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Application of the input-output model for structural analysis on the example of the agricultural sector in Poland

1. Introduction

The macroeconomic input-output models are an excellent reference to structural analyses of economic processes. The most well-known are the assessments made by Leontiev (1936), who analysed the structures of the American economy. By evaluating streams of flows, that express the value of transactions between suppliers and receivers (input-output), this model concretises the ideas of the functioning of the economy (market and budget mechanism), its structure, internal links, effects of the reproduction processes. Although this trend of research in Poland has not been at the centre of interest, it may be a useful instrument for assessing the functioning of the economy, in aggregate terms in the long-term perspective (Tomaszewicz 1994). This is all the more reasonable as there are encouraging conditions for the further development of the input-output approach in the economic analysis (Boratinski et al. 2015). Using the assumptions of general equilibrium theory, this model allows analysing the creation and distribution of produced macroeconomics

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effects, the impact of global processes on the economy through the prism of export and import. It is not negligible that this model is universal in examining the interdependencies within the economies of the countries. It also provides an analysis of the characteristics of economic systems that are independent of the way of regulation of production and its distribution (Leontief 1936; Stankiewicz 2007). On the other hand, it is important to note that a significant range of data aggregation requires caution in interpreting the input-output table (Lonc 1985).

Understanding the nature of structural changes and trends is particularly useful in shaping the economic policy of the state concerning the use of non-automatic economic stabilizers and the identification of areas that constitute development barriers. In the initial period of political transformation, the understanding of the intersectoral linkage mechanism was particularly crucial in creating restructuring and privatization programs for economic entities in Poland.

The main objective of the article is to recognize possibilities of use of the input-output model to structural assessments in the economy, with particular reference to the agricultural sector. The presented reflections are theoretical, with empirical illustrations of the agricultural sector. The accepted research approach refers to the structuralist researches (Taylor 1983), because of the nature of the assessment, as for the input-output model. The research question is what are the possibilities of using the input-output model for structural evaluation changes, on the example of the agricultural sector in Poland.

2. Method of input-output model[1]

The economy of a country consists of many different sections[2], which are interrelated. These linkages are carried out through the purchase and sale of goods and services that integrate all economic operators. The measurable effect of these transactions is streams that are structure-forming nature, and their value determines the strength of dependence between the sections[3]. The

1 The paper (Czyżewski 2011) was used in this part of the article.

2 We use the term „sections" of the economy (as in the GUS publications) or „sector" in the article alternatively.

3 In this case, the degree of aggregation of sections should be taken into account. For example, when for 2010 the GUS in Poland made, in the published data of intersectoral linkages division into 77 sections, in 2005 it was only 55 sections. The increase in the number of divisions did not change in the case of agriculture that aggregation remained unchanged as „agricultural and hunting products".

existence of product flows (services) between sections in the economy creates the need for an analysis of inputs and outputs across the various branches and the whole economy. The theoretical bases of development of the model result from the simplified version of the classical general equilibrium theory, referring to the description of the dependence of the economy regarding the GDP and its structure.

Moreover, the input-output model is flexible enough to allow to evaluate the performance of economies in the different economic systems according to the methodology of macro-economic aggregation, both according to the Material Product System (MPS) and the SNA (System of National Account). In the first case, only production sections were considered, assuming that the non-material sphere was redistributed through the budget (government consumption). In turn, the SNA method takes into account the full economic activity of the economic entities.

The concept of intersectoral linkages is both theoretical and deep-rooted in the history of economic thought and applied to the publication by the statistical offices of the appropriate balances. Let us present here an example of the input-output table, used to explain the economic interdependences. This approach includes the interpretation of the model for its four parts. What distinguishes this table from the method used by GUS is the occurrence of quadrant IV, which in economic practice was rarely fulfilled[4]. In the first part of this model, intermediate demand was reported by the economic sectors. Transactions between industries were presented here. The lines show the intermediate demand stream. These are the purchases of products (services) that are used for further processing. The columns are interpreted as the structure of the impersonal costs of individual departments. The second part of the table presents the final demand: individual consumers, budget, banking sector, investors and restitution. From the data contained there, it is possible to evaluate the streams related to the distribution of the products of the sections concerned to meet the final demand by the operators. This quadrant of the table may also be considered by the prism of potential demand, i.e. the aspirations of the distinguished entities. The demand for which they aspire is higher than effective (carried). The difference between these categories in Keynesian economics becomes the existence of a gap in

4 Only three parts are published in the GUS materials in Poland. This is because the aggregate level omits the fourth part of the income distribution. Nevertheless, the processes that are associated with these phenomena are important for the functioning of the economy, and therefore the distribution of income has been taken into account at the theoretical level (Czyżewski 2011).

demand. In the market economy, this is illustrated by the occurrence of supply disequilibrium. Produced output, which is a simple way reflects the aggregate demand that aspirants have, does not find real (effective) demand in market conditions. Thus, the pressure on the consumer by promotional activities is growing.

