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MEASURING THE AGRIBUSINESS GDP IN EUROPEAN UNION COUNTRIES

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ABSTRACT

The purpose of this paper was to measure the Gross Domestic Product of the agribusiness in European Union countries and to determine its contribution to national economies. The agribusiness GDP was measured using a proprietary method based on input–output tables. The study covered all 28 European Union countries and relied on 2014 data, the most recent available information in the World Input–Output Database (used as data source). The study found the prevalence of two relationships; (i): the higher the development level of a country, the lower the share of agribusiness GDP in the national economy; (ii): as the country develops, the share of the 2nd agribusiness aggregate in the GDP becomes relatively smaller compared to that of other agribusiness aggregates. A known problem faced in these analyses is that the I/O tables are published with a huge delay and are only available for some countries. Therefore, the studies on agribusiness measurement for all European Union countries in one period are relatively scarce in the relevant literature. Also, a proprietary method of agribusiness GDP measurement was used which takes account of the particular role of the food industry.

Key words: agribusiness, GDP, European Union
JEL codes: Q11, Q13, Q47

INTRODUCTION

As indicated by many researchers, including Leones, Schluter and Goldman (1994), the importance of agriculture in the national economy should be determined based not only on the agricultural production sector alone but also on its relationships with other industries which grow stronger as the country develops. This is explained in the findings by Cook and Chaddad (2000) who indicate that as the countries develop, there is increasing importance of activities which add value at the pre- and post-farmgate levels while decreasing value at the farm production level. These relationships can be best traced with the input–output model conceived and developed by Leontief. Davis and Goldberg (1957) were the first ones to use it in studying the connections between the agricultural sector and other industries. They referred to the entire system of connections as "agribusiness". Since then, research efforts have addressed many aspects of

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this issue (King et al., 2010), including the measurement of the actual contribution of agribusiness to the national economy.

The purpose of this paper is to measure the Gross Domestic Product of the agribusiness in European Union countries and to determine its contribution to national economies. The studies on this matter are relatively scarce in the relevant literature. Moreover, they are impeded by the relatively poor availability of comparable up-to-date data for all Community countries. The World Input–Output Database, used as data source in this paper, is among the solutions which provide an opportunity to change that state of affairs.

THEORETICAL BACKGROUND

The term "agribusiness" was first used by Davis in 1955 at a conference held in Boston. In January 1956, he published a paper titled "From Agriculture to Agribusiness" (Davis, 1956). Ultimately, the concept of agribusiness was characterized and explained in detail one year later, in "A Concept of Agribusiness" (Davis and Goldberg, 1957). As noted by the authors, the relationships between agriculture and other industries are more complex than anywhere else in the economy. Therefore, it was necessary to analyse the relationships with input–output tables which continue to be the main method for measuring the importance of agribusiness in the national economy as they allow to trace the most complicated flows between the sectors (Miller and Blair, 2009).

According to the classical concept by Davis and Goldberg, agribusiness is "the total of all operations involved in the manufacture and distribution of farm supplies; production operations on the farm; and the storage, processing, and distribution of farm commodities and items made from them" (Davis and Goldberg, 1957). The authors also defined certain aggregates to help analysing the interdependencies. In the initial concept, agribusiness was divided into three aggregates: farm supplies; agriculture; and processing and distribution of agricultural produce. Later in their book, Davis and Goldberg carried out an in-depth analysis of interdependencies and redefined the three aggregates to use them as a reference for research findings, namely: agriculture, food processing, and fibre plants processing (at that time, these were believed to be the most important elements of agribusiness). Hence, interdependencies in the agribusiness may be examined from different standpoints. Therefore, the appropriate selection of aggregates plays an important role in analyses based on the I/O model. What also matters is whether or not certain flows between production sectors are classed as components of agribusiness. This gives rise to doubts because no official statistics exist for that subsystem of the economy. As a consequence, particular areas of agribusiness are interpreted in different ways by authors dealing with this topic.

