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**Elżbieta Kacperska<sup>1</sup>**

Department of Agricultural Economics and International Economic Relations  
Warsaw University of Life Sciences – SGGW

## **The influence of international trade with Germany, the agro-food trade in particular, on the Polish GDP size**

**Abstract.** The influence of international trade on the growth of GDP has undergone some changes over time. The paper presents national trade between Poland and Germany with special emphasis on the agro food trade. The paper includes the estimation of the effects of Polish income obtained through trade with Germany, including the agro-food trade.

**Key words:** agro-food products, Polish international trade, multiplier effect, Germany

### **Introduction**

The relationship between foreign trade and economic development is the subject of research of many economists. The subject was analyzed in detail by J. Viner [Misala 2005] later, it was criticized by the classics, among others Adam Smith and David Ricardo. Adam Smith believed that foreign trade plays an important role as a factor in opening up new markets for production surplus in the country and thus contribute to the growth and development of the national economy [Smith 2012]. D. Ricardo emphasized the possibility of increasing the income of the country by improving the terms of trade [Kamecki, Słodaczuk & Sierpiński 1971]. Neoclassicals, including A. Marshall similarly presented the role of trade in economic development. J. M. Keynes presented a new perspective on the impact of foreign trade on changes in national income and employment. He pointed out that the foreign trade multiplier effects start affecting national income. J. M. Keynes and his followers argued that a positive trade balance can work toward economic recovery in the country and the negative trade balance can contribute to the deepening economic depression [Keynes 1931; Kamecki, Słodaczuk & Sierpiński 1971].

In the postwar period, R. F. Harrod took up the issue of long-term economic development and its relation to international trade [Kamecki, Słodaczuk & Sierpiński 1971].

The current trends of research both criticize, as well as develop earlier theories, as well as recognize and explore new phenomena and relationships occurring between international trade, the domestic economy and the global economy.

For many years Germany has been the main trading partner with Poland. The importance of the German economy is evident from the Polish marketization. In the 1980s and 1990's, relationships were strengthening in the exchange of goods, including agricultural and food products. Polish integration with the European Union in 2004 led to the opening of markets and standardization of methods of mutual exchange. Since 2003 the mutual trade was characterized by a increased tendency for Germany's share in Polish international trade, which accounted for over a quarter of all sales, both in exports and

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<sup>1</sup> PhD, e-mail: elzbieta\_kacperska@sggw.pl

imports. The German economy in the years 2004-2012 remained the most important recipient of agro-food products and their exchange was beneficial for Poland. Therefore it is important to know the impact of international trade with Germany on the size of Polish GDP.

## Research methodology

The aim of the study was to present the volume of trade between Poland and Germany with particular emphasis on agro-food trade and to estimate the effects of income derived from the Polish-German trade, including the agro-food trade, taking into account the multiplier response from the demand side. The analysis covered the years 2004-2012 and was related to the impact of exports and imports on the size of GDP.

In the analysis indicators of the impact of exports and imports to national income were used, ie: the rate of export, import rate, the marginal rate of export, the marginal rate of import, income elasticity of exports, the income elasticity of imports, international trade multiplier.

The rates of exports and imports indicate the importance of foreign trade in the country. Export rate shows the percentage share of exports in national income at a given time. It is written using the following formula:

$$s_e = \frac{Ex_i}{Y_i} \times 100 \quad (1)$$

where:

$s_e$  – the rate of export,

$Ex_i$  – global export value of the country  $i$ ,

$Y_i$  – the national income of the country  $i$ .

The rate of import shows the percentage share of imports in national income at a given time. It is written using the following formula:

$$s_{im} = \frac{Im_i}{Y_i} \times 100 \quad (2)$$

where:

$s_{im}$  – the rate of import,

$Im_i$  – global value of import of the country  $i$ ,

$Y_i$  – the national income of the country  $i$ .

Further indicators in the analysis are the marginal rates of export and import. They depend on the structures of production and level of living. High marginal rate of export will attest to the fact that the country's economic growth is largely based on export expansion, while high marginal rate of import indicates a high absorption capacity of the economy associated with an increase of GDP. Marginal rate of export determines the growth of export with the individual's national income and it takes the form:

$$sk_{ex} = \frac{\Delta Ex_i}{\Delta Y_i} \quad (3)$$

where:

$sk_{ex}$  – marginal rate of export,

$\Delta Ex_i$  – the country's  $i$  export growth  $i$ ,

$\Delta Y_i$  – increase of the national income of the country  $i$ .