The third part of the input-output model shows the income and their structure that were generated in the various sections of the economy. In the lines, the elements of added value are highlighted: wages, economic surplus. In separate lines, the influence of the state budget and banks on the revenues of enterprises was recorded, by the change in the amount of issue and credit money and taxes. Based on the information contained in this quadrant we can determine the macroeconomic effects of the activities of the various sections, especially in the formation of added value. The 4 part of the table deals with the secondary distribution of generated income, which in turn serves to carry out the final demand[5]. In this quadrant, the income is distributed among the entities in the economy: individual consumers, budget, bank and investors. On the revenue side of the budget, the revenue from taxes and fees is mainly taken into account, but also from other titles such as profits from state-owned enterprises. In turn, expenditure includes resources for government consumption, investment, grants and subsidies, as well as possible distribution of proceeds from other titles. Concerning banks, it contains information on open accounts and money issues, as also expenses of credit on working capital and investment credits. Such a table structure guarantees the possibility of observing both the material and financial flows (Czyżewski 2011), e.g. the processes of globalisation affect this part of the balance of intersectoral flows by the pressure exerted on reducing the role of the state in economic processes (Czyżewski, Grzelak 2009).

It is worth stressing here that the model of intersectoral flows used in business practice today assumes that the second and the third quarters are sufficient for the interpretation of economic equilibrium processes. Thus it is expected that the Gross Domestic Product (GDP) is equal to the distribution as if there was no economic inequality (supply here), and effective demand was equivalent to a potential that market participants aspire to, which is, of course, an idealistic assumption (Czyżewski, Grzelak 2012). From the presented perspective, the sum of values from the rows is equal to the sum of values from the columns

5 In economic practice in Poland, it was used only sporadically for the coordination of financial aspects of economic plans. The latest published data on this subject concern the balance of the Polish economy in 1957. Prepared by the NBP Economic Bureau, Warsaw 1958.

for particular parts of the examined model, which results from the identity character of macroeconomic relationships. The effects of some entities are inputs for others. For this reason, we are dealing with a balance inside the individual quarters. This is reflected in the GUS materials, in equilibrium (the same values of the total balance sheet) between quarter 2 and 3.

3. Structural analyses in the model of intersectoral flows

Structural changes are an essential element of economic policy and hence their importance regarding positive and normative economics. Recognition of these phenomena is essential for identifying sources (barriers) of economic development, functioning of the labour market and the competitiveness of the economy (Jaworska 2007). As a result of these processes, there are quantitative and qualitative changes between the elements of the economy and between them, and the whole structure that they create (Ładysz 2008). The most frequent structural assessments in the traditional sense were the changes in three main sectors of the economy: agriculture (I), industry (II) and services (III). The same structural assessments of the economy had their renaissance during the systemic transition of the countries of the Central and Eastern Europe. This was due to the need to assess the transformations of branches and manufacturing structures in the economy, which was related to the processes of restructuring and privatisation of sectors in the economy.

Significant opportunities for structural assessments are provided by the input-output model, which allows for more detailed evaluation due to the disaggregation of the economy into sections (see footnote 3). Also, in the input-output approach, it can be seen that the streams form structures that determine economic effects (added value, final demand, output, intermediate consumption), which accumulates in resources. At this point, there may be a question about the importance of institutions in these processes, but this goes beyond the scope of this study. The input-output model enables the visualisation of the economic structure of the country. It allows us to better understand the economic mechanisms and the structural complexity of the economy. On the other hand, however, one need to be aware of certain limitations associated with this type of analysis. It is about publishing data for the input-output model, as in the case of Poland, with a significant delay, as well as in five-year intervals.