The relevant literature provides two main methods for estimating the size of agribusiness. The first one, proposed by Davis and Goldberg (1957) and described by Schluter, Lee and Edmondson (1986), estimates the Gross National Product of agribusiness by computing the influence coefficient for food and fibre sectors also for the period not covered by the input–output tables published. However, that method assumes that the structures of intersectoral connections remain unchanged even if the structure of agribusiness evolves, which is not a realistic prospect (Yan, Fan and Zhou, 2011). The second method, proposed by Furtuoso, Barros and Guilhoto (1998), allows to estimate the Gross Domestic Product of agribusiness directly based on I/O tables and relaxes the assumption of the first method. Furtuoso, Barros and Guilhoto (1998) proposed a division of the agribusiness into four aggregates: (a) inputs to agriculture; (b) agriculture; (c) agriculture-based industries which include industries the most related to agriculture in terms of demand for its products; and (d) final distribution. That classification is also applicable to the structure of the food supply chain, and was used to measure the size of agribusiness by other authors, too (Guilhoto, 2004; Xianhui and Yingheng, 2010; Yan, Fan and Zhou, 2011; Moreira, Kureski and Veiga, 2016).

However, certain difficulties in using this classification emerge in the context of international benchmarking. This is especially true for the extraction of sectors comprising the third aggregate (agriculture-based industries). In each country, the sectors differ

in their demand for agricultural produce. In turn, the agribusiness measurement method takes account of total value added in sectors classed as agriculture-based industries. Therefore, identifying the same sectors in each country may result in revaluations. Conversely, if different sectors are considered in each country, this could result in understatements in relation to countries with a larger number of sectors (if a sector is not classed as an agriculture-based industry, it does not necessarily mean it does not require any agricultural produce at all; instead, it only means it requires agricultural produce in small quantities compared to its demand for products of other sectors).

As found in research by Wilkinson and Rocha (2009), food industry is the sector most strictly related to agriculture, and its role becomes increasingly important as the population's incomes grow. Agriculture can be observed to be more closely related to the food industry than to other sectors in all countries around the world. Together, agriculture and food industry are responsible for the entire production and processing of food. This is reflected in the concept of food economy which has been developed since late 1960s in socialist European countries (Kapusta, 2012). That concept places focus on the particular responsibility of (broadly defined) agriculture as a sector which is supposed to ensure sufficient supply of food for the society. Hence, the most important sector – in addition to agriculture itself – is the food industry whose role is strictly related to food. Woś (1979) proposed that the inflows of materials and services to the food sector also be considered a component of agribusiness to emphasize that the food sector and agriculture are inseparable. In his concept, agribusiness was divided into three aggregates: (a) supply of goods and services to the agriculture and the food industry; (b) agriculture; and (c) food industry.

For a detailed theoretical description of the agribusiness concept (underpinned by the classification proposed by Woś), see Poczta and Mrówczyńska-Kamińska (2004). This became the basis for many other papers (e.g. Czyżewski and Mrówczyńska-Kamińska, 2011; Mrówczyńska-Kamińska and Poczta, 2013). Also, the relevant literature presents some other, less frequent methods for the identification and division of the agribusiness (e.g. van Leeuwen, 2000; Trejos, Segura and Arias, 2004).

MATERIALS AND METHODS

The calculations were based on I/O tables retrieved from the World Input–Output Database (WIOD), Release 2016. The advantage of WIOD is that it publishes methodologically unified tables for all countries. Moreover, particular focus is placed on data quality, so that the figures provide the best possible reflection of official national statistics. The calculations were based on 2014 data, the most recent information available in the database. In WIOD Release 2016, data for 56 sectors was classified as per the International Standard Industrial Classification revision 4 (ISIC Rev. 4). The tables adhere to the 2008 version of the System of National Accounts (SNA). Detailed information on the structure of tables can be found in publications by Dietzenbacher et al. (2013), Timmer et al. (2015) and Timmer et al. (2016).

In accordance with what was proposed by Woś (1979), three aggregates of agribusiness were identified: (1) supply; (2) agriculture; (3) food industry. As provided for in ISIC Rev. 4, agriculture is defined as sector A01: Crop and animal production, hunting and related service activities. In turn, the food industry are sectors C10–C12: Manufacture of food products, beverages and tobacco products.

The GDP of agribusiness was calculated using a proprietary method, by modifying the one described by Furtuoso, Barros and Guilhoto (1998). The first step consists in determining the value added at producer prices in the I/O table. In accordance with SNA 2008, that amount is calculated as total value added at basic prices plus taxes on products less subsidies on products.

The coefficients of value-added flows from different sectors (CVA_i) need to be calculated in order to determine the part of GDP of particular sectors which contributes to agribusiness GDP. This was done by dividing value added at producer prices in the sector concerned by the corresponding output. The coefficients calculated this way were first used to calculate the GDP of the 1st aggregate.

