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The impact of foreign trade on the economic growth rate in Poland in the years 2006-2015

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ABSTRACT

The aim of this paper is to examine the impact of foreign trade on Poland's economic growth in the years 2006-2015. In the article, econometric analysis was carried out and the VAR model was used. In the first part of the work, a review of the literature relating to the subject of the work was undertaken. The second part of the article presents an analysis of statistical data and, based on them, the VAR model. The GNU Regression Econometric and Time-Series Library (GRETL) software was used for calculations.

***Keywords*:** Foreign trade, economic growth, GDP, export, import

1. INTRODUCTION

In the modern world, there is no country that could produce all the goods and products on its own. Foreign trade policy of the state is its shaping of trade relations with foreign countries. It includes export and import policies. The abolition of customs barriers and the increasing globalization led to the interrelation of economies of individual countries. Consequently, the international trade creates trade relationships between the countries participating in it. Thanks to it, the economy of the given country is united with the outside world (open economy). Economic growth, in turn, is regarded as one of the most significant concepts in economics. It is defined as a process of enlarging the basic macroeconomic values

in the economy, but also as a process of enlarging production in the scale of the whole economy (Kosztowniak, Sobol, 73). The impact of foreign trade on economic growth takes place on many levels. These include scientific and technical knowledge (McNeil, Farumeni, 1-4), the transfer of modern technologies (Schmieder, 2-3) and direct foreign investments (Makki, Somwaru, 795-796). Foreign trade is thus an "engine" driving the economic development of the country. The main aim of this article is to analyze the impact of foreign trade on Poland's economic growth in the years 2006-2014. In the study, the relationship between GDP and exports and imports was examined. The GRETL program was used for calculations.

2. IMPACT OF FOREIGN TRADE ON ECONOMIC GROWTH

It is widely believed that the open economy outweighs the closed economy and the international exchange brings many benefits to all who take part in it. The degree of openness of the economies of individual countries is measured by the share of exports in gross domestic product (GDP) (wider: Hye). The main effects of foreign trade are its impact on the size of GDP, its structure and management efficiency. Gross domestic product may be equal to the produced, higher or lower than it.

This depends on the relationship between exports and imports. When these two values are equal, there is a zero balance. When exports dominate over imports, a positive trade balance occurs. Then the country can spend on consumption and investment less than it created. The negative trade balance leads to the situation where the product for division is greater than the produced. It should be remembered that both positive and negative trade balances determine the positive and negative consequences for the country. Increased imports are used for the investment, which in the near future will stimulate effective export and thus the debt of the country will be repaid.

This is one of the positive consequences. However, if the increased imports are used for consumption or budgetary expenditure of the government, it can mean big problems with repayment of debt and the need to reduce consumption. In turn, a different situation is in the case of the positive trade balance. The excess of exports causes a reduction of domestic consumption, which, at the same time, leads to deterioration of the standard of living and social attitudes (Rymarczyk, 142).

Despite the described situations, many countries are consistent with the view that international exchange brings many economic and social benefits, whose nature usually is:

- economic;
- technological and technical;
- raw material and climatic;
- competitive and complementary.

International exchange is considered to be one of the most dynamically developing forms of economic activity. This dynamics is justified primarily by the benefits enjoyed by the economic entities participating in the exchange. They include:

- increase in production and provided services;
- increase in tax revenue;

- employment growth;
- strengthening the international position;
- possibility of changes in technique and technology;
- favorable balance of payments of the world;
- improvement of the liquidity of the state (Bernaś, 29).

3. METHODOLOGY / METHODS

When analyzing the impact of exports and imports on Gross Domestic Product, econometric analysis based on the VAR model was used. The VAR model can be analyzed using time series models (vector autoregression model). The VAR model was created as a result of criticism and is a response to the concerns that have arisen in connection with the structural modeling. They resulted from a lack of rigorous theoretical basis indicating the correlation of processes, which has led to different specifications received as a result of compliance with the requirement of equations traceability.

The general VAR model has the following form:

$$Y_{1t} = a_{10} + \sum_{i=1}^{p} a_{11i} Y_{1t-i} + \sum_{i=1}^{p} a_{12i} Y_{2t-i} + \ldots + \sum_{i=1}^{p} a_{1ki} Y_{kt-i} + \varepsilon_{1t}$$
$$Y_{2t} = a_{20} + \sum_{i=1}^{p} a_{21i} Y_{1t-i} + \sum_{i=1}^{p} a_{22i} Y_{2t-i} + \ldots + \sum_{i=1}^{p} a_{2ki} Y_{kt-i} + \varepsilon_{2t}$$
$$Y_{3t} = a_{30} + \sum_{i=1}^{p} a_{31i} Y_{1t-i} + \sum_{i=1}^{p} a_{32i} Y_{2t-i} + \ldots + \sum_{i=1}^{p} a_{3ki} Y_{kt-i} + \varepsilon_{3t}$$

It is treated as a multi-equation econometric model, which consists of *k* equations. There are no simultaneous dependencies (cross-dependencies) in it, and a set of explanatory variables consists of processes delayed in time (Kufel, 165).