The input-output balances can be used to evaluate the structure of input streams for particular sectors (corresponding columns in the I-part of the input-output table). This allows us to determine the extent of self-supply or

interdependencies between sections in the subject and dynamic system (for multi-year projections). By evaluating the distribution structure of the sector's products, and in particular the components of the final demand (consumption, accumulation), they can evaluate their position in the economy. In the literature of the subject, there are many examples of this type of intersectoral applications, particularly in the case of food economy (Mrówczyńska 2015; Grzelak 2006). The identification of interconnections is particularly important in the restructuring programs of sectors of the economy. In a multiannual view, one can evaluate the nature of changes in a section defining economic processes.

By developing this topic one can also examine the structure of current inputs, and by reversing the so-called "absorbency" coefficients determine the effectiveness of the different types of inputs. The purpose is to product consumption coefficient (material intensity), otherwise referred to as the coefficients of technical production (1).

$$a_{ij}=\frac{w_{ij}}{X_j} \quad (i=1,2,\ldots,n;\ j=1,2\ldots,m) \tag{1}$$

X_j – gross agricultural output

These coefficients can be written in the form of matrix (2)

$$A=[a_{ij}]=\begin{pmatrix} a_{11} & \ldots & a_{1j} \\ \ldots & \ldots & \ldots \\ a_{i1} & \ldots & a_{ij} \end{pmatrix} \tag{2}$$

The coefficients of the technical production can be used to evaluate the technology of the production process of each sector. Regarding interpretation, it determines what the value of the i-th product of a given section is necessary to produce the unit of output of the j-th section. In this way, the input-output model can be used to short-term predictions of the future value of gross output as well as the final assumption of an unchanging technology of production[6]. The market mechanism exerts pressure to lower of these coefficients and thus

6 There are many examples in the literature of the subject of such applications, such as CGE (Computable General Equilibrium) models (Dixon, Jorgenson 2013) or integrated models (input-output econometric models).

reduce the importance of intermediate demand in the economy. This is related to the introduction of the innovation and therefore technical progress. However, there is a different pace of these changes, which determines the structural transformations in the economy. Hence, material consumption coefficients can also be used to estimate intersectoral diffusion of innovation (Wolff 2011; Świeczewska, Tomaszewicz 2012), and identify which sectors are most influential in increasing the potential of innovative economy (Świeczewska 2014).

The input-output model can also be used for structural analyses to identify clusters in the economy (Gurgul, Majdosz 2006). In this case, it is possible, using specific methods[7], to determine the strength of links the clusters with the rest of the economy, between clusters, or between sectors within the clusters. The research carried out (Gurgul, Majdosz 2006) for the tables in Poland for the year 2000, distinguished five clusters created by the sectors of the economy[8], of which the most numerous was energy and fuel cluster, and the least numerous agro-food (agricultural and hunting products, food processing, distribution). In turn, (Guo, Planting 2000) used an input-output model to analyse structural transformations in the US economy. It was clear that the importance of the industrial sectors in the country in 1972-1996 was relatively lower due to the increasing influence of imports.

An interesting example of the application of the input-output model in the area of structural analysis was included in (Tomaszewicz, Trębska 2017). The model was used to evaluate the significance of sectors in the flows of financial instruments in Poland in the years 2003-2015. The analyses allowed, among other things, to examine the structure of financial instruments. The results of these studies show the growing role of financial institutions in the economy in Poland, due to the increase in cash and deposits, as well as loans and credits. The importance of „abroad" in the financing of demand for funds from economic entities in Poland has also increased.

4. Emipircal illustration

There is a rich literature on the application of input-output modelling to agriculture (Ardeni, Freebairn 2002) also in the light of Polish experiences (Zawalińska 2009). They point out, among others, to the transmission

7 This includes methods such as maxima, restriction, diagonalization, triangulation (Gurgul, Majdosz 2006).

8 Within the 55 sectors separated by the GUS of the input-output tables for 2000.

mechanism of the impact of agriculture on other sectors and vice versa, as well as the structure-creating nature of these compounds (Mrówczyńska 2013). In the exemplary presentation of the possibilities of structural analyses from the perspective of the input-output model, one has used GUS data in base prices for 2005 and 2010[9]. The evaluations focused on the agricultural sector, which also allowed to show its position in the economy. By comparing the streams of input to agriculture, we can see a decrease in the role of self-supply between 2005 and 2010 and an increase in the importance of import supply (table 1). In the case of directions of the distributions of streams, the

