Terms of Trade and Economic Growth in Poland in the period 1980-2009

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The article aims to analyze the impact of changes in terms of trade and terms of trade volatility on economic growth in Poland in the period 1980-2009. The results of test using the vector autoregressive model (VAR) revealed that improved terms of trade in Poland led to increased growth of GDP per capita, while the increase in terms of trade volatility reduced the growth rate of GDP per capita in Poland. In addition, there was confirmed the greater impact of changes in terms of trade, than the terms of trade volatility on the dynamics of economic growth in Poland. It was also demonstrated that the changes in terms of trade and terms of trade volatility explained in a similar degree the variation of GDP per capita in Poland in the period 1980-2009.

Keywords: terms of trade, economic growth, vector autoregressive model (VAR)

JEL Classifications: F430, F490, C100

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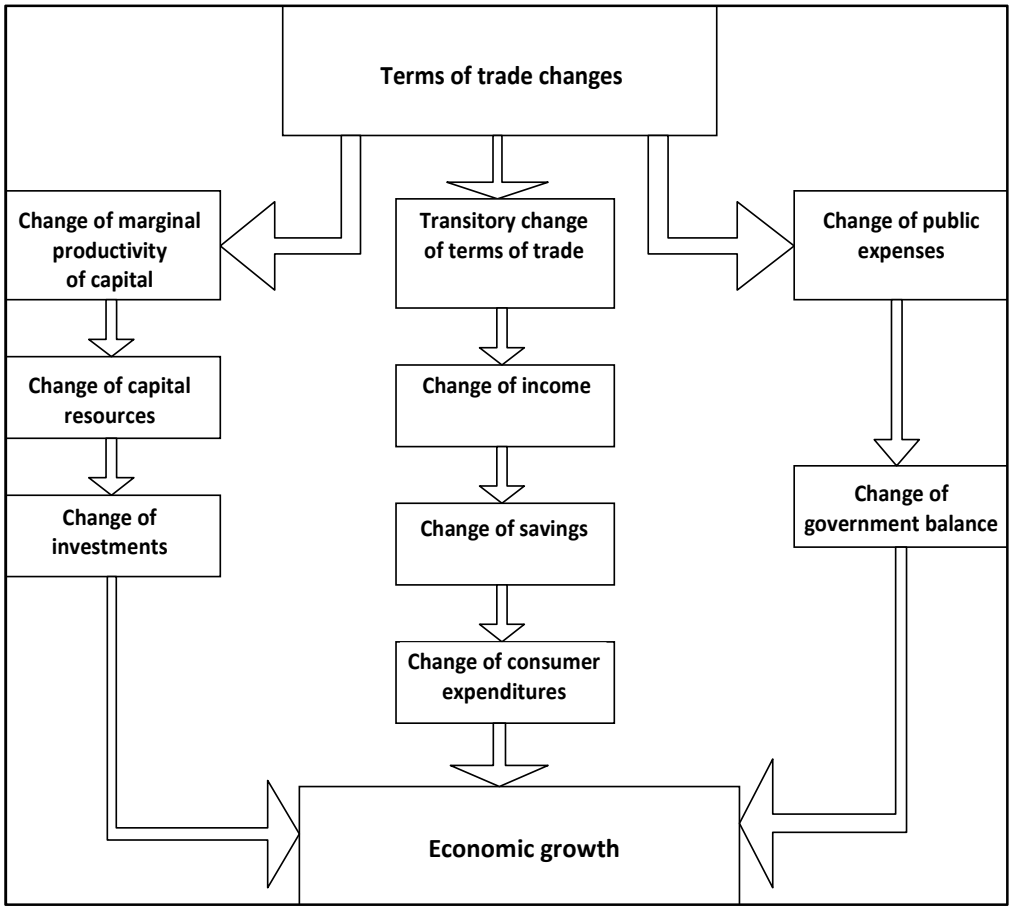
I. Introduction

Terms of trade is defined as the ratio of price changes of exported commodities to imported ones. This indicator shows the changes in the purchasing power of exports relative to imports of individual countries. Improvement of terms of trade occurs when export prices are growing faster or decreasing slower than prices of imported goods and the deterioration of terms of trade occurs when export prices are rising more slowly or decreasing more rapidly than the prices of imported goods.

