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МОДЕЛИРОВАНИЕ РЫНКА КАПИТАЛА НА ПРИМЕРЕ НОРВЕГИИ

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АННОТАЦИЯ

В этой статье рассматривается модель рынка капитала на примере Норвегии, а именно, зависимость валового внутреннего продукта от процентной ставки банка и внутренних инвестиций. Норвегия была выбрана, поскольку экономика этой страны - смешанная экономика с государственным влиянием в стратегических отраслях экономики. Государственный сектор является одним из крупнейших в мире как процент от общего валового внутреннего продукта. Страна имеет очень высокий уровень жизни по сравнению с другими европейскими странами, и сильно интегрированную систему социального обеспечения. Модель рынка капитала был выбрана, потому что Норвегия, будучи одним из развитых стран с хорошей макроэкономических показателей, может быть примером того, как ВВП зависит от процентной ставки и объема инвестиций.

Анализ показывает отрицательную связь между ВВП и ставки банковского и положительной корреляции между ВВП и объема инвестиций.

Ключевые слова: ВВП, банковская ставка, общий объем инвестиций

THE CAPITAL MARKET MODEL ON THE EXAMPLE OF NORWAY

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ABSTRACT

This paper explores the Capital Market model on the example of Norway: the dependence of Gross Domestic Product on bank rate and domestic investment. Norway was chosen, inasmuch as the economy of this country is a developed mixed economy with state-ownership in strategic areas of the economy. Although sensitive to global business cycles, the economy of Norway has shown robust growth since the start of the industrial era. The public sector is among the largest in the world as a percentage of the overall gross domestic product. The country has a very high standard of living compared with other European countries, and a strongly integrated welfare system. Norway's

modern manufacturing and welfare system rely on a financial reserve produced by exploitation of natural resources.

The Capital Market model was chosen, because Norway, being one of the developed countries with good macroeconomic indicators, may be an example of how GDP depends on the interest rate and total investments. It is useful to understand this correlation, as it will help the government in the monetary policy.

The analysis reveals a negative link between GDP and the bank rate and a positive correlation between GDP and total investment. As this work will show that R^2 is not very good, the impossibility of using the least square method, there is autocorrelation of the residuals. However, R^2 is not random and the quality of the model is high, all the regression coefficients are significant and the capital Model is adequate. So the given model is suitable for the economy of Norway.

Keywords: GDP, bank rate, total investment

Introduction.

One of the main macroeconomic indicators is Gross domestic product, expressing the cumulative cost of the final product estimated in market prices, that is to say production, goods and services, created with in a year in the country with the use of factors of production belonging both to this vary country and other countries. It is useful to understand what indicators can influence on GDP. In the given work the Capital Market Model has been chosen, as it shows how changes in bank rate and domestic investment can impact on GDP. The reason of why particular Norway was chosen is that despite the financial crisis of the world economy this area shows one of the best results among European countries. [1]

Norway's economic freedom score is 70,9, making its economy the 32nd freest oin the 2014 Index. Its score has increased by 0,04 point since last year, with improvements in investment freedom, the management of goverment spending, and monetary freedom partially offset by declines in freedom from corruption and business freedom. Norway is ranked 16th out of 43 countries in the Europe region, and its overall score is well above the world and regional averages.[2][3]

The Capital Market model includes the dependence between GDP, the interest rate and domestic investment. The most important use of GDP is a measure of the size of the economy, providing people a scale against which to measure the economic

[1] International Monetary fund. MF Executive Board Concludes 2014 Article IV Consultation with Norway.Press Release No.14/406. 2014

[2] Sarah Treanor. How Norway has avoided the "curse of oil"//BBS News. 2014 (http://www.bbc.com/news/business)

[3] Randall Hoven. The Norwegian: "Miracle"//American Thinker.2012 (http://www.americanthinker.com/articles)

performance of other years or to compare the economic performance of other countries.[4] The domestic investment is an important component of GDP because it provides an indicator of the future productive capacity of the economy. The bank rate acts as a certain tool for influence on a rate of inflation in the country. To decrease the inflation rate the bank rate is increased. So, the credits become more expensive. It is unprofitable and expensive to take them, consequently, it is reflected in consumer ability. [5]

