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AGRI-FOOD EXPORTS VS STATE BUDGET AND PUBLIC DEBT

Abstract

Polish agri-food trade already in 2003 generated a positive balance. After accession to the EU it has rocketed and in 2013 twelve-fold surpassed its level recorded in 2003. Naturally, this success arouses great interest. It also has a number of macroeconomic implications. The article focuses on the problem of poorly recognized, i.e. on interdependencies be-tween this trade and the state budget and public debt. On the purely theoretical basis, it was found that growing exports and net exports may reduce both the budget deficitand the public debt, as well as indicators based on them. In Polish conditions, this positive effect cannot, however, be large, because the balance of agri-food trade (net exports) recently is only 1-1.5% of GDP. Even lower (approx. 0.5%) was the share of taxes paid by exporters of the food industry in GDP.

While the econometric analysis showed that the impact of exports of agri-food products and total exports of goods in GDP is positive and leads to a decline in public debt. It turned out that one-percent increase in agri-food exports lowers the above debt by 0.06%, while the same increase in total exports of goods – reduces debt by 0.1.

Keywords: agri-food products, import, export, state budget, public debt, foreign trade, Exports-Led Growth.

Introduction

Undisputed export successes of the Polish agri-food sector deserve respect, but at the same time arouse great interest of politicians, economists, media and the very agri-producers. The current export performance analyses focus mainly on the sources of high competitiveness of our agribusiness, which, above all, include accession to the EU, the following modernisation of the manufacturing potential and low manufacturing costs (Szczepaniak I. 2012, 2013).

Export is commonly, and in the neoclassical theory, considered to be the driving force of the economic growth. It is reflected in the Exports-Led Growth (ELG) hypothesis, which states that export is ahead of economic growth (e.g., Balassa B. 1978). On the other hand, there are many supporters (e.g., Krugman 1984) of a hypothesis according to which it is the economic growth that precedes changes in the Growth-Led Exports (GLE). A number of empirical studies have been devoted to the analysis of the dependencies between economic growth and export (e.g., Jin J.C. and Yu E.S.H. 1996; Ukpolo V. 1998). They attempt to answer questions concerning the directions of cause-effect dependencies and the nature of the relationship between them. However, in these studies, almost no attention is given to the agri-food exports.

In the present study, the subject of interest is a very poorly recognized problem in domestic and foreign research, namely the relationship between exports and net exports of agri-food products vs the state budget and public debt. Although there are several studies on the relationship between these variables, they analyse exports at an aggregated rather than sectoral level (Saad W. 2012; Dritsaki Ch. 2013). This problem is also important in view of the ongoing discussions on Poland's budgetary problems, economic and budgetary impact of the embargo imposed by Russia or of the African swine fever (ASF).

The structure of the study's content was subordinated to this fundamental objective. Firstly, identity and formal dependencies are presented, which is followed by a general information on the results of the trade in agri-food products and receipts from taxes paid by exporters of these products to the state budget and then an econometric analysis of the collected empirical material is performed. The text ends with synthetic conclusions.

Basic interdependencies – theoretical approach

By default, in macroeconomics and international economics the problem contained in the title of the article is analysed with the help of a certain set of identities. The latter, as it is known, are always satisfiable (true) equations, as they bind variables in a definitional way. However, a major problem arises here right away. Generally, on average these identities are not based on any well-established theory of economic behaviour. Consequently, the effects of a given policy's changes cannot be derived from them if one does not have an economic model at the same time. Besides, there may be many economic models compat-

ible with a given identity equation (Bartling H., Luzius F. 2008; Krugman P.R., Obstfeld M. 2006; Mankiw G. 2010; Oziewicz E., Michałowski T. (ed.) 2013; Streit E.M. 2005; Świerkocki J. 2011). Another complication is that the considerations are different for a small and large economy, as well as for open and closed. Our further analysis will be carried out in the convention of a small and open economy, because this type of economy is in Poland.

The starting point for the considerations is the following identity equation of product or income creation in the national economy:

$$Y = C + I + G + NX \tag{1}$$

where:

Y – national product (GDP or GNP) or national income,
C – consumption,
I – investment,
G – government spending,
NX – net exports as the difference between the export of the products (*EX*) and their import (*IM*). This category is also referred to as net trade balance. When it is positive, there is a trade surplus. Otherwise, there is a trade deficit[1].

On the basis of equation 1, it is possible to calculate four share indicators of the macroeconomic categories identified therein in the process of creation of domestic/national product or national income. The relationship NX/Y is of major importance for our considerations. In case of a single country, it could be assumed that its higher value would automatically improve the situation in terms of the external and internal balance. In fact, it is not so obvious. A higher balance of trade in goods actually generates a surplus in domestic capital which can be exported and it will be reflected in the capital account. However, export of capital entails the risk of losing it, at least in part.

This issue has been recently raised in Germany. The country is also a challenge for the euro zone. Roughly, the point is that for many years Germany has been developing a huge trade and current account surplus, but other countries of the Euroland parallelly record high deficits. Therefore, every now and then, there are proposals to impose an upper limit for the above surplus in the Eurozone at 7% of GDP. In the case of Poland, however, it can be assumed without major reservations that a higher *NX*/*Y* ratio represents an improvement in our international investment position (IIP). Therefore, we become less risky for foreign investors. The acceleration of the GDP growth rate caused by a higher *NX* has an impact in the same direction, which improves the indicators in terms of budget deficit and

[1] In the simplest terms, net exports refer only to commodity/product exchanges. The extension of the analysis to the service area leads us to the current account balance (*CA*). However, this is not too precise, as transfers are not yet covered.

public debt. Ergo: the government can finance its borrowing needs cheaper on the market. Let us add immediately, however, that this is an indirect effect of *NX* on the state budget's condition. We will come back to these problems later.

A deeper understanding of dependencies between net exports and the state budget requires referring to the category of domestic savings. In order to do this, we will rearrange equation 1 and introduce net taxes (gross taxes on households less budgetary transfers to households). We obtain the following identity:

$$NX = (S - I) + (T - G) \tag{2}$$

where:

S – savings of private persons, which are formed by the total value of the actual disposable income from the factors of production (Y) minus consumer spending (C) and net taxes (T).

The first expression on the right-hand side of equation 2 is the surplus/financial deficit of the private sector and the second is the fiscal surplus/deficit of the public sector. Let us establish it right away: higher net exports can mean improvement in both the position of households and the state budget. Under no circumstances it is about automatism. Moreover, a conclusion can be drawn that, since the economic theory does not provide clear conclusions on the interdependence between the trade balance and the state budget, we should analyse them parallelly with empirical tools. We should also add that equation 2 can be rearranged as follows (Hoover K.D. 2012):

$$NX + (S - I) + (T - G) = 0 \tag{3}$$

It follows from the above that an increase in net exports must lead to a reduction in the private and/or public sector balance. In practice, algebraic operations do not always result in zero, as there are various types of rounding in national accounts.

