



Sectoral Interdependencies and Key Sectors in the Romanian, Hungarian and Slovak Economy – An Approach Based on Input-Output Analysis

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Abstract. The aim of this paper is to analyse sectoral interdependencies and to identify the key sectors in the Romanian, Hungarian and Slovak economy, drawing a comparison between these three countries. In order to do these investigations, input-output analysis is applied, as it is based on a model which presents interactions between sectors of the economy. This method can also be used for determining the role of each sector in the national economy regarding its contribution to the total output, incomes, export-import and so on, and for quantifying direct and indirect impact on the whole economy caused by any change produced in a sector's activity. As the results of the analyses show, several similarities and differences appear in the economic structure, the sectoral interdependencies and the key sectors of the analysed countries. For example, in Romania, intersectoral transactions are axing mainly on the *Trade* and *Manufacturing* sectors, while in Hungary and Slovakia on the *Manufacturing* and *Other professional, scientific and technical services sectors*. Key sectors – identified by applying output and income backward linkages – also differ as in Romania the output backward linkage is the largest in the case of the *Trade sector*, in Hungary, in the *Food sector* and in Slovakia in the *Electricity, gas, water and waste management sector*. In the case of the income linkages, *Social, collective and personal services* rank in the first place in all three countries.

Keywords and phrases: key sectors, input-output analysis, Romania, Hungary, Slovakia.

JEL Classification: D57, O57

1. Introduction

This study aims at analysing the sectoral interdependencies and identifying the key sectors in Romania, Hungary and Slovakia, three countries situated entirely or partly in the Carpathian Basin, with a significant Hungarian population. Hungary and some parts of Romania and Slovakia had once belonged to the same economic bloc, but since then the different social, demographic and political processes provided different backgrounds for their economic developments. At the same time, differences in the relief and in the availability of the natural resources also influence the economic situation of these countries. However, all of them are Central and Eastern European countries, member states of the European Union; so, many common economic features are expected to be identified.

Investigating some general demographic and economic characteristics of the countries, we highlight the following aspects: the total surface of Romania (238,394 km²) is more than twice as large as that of Hungary (93,023 km²) and four times larger than that of Slovakia (49,037 km²). The land use also shows significant differences: the share of the cropland is much higher in Hungary (47%) than in the other countries (36% in Romania and 28% in Slovakia), while the woodland has the highest share in Slovakia (46%, while in Romania it is 31% and in Hungary 24%), and the share of the grassland is the highest in Romania (25%, while in Hungary and Slovakia it is 19%).¹ Romania has about 20 million inhabitants, Hungary 9.9 million, while Slovakia only 5.4 million inhabitants.² Regarding the GDP per inhabitant,³ relatively high differences appear, as the value of this indicator is the highest in Slovakia (19,400 PPS), being followed by Hungary (17,000 PPS), and it is the lowest in Romania (13,500 PPS).

For investigating the economic structure, the sectoral links and key sectors in the chosen countries, we apply the method of input-output analysis. The study is structured in the following way: in Section 2, we present the methodology of the input-output analysis. This is followed by Section 3 containing results and discussion. In this section, we present a descriptive analysis of the structure of the Romanian, Hungarian and Slovak economy, we characterize intersectoral transactions and direct linkages between the sectors for all three countries, and we present the results of the key sector analysis based on the calculation of some output and income backward linkages in order to identify those sectors which can trigger the largest changes on the economic level. In Section 4, we outline some conclusions and remarks.

1 Eurostat data for year 2012

2 Eurostat data for year 2013

3 Eurostat data for year 2012

2. Material and Methods

Input-Output Analysis

The input-output analysis was developed by Wassily Leontief in the late 1930s, and since then it has become a widely used modelling tool, as it can be applied to reveal sectoral interdependencies in an economy, to analyse the structure of the total output, respectively input, and to identify the key sectors in the national economy from the demand and supply side. Those sectors can be considered as key sectors which can trigger the most significant changes in the national production, value added, income and so on. Due to the above-mentioned opportunities provided by this technique, input-output models can be used as policy tools, too, because they allow the prediction of changes over the output, income or employment level initialized by a certain policy measure that is intended to be applied (Mattas et al., 2006a, p. 55).

The input-output analysis is based on the input-output table, which “is designed to provide a concise and systematic arrangement of all economic activities within an economy. It shows the intersectoral flows in monetary terms for a particular year where the flows represent intermediate goods and services.” (Rameezdeen et al., 2005, p. 3) The rows of the input-output table present the structure of the demand for the production of each sector, while its columns present the structure of the resources used by the sectors (Table 1). So, sectoral interdependencies can be analysed both from the demand and the supply side.

