

ANDRZEJ CZYŻEWSKI
KATARZYNA
SMĘDZIK-AMBROŻY

The efficiency of the agricultural sector in Poland in the light output-input model¹

1. Introduction

The highly complex nature of the relations between the suppliers of the factors of production and material costs for the agricultural sector, and the farms and the final recipients of their final products, meaning the existence of many of them at the same time in the role of supplier, the producer and the consumer, triggers the necessity to look for increasingly more and more sophisticated tools to evaluate the effectiveness of the agricultural sector through the prism of the relationship of the type of disbursement - effect. Showing this type of relations underpins the accounts of interbranch flows, published by the majority of statistical offices of the particular national economies, structured by sector (branches) occurring in them, including the agricultural sector. The essence of the account of interbranch flows refers to the model of determining quantitative relations among the different sectors, based on the type of relations

Professor Andrzej Czyżewski
Poznań University of Economics
Ph.D. Katarzyna Smędzik-Ambroży
Poznań University of Economics

▼
1 The project was funded with the means of the National Science Centre allocated on the basis of the decision number DEC-2012/07/D/HS4/01601.

disbursement – effect in the scale of the entire economy, as well as individual branches (sectors). At the same time interbranch flows, through the analysis of the relationship type of supplier-recipient, flesh out the ideas of the functioning of the economic mechanism, its internal relationships and dependencies.

The main goal of the article is to point out the applicability of the *input-output* model (account of interbranch flows) in macroeconomic assessments of the effectiveness of the agricultural sector. Serve ago following research tasks: the determination of indicators to assess the effectiveness of the agricultural sector on the basis of *input-output* model and the use of *input-output* table for the Polish economy in the years 2000 and 2005 to assess the effectiveness of the agricultural sector in Poland.

The idea of input-output has its own dimension, both theoretical, deeply embedded in the history of economic thought, and the application referring to publishing the relevant balance sheets (Czyzewski A., Grzelak 2012 pp. 104-109). The first who noticed and took advantage of the sense of the flow analysis was Quesnay, the court physician of Louis XV, who, using an economic table, presented flows of goods between the three branches of the economy: agriculture (production class), the sphere of non-agriculture (arid class) and the owners (the secular authority and the clergy). On this basis he presented the interdependence of the manufacturing sphere of the economy, the distribution of the social product manufactured and the sphere of income, answering the question: who and what kind of income gets (Quesnay F. 1928). In the input-output language also the Marxian analysis of the processes of reproduction is presented (Marks K. 1955, p. 418. 540. 568). It shows the dependencies between the two branches of the economy: production of the means of production (I) and production of means of consumption (II), and on this basis formulates the basic equations of general balance in the economy. The idea of presenting the theory of general balance, by the presentation of the related systems of equations, was concretised also by Walras (Walras L. 1926, p. 491.). The four systems of equations of production, in the conditions of openly competitive prices, he presented a general balance model in a relatively complete form (Czyzewski A. 2011, p. 5-6). Modern analyses are based on Leontief's most transparent model of the relations of type supplier – recipient, as a record of checker material and financial flows (Leontief 1936). Its essence comes to the assumption that the national economy is the aggregate of resources and streams consisting of several systems coupled together: manufacturing and services and foreign issues, households, budget and banks, which are described with the use of the by disbursement and effects method

(input-output) in the tabular (checkered) form. This model consists of four parts.