So, it can be said that when the bank rate increases, GDP will decline, as it will be expensive for households to take credits and the supply for loanable funds decrease. Consequently, aggregate demand goes down and GDP decreases. Moreover, if domestic investment increases, GDP will also rise, inasmuch as more output will be produced.[6]

The structure of this work consisits of introduction, the description of variables and data, the correlation and regression analyzing, model testing, checking the adequatcy, predictions and conclusion.

So the purpose of this project is to study and analyze the influence of the bank rate and domestic investment on Norway's GDP, and if the Capital Market Model can be applied to the Norway economy. Due to this purpose the following goals were set up:

- To construct the econometric model;
- To analyze and test the econometric model for Norway;
- To make conclusions and recommendations on the base of the results.

The description of the variables used.

In my research GDP is an endogenous (internal) variable because it is dependent and it can be calculated by using different factors and indicators which have influence on it. This variable will be explained by the econometric model. Total investment and bank rate are exogenous (external) variables, because they will explain the internal variable Y (GDP).

[4] John Black, Nigar Hashimzade, Gareth Myles. Dictionary of economics.-M.:Oxford University Press, 2013.-470 p.

[5] Norway's economy: The spirit is willing//The economist,. 2013 (http://www.economist.com/news/europ)

[6] Erik Johannes Bruce. Norway: GDP growth as expected// Norfea Bank AB.2014 (https://nexus.nordea.com)

Required data for the estimation.

In order to analyze and test Capital market model it needs to find sources of international statistics information: the volume of GDP in billions of NOK, which I denoted as Y, the domestic investment as % of GDP, denoted as I, and bank rate (%), which is denoted as R. Under the interest rate the data of the bank rate was provided. However, in my research instead of domestic investment I have taken total investment, because there was no need information for domestic investments on different international statistic sites as www.imf.org[7] and www.countryeconomy.com.[8] I have taken annual data, as the nature of the data does not provide monthly or quarterly information of the chosen indicators. It is capable to represent an overview of the main numerical characteristics of the variables in the Application 1. The indicators are taken for the period from 1992 to 2013, inasmuch as on different international statistic sites there was no earlier information for Norway.

The Regression analysis.

The next step of the analysis is to make the regression analysis. It is important to note that when the arrays of data were selected, all cells should be chosen except the last array of each variable, so the data of 2013 was not taken. The level of significance is 90%. The results of the regression statistics: Multiple R=0,68, R^2=0,46, Adjusted R^2=0,4, Standard error=266,8, Observations=21.

The following estimated model has been obtained:

$$\begin{cases} Y_t = 1761{,}06 - 87{,}84 \cdot R + 45{,}22 \cdot I + \varepsilon_t \\ \quad (600{,}47) \quad (27{,}28) \quad (25{,}81) \ (266{,}8) \\ \quad [2{,}93] \quad [-3{,}22] \quad [1{,}75] \\ R^2 = 0{,}46 \quad F = 7{,}72 \\ t_{crit} = 1{,}73 \quad F_{crit} = 3{,}55 \end{cases}$$

Coefficients, obtained from the regression analysis, show how the resulting indicator will alter, if the factor indicator changes. $a_0 = 1761{,}06$, which means that GDP will be equal 1761,06 bln NOK if the bank rate and total investment are equal to zero. $a_1 = -87{,}84$ which means that if the base rate increases by 1 %, GDP will decline by 87,84 bln NOK and vice versa, if the base rate decreases by 1 %, GDP will raise by 87,84 bln NOK under the condition that total investment will not change. $a_2 = 45{,}22$ which means that if total investment goes up by 1%, GDP will increase by 45,22 bln and vice versa if the total investment decreases by 1 %, GDP will decline by 45,22 bln NOK under

[7] International Monetary Fund
[8] The Internet statistical resource: Countryeconomy

the condition that the base rate is unchanged. All the values in the round brackets are standard errors of the coefficients and these values were obtained from the Table 4. In the square brackets there are the value of t-statistic, which is in the Table 4.