Table 1. The structure of input and output streams from agriculture in Poland in 2005 and 2010 (in %)

Years	Directions of input streams				
	From agriculture (self supply)	From food industry	From other sectors	From import	Total
2005	32.7	14.0	37.7	15.6	100
2010	28.3	15.9	36.9	18.9	100
	Directions of output streams				
	To agriculture (own consumption)	To food industry	Other sectors	Final demand	Total
2005	18.5	36.8	3.0	41.7	100
2010	16.9	34.7	3.3	45.1	100

Source: own elaboration based on Balances: 2004 and 2014

importance of the final demand increased, and the consumption for own consumption decreased. These tendencies indicate that agriculture is increasingly integrated into the intersectoral flow mechanism in the economy. Its situation depends more on cooperating with other sectors and abroad. In the future, one can expect a further increase in the importance of "other departments" inflows coming out of agriculture due to the growing importance of the non-agricultural use of agricultural production, e.g. for bioenergy.

9 In June 2018 there were available data of the input-output for 2010 for Poland.

The survey of mutual dependencies and structures in agribusiness conducted by (Mrówczyńska-Kamińska 2013) shows that in highly developed the EU countries a significant role in food production have: sectors producing agricultural inputs, and services for agriculture and the food industry. In turn, from the research (Olczyk 2011) on the identification of key sectors, using the input-output model, it follows that the sectors of trade, construction, food products, beverages and tobacco have the most significant impact on the Polish economy (in the considered period 1995-2004) through relationships between suppliers as well as recipients.

In the analysed period, a decrease of a coefficient of product consumption (table 2) was observed as well as an increase in the efficiency of the intersectoral linkages of agriculture. This points to improve efficiency in the sector, which can be connected to the widespread use of innovations in the field of genetic improvement of animal breeds, plants, modernization of production technology, increased mechanization, and support for agriculture under the EU CAP (Józwiak, Ziętara 2013). Positive tendencies should also be counted as a decrease in the share of intermediate demand in the global demand for agricultural products and an increase in the share of exports in the final demand. At the

Table 2. The selected categories for structural assessments of agriculture from the perspective of intersectoral linkages in the economy (2005 and 2010, given in%)

Specification	2005	2010
The coefficient of product consumption (a)	0.192	0.182
The share of intermediate demand for agricultural products in the total demand for agricultural products	58.2	54.9
The share of final demand for agricultural products in total final demand in the economy	2.9	2.7
The share of gross agricultural output in total output in the economy	4.1	3.5
The share of export of agricultural products in final demand for agricultural products	12.3	14.8
The share of export of agricultural products in total exports in the economy	1.3	1.3
The share of gross value added in gross agricultural output	45.0	42.7

The share of gross value added of agriculture in total value added in the economy	4.2	3.4
The indicator of the efficiency of intersectoral linkages of agriculture (b)	73.5	75.5

a) com. formula 1; b) The ratio of final demand for agricultural products to the value of input streams for agriculture (%)

Source: own elaboration based on Balances: 2004 and 2014

same time, the importance of agriculture in the mechanism of intersection flows in the economy declined. This is confirmed by the decrease in the share of final demand for agricultural products in total demand in the economy. The same was true of lowering the share of agriculture in gross output and added value in the economy (tab. 2). In turn, the decline in the share of added value in total agricultural production in Poland may indicate a deterioration of the position of agriculture in economic processes. The processes are complicated, which is repeatedly emphasized in the literature on the subject (Timmer 2002). An increasing proportion of added value generated in the food sector is created outside agriculture. These phenomena confirm the earlier conclusion that agriculture is shrinking, weakening its position in the economy in the sense of production, although it improves its efficiency. This can be done with the universal mechanism of the so-called technological treadmill[10] (Cochrane 1958; Czyżewski B. 2017). On the other hand, it should be taken into account that both the literature on the subject (Wilkin 2010) and the economic practice (the EU CAP instruments) are perceived and exhibited more and more the non-productive functions of agriculture and rural areas as well as the public goods created by this sector.

5. Conclusions

The use of input-output models is particularly useful for structural analysis in the economy. This is due to the way in which economic processes, exposing intersectoral linkages in the economy are considered. It is also about evaluating the "input" and "output" streams, because of their structure-formation nature.

10 The technological treadmill is related to the sequence of events: increase of production over demand - price reduction - change of technology improving productivity - an increase of supply - price reduction, etc.