National savings can be expressed in yet another way:

$$S = I + NX \tag{4}$$

In addition, even a rapid analysis of the balance of payments shows that net exports must match the value of net capital outflows (NCO). In other words, we obtain:

$$NX = NCO \tag{5}$$

Figure 1 is a kind of a summary of what has been discussed so far. It shows the possibilities of the macroeconomic policy in terms of coordination of four important aggregates: national savings (S), investment (I), net capital outflow

(NCO) and net exports. Let us add immediately that these interdependencies are highly stylized.

So far our analyses have been carried out in a comparative and static convention. However, there is still a dynamic approach (Woll A. 2011). The simplest is the one which uses the growth of relevant macroeconomic categories. Accordingly, changes in net exports over a period of time (ΔNX) can be written down as follows:

$$\Delta NX = \Delta EX - \Delta IM \tag{6}$$

Moreover, we also know that part of the national income (Y) can be spent on savings, which is expressed by the s rate, but also on import, which is described by the m rate. After several rearrangements, the following formula can be obtained, combining changes in net exports with changes in the export itself:

$$\Delta NX = \frac{s}{m+s} \times \Delta EX \tag{7}$$

where:

$s/(m+s)$ – balance/trade balance multiplier.

At this point, three most interesting cases can be distinguished:

1. Firstly, s and m are different from zero. Then we will always have $\Delta EX > \Delta NX$. In other words, the increase in exports only partially translates into an improvement in the trade balance, thus possibly and later on into a better fiscal position of a given country.
2. Marginal import rate $m = 0$. Then $\Delta NX = \Delta EX$. Ergo: export growth is entirely "concentrated" in the net export balance. As a result, the situation in terms of budget deficit and public debt may also improve.
3. Marginal savings rate $s = 0$. In this case $\Delta NX = 0$, so we are faced with a trade balance equilibrium. Certainly, this would be tantamount to the lack of any links between foreign trade and the state budget.

Net exports in macroeconomics and international economics occur as a variable explaining the behaviour of other economic aggregates, but they are also reflexively shaped by them. Just as an example, we present the second approach below:

$$\underset{+\ +}{NX = X(E^r, Y^f)} - \underset{-\ +\ -\ -\ +}{E^r M(E^r, Y, \tau, r, \varepsilon)} \tag{8}$$

where:

X – export,
$E^r M$ – nominal import value measured in national currency,
E^r – real exchange rate,
Y^f – total product of the rest of the world,
Y – total product of a given country's economy,

π – tax rate,
r – real interest rate,
ε – expected rate of future economic growth,
+,– – below the variable symbols determine partial derivatives and, therefore, their pure impact on net exports (Sorensen P.B., Whitta–Jacobson H.J. 2010).

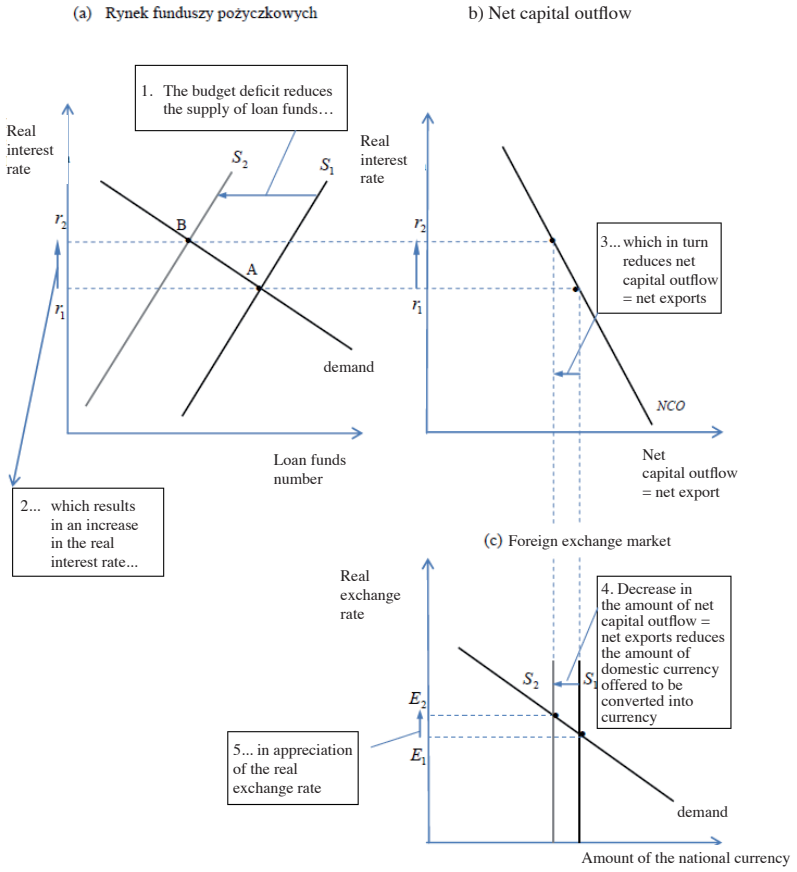


Fig. 1. Interdependencies between budget deficit (Figure a), net capital outflow = net exports (Fig. b) and exchange rate (Fig. c).

Source: own study based on: (Mankiw N.G., Taylor M.P.: Macroeconomics, PWE, Warsaw 2009).

However, the problems we are interested in must be analysed in the light of all economic policies carried out in a given time and place. Briefly speaking, we can say that a macroeconomic policy is always a combination of fiscal and monetary policies, which in an open economy can be conducted under a fixed

or floating exchange rate regime. For our considerations, the latter is binding. After B. Czarny, below we juxtapose a standard sequence of cause-effect dependencies in the above-mentioned policies (Czarny B. 2011):

1. Fiscal/budgetary policy:

a) mild:

$$\left.\begin{matrix} G\uparrow \\ NT\downarrow \end{matrix}\right\} \rightarrow AE\uparrow \rightarrow Y\uparrow \rightarrow M^{D}\uparrow \rightarrow i\uparrow \rightarrow CF\uparrow \rightarrow \varepsilon_{r}\uparrow \rightarrow \boldsymbol{NX}\downarrow \rightarrow AE\downarrow \rightarrow Y\downarrow$$

b) restrictive:

$$\left.\begin{matrix} G\downarrow \\ NT\uparrow \end{matrix}\right\} \rightarrow AE\downarrow \rightarrow Y\downarrow \rightarrow M^{D}\downarrow \rightarrow i\downarrow \rightarrow CF\downarrow \rightarrow \varepsilon_{r}\downarrow \rightarrow \boldsymbol{NX}\uparrow \rightarrow AE\uparrow \rightarrow Y\uparrow$$