Model Testing.

Another step of the analysis is model testing. Let me consider R^2-test, F-test, t-test, Goldfeld-Quant test and Durbin-Watson test.

R^2-test

Value of the multiple coefficient of determination R^2 equals to 0,46 shows that 46 % of total deviation of GDP is explained by the variation of bank rate and total investment. It can said that such value of the R^2 is not good, because it is close to 0 (maximum $R^2 = 1$). The meaning of it is that selected factors do not affect significantly the given model.[9]

F-test

It is needed to check the following inequality: F_{crit}<F. F_{crit}=3,55 < F=7,72 was calculated.Consequently, the inequality is right, and it means that R^2 is not random and the quality of the economic model is high.

t-test

It needs to check the significance of the coefficients a_0 and a_1. The inequality $|t|> t_{crit}$ should be checked, where t is the value of t-statistics. As t_{a_0} =2,93 $|t_{a_0}|> t_{crit}$, consequently, the regression coefficient a_0 is significant under the probability 5% by the given linear regression model. $t_{a_1} = -3{,}22$, so $|t_{a_1}|> t_{crit}$, consequently, the regression coefficient $a_1$is significant under the probability 5% by the given linear regression model. $t_{a_2} = 1{,}75$, so $|t_{a_2}|< t_{crit}$, consequently, the regression coefficient $a_1$is not significant under the probability 10% by the given linear regression model, and it needs to take another probability, which is equal 10%. So t_{crit}=1,73. As $t_{a_0} = 2{,}93$, so $|t_{a_0}|> t_{crit}$, consequently, the regression coefficient a_0 is significant under the probability 10% by the given linear regression model. $t_{a_1} = -3{,}22$, so $|t_{a_1}|> t_{crit}$, consequently, the regression coefficient $a_1$is significant under the probability 10% by the given linear

[9] Ekaterina Kabanova, Ilona V. Tregub. Okun's Law Testing Using Modern Statistical Data// The Finance University under the Government of the Russian Federation

regression model. $t_{a_2} = 1{,}75$, so $|t_{a_2}| > t_{crit}$, consequently, the regression coefficient $a_1$is significant under the probability 10% by the given linear regression model.[10]

Goldfeld-Quandt test

To persuade the possibility of using method of ordinary least square, three conditions of Gauss-Markov theory should be checked:

1) Expectation of residuals is equal to 0.
2) Residuals are homoscedastic.
3) There is no autocorrelation between residuals.

To check, whether the expectation of residuals is equal to 0, it needs to use the function «СРЗНАЧ». So in the given model E(ε_t)=0.

After this it is important to check the homoscedasticity of random disturbances in the regression analysis, using the Goldfeld-Quandt test:

$$Var(\varepsilon_1) = Var\ (\varepsilon_2) = \cdots = Var\ (\varepsilon_n) = \ \sigma^2$$

ESS_1=312420,67, ESS_2=760197,06, GQ=0,41, 1/GQ=2,43, $F_{crit\ GQ}$=3,79 were obtained and $GQ < F_{crit\ GQ}, \frac{1}{GQ} < F_{crit\ GQ}$. All the inequalities are right and the assumption about homoscedasticity of random disturbances is adequate, and we may use ordinary least square in order to estimate parameters of the coefficient of the given linear model.

Moreover, Durbin-Watson is used to check the absence of autocorrelation between adjacent random residuals in the model: Cov ($\varepsilon_i, \varepsilon_j$)=0 if j=i-1

Using values of the residuals ε_t, we can compute Durbin-Watson statistics:

DW=$\frac{\sum_{t=2}^{n}(\varepsilon_t - \varepsilon_{t-1})^2}{\sum_{t=1}^{n} \varepsilon_t{}^2}$.