In this work, the VAR model consists of three equations for the following macroeconomic categories: GDP_{1t}, Ex_{1t} and Im_{1t}. The data relate to Poland in the period 2006-2015.Variables are:

- GDP_1 - Gross domestic product at current market prices (mld ECU/EUR),
- Ex_{1t} - Total exports of goods (mld ECU/EUR),
- Im_{1t} – Total imports of goods (mld ECU/EUR).

To verify the model, test for autocorrelation, test for ARCH effect and Doornik-Hansen test for the multivariate normality of residuals were used. The GNU Regression Econometric and Time-Series Library (GRETL) software, which provides advanced econometric methods, was used for calculations.

4. RESULTS AND DISCUSSION

Statistical data used for the calculation are presented in Table 1. The results of the model described above are shown in the following tables and charts, and, below them, the results of the most important and, at the same time, necessary tests are provided.

Table 1. Statistical data of selected variables.

Lata	GDP_{1t}	Ex_{1t}	Im_{1t}
2006	273,4	88,2	101,1
2007	313,7	102,3	120,9
2008	363,7	115,9	142
2009	314,7	97,9	107,2
2010	361,7	120,5	134,3
2011	380,3	135,6	151,3
2012	389,3	144,3	154,9
2013	394,6	154,3	156,3
2014	410,9	165,7	168,4
2015	427,7	178,7	175

Figure 1. Chart time series

The VAR, maximum government delayed 2

An asterisk (*) indicates the best (that is the minimum) value for the relevant information criteria, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion and HQC = Hannan-Quinn Criterion.

Table 2. The values for your information.

delays	log-likehood	p(LR)	AIC	BIC	HQC
1	-33,7061		10,42653	10,50598	9,890733
2	-7,60058	0,00000	4,900144*	5,019307*	4,096442*

The VAR, maximum government delayed 2

An asterisk (*) indicates the best (that is the minimum) value for the relevant information criteria, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion and HQC = Hannan-Quinn Criterion.

Table 3. The values for your information.

delays	log-likehood	p(LR)	AIC	BIC	HQC
1	-34,4089		10,60222	10,68166	10,06642
2	0,5002	0,00000	2,874950*	2,994112*	2,071248*

Estimated parameters and their errors testify to the presence of irrelevant variables in the equation, but the global assessment indicates a high level of fit and absence of autocorrelation in the residual process. For each equation, the results of testing the adopted maximum order of delay *p* were presented.

The VAR (vector autoregression model), the order of the delay 1
Estimation KMNK for observation 2007-2015 (T = 9)
log-likelihood = –75,934484
Determinant of the covariance matrix = 4275,6809
AIC = 19,5410
BIC = 19,8040
HQC = 18,9735
Test Portmanteau: LB(2) = 19,6782, df = 9 [0,0200]

Table 4. Equation 1: GDP_t

	Factor	*Standard error*	*t-Student*	*p- value*	
const	233,302	92,4398	2,5238	0,0529	*

GDP_{1t}	0,476841	0,768963	0,6201	0,5624	
Ex_{1t}	2,79524	1,02675	2,7224	0,0417	**
Im_{1t}	−2,76117	1,68551	−1,6382	0,1623	

Arith. me. of the dep. variab.	372,9556	Stand. devi. of the dep. vari.	39,28037
The sum of squared residuals	2054,253	The stand. error of residuals	20,26945
Factor determ. R-squared	0,833577	Adjusted R-squared	0,733724
F(3, 5)	8,347990	P-value of F-test	0,021602
Autocorrelation residues	−0,527172	Stat. Durbin-Watson	2,907628

F-test for the hypothesis about the lack of restrictions:
All variable delay GDP_{1t}F(1, 5) = 0,38454 [0,5624]
All variable delay Ex_{1t}F(1, 5) = 7,4116 [0,0417]
All variable delay Im_{1t}F(1, 5) = 2,6836 [0,1623]

Table 5. Equation 2: Ex_t.