2. Monetary policy:

a) mild:

$$M^{S}\uparrow \rightarrow i\downarrow \rightarrow \begin{cases} AE\uparrow \rightarrow Y\uparrow \\ CF\downarrow \rightarrow \varepsilon_{r}\downarrow \rightarrow \boldsymbol{NX}\uparrow \rightarrow AE\uparrow \rightarrow Y\uparrow \end{cases}$$

b) restrictive:

$$M^{S}\downarrow \rightarrow i\uparrow \rightarrow \begin{cases} AE\downarrow \rightarrow Y\downarrow \\ CF\uparrow \rightarrow \varepsilon_{r}\uparrow \rightarrow \boldsymbol{NX}\downarrow \rightarrow AE\downarrow \rightarrow Y\downarrow \end{cases}$$

where:

AE – aggregated expenses,
CF – foreign capital flows,
ε_r – real exchange rate,
G – government expenditure,
i – interest rate,
M^D – real demand for money,
M^S – money supply,
NT – net taxes,
$\boldsymbol{NX}$ – **net exports,**
Y – production.

The above dependencies are also of a highly stylized nature. This is just a general idea of the likely reaction of the economy, including net exports, to changes in the fiscal and/or monetary impulses. A more complete picture would have been undoubtedly obtained, if we had had a model of a national economy in the overall and dynamic equilibrium convention, on the basis of which it is possible to simulate different scenarios, e.g., changes in the trade balance of for-

eign exchange of agri-food products. In Poland, it is the Economic Institute of the National Bank of Poland that has sufficient human resources and software and hardware capabilities.

Now we return to the dependencies between the economic growth and budget deficit and public debt. As we remember, growth is an indirect channel through which exports and net exports can influence the fiscal position of a country. At this point, we will take advantage of the achievements of O. Blanchard, chief economist of the IMF and professor of economics at the Massachusetts Institute of Technology. The starting point for the considerations is the simplest so-called government budget constraint:

$$B_t - B_{t-1} = rB_{t-1} + G_t - T_t \tag{9}$$

where:
B_t, B_{t-1} – public debt in t and t-1 respectively,
G_t – government expenditure in t year,
r – real interest rate,
T_t – net taxes, hence gross taxes less transfers, in t year (Blanchard O. 2011).

We shall add that the $G_t - T_t$ is defined as the primary balance of the state budget (Blanchard O. 2011; Blankart Ch.B. 2011; Brümmerhoff D. 2011)[2]. Adding to formula 9 the real amount of GDP (Y) and the rate of its growth (g), we obtain the final form of government budget constraint:

$$\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}} = (r - g)\frac{B_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t} \tag{10}$$

On the left-hand side of equation 10, we have changes in the public debt/GDP ratio over time, so the indicator which was very closely followed, e.g. by the European Commission, which takes it into account when assessing the fiscal situation of the Member States. For example, it is considered at the time of analytical works related to the implementation of the so-called excessive deficit procedure. The above relation is also explicitly included in our constitution and the Public Finance Act. Generally, the above ratio grows when:

[2] There are other types of budget deficit. It can be calculated as the difference between the total state expenditure and its revenues (the actual budget deficit). On the expenditure side, real interest rate on government debt (budget deficit adjusted for inflation) can be used. This category can be determined even on the assumption that the economy is growing according to the normal trend (cyclically adjusted budget deficit). In this case, the change in the budget balance is due to the differences between potential and actual production. Structural deficit, in turn, is the one that could exist in the conditions of achieving the production potential. In Poland, budget deficit and public debt are calculated in accordance with the provisions of the Public Finance Act. The European Union, in turn, applies its own system. Previously, it was ESA 1995 and now ESA 2010. Differences between Polish and the EU statistics amount to 1-3 pp for the public debt/GDP ratio.

- there is an increase in real interest rate,
- GDP growth declines,
- the starting level of GDP is higher,
- the primary deficit/GDP ratio is higher.

The budgetary deficit-to-GDP ratio is also used to determine the "sustainable" debt, i.e. repayable debt. We will briefly present here a concept of Ch.B. Blankart, which is in fact another dynamization of O. Blanchard's modified approach (Blankart Ch.B. 2011). After a few rearrangements we arrive at the final equation:

$$\frac{d\left[\frac{D(t)}{Y(t)}\right]}{dt} = \frac{G'(t)-T(t)}{Y(t)} + (i-g)\frac{D(t)}{Y(t)}, while\ g = \frac{Y\prime(t)}{Y(t)} \tag{11}$$

where:
$D(t)$ – public debt at the t time,
i – real interest rate,
remaining symbols as in equation 10.

Formula 11 shows that in a growing economy, without taking into account inflation, public debt is permanently sustainable, i.e. its relation to GDP is constant when:

1. When $i = g$, primary deficit is equal to zero. In other words, debt is financed entirely by the national economy.
2. If $i > g$, primary surplus is needed. However, the later the latter appears, the higher its level must be.
3. If $i < g$, primary deficit in relation to the public debt must be equal to the difference between the rate of economic growth and the real interest rate.

Foreign trade in agri-food products and state budget revenues from taxes paid by the food industry

During the period of system transformation, and then Poland's membership in the European Union, major changes in the Polish foreign trade in agri-food products occurred. The faster growth of exports than imports has led to a substantial change in the trade balance of the agri-food sector's foreign trade. Poland has evolved from a net importer, which it was until 2002, to an increasingly important net exporter of food. The value of exports has increased almost seven-fold between 2000 and 2013, and the value of imports more than four-fold. As a result, in 2013 the trade surplus in food turnover came close to EUR 6 billion (Fig. 2).

A particularly rapid increase in trade was taking place since 2003, as trade liberalisation with the European Union accelerated. The signing of a "double zero agreement" with the EU in 2002, which increased the access of Polish exporters to the Single European Market, accelerated the average growth rate of export value, mainly due to the increase in exports to the Member States.

Contrary to earlier fears arising from outdated production structures of Polish agriculture, food technology technological delay, less developed market structures, lack of branded products and low level of marketing and promotional activities, it turned out that the progress that was achieved in the preparatory period for integration with the EU[3], enabled the use of comparative advantages at the time of opening of the EU market and in subsequent years. Previously, this access was limited by the EU trade policy which, through high (sometimes prohibitive) tariff barriers, effectively protected the internal market, and preferential access was strictly limited (Szczepaniak I. 2012).