The first one presents the different stages of production specifying the meeting of the intermediate demand of the production branches, including the agricultural sector. The lines relating to agriculture include descriptions of streams of flow of products for which the (intermediate) demand was carried out by other branches, in order to further process them. And the columns show the cost structure of the individual manufacturers: branches (sectors), and the entire economy. Thus, the columns relating to agriculture include the structure of purchases of goods and services (except for labour costs, which are provided in the third part) realized by agriculture to order to create agricultural production (Czyzewski A. 2011, p. 24, 25). The second part refers to the final demand. Its recipients are: the individual and collective consumer (society), as well as the investment sphere acquiring fixed and current assets. In this section, the exporter may also occur if the "foreign" is not treated as a branch of production (in this case it shall be transferred to the first part). In the agricultural sector, assessment refers to the streams of the distribution of agricultural products, used to meet the final demand reported by the economic entities, as well as the export of agricultural products (Czyzewski A. 2011, p. 24). The third part shows the income generated in the branches of production. It concerns not only the income received in the branches (sectors), but also the retransfer of income received in advance through the state budget. The lines mention the individual elements of the value added, including salaries and operating surplus, but also the influence of changes in the quantity of issue money and the liability resources for the amount of the revenue and taxation, and depreciation. The information contained in this part of the model can evaluate the macroeconomic effects of agricultural activities, including, in particular, the size of the economic surplus, value added in agriculture, or the volume of imports of products for agriculture. The fourth part refers to the division of the generated revenue. In a market economy it shows a breakdown of gross income (including depreciation) of individual consumers, the budget and banks. On the revenue side of the budget, it consists mainly of income from fees and taxes, but also from other titles, such as corporate profits. On the expenditure side – the funds allocated for social consumption, non-productive investments, grants and subsidies to businesses, local budgets, as well as the possible allocation of the proceeds from other titles. This table design provides the opportunity to observe both the factual side, as well as financial flows (Czyzewski A., Grzelak 2012, p. 174). The market mechanism that depreciates agriculture in the process of generating income, by

a transfer of the earned economic surplus from producers to processors, traders and consumers is in this part modified by budget retransfers, using mostly non-automatic stabilizers of the economic trend, referring both to agriculture and rural areas. As a result of direct financial support, mainly direct payments, but also through other market regulators and subsidies, agricultural producers receive additional income to improve their income situation towards the level of the average household in the country or those who are employed outside of agriculture (Czyzewski B., Mrowczyńska-Kaminska 2010, p. 18, 19).

Thus, the table of interbranch flows is a reflection of all business transactions taking place between the various sectors in the national economy. It illustrates the relationship and dependencies, enabling a comprehensive analysis of the costs, value added and directions of flows of resources and annuity between the productive sector and services, abroad, households, budget and banks. In the agricultural sector, it is basically the only tool available, enabling macroeconomic and engaging many aspects assessment of the effectiveness of its components on the general background (of other sectors of the entire national economy). This allows both the assessment of financial performance, specifying the impact of market relations on the economic situation of the sector and also the relationships stemming from discrepancies in terms of resource productivity. Useful is also the fact that the interbranch flows statistics need not be confined to one region of the world, or one economy. The input-output model allows the agricultural sector to be seen not only as at the national or regional level, but as an integrated food system in the global economy (Coleman, Grant, Josling 2004, p. 88). Therefore, it is hypothesized that the input-output model is a useful tool in macroeconomic assessments of the effectiveness of the agricultural sector. The aim of this article is to evaluate the effectiveness of the agricultural sector in Poland on the basis of the latest available input-output statistics.

2. The input-output model in the evaluation of the effectiveness of agri-food sector

The balance of inputs and outputs, as a developed form of a synthetic account of the creation and distribution of the global product and national income, allows not only to recognize the linkages between the various branches (sectors) of the national economy, but also allows to make complex calculations of basic economic relationships, appropriate to the sectoral performance analyses. On the basis of the statement of cash interbranch flows one can calculate measuring instruments of economic efficiency of the individual branches (groups of companies)

against the others or those separated from the immediate environment. We mean, inter alia, such measures of the economic efficiency of the flows, as e.g. the relationship of the output in a particular industry (sector) to the own costs (material, personal and depreciation) borne for their production or conversion of pure net production of per one thousand PLN of the consumed fixed assets (effectiveness of fixed assets) or per one employee (labour productivity). These are the basic indicators of sectoral assessment of financial performance, which input-output balances allow.