The economic literature suggests three main transmission channels of the shock in the form of terms of trade on economic growth. Namely, changes in terms of trade cause changes in capital productivity and changes in the size of investment, which affects the dynamics of economic growth. Moreover, changes in terms of trade lead to changes in economic growth by altering the size of total savings and consumption in the country. Finally, changes in terms of trade lead to changes in the value of public spending, resulting in a change in the government balance and consequently change in the rate of economic growth [Figure 1].

Figure 1

Transmission channels of terms of trade on economic growth



Source: Own study.

Prebisch (1950) and Singer (1950) suggested that in developing countries, there is a downward trend in terms of trade relative to developed economies. This regularity is known as the Prebisch-Singer hypothesis and concludes that the prices of primary commodities exchanged internationally decrease in comparison with the prices of manufactured goods. In addition, Prebisch (1959) found that the

deterioration in terms of trade in developing countries leads to a reduction in income and wealth in these countries.
Furthermore, Singer (1950) suggested that changes in the terms of trade affect substantially the financial resources available in the developing countries, which affects the volume of investment and consequently the economic growth in these countries. This situation is a consequence of the fact that changes in volume of foreign trade are essential for the underdeveloped countries, because the disposable income and thus the size of investment depend heavily on export income of these countries.
Changes in terms of trade are therefore one of the factors explaining the growing income gaps between developing and developed economies. Prices of goods exported by developing countries are typically characterized by high volatility in the short run. However, the prices of industrial goods exported mainly by the economically developed countries are characterized by greater stability in the short run. Hence, fluctuations in the prices of goods exported by developing countries may contribute to increase in the volatility of the domestic production.

II. Terms of trade and economic growth in the light of empirical analysis

Economic literature on the relationship between economic growth and changes in the terms of trade is relatively poor and the results of research more controversial than those related to the impact of terms of trade volatility on economic growth. In fact, there is no well-formulated economic theory to clarify the direction and extent of the impact of terms of trade on economic growth.
The results of many studies indicate the existence of positive correlation between terms of trade improvement and dynamics of economic growth. Namely, terms of trade improvement leads to faster

economic growth as a result of acceleration of capital accumulation over a long run (Kose, Reizman 2001, Deaton and Miller 1996).
Some economists have discovered a very significant impact of changes in terms of trade on economic growth (Ghirmay, Sharma, Grabowski 1999, Mendoza, 1997; Blattman 2003). In their view, terms of trade improvement leads to higher investment and thus accelerates the rate of economic growth.
Bleaney and Greenway (2001) investigated the relationship between changes in the terms of trade and economic growth in 14 sub-Saharan Africa in the period 1980-1995. The results revealed that the variability of terms of trade negatively affects economic growth and investment, but terms of trade improvement has a positive effect on economic growth.
Moreover, research did by Grimes (2006) suggested that terms of trade improvement and the lower terms of trade volatility contribute to acceleration of economic growth, particularly in developing countries. Moreover, these studies have confirmed that since 1960 about half of the variability of GDP growth in New Zealand can be explained by changes in terms of trade variability in this country.
Research conducted by Eicher, Schubert, Turnov (2008) showed that the terms of trade deterioration has a negative impact on national income and wealth. In the long run terms of trade deterioration only leads to a proportional decrease in the level of national debt, but does not contribute to changes in production and investment. Thus, changes in terms of trade affect economic growth only in the short run. Moreover, the high volatility of terms of trade causes a fall in economic growth due to the common aversion to risk.
The results of many empirical studies have also confirmed that changes in terms of trade explain about half of the production variability in developing countries. Mendoza (1997) analyzed the impact of terms of trade on economic growth in 40 countries (9 economically developed countries and 31 developing countries) in the