To calculate the GDP for the 1st aggregate, the coefficients (CVA_i) must be multiplied by the value of products and services (inputs) from the corresponding sectors delivered to the agriculture (z_{ia}) and to the food industry (z_{if}). These values were retrieved from the I/O tables. Then, the flow of value added (which results from self-supply in the agriculture and food industry) must be deducted from the amount calculated above in order to avoid double counting. In accordance with what was described above, the GDP for the 1st aggregate was calculated as follows:

$$GDP_{\mathrm{I}} = \sum_{i=1}^{n}\left(z_{ia} \cdot CVA_i\right) + \sum_{i=1}^{n}\left(z_{if} \cdot CVA_i\right) - \\ -\left(z_{aa} \cdot CVA_a\right) - \left(z_{ff} \cdot CVA_f\right)$$

$i = 1, 2, ..., n$ – economic sectors

where:

GDP_{I} – Gross Domestic Product of the 1st aggregate;
z_{ia} – total inputs delivered from sector i to the agriculture (sector a);
z_{if} – total inputs delivered from sector i to the food industry (sector f);
z_{aa} – total inputs delivered by the agriculture (sector a) to itself;
CVA_a – value added coefficient for the agriculture (sector a);
z_{ff} – total inputs delivered by the food industry (sector f) to itself,
CVA_f – value added coefficient for the food industry (sector f).

The GDP for the 2nd aggregate was calculated as agriculture value added at producer prices less value added delivered from the agriculture to the food industry (classed under the GDP of the 1st aggregate). This allowed to avoid double counting.

$$GDP_{\mathrm{II}} = VA_{PPa} - z_{af} \cdot CVA_a$$

where:

GDP_{II} – Gross Domestic Product of the 2nd aggregate;
VA_{PPa} – agriculture value added (sector a) at producer prices;
z_{af} – total inputs delivered from the agriculture (sector a) to the food industry (sector f);
CVA_a – value added coefficient for the agriculture (sector a).

The GDP for the 3rd aggregate was calculated in a similar manner, as value added of the food industry at producer prices less value added delivered from the food industry to the agriculture (classed under the GDP of the 1st aggregate):

$$GDP_{\mathrm{III}} = VA_{PPf} - z_{fa} \cdot CVA_f$$

where:

GDP_{III} – Gross Domestic Product of the 3rd aggregate;
VA_{PPf} – value added of the food industry (sector f) at producer prices;
z_{fa} – total inputs delivered from the food industry (sector f) to the agriculture (sector a);
CVA_f – value added coefficient for the food industry (sector f).

The GDP of the entire agribusiness is the total GDP of its aggregates.

RESULTS AND DISCUSSION

The calculation results for the GDP of the agribusiness and its different aggregates, for all 28 European Union countries, are presented in Table 1. In the interest of clarity, the countries are sorted in descending order by the share of agribusiness GDP in total GDP. The following general pattern could be observed: the higher the development level[3] of a country, the lower the share of agribusiness GDP in the national economy. This is primarily because of a low share

[3] The country's development level was determined based on the World Bank's 2014 data on GDP per capita in purchasing power.

Table 1. Amount and share of GDP of the agribusiness and its aggregates in the GDP of European Union countries in 2014 (million USD)