Marginal rate of import defines the change in import of a particular country with an increase in the national income of the individual. This indicator takes the form:

$$sk_{im} = \frac{\Delta Im_i}{\Delta Y_i} \quad (4)$$

where:

$sk_{im}$  – marginal rate of import,

$\Delta Im_i$  – increase in import of the country  $i$ ,

$\Delta Y_i$  – increase the national income of the country  $i$ .

Indicators of income elasticity of export and import determine the impact of export and import on economic growth. Ratio of export income elasticity informs about relative changes of export in relation to the relative changes of national income, it takes the form:

$$d_{ex}^e = \frac{\Delta Ex_i}{Ex_i} \div \frac{\Delta Y_i}{Y_i} \quad (5)$$

where:

$d_{ex}^e$  – income elasticity of export,

other symbols as above.

Ratio of import's income elasticity indicates the relative changes in import in relation to relative changes in national income, it takes the form:

$$d_{im}^e = \frac{\Delta Im_i}{Im_i} \div \frac{\Delta Y_i}{Y_i} \quad (6)$$

where:

$d_{im}^e$  – income elasticity of import,

other symbols as above.

If the coefficients of income elasticity of export or import take the values above unity, it means that the export/import is a key factor of economic growth in the country and its share in the national income grows. These values can be smaller than unity and the export/import inhibit the economy and their share in national income reduces [Misala 2005].

Another instrument used in the study is the international trade multiplier. Multiplier (investment, export) is a factor determining the increase in national income due to

economic growth (increase in investment, exports) [Bożyk 2008]. This concept was introduced by R. F. Kahna and developed by J. M. Keynes [Keynes 1956]. The multiplier is only present in a market economy, in which there are production reserves and it is activated by certain impulses of economic growth (increase in investment, export growth) which create additional demand [Bożyk 2008]. It takes the form:

$$k_o = \frac{1}{\frac{\Delta S}{\Delta Y} + \frac{\Delta Im}{\Delta Y}} \quad (7)$$

where:

$k_o$  – the multiplier in an open economy,

$\Delta S/\Delta Y$  – marginal propensity to save (accumulate),

$\Delta Im/\Delta Y$  – marginal propensity to import.

It can be concluded that the foreign trade multiplier is the inverse of the marginal propensity to save plus the marginal propensity to import. The growth of national income induced by multiplier reaction is determined by the following formula [Guzek 2004]:

$$\Delta Y^g = \Delta Ex \times k_o \quad (8)$$

where:

$\Delta Y^g$  – increase of the national income generated by the growth of export from the multiplier reaction,

$\Delta Ex$  – increase export.

The growth in export is treated as equivalent to the so-called, autonomous investments and the degree of its impact on national income depends on the impact of the marginal propensity to import on the multiplier level. The greater inclination the lower multiplier, which means lower impact of export growth on national income [Guzek 2004]. Form of multiplier for the practical analysis in an open economy must be verified due to the fact that it is not subject to decomposition, i.e. that the effect calculated for the international trade of the particular country is not the total sum of income effects calculated separately for each of its partners [Guzek 2004]:

$$k_o = \sum_{i=1}^n k_i w_i \quad (9)$$

where:

$k_o$  – overall multiplier of international trade of the particular country,

$i=1, 2, \dots, n$  – number of the country-partner;

$k_i$  – individual international trade multiplier of the tested country with the country  $i$ ,

$w_i$  – weight in the form of participation of the country in the overall increase of export in a tested country to all partners.