period 1971-1991. The results revealed the presence of positive correlation between the analyzed variables.
However, Wong (2010) analyzed the impact of terms of trade changes and terms of trade volatility on economic growth in Japan and Korea during the period 1960-2006. The results indicated that the increase in terms of trade volatility led to a decline in real GDP per capita in both analyzed countries. According to the results of analysis the improvement in terms of trade and less volatility of terms of trade are important factors for economic growth.
There are also some empirical evidence supported the negative correlation between the improvement in terms of trade and economic growth in developing countries. In turn, Hadassah, and Williamson (2003) investigated the relationship between terms of trade and economic growth in developing countries during 1870-1940. They have proved that the positive changes in terms of trade from 1870 to World War I in developing countries contributed to reducing the dynamics of economic growth in these countries. The results also indicated that changes in terms of trade explained less than one-fifth of the changes in GDP per capita in these economies.

III. Terms of trade and economic growth model approach

In the economic literature, there are used several different econometric models to analyze the impact of terms of trade changes and terms of trade volatility on economic growth in countries with different levels of economic development. In order to analyze the correlation between terms of trade and economic growth in Poland in the period 1980-2009 there was used VAR model (Vector Autoregression Model) constructed on the basis of the model of Blattman, Hwang and Williamson (2003), represented by the following expression:

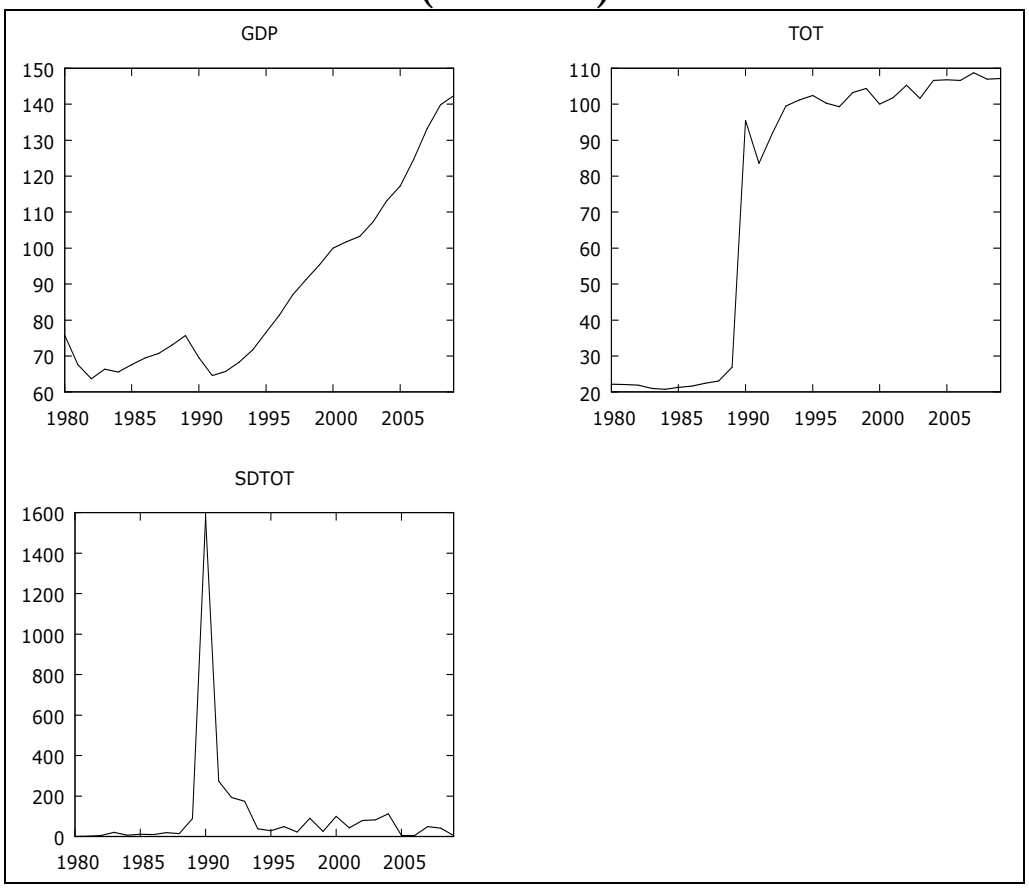
$$\Delta GDP_t = \sum_{j=0}^{n} \alpha_j \Delta GDP_{t-j} + \sum_{j=0}^{n} \gamma_j \Delta TOTt_{t-j} + \sum_{j=0}^{n} \beta_j \Delta SDTOT_{t-j} + \mu_t \quad (1)$$

where:
ΔGDP - changes in GDP per capita (2000 = 100);
ΔTOT - changes in terms of trade (2000 = 100);
ΔSDTOT - terms of trade variation measured by the standard deviation (2000 = 100);
t - analyzed period;
j - lag of variables;
μ - random component.