In this way, it is possible to diagnose structural transformations in the economy, the source of different development between sectors within the economy in the country, or changes in the market position of the examined sectors of the economy.

The example case analysis of the agricultural sector in the input-output model from the perspective of structural assessments allows us to state that there are evident transformations. This includes, in particular, the relative increase of links with other sectors and recipients of final demand, the growth in the importance of imports, and the decline in the role of self-supply. At the same time, the importance of agriculture in the economy declined during the considered years (2005 and 2010). More and more of the added value created in the food sector is generated outside agriculture, which is due to the relative importance of the processing sector (food industry), agricultural inputs and distribution. The efficiency of agriculture as a whole sector has also improved, which has been reflected in the increase in the efficiency of intersectoral linkages of agriculture and a reduction in the coefficient of product consumption. It is expected that these trends will deepen regarding economic development.

Summary

Application of the input-output model for structural analysis on the example of the agricultural sector in Poland

The main objective of the article is to recognize possibilities of use of the input-output model to structural assessments in the economy, with particular reference to the agricultural sector. The included considerations have a theoretical and application dimension related to the agricultural sector. Understanding the nature of structural changes and associated tendencies is particularly useful in shaping the economic policy of the state about the use of non-automatic economic stabilizers and the identification of areas that constitute development barriers. Analysis of the case of the agricultural sector in the input-output model, from the perspective of structural evaluation, indicate that there are evident transformations. It includes, in particular, the relative increase of links between agriculture and other branches, the growth in the importance of imports (supply), and the decline in the role of self-supply. It can be expected that these trends will deepen under conditions of economic development.

Key words: *input-output, economy, agriculture, structural analysis.*

Streszczenie

Zastosowanie modelu input-output do analiz strukturalnych na przykładzie sektora rolnego w Polsce

Głównym celem artykułu jest rozpoznanie możliwości wykorzystania modelu przepływów międzygałęziowych do makroekonomicznych analiz strukturalnych w gospodarce, ze szczególnym uwzględnieniem sektora rolnego. Zawarte rozważania łączą wymiar teoretyczny z aplikacyjnym dotyczącym sektora rolnego. Zrozumienie charakteru zmian strukturalnych i tendencji z tym związanych jest szczególnie przydatne w kreowaniu polityki gospodarczej państwa w zakresie stosowania nieautomatycznych stabilizatorów koniunktury, jak i identyfikacji obszarów stanowiących bariery rozwojowe. Analiza przypadku sektora rolnego w modelu input output z perspektywy ocen strukturalnych pozwala na stwierdzenie, że następują wyraźne przeobrażenia. Chodzi tu w szczególności o relatywne zwiększenie powiązań rolnictwa z pozostałymi działami, wzrost znaczenia importu (zaopatrzenia), przy spadku roli samozaopatrzenia. Można oczekiwać, że tendencje te pogłębiać się będą w warunkach rozwoju gospodarczego.

Słowa kluczowe: *przepływy międzygałęziowe, gospodarka, rolnictwo, analizy strukturalne.*

JEL Classification: E10, E66, Q10

References

1. Ardeni P., Freebairn J. (2002), *The macroeconomics of agriculture*. Chapter 28, [in:] Gardner B., Rausser G. (eds.), Handbook of Agricultural Economics. Agriculture and its External Linkages, Vol.2, Part A, 1455-1485.
2. Bilans przepływów międzygałęziowych w bieżących cenach bazowych w 2010 r. (2014), GUS, Warszawa.
3. Boratyński J., Przybyliński M., Świeczewska I. (2015), *Metody input-output: wybrane kierunki rozwoju*, [in:] P. Wdowiński (ed.), Nauczyciel akademicki wobec nowych wyzwań edukacyjnych, Lodz University Press.
4. Cochrane W. (1958), *Farm Prices: Myth and Reality*, University of Minnesota Press.