Individual multiplier takes the form:

$$k_i = \frac{1}{\frac{\Delta S^t}{\Delta Y^t} + \frac{Im_i^{t-1}}{Y^{t-1}} \times \frac{\frac{\Delta Im_i^{t-1}}{Im_i^{t-1}}}{\frac{\Delta Y^t}{Y^{t-1}}}} \quad (10)$$

where:

$Im_i^{t-1}/Y^{t-1}$  – the share of import of the country from a partner  $i$  year  $t-1$  in the national income in a given country in year  $t-1$ ,

$\Delta S^t/\Delta Y^t$  – marginal propensity to save in the examined country in year  $t$ ,

$\Delta Im_i^{t-1}/Im_i^{t-1}$  – the rate of growth of import of a particular country with country  $i$  year  $t$ ,

$\Delta Y^t/Y^t$  – rate of growth of national income in a given country in year  $t$ .

The multiplier can be kept within the range of unity to infinity. If it is one, it means that economic growth does not increase the national income. Values greater than unity indicate that the increase in national income exceeds the increase in investments or export [Bożyk 2008].

## Gross domestic product in Poland in the years 2004-2012

The value of Polish GDP increased from 924 PLN billion in 2004 to nearly 1.6 trillion PLN in 2012. The GDP grew during the period, but annual analysis shows variable value increments. Since 2009, annual GDP growth increased. The reason for the slowdown of GDP growth was the global crisis.

The share of capital formation in GDP ranged from 19.27% to 24.45%. In 2009, it was observed that the value of investments declined (Table 1).

Table 1. The value gross domestic product and gross capital formation in 2004–2012

Specification	Year								
	2004	2005	2006	2007	2008	2009	2010	2011	2012
GDP of Poland (in million PLN)	924538	983302	1060031	1176737	1275508	1344505	1416585	1528127	1595225
GDP growth compared to the previous years	81382	58764	76729	116706	98771	68997	72080	111542	67098
Accumulation of total (in million PLN)	185542	189445	223162	287657	304848	273568	297449	337076	325688
The increase of accumulation compared to the previous period (million PLN)	27514	3903	33717	64495	17191	-31280	23881	9627	-388
The share of accumulation in GDP (%)	20.07	19.27	21.05	24.44	23.90	20.35	21.00	22.06	20.42
Marginal propensity to save	0.34	0.07	0.44	0.55	0.17	-0.45	0.33	0.36	-0.17

Source: Own calculations based on data from Statistical Yearbooks for the years 2004-2013, Central Statistical Office, Warsaw.

## Polish International trade in the period 2004-2012

Polish foreign trade in the period 2004-2012 showed increasing trends in export and import. Export in the analyzed period doubled, reaching a value of 744.7 billion PLN in 2012; the account balance was negative except for 2009 and 2012. Increase in export analyzed year on year showed high variability, especially the decrease in growth occurred in 2008 and 2009, which was a result of the global financial crisis. Between 2010 and 2011 export definitely improved in increments of 90 billion PLN in 2011, but in 2012, the growing trend weakened rapidly.

A similar tendency was observed in import. In 2009 there was a decline in the value of import, but in subsequent years, there was a rapid growth (Table 2). Indicators of export and import's rate were quite high and ranged at 37-45%.

Marginal rate of export has shown considerable volatility during the period. However, its value was greatly improved in the years 2010-2011 (Table 2).

Table 2. Polish international trade and main indicators of international trade in 2004-2012

Specification	Year								
	2004	2005	2006	2007	2008	2009	2010	2011	2012
Export (in million PLN)	346631	364658	427776	479606	508887	530278	598369	688738	744748
Import (in milion PLN)	368365	371946	446927	513425	559521	529269	615470	706326	739947
Increase of export (in million PLN)	65743	18027	63118	51830	29281	21391	68091	90369	56010
Increase of import (in million PLN)	64790	3581	74981	66498	46096	-30252	86201	90856	33621
Export range	37.49	37.09	40.36	40.76	39.90	39.44	42.24	45.07	46.69
Import range	39.84	37.83	42.16	43.63	43.87	39.37	43.45	46.22	46.39
Marginal export range	0.81	0.31	0.82	0.44	0.30	0.31	0.94	0.81	0.83
Marginal import range	0.80	0.06	0.98	0.57	0.47	-0.44	1.20	0.81	0.50

Source: as in Table 1.

## Marginal propensity to save in Poland and to import from Germany

Polish-German trade relations from the beginning of the transition are characterized by a positive trend. This trend was observed until 2009, in that period the financial and economic crisis has weakened the mutual trade. After a period of weakening of the exchange from 2010 a growing trend returned.