The subject of Polish foreign trade in agri-food products are primarily food industry products. Estimated share of food industry products in total Polish agri-food exports reaches as much as 80-85%. The share of food industry products in agri-food imports is lower and amounts to 70-75%. In turn, agri-food trade plays an important role in Polish foreign trade. The share of agri-food exports in the total export of Poland before the accession oscillated around 8-9%, in subsequent years it increased to nearly 10%, and since 2009 it has oscillated in the range of 11-12% (in 2013 it exceeded 13%). The share of agri-food imports in the total import of Poland was lower and in 2003-2008 it fluctuated in the range of 6-7%. Since 2009, the share of agri-food products in the total import has consistently exceeded 8% (in 2013 this ratio was 9.2%). These changes result from a much higher growth dynamics of trade in agri-food products than in other sectors (Ambroziak Ł., Szczepaniak I. 2013).

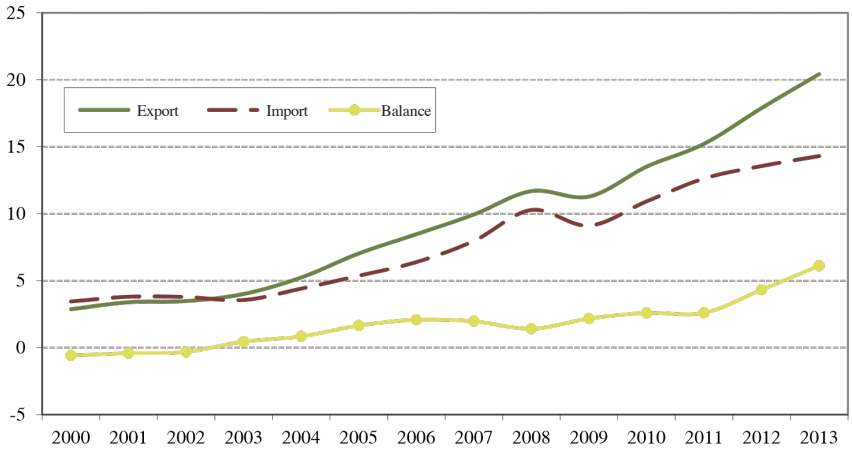
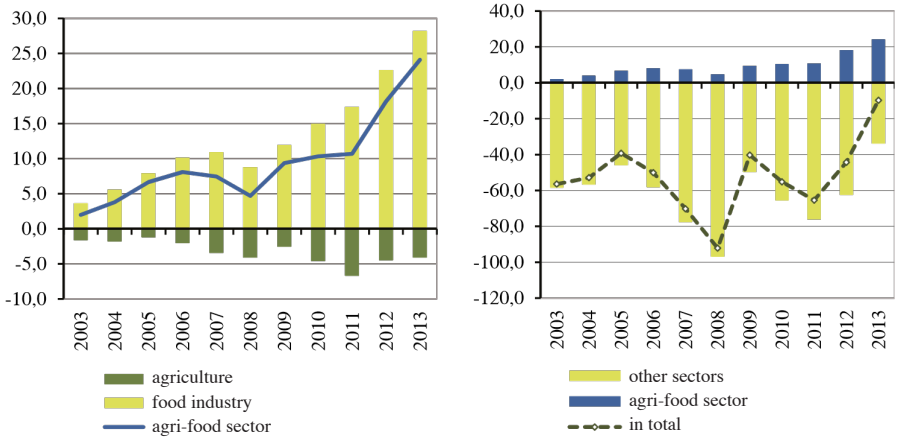


Fig. 2. Polish foreign trade in agri-food products (in PLN billion).

Source: own study based on the data of the Customs Administration Analytical Centre.

[3] Adaptation processes caused by shifting the food economy towards the market (including privatization processes with foreign capital participation), as well as high requirements concerning the standards and quality of the produced food played a decisive role. The presence of international retail chains on the Polish market with developed distribution channels in all Member States was also important.

The agri-food sector is one of a few branches of the national economy that has a positive trade balance. In the context of a significant deficit in the Polish non-food trade (in 2013, EUR 8.1 billion, i.e. PLN 33.8 billion), a high surplus in trade in agri-food products (EUR 5.7 billion, i.e. PLN 24.1 billion) is, therefore, of great importance for our trade balance. In 2013, this surplus covered over 70% of the deficit in trade in products of other sectors and had a significant impact on the direction of changes in Poland's total trade balance (deficit decreased by more than 3/4) – see Fig. 3b. The balance of trade in agri-food products is mainly influenced by the balance of trade in food products, which is positive and was growing rapidly since 2004, while the deficit in foreign trade in agricultural goods remains very deep (Fig. 3a).



a) products of the food industry and agriculture

b) products of the agri-food and other sectors

Fig. 3. Poland's trade volume balance (PLN billion).

Source: own study based on the data of the Customs Administration Analytical Centre.

The developed commodity structure of trade in agri-food products is advantageous for the Polish economy and confirms the thesis that the development of the domestic food industry is pro-export oriented. By exporting processed products, the producers benefit much more from the added value than by exporting only raw materials needed for their manufacture. In addition, industrial food processing for export allows for better use of resources and thus enables benefiting from economies of scale. Export of processed (final) products is also conducive to the promotion of the Polish food sector on external markets, which is more difficult to carry out by exporting agricultural raw materials or semi-finished products. On the other hand, import of raw materials (usually from other climate zones) and their subsequent domestic processing is more advantageous than import of finished products, as it helps to improve the balance of foreign trade, as well as to generate more added value, use economic potential more efficiently and create new jobs.

During the analysed period, both GDP and the external trade balance of agri-food products showed an upward trend, although the latter was characterised by much greater fluctuations (Fig. 4). However, the impact of the food balance on GDP should not be overestimated, although recently the relation has significantly increased. In 2012-2013, the balance of trade in agri-food products accounted for only 1.0-1.5% of GDP (in previous years, this proportion was clearly below 1%).