All the above mentioned time series had the yearly frequency and covered the period from 1980 to 2009. The indexes of analyzed variables in Poland in the period 2000-2009 were presented in the following figure [Figure 2].

Figure 2

Growth rate of GDP per capita, terms of trade changes and terms of trade volatility in Poland in the period 1980-2009 (2000 = 100)



Source: Own calculations on the basis of International Financial Statistics, (2010).

All time series were logarithming, in order to obtain linear relationships between the analyzed variables. Calculated on the basis of these data the correlation coefficient between the dynamics of GDP per capita and terms of trade dynamics in the period 1980-2009 amounted to 0.63 which indicated the occurrence of significant and

positive linear relationship between variables. However, the calculated correlation coefficient between the dynamics of GDP per capita and terms of trade volatility in the period 1980-2009 was -0.17 what meant the existence of a relatively significant and negative linear relationship between the analyzed variables [table 1].

Table 1.

Correlation coefficients for observations in the sample 1980-2009

GDP	TOT	SDTOT	
1,0000	0,6316	-0,1751	GDP
	1,0000	0,1726	TOT
		1,0000	SDTOT

Critical value (at 5% two-sided critical area) = 0.3610 for n = 30
Source: Own calculations.

Before model estimation, it was necessary to specify stationarity of analyzed time series. To this purpose, the Augmented Dickey-Fuller Test (ADF) was used. The results of ADF test indicated a lack of stationarity of all time series. Among the analyzed variables used in model were only time series with 1 and 2 integration rows. Relevant results of ADF test were presented in Table 2.

Table 2.

The results of Augmented Dickey-Fuller test

Time series	Integration row
ΔGDP - changes in GDP per capita	*I(1)*
ΔTOT - changes in terms of trade	*I(2)*
ΔSDTOT - terms of trade volatility	*I(2)*

Source: Own calculations.

In the paper it was adopted three lag period (three years) between explanatory variables. The choice of lag lengths was in line with results of the information criteria of the Akaike, Schwartz-Bayesian and the

Hannan-Quinn models. According to these criteria, a model with three lags length was characterized by the biggest information capacity. Moreover, due to the lack of cointegration between variables it was not possible to expand and transform the structural VAR model in vector error correction model (VECM - Vector Error Correction Model).

The next stage of analysis was to estimate structural parameters of the VAR model. Based on data presented in Table 3 it can be seen that the sensitivity coefficient of GDP per capita to changes in terms of trade amounted to nearly 0.07 at 1% of significance level. Thus, the value of this ratio indicated a relatively low and the positive impact of improvement in terms of trade on GDP growth per capita in Poland. However, the elasticity coefficient of GDP per capita to terms of trade volatility amounted to -0.01 at the 1% of significance level, indicating relatively low and negative effect of terms of trade volatility on GDP growth per capita in Poland.

Table 3.

Results of the VAR model estimation

OLS estimates, observations 1984-2009 (T = 26)
Log-likelihood = 40.459194
Determinant of covariance matrix = 8.9319407e-006
AIC = -1.0353 BIC = 0.2712 HQC = -0.6591
Portmanteau test: LB(6) = 48.5247, df = 27 [0.0067]

Equation 1: GDP

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
GDP_1	0.568295	0.179015	3.1746	0.00554	***
GDP_2	0.258399	0.323243	0.7994	0.43509	
GDP_3	-0.0586462	0.149163	-0.3932	0.69908	
TOT_1	-0.0048044	0.0223284	-0.2152	0.83220	
TOT_2	0.0664794	0.0181931	3.6541	0.00196	***
TOT_3	0.0334645	0.0147046	2.2758	0.03609	**
SDTOT_1	-0.0124817	0.00595721	-2.0952	0.05143	*