Table 1 Indicators of the effectiveness of the agricultural sector based the statistics of monetary interbranch flows

Name of indicator	Construction of indicator	Interpretation
effectiveness (efficiency) of own costs	output / own costs including material costs (I part), personnel and depreciation (III part)	value of output per own costs unit
effectiveness (efficiency) of fixed assets	pure gross production / consumption of fixed assets (depreciation - III part of the table)	value of pure gross production per consumed fixed assets unit
effectiveness (efficiency) of work	pure gross production / personnel costs (III part of the table)	value of pure gross production per labour unit
absorbency of costs - the converse of own cost efficiency ratio	own costs / output	value of own costs per unit of global created production
technical factor of production (direct consumption of materials)	material costs (I part) / output	value of material costs per unit of global created production
absorbency of assets	consumption of fixed assets (depreciation - III part of the table) / output	consumption of fixed assets per unit of global created production
absorbency of labour	value of personnel costs / output	labour charge per unit of global created production

Source: own study based on Czyzewski A. 2011

Going further, the reversal of cost effectiveness ratios and the different types of inputs enables the assessment of “absorption capacity”, therefore, the absorption of direct and indirect current expenses and current assets needed to produce a unit (a zloty) of the effect (production). Thus, the goal is achieved due to, among others, the factors of the absorbency of costs, the direct material consumption, as well as the absorbency of property and labour. The ratio of direct material consumption is called the technical quotient of production. It determines the relation of the value of goods consumed directly by the test branch (group of companies) to the value of the production volume. It is, therefore, the relationship of the current (annual) consumption of raw materials, spare parts, energy and services to the value of the global created production. Thus, the direct consumption of materials corresponds to the notion of the material costs of production. In a similar way as the coefficients of direct absorbency of materials, one can estimate coefficients of labour consumption in specific areas of production, absorbency of assets in relation to the active production assets of the individual branches (sectors), as well as the absorbency of costs which is the reversal of ratio of the effectiveness of own costs (see table 1).

Basic interbranch interdependencies published in national statistics. This applies to both direct material consumption rates and various measures of effective production of the particular branches or group of companies (Czyzewski A. 2011, p. 25). It is also worth mentioning of the use of the input-output model to the assessments of the agricultural sector in the regional structure, which allows for a comparative analysis of the regions (provinces) in terms of the discussed indicators. In the event of such an approach, however, the significant shortage of the source has to be taken into account. There is, in fact, shortage of input-output tables in the regional structure, published by the statistical office. A significant difficulty in perennial comparisons is also due to the remoteness in time of the publication of flow statistics (in Poland every 5 years) and with a considerable time shift (about 4 years) (Czyzewski A., Grzelak 2012, p. 174).

3. An attempt to use *input-output* models to evaluate the efficiency of the agricultural sector in Poland, in 2000 and 2005

This part of the study describes an attempt to assess the efficiency of the agricultural sector in Poland on the basis of the input-output balances for the years 2000 and 2005. For this reason, the indicators listed in Table 1 were used. It should, however, be noted that only in statistics for 2005 the value of the depreciation of the assets was included as a separate category in the interbranch

flows. The balance sheets for 2000 did not include any category that would allow to infer about the costs associated with the involvement of fixed assets in the particular branches of the economy in Poland. The statistics for the year 1995 included the value of fixed assets and gross fixed capital formation, then the balance sheet for 2000 omitted these items, only the statistics for 2005 included the value of depreciation. It is the most appropriate category, allowing to infer about the annual costs of machinery and equipment involvement in agriculture. Thus, the calculation of some of the indicators listed in Table 1 for 2000 proved not possible.

Table 2 Indicators of the effectiveness of the agricultural sector in Poland based on the statistics of interbranch flows in years 2000 and 2005

Name of indicator	2000	2005
effectiveness (efficiency) of own costs	-	1,43
effectiveness (efficiency) of fixed assets	-	4,20
effectiveness (efficiency) of work	6,68	6,39
technical factor of production (direct consumption of materials) _	0,66	0,52
absorbency of labour	0,05	0,07

Source: own study based on GUS (2004), Input-output table in the current basic prices in 2000. Warsaw. GUS (2009), Input-output table in the current basic prices in 2005. Warsaw