Code	1st aggregate		2nd aggregate		3rd aggregate		Agribusiness		Total GDP
	value	%	value	%	value	%	value	%	
ROU	7 845	4.2	5 977	3.2	9 724	5.2	23 545	12.6	187 508
IRL	15 187	6.5	2 557	1.1	11 572	4.9	29 316	12.5	234 028
BGR	2 315	4.5	1 999	3.9	2 005	3.9	6 319	12.3	51 450
HRV	2 887	5.7	1 037	2.1	1 983	3.9	5 907	11.7	50 278
LTU	2 429	5.4	849	1.9	1 940	4.3	5 218	11.7	44 676
GRC	8 875	4.2	5 406	2.5	6 417	3.0	20 698	9.7	213 691
POL	23 442	4.7	7 596	1.5	15 499	3.1	46 536	9.3	502 326
HUN	4 942	4.0	3 345	2.7	2 598	2.1	10 885	8.9	122 155
ESP	49 219	3.8	11 679	0.9	33 826	2.6	94 725	7.4	1 286 714
LVA	785	2.8	405	1.4	817	2.9	2 007	7.0	28 508
EST	756	3.1	310	1.3	534	2.2	1 601	6.6	24 185
PRT	6 930	3.3	1 419	0.7	5 286	2.5	13 635	6.4	212 105
CYP	721	3.3	262	1.2	382	1.8	1 365	6.3	21 730
SVK	2 122	2.3	2 346	2.5	1 305	1.4	5 773	6.2	93 787
CZE	5 459	2.9	2 026	1.1	3 783	2.0	11 267	5.9	191 356
NLD	22 985	2.8	6 051	0.7	17 441	2.1	46 477	5.7	814 540
FRA	65 637	2.5	22 032	0.8	55 123	2.1	142 791	5.4	2 620 850
ITA	53 451	2.7	19 156	1.0	32 657	1.7	105 265	5.3	1 978 296
SVN	923	2.1	662	1.5	652	1.5	2 237	5.0	44 331
DNK	8 227	2.6	2 358	0.8	4 964	1.6	15 549	5.0	312 320
BEL	13 317	2.7	463	0.1	9 835	2.0	23 616	4.8	490 249
AUT	8 055	2.0	1 591	0.4	7 162	1.8	16 809	4.2	399 466
DEU	84 109	2.4	4 743	0.1	57 172	1.6	146 024	4.1	3 573 024
MLT	147	1.5	63	0.7	163	1.7	373	3.9	9 680
FIN	4 755	1.9	983	0.4	2 899	1.2	8 637	3.5	244 885
GBR	38 812	1.4	9 759	0.4	45 301	1.6	93 873	3.4	2 783 344
SWE	7 073	1.3	935	0.2	5 838	1.1	13 846	2.6	527 118
LUX	309	0.5	125	0.2	399	0.7	833	1.4	60 472

Source: own calculations based on data retrieved from the World Input–Output Database.

of the 2nd aggregate in countries at higher levels of development. However, some exceptions exists, such as Ireland, Spain or Slovenia. The two former, despite a high development level, exhibit a relatively large share of agribusiness GDP in the entire economy. This is best illustrated by the example of Ireland where the 3rd aggregate (directly related to the food industry) holds a very high share of ca. 5%, whereas

the 1st aggregate (supply) has the largest contribution to GDP (6.5%) of all the countries. Things look similar in Spain where the share of the 2nd aggregate is relatively small while that of the 1st and 3rd aggregate is large. In turn, Slovenia, as mentioned earlier, reports a low contribution of agribusiness GDP to the national economy while being at a relatively lower level of development. This can have multiple reasons, probably including the adverse natural conditions affecting the agricultural business (the national territory is mostly covered by forests, highlands and mountains). On the other hand, the 3rd aggregate has a relatively low contribution to GDP. This can suggest that the Slovenian food industry is less developed than in highly developed countries.

A relationship between the contribution of different agribusiness aggregates to GDP and the development level can be observed throughout the European Union. Better developed countries exhibit a clearly larger gap between the contribution of the 2nd aggregate (which is low) and that of the 1st and 3rd aggregates. This results from a pattern well known in economic theory: as the economy grows, the share of agriculture in the national economy declines. Production shifts to the industrial and service sectors (Kuznets, 1973). Slovenia and Slovakia can be regarded as an exception from this pattern. When it comes to Slovakia, this is probably because of the topography: as the country is mostly covered with mountains, the agriculture must be relatively more efficient. In turn, when it comes to Slovenia, the reasons are similar to those presented in the first relationship discussed.

CONCLUSIONS

The analysis of the amount and share of agribusiness GDP in total GDP of European Union countries proved the existence of two major relationships involving the level of economic development: (i) the higher the development level of a country, the lower the share of agribusiness GDP in the national economy; (ii) as the country develops, the share of the 2nd agribusiness aggregate in the GDP becomes relatively smaller compared to that of other agribusiness aggregates. Note however that a few exceptions can be found.

The studies on agribusiness measurement for all European Union countries in one period are relatively scarce in the relevant literature. A known problem faced in these analyses is that the I/O tables are published with a huge delay and are only available for some countries. With the World Input–Output Database, it was possible to carry out a study for a relatively recent period. Moreover, a proprietary method of agribusiness GDP measurement was used which takes account of the particular role of the food industry.

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