Polish trade with Germany in the years 2004-2012 showed a negative balance of deepening trend. The value of import in 2004 amounted to 79.3 billion PLN and increased to 138.2 billion PLN in 2012, particularly large increases in imports was observed in 2010 and 2011, in 2012 there was a decline in the value of import (Table 3).



In the analyzed period, the marginal propensity to save in Poland significantly changed. In the years 2006–2007 it was relatively high, both in relative terms and absolute terms. The negative impact on the growth of savings was the economic crisis in 2009 (Table 1). Years 2008 to 2009 were characterized by a slowdown of the Polish economy, despite its further development. During this period, most of the indicators declined.

Polish marginal propensity to import from Germany in the period was rather low. This indicator was characterized by high volatility; in 2012, it was negative (Table 3).

Table 3. The value of import from Germany and its main indicators in 2005-2012

Specification	Year							
	2005	2006	2007	2008	2009	2010	2011	2012
Import from Germany (in million PLN)	80994.3	94645.7	109873.9	114166.3	103672.5	117305.9	139088.6	138180.0
Import growth (in million PLN)	1602.7	13651.4	15228.2	4292.4	-10493.8	13633.4	21782.7	-908.6
Poland's marginal propensity to import from Germany	0.03	0.18	0.13	0.04	-0.15	0.19	0.20	-0.01

Source: as in Table 1.

## Polish income effects generated by trade with Germany

Polish exports to Germany in the analyzed period increased from 81.7 billion PLN in 2004 to 151.7 billion PLN in 2012. In the analyzed period there was a slowdown in export in 2005 and 2008. In the analyzed period, the international trade multiplier clearly deteriorated. In 2005, it amounted to 7.85 % and was the highest in the period. In later years, it hesitated in the range of 0.65 - 1.56%; in 2009 it was the lowest. In 2012, the Polish international trade multiplier reached a value of 3.02 and was the best since 2005. Low multiplier values point to a slow growth of national income but if the upward trend continues, an increase in national income will generate (Table 4).

Table 4. The value Polish of export to Germany and its main indicators in 2005-2012

Specification	Year							
	2005	2006	2007	2008	2009	2010	2011	2012
Export to Germany (in million PLN)	81449.4	93337.8	100120.0	101520.0	110679.9	125550.6	145764.2	151747.7
Export growth (in million PLN)	-324.2	11888.3	6782.2	1400.0	9159.9	14870.7	20213.6	5983.6
International trade multiplier	7.85	0.71	0.89	1.56	-1.12	0.65	0.85	3.02
Poland's income effect arising from trade with Germany (in million PLN)	-2545.4	8391.9	6042.5	2184.9	-10271.2	9737.1	17279.4	18058.0

Source: as in Table 1.

The combined effect of income on account of Polish trade with Germany for the period 2005-2012 amounted to 49.6 billion PLN. This amount is very low, taking into account the value of total export of 991.9 billion PLN and import 977.3 billion PLN for this period. Years 2010-2012 showed an increase in the multiplier effects (Table 4).

Indicators of income elasticity of total export to Germany showed a high variability in the considered period. Only the years 2010-2012 show a positive impact of export on GDP. Indicator of income elasticity of export to Germany in the years 2005-2008 and 2012 was significantly lower than the total index. In 2009-2011 the rate was higher, which means trade with Germany generates additional revenue. Indicators of income elasticity of import to Germany showed similar trends (Table 5).

Table 5. The index of income elasticity of export and import in general and to Germany together with export multiplier to Germany in 2005-2012

Specification	Year							
	2005	2006	2007	2008	2009	2010	2011	2012
Income elasticity of export	0.83	2.04	1.09	0.74	0.79	2.24	1.80	1.79
Income elasticity of import	0.16	2.32	1.31	1.06	-1.11	2.75	1.76	1.08
Income elasticity of export to Germany	-0.07	1.76	0.68	0.18	1.61	2.33	1.90	0.94
Income elasticity of import to Germany	0.33	1.99	1.40	0.49	-1.97	2.28	2.15	-0.16
Multiplier export to Germany	-3460	19257	9928	6436	-15129	28573	36715	-32650

Source: as in Table 1.