On the basis of the analyses carried out it can be noted, however, that the efficiency of the agricultural sector in Poland in 2005, compared to 2000, increased, which is evidenced by an increase in the share of gross added value in the value of the output. In 2005, this share was 45% compared to 34% in 2000. Direct material consumption also decreased, measured by the value of the indirect production needed to produce a unit of the output. In 2005 it amounted to 0.52, which means that the share of indirect production in a zloty of the global agricultural production was then slightly more than 50%, while in 2000 it was nearly 15% higher. This indicator stood at the level of 0.66 then. In 2005, the agricultural sector in Poland as compared to 2000, showed slight decrease in productivity and increase in labour consumption of production. In 2005, the labour productivity indicator was 6.39 as compared to 6.68 in 2000. In 2000 labour consumption reached the level of PLN 0.05 and

in 2005 PLN 0.07. Thus, in order to produce a zloty of agricultural production in 2000, it took about PLN 0.02 less costs related to employment than in 2005. The differences in the efficiency of labour in the two years compared were, therefore, small. Definitely a greater difference occurred in the field of direct material consumption (15% decrease in the share of indirect production of the output of the agricultural sector in 2005 compared to 2000) and the total profitability (12% increase in the share of gross value added in the output of the agricultural sector in 2005 against 2000). It enables to state that the effectiveness of the agricultural sector in Poland in 2005 as compared to 2000, significantly improved, which was primarily the result of limitations of direct material consumption and, therefore, resulted from the implementation, after Poland joined the EU, of more efficient manufacturing techniques, probably resulting from the implementation of numerous EU programmes aimed at the modernization of the agricultural sector, and also resulted from including farms in Poland the in the programme of the acquisition of payments for certain agricultural products (e.g. Czyzewski A., Stepień 2009, pp. 231-239, Czyzewski A., Poczta-Wajda 2009, pp. 202-209). The components of the gross value added and output in the input-output tables are net taxes which include taxes on products less subsidies. This group includes also, with respect to the agricultural sector, the following transactions *in plus*: the tax on goods and services to pay duties and other import charges, sugar fees and *in minus* subsidies on products. In 2005, the Polish agricultural producers, thanks to the Polish accession to the EU, received supplementary subsidies supporting the following plants: basic crops (cereals, oilseeds, proteins), hops, potatoes, tobacco (Smedzik-Ambrozy K. 2012, pp. 81-86). As a result, in 2005 the value of net taxes in the agricultural sector specified in the table of interbranch flows amounted to more than PLN 3 million *in minus*, which means a surplus of subsidies over taxes of nearly PLN 500 thousand *in plus* in 2000, which meant a surplus of taxes over subsidies on products. Thus, the growth of output, and also of the gross value added of the agricultural sector in Poland after the accession to the EU also resulted from the impact of subsidies on agricultural products. However, bearing in mind that in 2005, the global production of the agricultural sector increased by almost PLN 23 million (40%), and the gross value added of more than PLN 16 million (85 %) compared to 2000, it should be stated that the increase of the efficiency of the agricultural sector in Poland in 2005 compared to 2000, resulted primarily from the implementation of more efficient manufacturing techniques and the impact of favourable exogenous conditions (increase in prices of most agricultural products after the Polish

accession to the EU and a significant increase in their exports to foreign markets²). To similar conclusions have also led research of B. Czyzewski and A. Grzelak (e.g. Czyzewski B. 2013, Grzelak 2012, pp. 104-109). Based on a static analysis of the interbranch flows for 2005 it can also be said that agriculture in Poland achieved higher labour efficiency than that for the fixed assets that year. It amounted to PLN 6.39 against PLN 4.20 in case of the indicator of the efficiency of fixed assets. Thus, on average, each zloty engaged in the agricultural sector, intended to remunerate the labour factor generated PLN 6.9 of the gross value added (it can be identified with the gross income from agricultural production), and 1 zloty spent on depreciation of the fixed assets brought, on average, PLN 4.20 of this value. It should also be added that the effectiveness of own costs amounted to PLN 1.43, which allows to specify the overall profitability of the agricultural sector in Poland in 2005 at 43% - without a compensation for the factor of the earth (the own costs include, according to Table 1, the cost of materials, personnel and depreciation).