SDTOT_2	-0.00738923	0.00217869	-3.3916	0.00347	***
SDTOT_3	-0.0039288	0.00544298	-0.7218	0.48022	

Mean dependent var	0.029351	S.D. dependent var	0.037320
Sum squared resid	0.013722	S.E. of regression	0.028411
R-squared	0.760185	Adjusted R-squared	0.647330
F(9, 17)	5.987538	P-value(F)	0.000797
rho	-0.072286	Durbin-Watson	2.132145

F-tests of zero restrictions:

All lags of GDP	F(3, 17) = 12.062 [0.0002]
All lags of TOT	F(3, 17) = 9.3948 [0.0007]
All lags of SDTOT	F(3, 17) = 5.1898 [0.0100]
All vars, lag 3	F(3, 17) = 2.1172 [0.1358]

Equation 2: TOT

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
GDP_1	0.669672	1.35443	0.4944	0.62733
GDP_2	1.38485	2.01083	0.6887	0.50031
GDP_3	-0.538482	0.721874	-0.7460	0.46589
TOT_1	-0.137322	0.189559	-0.7244	0.47866
TOT_2	0.220016	0.188185	1.1692	0.25848
TOT_3	0.084202	0.120351	0.6996	0.49362
SDTOT_1	0.0567088	0.0687543	0.8248	0.42091
SDTOT_2	0.00490025	0.0235458	0.2081	0.83761
SDTOT_3	0.0377379	0.0495267	0.7620	0.45652

Mean dependent var	0.062629	S.D. dependent var	0.251101
Sum squared resid	1.429237	S.E. of regression	0.289953
R-squared	0.148389	Adjusted R-squared	-0.252370
F(9, 17)	0.329128	P-value(F)	0.953093
rho	-0.006035	Durbin-Watson	1.977862

F-tests of zero restrictions:

All lags of GDP	F(3, 17) = 0.34566 [0.7927]
All lags of TOT	F(3, 17) = 0.52147 [0.6733]
All lags of SDTOT	F(3, 17) = 0.24502 [0.8637]
All vars, lag 3	F(3, 17) = 0.51932 [0.6746]

Equation 3: SDTOT

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
GDP_1	0.503201	11.1432	0.0452	0.96451
GDP_2	-7.92667	17.2969	-0.4583	0.65256
GDP_3	8.15396	9.52847	0.8557	0.40404
TOT_1	-0.187797	1.33416	-0.1408	0.88971
TOT_2	-0.552999	1.21444	-0.4554	0.65462
TOT_3	0.0437377	0.708186	0.0618	0.95147
SDTOT_1	-0.235335	0.259208	-0.9079	0.37662
SDTOT_2	-0.249501	0.302334	-0.8252	0.42066
SDTOT_3	-0.160055	0.257721	-0.6210	0.54281

Mean dependent var	-0.054214	S.D. dependent var	1.386101
Sum squared resid	39.87842	S.E. of regression	1.531597
R-squared	0.171070	Adjusted R-squared	-0.219014
F(9, 17)	0.389820	P-value(F)	0.923692
rho	0.006631	Durbin-Watson	1.925196

F-tests of zero restrictions:

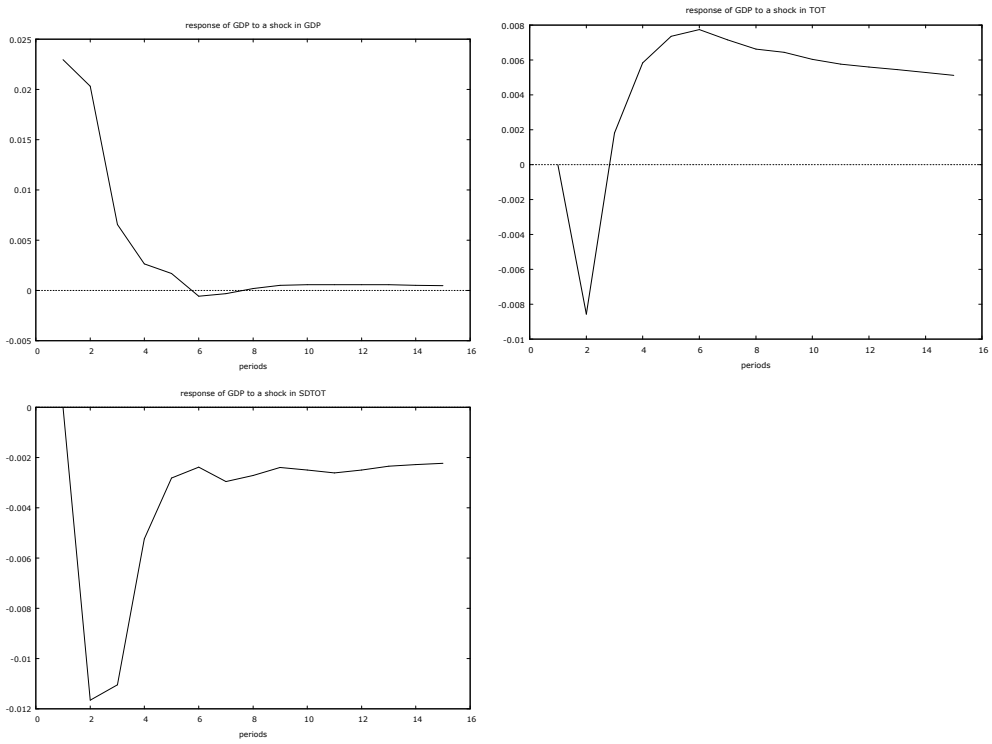
All lags of GDP	F(3, 17) = 0.32965 [0.8040]
All lags of TOT	F(3, 17) = 0.11805 [0.9483]
All lags of SDTOT	F(3, 17) = 0.43397 [0.7314]
All vars, lag 3	F(3, 17) = 0.29505 [0.8284]

Source: Own calculations.

The next step of the analysis was to measure the impact of terms of trade changes and terms of trade volatility on GDP growth per capita in Poland during 1980-2009. The measurement has been completed with the help of so-called impulse response function, which is the reaction function of GDP per capita to impulse in the form of unit change in various determinants of economic growth, i.e. changes in terms of trade and terms of trade volatility [Figure 3].

Figure 3.

Impulse response functions of GDP growth per capita to impulse caused by a unit change in GDP per capita, terms of trade changes and terms of trade volatility in Poland



Source: Own calculations.

According to the figure above, it was found that a shock rise in GDP per capita led to an immediate increase in GDP per capita in the first year after the shock, followed by a gradual decline in GDP growth and stabilization after six years. Relatively different was the impact of terms of trade increase on change in dynamics of GDP per capita. Namely, terms of trade improvement led to a gradual decline in GDP growth per capita during two years after the shock, and then to an increase in GDP growth and stabilization after six years. On the other hand, the increase in terms of trade volatility led to a sharp decline in

GDP growth per capita over the next two years after the shock and stabilization after six years.
The final stage of analysis was the variance decomposition of residual component of GDP growth per capita in order to estimate the impact of terms of trade changes and terms of trade volatility on the variability of GDP growth per capita in Poland [table 4].

Table 4.

Variance decomposition for variable GDP

Period	Standard error	GDP	TOT	SDTOT
1	0,02	100,00	0,00	0,00
2	0,03	81,79	6,39	11,82
3	0,04	74,63	5,82	19,55
4	0,04	71,45	7,99	20,56
5	0,04	68,46	11,35	20,19
6	0,04	65,51	14,80	19,69
7	0,04	63,03	17,48	19,49
8	0,04	61,05	19,62	19,33
9	0,04	59,34	21,53	19,13
10	0,04	57,88	23,12	19,01
11	0,04	56,57	24,47	18,96
12	0,04	55,39	25,70	18,91
13	0,04	54,34	26,82	18,84
14	0,04	53,38	27,83	18,78
15	0,04	52,51	28,75	18,74

Source: Own calculations.