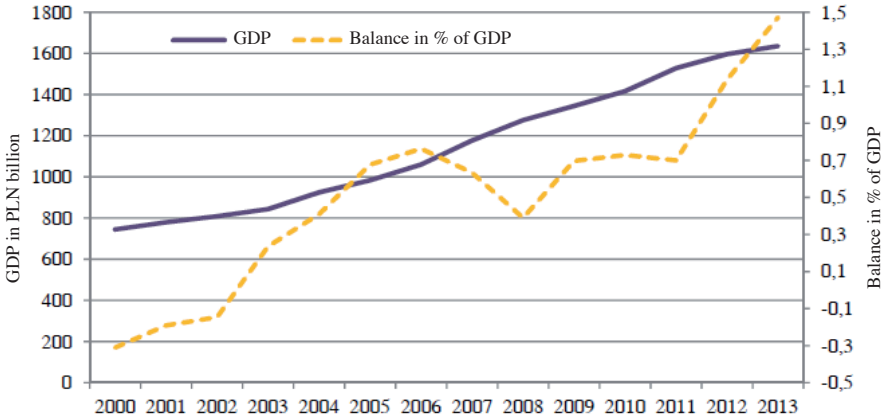


Fig. 4. Gross domestic product of Poland and the trade balance of Polish foreign trade in agri-food products.

Source: own study based on the data of the Customs Administration Analytical Centre and Central Statistical Office.

In the next step, an attempt was made to assess the contribution of the food industry and, consequently, the exporters from this sector to the state budget in respect of the taxes paid. From the performed calculations (Tab. 1), it follows that food industry enterprises are a significant and increasingly important contributor of taxes which make up the state budget revenue.

The largest role among the levied taxes is the excise duty. Therefore, any changes in the rates of this tax for the food industry are of great importance and should be well-thought, so that their effects are not counterproductive. Total taxes paid by food industry enterprises to the budget in 2011-2013 amounted to nearly PLN 74 billion, which in the following years was 9.4%, 10.2% and 10.6% of total tax revenues to the state budget, respectively. The share of taxes paid by the food industry in Poland's GDP was not high, however, and in the last three years it was at the level of only 1.5-1.6% (Tab. 1).

There are no precise statistical data concerning the payment of individual taxes by exporters of agri-food products or food industry enterprises selling their products abroad. However, available data on the commercial performance of the agri-food sector, as well as the Institute of Agricultural and Food Eco-

nomics – National Research Institute studies on the export orientation of the food industry (Szczepaniak I. 2012) allow for estimation of the tax burden scale in the group of exporting companies. In accordance with this estimate, these exporters contributed almost PLN 23 billion in taxes in 2011-2013, while the share of these taxes in the country's total tax revenues increased from 2.8% in 2011 to 3.5% in 2013 (although this was only about 0.5% of GDP). From among individual taxes, the largest inflow of funds to the budget came from the excise duty (from 7% to 9% of total budget revenues from this tax). The share of other analysed taxes in the state income from these taxes did not exceed 2% (Tab. 1).

It should be taken into account that only estimates of state budget revenues from taxes paid by exporters of food industry products were presented above. The net effect may vary considerably if we take into account budget expenditure related to transfers, promotion expenditure, etc.

Table 1

Food industry taxes and their role in the state budget in 2011-2013

Specification	Taxes in the food industry			including taxes paid by exporters of food industry products (estimation)		
	2011	2012	2013	2011	2012	2013
Excise duty						
Value (PLN million)	14,416.9	16,333.4	16,739.6	4,253.0	5,030.7	5,440.4
Share in total tax revenue (%)	24.9	27.0	27.6	7.3	8.3	9.0
VAT tax (balance)						
Value (PLN million)	4,766.6	5,242.5	5,433.9	1,406.2	1,614.7	1,766.0
Share in total tax revenue (%)	3.9	4.4	4.8	1.2	1.3	1.6
Corporate income tax (CIT)						
Value (PLN million)	1,501.7	1,501.9	1,121.7	443.0	462.6	364.6
Share in total tax revenue (%)	6.0	6.0	4.9	1.8	1.8	1.6
Personal income tax (PIT)						
Value (PLN million)	2,229.2	2,306.8	2,381.0	657.6	710.5	773.8
Share in total tax revenue (%)	5.9	5.8	5.8	1.7	1.8	1.9
Taxes in total						
Value (PLN million)	22,914.4	25,384.6	25,676.2	6,759.8	7,818.5	8,344.8
Share in total tax revenue (%)	9.4	10.2	10.6	2.8	3.1	3.5
Share in GDP (%)	1.5	1.6	1.6	0.4	0.5	0.5

Source: own study based on published and unpublished GUS data.

Econometric analysis

The next part of the empirical analysis is focused on the econometric assessment of the impact of changes in foreign trade in agri-food products on the national debt. The hypothesis of the influence of exports on economic growth (ELG vs GLE) was also reviewed. In view of the fact that agri-food trade is only a part of the foreign trade, we have also analysed the total exchange of goods in order to verify the reasonableness of the results obtained at a lower level of aggregation.

The study was based on quarterly data from 2002-2013. Interdependencies between the following variables (economic categories, the adopted symbols are given in brackets) were analysed:

- government deficit after consolidation (GovDebt), PLN million, according to NBP;
- GDP (GDP), PLN million, according to the GUS;
- PLN/EUR exchange rate (EUR), average of monthly data, according to NBP;
- total exports of goods (EXP_T), PLN million, according to Eurostat;
- export of agri-food products (EXP_Ag), PLN million, according to Eurostat;
- total net exports of goods, or trade balance (TB_T), PLN million, according to Eurostat;
- net exports of agri-food products (TB_Ag), PLN million, according to Eurostat.

In the empirical evaluation several methods were applied, starting from the simplest ones and ending with econometric models. In the first step, a graphic and correlation analysis was carried out between changes in the government debt and exports and net exports of agri-food products. The analysis was based on seasonally adjusted data without a long-run trend. The X-12-ARIMA method (Grudkowska S., Paśnicka E. 2007, X-12 ARIMA 2007) was used for seasonal data adjustment, while the Hodrick-Prescott filter (Hodrick R., Prescott E. 1997) was used for trend elimination.

In the next step, Granger causality analysis was used for pairs of selected variables in order to grasp the direction of dominant short-run dependencies. We have focused on searching the reasons for the changes of the government deficit. The analysis was preceded by the evaluation of stationarity of individual time series with the use of the augmented Dickey-Fuller test (ADF) for a unit root (more on this subject, e.g., Enders W. 2010). The causality test assumes that the variable X Granger-causes the variable Y, if using it, we can improve the quality of the predictions of the variable Y. Due to the non-stationary character of variables, causality was examined with the help of Granger test of the following structure (Lütkepohl H., Krätzig M. 2007; Pindyck R., Rubinfeld D. 1998):

$$\Delta y_t = A_0 D_t + \sum_{j=1}^{k} \alpha_j \Delta y_{t-j} + \sum_{j=1}^{k} B_j \Delta x_{t-j} + \varepsilon_t \qquad (12)$$

where:
A_0, α_j, β_j – model parameters,
D_t – deterministic variables to take into account the constant and seasonal fluctuations,
y and x – model variables to be tested,
k – number of delays,
Δ – growth of variables,
ε – random element.