## Trade in agro-food products between Poland and Germany in the years 2004-2012

The most important recipient of Polish agro-food products is Germany. In 2012, about 22% of Polish agro-food export products was sold on this market. In the analyzed period, the mutual exchange of agro-food products between Poland and Germany proceeded successfully and was characterized by an upward trend, both in terms of export as well as import. Account balance showed a surplus in the considered period. Sale of food and agriculture, despite the crisis was characterized by a rapid increase, and the agro-food industry was one of the sectors with the highest growth rates. Although in the years 2010-2012 the German market recorded a decline in domestic demand, the turnover in the agro - food did not decrease but even increased [Kacperska 2012].

Polish agro-food products for many years have been becoming increasingly important in international trade. This is the effect of using high quality raw materials, modern technology and manufacturing original products with unique recipes. Polish products are highly appreciated on the international market and gain a growing number of customers [Kacperska 2012].

## Marginal propensity of Poland to import agro-food from Germany

Agro-food import from Germany to Poland is on high level. Its value in the analyzed period increased from 3.6 billion PLN in 2005 to 12.2 billion PLN in 2012. The share of import from Germany in Polish agro-food trade has stood since 2007 at over 20%. Marginal propensity of Poland to import agro-food products from Germany was at a low level, pointing to its marginal significance (Table 6).

Table 6. The value of agro-food import from Germany and its main indicators in 2005-2012

Specification	Year							
	2005	2006	2007	2008	2009	2010	2011	2012
Agro-food import (in million PLN)	3610.8	4212.1	5702.3	7707.8	8937.1	9493.1	12020.7	12274.4
Agro-food import's growth (in million PLN)	666.3	601.3	1490.1	2005.6	1229.3	556.0	2527.6	253.7
Marginal propensity of Poland to import agro-food from Russia	0.011	0.008	0.013	0.020	0.018	0.008	0.023	0.004

Source: as in Table 1.

## The effect of Poland's income on account of Polish agro-food trade with Germany

Agro-food export to Germany pointed to a growing trend. In 2012, reached 16.4 billion PLN. The share of agro-food export to Germany in total stood at 22-25%. Commodity structure of Polish export to Germany in the analyzed period has changed quite significantly. This was the reason for the change that occurred in Poland in the period of transition and the adjustment period to the requirements of the European Union.

The total income generated by the agro-food trade with Germany in the years 2005-2011 was 3.1 billion PLN and was relatively low in relation to total export to Germany 9.5 billion PLN (Table 7).

Table 7. The value of agro-food export to Germany and its main indicators in 2005-2012

Specification	Year							
	2005	2006	2007	2008	2009	2010	2011	2012
Agro-food export (in million PLN)	7342.1	8233.4	9707.9	10036.9	11314.9	12317.0	14209.5	16455.5
Agro-food export's growth (in million PLN)	1255.7	891.2	1474.6	328.9	1278.0	1002.2	1892.4	2246.0
The effect of Poland's income on account of Polish agro-food trade with Germany	13402.8	1443.6	2158.6	1512.2	-2110.9	1925.5	3437.3	-12255.7

Source: as in Table 1.

## Summary

For many years Poland has been developing cooperation with Germany. Good neighborly relations and membership to the European Union strengthen cooperation and contribute to increasing trade. Germany is the most important recipient of Polish agro-food products. About 24% of Polish agro-food export gets on this market. In 2012, the value of exported agro-food products amounted to EUR 3.8 billion. Processed products of plant and animal origin dominated in the commodity structure.

From Germany, every year we import more food products. In 2012, the value of import amounted to 3.0 billion EUR. Processed products have dominant position in import to Poland.

The balance of mutual exchange in the period was positive. The value of exported products has grown 4 times and the value of imports over 6-times during the surveyed years, indicating a faster rate of growth of import, which may be detrimental for our country.

In the analyzed period, Poland reached a total income effect of trade with Germany in the amount of 49.6 billion PLN - including the agro-food trade 3.1 billion PLN. Analysis of the impact of foreign trade with Germany on Poland's GDP growth indicates that it is small, but with an upward trend for the years 2010-2011.

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