5. Czyżewski, A. (2011), *Przepływy międzygałęziowe jako makroekonomiczny model gospodarki*, Wyd. UE w Poznaniu.
6. Czyżewski A., Grzelak A. (2009), *Możliwości oceny rozwoju rolnictwa w warunkach globalnych z zastosowaniem tabeli przepływów międzygałęziowych,* „Roczniki Naukowe SERiA", Tom XI, z. 2.
7. Czyżewski A., Grzelak A. (2012), *Możliwości wykorzystania statystyki bilansów przepływów międzygałęziowych,* „Przegląd Statystyczny", No. 1.
8. Czyżewski, B. (2017), *Kierat technologiczny w rolnictwie krajów UE*, PWN, Warszawa.
9. Dixon P. B., Jorgenson D. (eds.), (2013), *Handbook of Computable General Equilibrium Modeling,* Vol. 1A and 1B, North-Holland.
10. Grzelak A. (2006), *Powiązania rolnictwa z otoczeniem z perspektywy bilansów przepływów międzygałęziowych w warunkach transformacji systemowej*, „Polityka Gospodarcza", No 13.
11. Guo J., Planting M. (2000), *Using Input-Output Analysis to Measure U.S. Economic Structural Change Over a 24 Year Period*, Paper presented at the 13 International Conference on Input-Output Techniques, Macerata, Italy.
12. Gurgul H., Majdosz P. (2006), *Identyfikacja klastrów w oparciu o strukturę nakładów i wyników*, "Ekonomika i Organizacja Gospodarki Żywnościowej", No. 60.
13. Jaworska M. (2007), *Zmiany strukturalne w przemyśle państw OECD w latach 1993-2003*, Wyd. Akademii Ekonomicznej we Wrocławiu.
14. Józwiak W., Ziętara W. (2013), *Kierunki i zakres wsparcia inwestycji w polskich gospodarstwach rolnych w latach 2014-2020,* "Zagadnienia Ekonomiki Rolnej", No 1.
15. Leontief W. (1936). *Quantitative input and output relations in the economic system of the United States,* "The Review of Economics and Statistics", Vol. XVIII, August.
16. Lonc T. (1985). *Związki rolnictwa z gospodarką narodową na początku lat 1980-tych, "*Zagadnienia Ekonomiki Rolnej", No 6.
17. Ładysz J. (2008), *Polityka strukturalna Polski i Unii Europejskiej*, PWN, Warszawa.
18. Mrówczyńska-Kamińska A. (2015), *Gospodarka żywnościowa w krajach Unii Europejskiej. Kierunki rozwoju, przepływy i współzależności*, Wyd. Uniwersytetu Przyrodniczego w Poznaniu.
19. Mrówczyńska-Kamińska A. (2013), *Wykorzystanie modelu przepływów międzygałęziowych do badania zależności w agrobiznesie w krajach Unii Europejskiej*, Referat na IX Kongres Ekonomistów Polskich, 1-8.
20. Olczyk M. (2011), *Sektory kluczowe w polskiej gospodarce. Gospodarki narodowe w procesie przemian strukturalnych,* "Studia Ekonomiczne. Zeszyty Naukowe Wydziałowe", Wyd. UE w Katowicach
21. Stankiewicz, W. (2007), *Historia myśli ekonomicznej*, PWE, Warszawa.

22. Świeczewska I. (2014), *The externalities of enterprises' innovative activity – an input-output approach,* "Folia Oeconomica Stetinensia", No 2.
23. Świeczewska I., Tomaszewicz Ł. (2012), *Rola innowacji w procesie wzrostu efektywności polskiej gospodarki. Ujęcie gałęziowe,* [in:] A. Jakimowicz (ed.), Modele i prognozy w ekonomii i finansach, PWN, Warszawa.
24. Taylor L. (1983), *Structuralist macroeconomics: Applicable models for the third world,* Basic Books, New York.
25. Timmer P. (2002), *Agriculture and economic development Chapter 29,* [in:] Gardner B., Rausser G. (eds.), Handbook of Agricultural Economics. Agriculture and its External Linkages, Vol.2, Part A, 1487-1546.
26. Tomaszewicz Ł., Trębska J. (2017), *Finansowe modele input-output w analizie powiązań międzysektorowych*, „Studia Ekonomiczne", No 1.
27. Wilkin J. (ed.), (2010). *Wielofunkcyjność rolnictwa. Kierunki badań, podstawy metodologiczne i implikacje praktyczne*, IRWiR PAN, Warszawa.
28. Wolff E. (2011), *Spillovers, Linkages and Productivity Growth in the US Economy, 1958 to 2007*, NBER Working Paper, No 16864.
29. Zawalińska K. (2009), *Instrumenty i efekty wsparcia Unii Europejskiej dla regionalnego rozwoju obszarów wiejskich w Polsce,* Polska Akademia Nauk, IRWiR, Warszawa.