The null hypothesis of absence of causality assumes $\beta_1 = \beta_2 = \ldots = \beta_k = 0$. In turn, an alternative hypothesis declares a significant importance of delay values of the variable x. In the analysis of causality, the above restrictions were evaluated with the F-test (Wald test). Delays were selected on the basis of Akaike's criterion.

In the next step, the occurrence of long-run dependencies between GDP, GovDebt, EURO and one of the variables expressing total exports (EXP_T) or agri-food exports (EXP_Ag) was tested. Cointegration of variables was studied using the Johansen procedure, which is based on VAR and VECM vector models. The vector error correction (VEC) model includes a set of equations, in which each of the variables is explained by their past observations and past observations of other variables (Kusideł E. 2000; Tsay R. 2010):

$$Y_t = A_0 D_t + \sum_{i=1}^{k} A_i Y_{t-i} + \varepsilon_t \tag{13}$$

where: Y_t – vector of current observations, A_0 – matrix of parameters with variables of vector of deterministic variables D_t, A_i – matrix of parameters with delayed variables of vector Y_{t-i}, where the maximum government delay is k, e_t – vector of random variables.

Non-stationary time series shall be cointegrated if their linear combination is stationary I(0). It is called a long-run equilibrium path. For testing the cointegration dependencies, the VAR model is transformed into a VECM model (Kusideł E. 2000; Tsay R. 2010):

$$\Delta Y_t = \omega_0 D_t + \prod Y_{t-1} + \sum_{i=1}^{k-1} \prod_i Y_{t-i} + \varepsilon_t \tag{14}$$

where: $\prod = \sum_{i=1}^{k} A_i - I$, and $\prod_i = -\sum_{j=i+1}^{k} A_{j^i}$. The matrix Π is called the matrix of long-run equilibrium and consists of a matrix of cointegrating vectors β and an adjustment matrix to long-run equilibrium α, which can be written as $\Pi = \alpha \cdot \beta$. is the matrix of short-run parameters.

For Johansen's cointegration test, the rank of Π matrices is used, which is equal to the number of independent cointegrating vectors. This regularity is used in the Johansen trace test to determine the number of cointegrating vectors (Kusideł E. 2000):

$$LR_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \tag{15}$$

where: LR_{trace} – test statistic, T – number of observations, $\hat{\lambda}_i$ are proper values of the matrix Π.

The trace test is used to test the null hypothesis that the number of cointegrating vectors is equal to or less than r. An alternative hypothesis assumes that this number is greater than r.

Correlating random elements between each other enables converting the VECM model to a structural form and exploring better the correlation between the variables, as well as the importance of each variable in explaining others. To this end, impulse response function – IRF and forecast variance error decomposition – FVED is used (more details Kusideł E. 2000; Lütkepohl H., Krätzig M. 2007).

The statistical analysis starts with a graphic presentation of the dependencies between the state budget deficit and exports of goods and the balance of external trade in goods (all goods and agri-food goods). Given that the trend and seasonality may interfere with the inference, Figure 5 shows seasonally adjusted data and the data without the trend.

The PLN/EUR exchange rate shows the most significant positive correlation with the budget deficit (correlation factor 0.63). Due to the fact that the foreign national debt expressed in EUR represented 15-22% of Poland's total debt in 2002-2013, the PLN/EUR exchange rate has a strong influence on the fluctuations in the government deficit. The dollar exchange rate should be less significant, as the share of the USD-expressed debt in 2013 did not exceed 6%.

Foreign trade links (total and agri-food trade) to debt are less obvious. Correlation coefficients are between 0.18 (exports in total) and 0.5 (agri-food exports). However, one can notice that (Fig. 5) the debt expressed in EUR precedes foreign trade performance. Exports are also negatively correlated with GDP.

The subsequent part of the study tried to answer two questions. Firstly, what is the direction of the dependencies between certain variables and, in particular, between debt and foreign trade? Secondly, is there a long-run equilibrium between the selected variables, which in principle indicates in itself the existence of causal dependencies?

Due to the fact that the analysed variables were of a non-stationary character (the only concerns are connected with the EURO variable, for which the test results were ambiguous), integrated of order one, causality models are based on the first increments of logarithms of variables. Below, the directions of short-run impulse flow between pairs of variables (symbols as above) are determined using arrows (without entering into the details of individual equations):

- GDP → GovDebt,
- GDP → EURO,
- GDP → TB_T,
- GovDebt → TB_T,
- GovDebt → Ex_T,
- GovDebt → Ex_Ag,
- GovDebt → EURO,
- EURO → TB_T,
- EURO → TB_Ag.

In the above context, it turns out that the level of government debt determines the development of foreign trade and not the other way round. First of all, it influences the exchange rate, so important for foreign trade. The only variable that "Granger-causes" the government debt is GDP. No statistically significant causal links between the government debt and balance of foreign trade in agri-food products were identified. There were also no statistically significant links between changes in GDP and exports or the balance of trade in agri-food products.

In summary, this analysis allows to formulate an assumption saying that the main short-run directions of dependencies of causative nature can look like the following: GDP → GovDebt → EURO → TB_T, TB_Ag, EXP_T, EXP_Ag. In this context, exports (balance) appear to be a result category, which suggests that this is a GLE type dependency. It is possible for exchange rates and certain commercial categories to show bilateral dependencies.

The occurrence of long-run dependencies between variables was also analysed. Further analyses focused on the impact of exports (in total and of agri-food products). The results of the trace test are included in Table 2. The null hypothesis of no cointegration between the variables was rejected in both variable sets ($p = 0.05$)[4]. We could carefully assume that we are facing one cointegrating vector, which has the following implications. Firstly, it indicates that there is a long-run dependency between the variables. Secondly, it is a confirmation of the existence of cause-effect dependencies. Thirdly, the use of the VECM model is appropriate for further analysis.

Subsequently, an attempt was made to assess the interdependencies between the government, changes in GDP, development of PLN/EURO exchange rate and exports. The characteristics of the data (non-stationary character and the existence of one cointegrating vector) suggest a possibility of using the VECM model, which allows for a comprehensive analysis of both short- and long-run dependencies.

[4] It is interesting that the test also partially suggests a full row of matrices. This may be due to the fact that some of the variables may be stationary (or integrated to a fractional degree); this is the case of, for example, the EURO variable).