According to data presented in Table 4, terms of trade changes explained more than 11.3% of the variability of GDP growth per capita after five years and more than 28.7% after the fifteen years after the shock. In turn, terms of trade volatility accounted for about 20% of the variability of GDP growth per capita after five years and nearly

19% after the fifteen years after the shock. The largest share in explanation the variability of GDP growth per capita in Poland was an inertial factor, i.e. lag changes in GDP per capita.

IV. Conclusions

Results of the study confirmed that terms of trade improvement in Poland led to increase in GDP growth per capita in the period 1980-2009. On the other hand, the increase in terms of trade volatility in Poland reduced the growth rate of GDP per capita. What's more, there was revealed that changes in terms of trade in a relatively greater degree influenced the dynamics of economic growth in Poland, than the terms of trade volatility. It was also demonstrated that the change in terms of trade and terms of trade volatility, explained in a similar degree the variation of GDP per capita in Poland in the period 1980-2009.

References

1. Blattman C., Hwang J., Williamson J. G. (2003), The Terms of Trade and Economic Growth in The Periphery 1870-1983, NBER Working Paper Series, No 9940.
2. Bleaney M. F., Greenaway D. (2001), The impact of terms of trade and real exchange rate volatility on investment and growth in sub-Saharan Africa, Journal of Development Economics, No 65.
3. Deaton A., Miller R. I. (1996), International Commodity Prices, Macroeconomic Performance and Politics in Sub-Saharan Africa, Journal of African Economics, No 5.
4. Eicher T. S., Schubert S. F., Turnovsky S. J. (2008), Dynamic effects of terms of trade shocks: the impact on debt and growth, Journal of International Money and Finance, Vol. 27, Issue 6.

5. Grimes A. (2006), A Smooth Ride: Terms of Trade, Volatility and GDP Growth, New Zealand Ministry of Economic Development Occasional Paper, No 04.
6. Hadass Y., Williamson J. (2003) Terms of Trade Shocks and Economic Performance 1870- 1940: Prebisch and Singer Revisited, Economic Development and Cultural Change, No 51(3).
7. Hadass Y., Williamson J. (2003), Terms of Trade Shocks and Economic Performance 1870- 1940: Prebisch and Singer Revisited, Economic Development and Cultural Change, No 51(3).
8. Kose M. A., Reizman R. (2001), Trade Shocks and Macroeconomic Fluctuations in Africa, Journal of Development Economics, No 65(2).
9. Mendoza E. (1997), Terms of Trade Uncertainty and Economic Growth, Journal of Development Economics, No 54.
10. Prebisch R. (1950), The Economic Development of Latin American and Its Principal Problems Lake Success, United Nations, Department of Economic Affairs, New York.
11. Singer H. W. (1950), The Distribution of Gains between Investing and Borrowing Countries, American Economic Review, No 40.
12. Turnovsky S. J. , Chattopadhyay P. (2003), Volatility and growth in developing economies: some numerical results and empirical evidence, Journal of International Economics, No 59.
13. Wong H. T. (2010), Terms of trade and economic growth in Japan and Korea: an empirical analysis, Empirical Economics, No 38.

Appendix 1

Summary Statistics, using the observations 1980 - 2009
for the variable GDP (29 valid observations)

Mean	Median	Minimum	Maximum
0.0217364	0.0364125	-0.114314	0.0678112
Std. Dev.	C.V.	Skewness	Ex. kurtosis
0.0469325	2.15917	-1.63481	1.72113

Summary Statistics, using the observations 1980 - 2009
for the variable TOT (29 valid observations)

Mean	Median	Minimum	Maximum
0.0542954	0.0119931	-0.133031	1.26831
Std. Dev.	C.V.	Skewness	Ex. kurtosis
0.238637	4.39516	4.75691	21.7957

Summary Statistics, using the observations 1980 - 2009
for the variable SDTOT (29 valid observations)

Mean	Median	Minimum	Maximum
0.113862	-0.00695195	-3.26329	2.88754
Std. Dev.	C.V.	Skewness	Ex. kurtosis
1.41603	12.4363	-0.117271	-0.118657