	Factor	*Standard error*	*t-Student*	*p- value*	
const	54,8896	34,7349	1,5802	0,1749	
GDP_{1t}	0,080637	0,288943	0,2791	0,7914	
Ex_{1t}	2,21561	0,385807	5,7428	0,0022	***
Im_{1t}	−1,641	0,633342	−2,5910	0,0488	**

Arith. me. of the dep. variab.	135,0222	Stand. devi. of the dep. vari.	28,13422
The sum of squared residuals	290,0462	The stand. error of residuals	7,616379
Factor determ. R-squared	0,954196	Adjusted R-squared	0,926713
F(3, 5)	34,71993	P-value of F-test	0,000900
Autocorrelation residues	−0,235837	Stat. Durbin-Watson	2,412299

F-test for the hypothesis about the lack of restrictions:
All variable delay GDP_{1t}F(1, 5) = 0,077883 [0,7914]
All variable delay Ex_{1t}F(1, 5) = 32,98 [0,0022]
All variable delay Im_{1t}F(1, 5) = 6,7134 [0,0488]

Table 6. Equation 3: Im_t

	Factor	*Standard error*	*t-Student*	*p- value*	
const	108,734	55,3915	1,9630	0,1069	
GDP_{1t}	−0,0180065	0,460775	−0,0391	0,9703	
Ex_{1t}	1,82626	0,615245	2,9684	0,0312	**
Im_{1t}	−1,34636	1,00999	−1,3330	0,2400	

Arith. me. of the dep. variab.	145,5889		Stand. devi. of the dep. vari.	21,91737
The sum of squared residuals	737,6020		The stand. error of residuals	12,14580
Factor determ. R-squared	0,808065		Adjusted R-squared	0,692903
F(3, 5)	7,016808		P-value of F-test	0,030534
Autocorrelation residues	−0,315346		Stat. Durbin-Watson	2,535826

F-test for the hypothesis about the lack of restrictions:
All variable delay GDP_{1t}F(1, 5) = 0,0015272 [0,9703]
All variable delay Ex_{1t}F(1, 5) = 8,8111 [0,0312]
All variable delay Im_{1t}F(1, 5) = 1,777 [0,2400]

Equation 1:
Ljung-Box Q' = 3,43889 with a P-value = P(Chi-kwadrat(1) > 3,43889) = 0,0637

Equation 2:
Ljung-Box Q' = 0,688235 with a P-value = P(Chi-kwadrat(1) > 0,688235) = 0,407

Equation 3:
Ljung-Box Q' = 1,21423 with a P-value = P(Chi-kwadrat(1) > 1,21423) = 0,27

Test the effect of ARCH (Auto Regressive Conditional Heteroskedasticity) in a row: 1

Table 7. Test the effect of ARCH (Equation 1)

	factor	standard error	t-Student	P-value
alpha(0)	101,755	144,486	0,7043	0,5077
alpha(1)	0,457107	0,382192	1,196	0,2768

The null hypothesis: ARCH effect does not occur
The test statistic: LM = 1.5401 with a value of p = P (Chi-square (1) > 1.5401) = 0.214603

Table 8. Test the effect of ARCH (Equation 2).

	factor	standard error	t-Student	P-value
alpha(0)	42,0495	20,0369	2,099	0,0806*
alpha(1)	−0,219129	0,423354	−0,5176	0,6233

The null hypothesis: ARCH effect does not occur
The test statistic: LM = 0.341946 with a value of p = P (Chi-square (1)> 0,341946) = 0.558708

Table 9. Test the effect of ARCH (Equation 3).

	factor	standard error	t-Student	P-value
alpha(0)	59,4522	52,111	1,141	0,2974
alpha(1)	0,273033	0,414367	0,6589	0,5344

The null hypothesis: ARCH effect does not occur
The test statistic: LM = 0,539831 with a value of p = P (Chi-kwadrat(1) > 0.539831) = 0.462503

The correlation matrix residues, C (3 x 3)

1,0000	0,9362	0,96061
0,9362	1,0000	0,9488
0,96061	0,9488	1,0000

The eigenvalue for C

0,037353
0,065539
2,89711

Test Doornik-Hansen:
Chi-kwadrat(6) = 4,76193 [0,5747] (Doornik, 168)

Using a VAR model can also carry out the forecast for the coming years. An example of the forecast is shown in Figure 2.