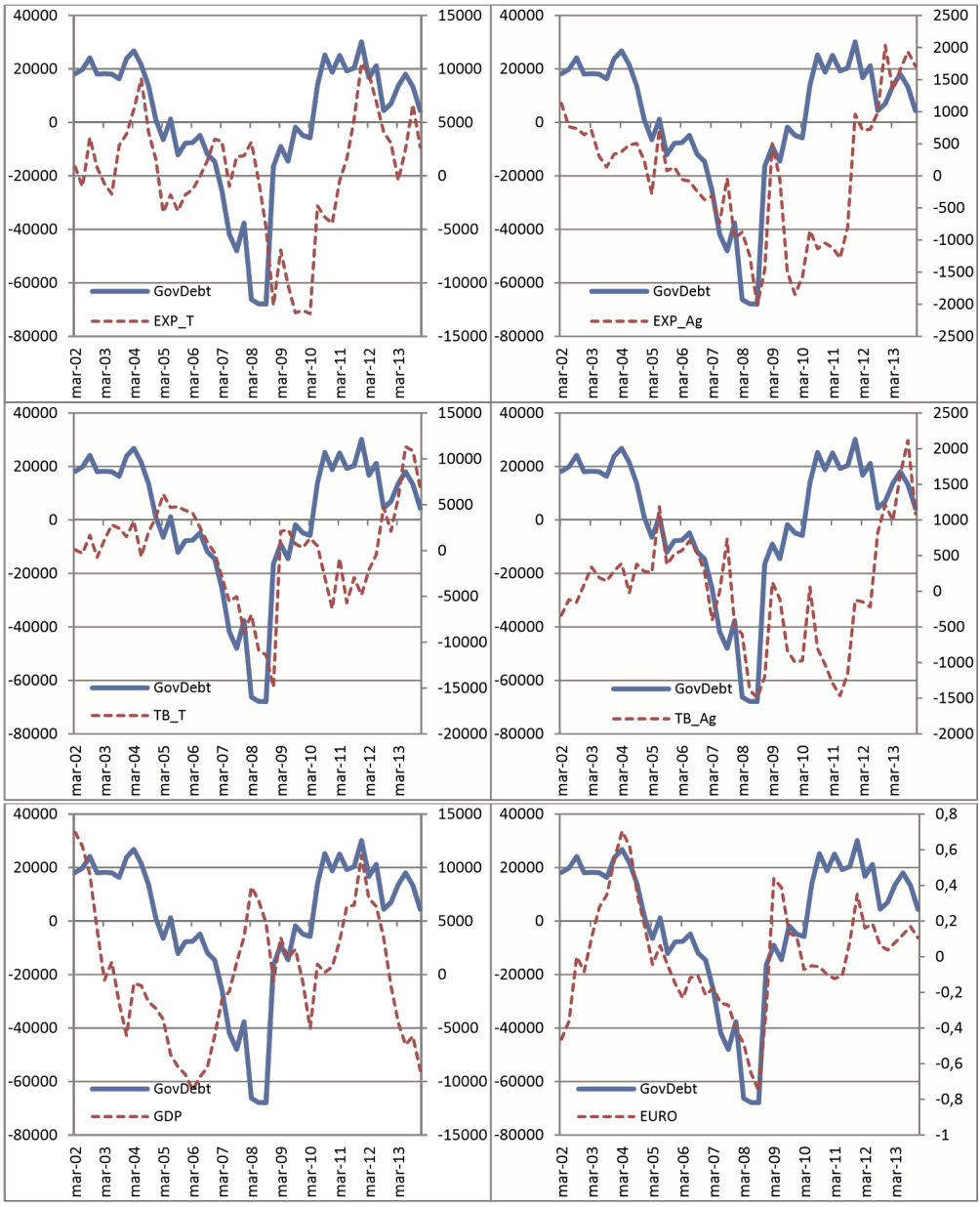


Fig. 5. Government deficit (left axis) vs exports, balance of trade, GDP and PLN/EUR exchange rate (right axis), data adjusted for trend and seasonal fluctuations

Source: own calculations based on data from NBP, GUS, Eurostat.

Table 2

Results of long-run dependencies tests using the Johansen trace test

r	GDP, GovDebt, EURO, EXP_T			GDP, GovDebt, EURO, EXP_Ag		
	Own value	LR statistics	*p* value	Own nvalue	LR statistics	*p* value
0	0.4169	52.3870	0.0162	0.3789	48.2390	0.0443
1	0.2640	27.5760	0.0900	0.2504	26.3280	0.1224
2	0.1811	13.4750	0.0981	0.1829	13.0680	0.1124
3	0.0890	4.2861	0.0384	0.0788	3.7746	0.0520

Source: own calculations.

Table 3

Estimates of VECM models

Symbols	Cointegrating vectors β	Adjusted vectors α	Student's t-test	*p* value
Model 1				
DGP	1.000	-0.043	-2.009	0.052
GovDebt	-1.180	0.062	1.628	0.112
EURO	-0.478	0.120	1.758	0.087
EXP_T	-1.684	0.178	3.100	0.004
Model 2				
DGP	1.000	0.001	0.889	0.380
GovDebt	-35.887	-0.003	-2.019	0.051
EURO	32.480	-0.008	-4.341	0.000
EXP_Ag	20.732	-0.012	-3.294	0.002

Source: own calculations.

Two VECM models were estimated on the basis of the logarithms of variables (Tab. 3) with an unlimited non-zero term and seasonal variables, assuming delays $k = 2$ (Akaike's criterion):

- Model 1, in which the development of total exports was analysed in comparison with changes in GDP, government debt and exchange rate.
- Model 2, in which the development of the exports of agri-food products was analysed in comparison with changes in GDP, government debt and exchange rate.

The estimated models meet the statistical-formal requirements (normal distribution of random element according to the Doornik-Hansen test and no autocorrelation of random element according to the Ljung-Box test). The estimated model 1 indicates that the adjustment to the long-run equilibrium occurs in total exports and to a lesser extent also in the exchange rate and GDP. The government

debt does not adjust to the equilibrium, which can be interpreted as a reason for changes in the exchange rate and exports, and even GDP. In the second model, the export of agri-food products and the exchange rate adapt to the long-run equilibrium. No adjustments to the equilibrium on the side of GDP and government debt were determined (Tab. 3). Essentially, these conclusions are similar to those obtained from the Granger causality test, but there is no clear answer to the question of the nature of the dependencies between GDP and government debt.

In the next step, an analysis of the forecast error variance decomposition (for 5 years horizon) to determine the meaning of each variable in the development of government debt was performed (Fig. 6). According to the first model, the debt is explained in around 4.5% by changes in the exchange rate and in 14% by the total exports, while in 13% by changes in GDP. Already on this basis, one can believe that, since the share of the export of agri-food products in total exports is around 10%, its impact on the government debt is minor. According to the estimates of the second model, the government debt is explained in 6% by GDP, in 14% by the PLN/EURO exchange rate and in 3% by agri-food export. Thus, the lesser importance of agri-food exports was confirmed. In turn, a comparison of these shares with the shares obtained on the basis of the first model indicates that VECM models are highly sensitive to changes in the set of variables (thus we suggest to be careful in interpreting the results).