Then, it needs to find Durbin-Watson statistics critical values d_L and d_U with the help of special statistical table, where n=22– total number of observations, k=2-total number of factors.

Table 7. Durbin-Watson test

	α=0,05	α=0,01
DW	0,37	
d_L	1,147	0,914
d_U	1,541	1,284

The source: the author

[10] И.В.Трегуб Математические модели динамики экономических систем/ Финансовый Университет при Правительстве Российской Федерациию. М., 2009

It is clear that the value of DW is in the interval between 0 and d_L with probabilities 5% and 1%, it means that there is a positive autocorrelation of the model's residuals and Cov $(\varepsilon_i, \varepsilon_j)$>0. Consequently, the parameters of the regression model, obtained by the least ordinary square method, are not objective and the third assumption of the Gauss Markov theorem is not adequate for this model for Norway. In this case the common least square method should be used.[11]

The confidence interval and the adequacy of the model.

The lower and upper boundaries are needed to be estimated. For this Y estimated $(\widehat{Y_p})$ should be calculated, so 1761,06+45,22·26,43%-87,84· 1,5% =2824,63. The lower boundary is obtained, using the following formula: $\widehat{Y_p}$-$t_{crit} \cdot S_{\Delta p}$, so 2824,63-2,10· 266,80=2264,10. The upper is obtained, using the following formula: $\widehat{Y_p}$+$t_{crit} \cdot S_{\Delta p}$, so 2824,63+2,10·266,80=3385,16. The real value GDP in 2013 (Y=2848,76) lies within the confidence interval, predicted by our model: $Y_{n+1} \in \{\widehat{Y_n}$ −st.error· $t_{crit})$; $(\widehat{Y_n}$+st.error · $t_{crit})\}$. So it means that the model is adequate.

Conclusion.

From the investigation it is clear that Gross Domestic Product of Norway depends moderate positively on total investment and moderate negatively on the bank rate of this country. All the tests except R^2-test and Durbin-Watson test have been checked, the reason may be that instead of domestic investment total investment was taken. Also it can be said that the model is adequate. To sum up, after analyzing the Capital Market Model under the limitation that instead of domestic investment total investment was taken is suitable for the economy of Norway. Also this model can be used for such developed countries as Norway.

Application 1.

Table 1. Initial Data

[11] И.В.Трегуб Математические модели динамики экономических систем/ Финансовый Университет при Правительстве Российской Федерациию. М., 2009

	Y, bln NOK	I, %	R, %
1992	1739,02	19,60	9,00
1993	1787,48	20,31	5,00
1994	1877,77	21,17	4,75
1995	1956,38	22,33	4,75
1996	2056,16	21,03	4,00
1997	2167,04	23,36	3,50
1998	2225,17	26,66	8,00
1999	2270,25	22,93	5,50
2000	2344,11	20,37	7,00
2001	2390,76	19,00	6,50
2002	2426,67	18,92	6,50
2003	2450,48	18,09	2,25
2004	2547,54	20,31	1,75
2005	2613,50	21,46	2,25
2006	2673,58	23,01	3,50
2007	2744,50	25,79	5,25
2008	2746,36	24,50	3,00
2009	2701,46	22,27	1,75
2010	2714,38	23,28	2,00
2011	2750,78	23,75	2,25
2012	2830,45	24,89	1,50
2013	2848,76	26,43	1,50

The sources: www.imf.org; www.countryeconomy.com

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6) International Monetary fund. MF Executive Board Concludes 2014 Article IV Consultation with Norway.Press Release No.14/406. 2014
7) Randall Hoven. The Norwegian: "Miracle"//American Thinker.2012 (http://www.americanthinker.com/articles)
8) Erik Johannes Bruce. Norway: GDP growth as expected// Norfea Bank AB.2014 (https://nexus.nordea.com)
9) International Monetary Fund [http://www.imf.org]
10) The Internet resource: http:// www.countryeconomy.com
11) The Internet resource: http:// www3.nd.edu