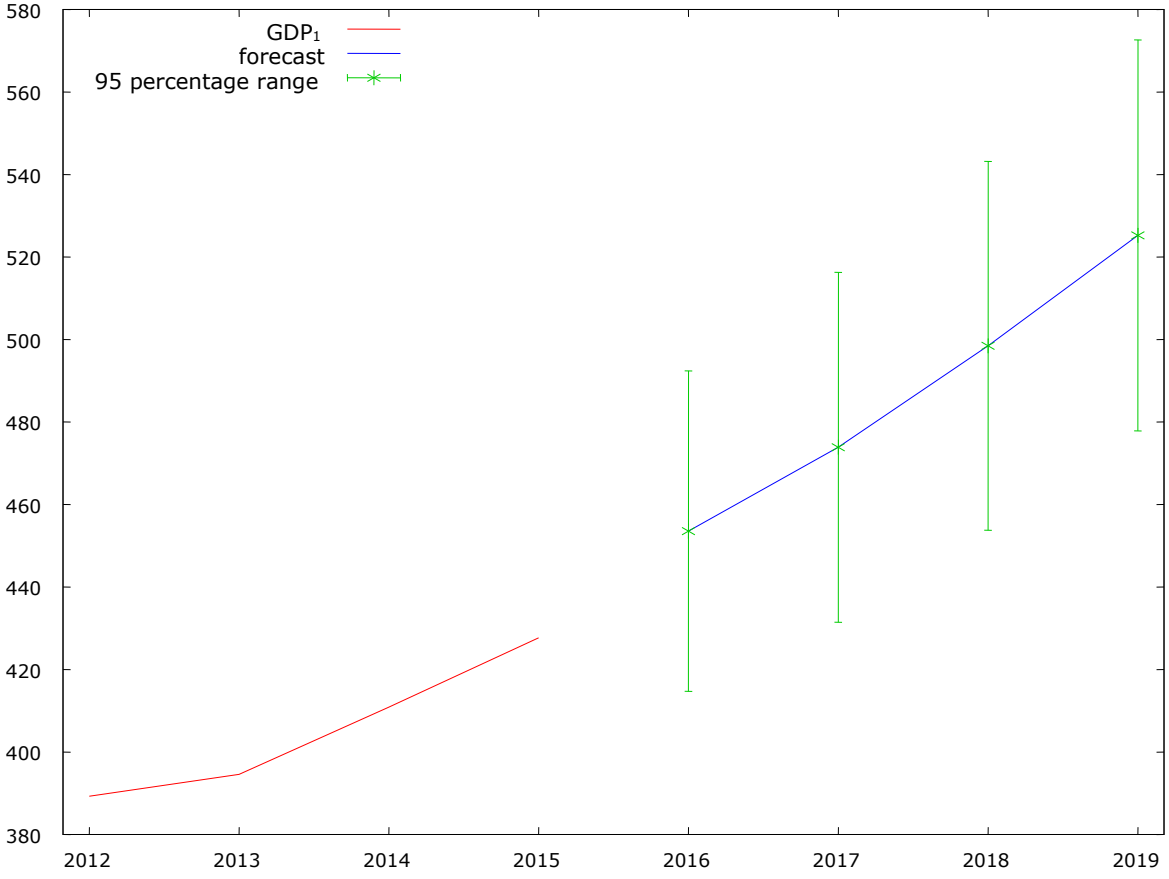

Figure 2. Forecast for GBP

Table 10. Forecast for GBP.

Years	GDPt	forecast	bug ex ante	95% confidence interval
2012	389,3	375,9	-	-
2013	394,6	394,6	-	-
2014	410,9	421,2	-	-
2015	427,7	427,4	-	-
2016	-	453,6	15,11	414,7 - 492,4
2017	-	473,9	16,5	431,5 - 516,3
2018	-	498,5	17,39	453,8 - 543,2
2019	-	525,2	18,44	477,9 - 572,6

3. CONCLUSIONS

In conclusion, the aim of the study was to analyze the relationship between changes in GDP and exports and imports in Poland in the years 2006-2014. The VAR model was built and annual data were used. To estimate the model, the vector autoregression model VAR was employed. For its verification, test for autocorrelation, test for ARCH effect and Doornik-Hansen test for the multivariate normality of residuals were used.

The results of the analysis presented in the work allow for formulating the following conclusions:

- VAR model can easily be estimated in the GRETL program;
- reduced form of multi-equation models is the basis for the construction of forecasts of endogenous processes;
- VAR model automatically determines the forecasts for future periods without the necessity of determining the values of explanatory processes in future periods;
- variability of the size of GDP is affected in a statistically significant manner by the level of exports and the level of imports;
- exports to a greater extent than the level of imports affect the level of GDP.

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