The analyses carried out show significant fitness of the interbranch flows accounts for the macroeconomic evaluation of the effectiveness of the agricultural sector. On their basis, a dynamic assessment of the amount of output was carried out, as well as gross value added, direct material consumption and efficient use of labour resources in the agricultural sector in Poland in 2005 in relation to 2000. No pricing of depreciation in the statistics of the interbranch flows in 2000, however, prevented from inferences on changes in the efficiency of the use of fixed assets in the analyzed period. The overall assessment of the effectiveness of the agricultural sector in Poland, consisting of the assessment of the indicators listed in Table 1 was possible only on the basis of flow statistics for the year 2005. Hence, it is important that statistical offices, preparing input-output tables, apply a uniform methodology for their preparation. This will allow for dynamic evaluation of the effectiveness of individual sectors included in the national economies, including the agricultural sector, in a long time, also increasing the applicational usefulness of the input-output model.

▼
2 In 2003, for the first time after 1993, Poland achieved a positive balance of trade in agricultural products of approximately USD 500 million. In 2004, it doubled to over USD 1 billion. The export of agri-food products increased by 40% then. First of all, there was a large increase in the value of exports of the meat industry from 660 million to over USD 900 million (Czyzewski A., Smedzik-Ambrozy 2013, p. 54-59).

4. Results

Turning to the conclusions, it must be stated that:

1. The account of interbranch flows is an important tool to assess the agricultural sector, through the prism effect - effort relationship. It also allows the analysis of the processes taking place in the sector against the background of the general economy and in relation to each of the branches appearing in it, which causes invaluable usefulness of this tool for macroeconomic cross-sector analyses.
2. The input-output model allows not only to recognize the linkages between the various branches (sectors) of the national economy, but also allows to make complex calculations of basic economic relationships, appropriate to the sectoral performance analyses, which is proved by making a dynamic assessment of the effectiveness of the agricultural sector in Poland in 2005 with references to 2000, using the input-output statistics for these years.
3. As a result of these analyses it was demonstrated that after the accession to the EU an increase in the efficiency of the agricultural sector in Poland was noticed. This resulted primarily from the implementation of more efficient manufacturing techniques, and the impact of favourable market conditions such as increased prices of most agricultural products and their export to foreign markets. To a lesser extent this increase resulted from the impact of subsidies on agricultural products introduced after 2004. Static analyses also made it possible to say that the agricultural sector in Poland in 2005 was characterized by higher efficiency of labour than that of fixed assets.
4. Considerable difficulty in the analysis turned out to be the omission of depreciation expenses in the interbranch flows account for Poland in 2000, which prevented a reference of performance indicators of the fixed assets to each other, in comparable points in time. Another obstacle to the dynamic analyses is also a significant time distance of each publication of output statistics, which causes some difficulties in the sectoral assessments of effectiveness. Standardizing the methodology of preparing balance sheets and outputs, as well as reducing the distance of time between the publication would certainly increase additionally their further practical fitness in macroeconomic and cross-sectional evaluations, both nationally and internationally. Despite these drawbacks, they are practically the only available tool for a comprehensive, including many aspects, assessment of the effectiveness of individual branches (sectors) of national economies, including also the agricultural sector. Therefore, adopted hypothesized of the

article espousing that input-output model is a useful tool in the assessment of macroeconomic performance of the agricultural sector.

Summary

The efficiency of the agricultural sector in Poland in the light output-input model

The study turns attention to the use of the *input-output* model (account of interbranch flows) in macroeconomic assessments of the effectiveness of the agricultural sector. In the introductory part the essence of the account of interbranch flows has been specified, pointing to its historical origin and place in the economic theory, and the morphological structure of the individual parts (quarters) of the model has been presented. Then the study discusses the application of the account of interbranch flows in macroeconomic assessments of the effectiveness of the agricultural sector, defining and characterizing a number of indicators which allow to conclude on the effectiveness of the agricultural sector on the basis of the account of interbranch flows. The last, empirical part of the study assesses the effectiveness of the agricultural sector in Poland on the basis of interbranch flows statistics for the years 2000 and 2005. The analyses allowed to demonstrate increased efficiency of the agricultural sector in Poland after Poland joined the EU, and also to say that the account of interbranch flows is an important tool enabling comprehensive assessment of the effectiveness of the agricultural sector in the macro-scale, through the prism of the effect - disbursement, which accounts for its exceptional suitability in this kind of analyses.

