed to being correlated with some other data. This means that we can use this model and there is no necessity to recalculate our model.

$$DW = \frac{\sum(e_t - e_{t-1})^2}{\sum {e_t}^2} = 1{,}37 \qquad (4)$$

Goldfeld - Quandt test

For the testing model on GQ test divide data on to parts [10]. GQ test shows us GQconst = 0,62; 1/GQ = 1.62; Fcrit = 19. As soon as GQconst and 1/GQ coefficients less than Fcrit, our variables are homoscedastic. It means that all random variables in the sequence or vector have the same finite variance. This means that our model is adequate.

Using all the information which was received through the regression analysis we can assert that Samuelson-Hicks business cycle model, which was modernized, is adequate to the realities of the Russian Federation in terms of investments. On practice it means that amount of Gross Capital Formation depends on the increase or decrease of GDP.

Conclusion

During the investigation I have analyzed Samuelson-Hicks business cycle model and its implementation in context of realities of the Russian Federation. Main conclusion is that this model is not adequate for implementation in Russian Federation if we consider initial form of this model. After upgrading investment function by adding one more variable Y_{t-1} model became adequate with significant connection between three variables. This fact was proved by R^2, Durbin-Watson test,

[1] Compiled by the author according to [8]

Goldfeld - Quandt test. Such group of tests as P-value test, t test showed us that initial variable $Y_{t-1} - Y_{t-2}$ is not significant when variable which was added through upgrading Y_{t-1} is significant. It is logical because we proved initially that model does not work with only variable $Y_{t-1} - Y_{t-2}$ in the Russian Federation. The main model result is that if $Y_{t-1} - Y_{t-2}$ experiences increase on 1 bln. dollars, amount of investment will also increase on 0,08 bln. dollars. If Y_{t-1} will increase on 1 bln. dollars, investment will increase on 0,22 bln. dollars as well.

References

1. Samuelson, P.A. Interactions Between the Multiplier Analysis and the Principle of Acceleration // Review of Economic Statistics. 1939, № 4. C.: 75-78, http://dx.doi.org/10.2307/1927758.
2. Tregub, I.V. Keynesianism and modern economy. 2015. URL: http://www.freit.org/WorkingPapers/Papers/Development/FREIT984.pdf
3. Prangishvili, A.I.; Obgadze, L.T. Mathematical modeling of economic cycles and optimal management of capital investments // Computer Sciences and Tele-communications. 2005. No. 3 (7). P.: 59-61.
4. Tregub. I.V. Econometrics. Model of Real System. M.: PSTM. 2016, 164 p.
5. Chragyan, V.P. Samuelson-Hicks Business Cycle Model Testing on the Example of Investment Function of the Germany / In: Financial modeling: analytical and informational opportunities for business management A collection of scientific articles of students. Edited by M.I. Sidorova, E.V. Ogloblina. 2019. P.: 129-134.
6. Geraskin, M.I.; Porubova, P.V. Analysis of macroeconomic processes in Russia using Keynesian models / In: Management of large systems Materials of the XII All-Russian school-conference of young scientists. edited by D.A. Novikova, A.A. Voronin. 2015. P.: 207-215.
7. Tregub, I.V. Econometrics in English: a study guide. - Moscow: Rusyns, 2017. 110 p.
8. World Bank national accounts data [Electronic resource] World Bank Open Data. 2019. URL: https://data.worldbank.org/, open.
9. Stanford University. Critical Values for the Durbin-Watson Test [Electronic resource] Stanford University. 2019. URL: https://web.stanford.edu/~clint/bench/dwcrit.htm, open.
10. Tregub, I.V. Econometric studies. Practical examples. - Moscow: Lan', 2017. P.: 49-50.