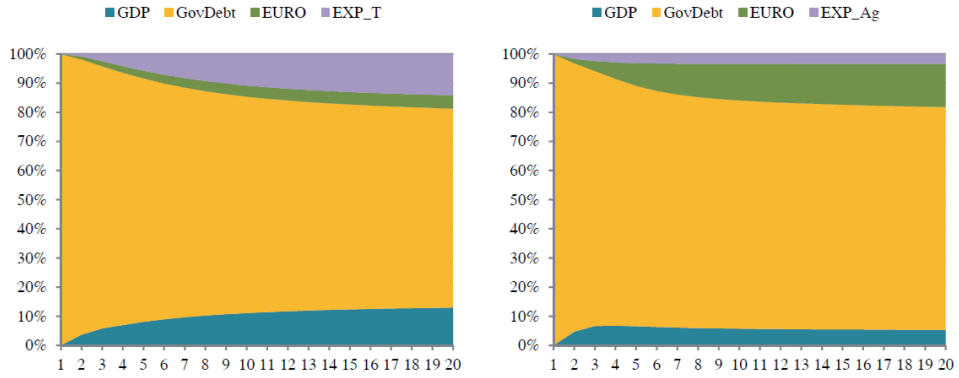


Fig. 6. Forecast error variance decomposition of the GovDebt variable obtained on the basis of alternative VECM models

Source: own calculations.

The research based on VECM models is complemented by the analysis of the impulse response. It enables the identification of a mechanism generating changes in the economic system. These results should also be interpreted with some degree of caution, as these methods are quite sensitive to the characteristics of the data, the structural changes or order of the variables.

Impulse analysis obtained on the basis of the first model indicates that GDP growth lowers government debt (and strengthens euro and the export growth). Conversely, the increase in government debt also has a positive impact on GDP (which may be related to the investments in recent years). Given the dominant direction of the dependencies, debt increase contributes to the weakening of the PLN/EUR exchange rate and, consequently, to the improvement of the profitability of exports. In turn, the export growth results in a reduction of debt. Therefore, taking into account the whole set of relationships and dependencies (net effect), the weakening of the zloty does not have to necessarily contribute to the increase in debt. The conclusions on the general mechanism based on the second model are consistent with those set out above.

Figure 7 provides only an answer to the question of how particular variables react to the growth of total exports and agri-food exports? The impact of export growth on GDP is positive and contributes to the reduction of government debt and strengthening of the zloty. The cumulative effects (5 years) of an increase in exports of agri-food products by 1% on the reduction of debt amount to 0.06%, while 1% increase of this export translates into an increase in GDP by 0.004%. According to the first model, total goods export growth by 1% results in reduction of government debt by about 0.14% and GDP growth of 0.08% within 5 years.

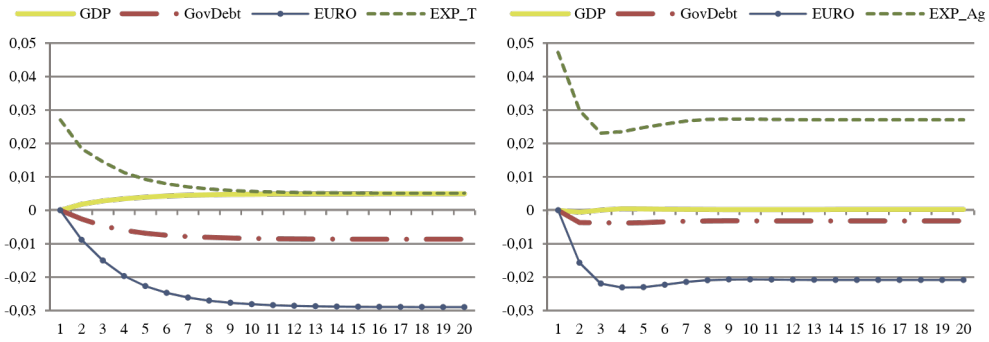


Fig. 7. Impulse response functions (IRF) of one standard deviation in the export (total or agri-food) variable derived from the VECM model.

Source: own calculations.

Conclusions

1. Theoretically, growing exports and net exports of agri-food products can reduce budget deficit and public debt, as well as fiscal ratios calculated on their basis. This can be done either directly (through the balance of the initial budget deficit) or indirectly, i.e. through changes in the volume of GDP and its real growth rate. Unfortunately, there are no automatic dependencies

in this area. It is obvious, given that the above exports and net exports are a small percentage of public debt and GDP. Moreover, there are many other development determinants of the above-mentioned categories, which are only partially developed by the national economic policy.

2. Positive balance of the foreign trade in products of the agri-food sector (with a high trade balance in the food industry products) and the increasing share of food in Poland's total exports clearly confirm positive structural changes which have taken place in the Polish food industry and their increasing importance for the national economy. The increase in the competitiveness of this sector and its broad connections with foreign markets serve not only to gain outlets for Polish food, but have also become a factor which stabilises the entire internal market and limits the dependence of the current situation on fluctuations in the economic situation on external markets. In terms of a significant deficit that occurs in the Polish trade in non-food products, high surplus in the trade in agri-food products is, therefore, of great importance for our trade balance. However, from the point of view of Poland's GDP changes, the food exchange balance does not play a significant role.
3. Food industry enterprises are a significant tax payer and their share in the total tax revenues of the state budget is about 10%. Excise duty plays the most important role among the taxes paid. Since Poland's accession to the EU, the increase in the export orientation of the food industry has led to an increase in the role of the taxes paid by exporters of food products (3.5% of the state's tax revenues in 2013). In terms of GDP, the significance of taxes coming from the food industry (including exporters) still remains, however, marginal (about 0.5% in 2012-2013).
4. Results of econometric analyses based on tests of causality and error correction models indicate that the statistical dependencies between debt, GDP, changes in exchange rates and the results of foreign trade are very complex. In general, exports of goods and the trade balance (in total and in agri-food products) are more driven by changes in government debt and GDP than are at the root of these changes. This is due to the impact of debt on the exchange rate development. Analyses confirm that the impact of exports of agri-food products and total goods on GDP is positive and, at the same time, contributes to a reduction of government debt. Estimates obtained on the basis of econometric models show that one-percent increase in exports of agri-food products reduces public debt by 0.06%, while one-percent increase in total exports of goods by 0.14%.

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