Key words: *input-output model, account of interbranch flows, effectiveness of the agricultural sector in Poland.*

Streszczenie

Efektywność sektora rolnego w Polsce w świetle modelu input-output

W opracowaniu wskazano na zastosowanie modelu *input-output* (rachunek przepływów międzygałęziowych) w makroekonomicznych ocenach efektywności sektora rolnego. W części wprowadzającej określono istotę rachunku przepływów międzygałę-

ziowych, wskazując na jego rodowód historyczny oraz miejsce w teorii ekonomii, a także zaprezentowano morfologiczną budowę poszczególnych części (ćwiartek) tego modelu. Następnie omówiono zastosowanie rachunku przepływów międzygałęziowych w makroekonomicznych ocenach efektywności sektora rolnego, wyznaczając i charakteryzując szereg wskaźników, pozwalających wnioskować o efektywności sektora rolnego na podstawie rachunku przepływów międzygałęziowych. W ostatniej, empirycznej części opracowania dokonano oceny efektywności sektora rolnego w Polsce na podstawie statystyk przepływów międzygałęziowych dla lat 2000 i 2005. Analizy pozwoliły dowieść wzrostu efektywności sektora rolnego w Polsce po akcesji Polski do UE, a także powiedzieć, że rachunek przepływów międzygałęziowych stanowi ważne narzędzie, umożliwiające kompleksową ocenę efektywności sektora rolnego w makroskali, przez pryzmat relacji efekt-nakład, co stanowi o jego wyjątkowej przydatności w tego typu analizach.

Słowa

kluczowe: *model input-output, rachunek przepływów międzygałęziowych, efektywność sektora rolnego w Polsce.*

References

1. Coleman W., Grant W., Josling T. (2004), *Agriculture in the New Global Economy*. E. Elgar. Northampton M.A.
2. Czyzewski A. (2011). *Interbranch flows as a macroeconomic model of the economy*. University of Economics in Poznan. Poznan.
3. Czyzewski A., Grzelak A. (2012), *Possibilities of using statistics of output balance sheets for macroeconomic assessments of the economy*. „Statistical Review Special Edition”, Volume I.
4. Czyzewski A., Poczta-Wajda A. (2009), *Role of Decoupling in the System of CAP Financial Support. Dilemmas and Recommendations*. „Proceedings of the international scientific conference Economic Science for Rural Development”, Issue 18.
5. Czyzewski A., Smedzik-Ambrozy K. (2013), *Intensive agriculture in the process of specialization and diversification of agricultural production. Regionally and locally*. PWN. Warsaw.
6. Czyzewski A., Stępien S. (2009), *Changes in the Mechanism of Direct Support and Agricultural Markets Stabilisation in the Aspect of the CAP “Health Check” Proposals*. „Proceedings of the international scientific conference Economic Science for Rural Development”, Issue 18.

7. Czyzewski B. (2013), *Economic rents in food economy in Poland*. PWE. Warsaw.
8. Czyzewski B., Mrowczyńska-Kaminska A. (2010), *Use of productivity surplus account and input-output in agricultural economics*. „Agricultural Economics”, Issue 4(325).
9. Grzelak A. (2012), *The economic situation in agriculture against the general economic trends in Poland in the years 1995-2010*. „Annals of the Association of Agricultural and Agribusiness Economists”. Volume XIV, Issue 3.
10. GUS (2004), *Input-output table in the current basic prices in 2000*. Warsaw.
11. GUS (2009), *Input-output table in the current basic prices in 2005*. Warsaw.
12. Leontief W.W. (1936), *Quantitative input and output relations in the economic system of the United States*. „The Review of Economic and Statistics”, Volume XVIII.
13. Marks K. (1955), *Capital*. KiW. Warsaw.
14. Smedzik-Ambrozy K. (2012), *Impact of Direct Payments on Sustainability of Farms in Poland - Simulation Based on the Example of FADN Farms from Wielkopolska and Slask Region*. „Production and Cooperation in Agriculture Finance and Taxes”, Issue 30.
15. Quesnay F. (1928), *Selected writings*. Gebethner i Wolf. Warsaw.
16. Walras L. (1926), *Elements d`economie politique pure*. Paris.