The input-output table is composed by three quadrants,⁴ which generally contain the following information:

- the first quadrant contains the transaction matrix, which shows the intermediate transactions of the economic sectors;
- the second quadrant (on the right-hand side) contains the final demand (Y) for the output of each sector, including consumption of households, consumption of the government and non-profit organizations, respectively gross fixed capital formation, changes in inventories and export;
- the third quadrant (below the first quadrant) represents the primary inputs (or final payments) (P) coming from the rest of the economy (not from the production of the other sectors): compensations of employees, taxes, subventions or other value-added components, and from imports.

⁴ The elements of the fourth quadrant representing the transactions of the primary inputs and final demand categories are generally not presented in the input-output tables.

Table 1. *Structure of the input-output table*

From	Intermediate demand (purchasing sectors)						Final demand	Total output
	To	1	2	...	j	...	n	
Intermediate inputs (selling sectors)	1	x_{11}	x_{12}	...	x_{1j}	...	x_{1n}	Y_1
	2	x_{21}	x_{22}	...	x_{2j}	...	x_{2n}	Y_2

	i	x_{i1}	x_{i2}	...	x_{ij}	...	x_{in}	Y_i

	n	x_{n1}	x_{n2}	...	x_{nj}	...	x_{nn}	Y_n
Primary inputs		P_1	P_2	...	P_j	...	P_n	
Total inputs		X_1	X_2	...	X_j	...	X_n	

Source: own creation based on Mattas et al., 2006a, p. 59.

Based on the input-output table, equations (1) and (2) can be written regarding the selling and purchasing activity of the sectors.

$$(1) \quad X_i = \sum_{j=1}^n x_{ij} + Y_i$$

- where X_i represents the total output of sector i , x_{ij} is the value of products or services sold by sector i for sector j , Y_i represents the final demand for products or services of sector i and n is the number of the sectors of the economy.

$$(2) \quad X_j = \sum_{i=1}^n x_{ij} + P_j$$

- where X_j represents the total input of sector j , x_{ij} is the value of the products or services purchased by sector j from sector i and P_j represents the primary inputs of sector j .

Measuring Direct Intersectoral Linkages: The Flow Index

The transaction matrix of the input-output table presents the intersectoral activities within the economy. In this study, we measure the degree of direct relationship between the sectors in the chosen countries using the flow index. The flow index between sectors i and j can be calculated by taking the average of the share of intermediate uses (x_{ij}) over the total intermediate input of sector j and over the total intermediate output of sector i . (EC-JRC IPTS,⁵ 2007, p. 3.)

If the flow index calculated for two sectors – i and j – is relatively high, it means that the sectors are strongly interrelated to each other. The interdependence between two sectors can be estimated both from demand and supply side.

5 European Commission – Joint Research Centre's Institute for Prospective Technological Studies

This means that sector i is strongly backward interrelated with sector j if an important part of sector i 's intermediate inputs are purchased from sector j and, at the same time, this amount represents a relatively high share in sector j 's total intermediate output.

In turn, sector i is strongly forward interrelated with sector j if sector j is an important consumer of the intermediate outputs of sector i and, at the same time, these products represent an important share in the total intermediate input of sector j .

For example, in the case of Romania, 52% of the total intermediate output of agriculture is used by the *Food products, beverages and tobacco products* sector, which corresponds to the 57% of the total intermediate input of the latter sector. So, the flow index is calculated in the following way: $(52\% + 57\%) / 2 = 54.5\%$.

Inversely, the food sector delivers 6% of its total intermediate output for the agriculture, which counts 2% in the total intermediate input of the agriculture. In this case, the value of the flow index is 4%. So, it can be concluded that *Agriculture* is strongly forward interrelated with the *Food sector* and relatively weakly backward interrelated with it.

Indirect Linkages

Interdependencies from an economy are represented – besides the direct linkages – by the intensity of the indirect linkages too. These indirect linkages can be calculated and estimated in several ways, as several multipliers and indicators were invented by the specialists of the input-output methodology. Linkage indicators are mainly used to quantify changes in the total national output, income, employment, value added etc. triggered by a change produced in the activity of a certain sector. Sectors with the highest linkage values can be considered key sectors as they can generate the highest changes on the economic level. Kweka, Morrissey and Blake (2001, p. 21.) draw attention to the fact that all the sectors of the economy are somewhat important; so, “identification of key sectors may only be justifiable on ordinal terms”.

In this study, we calculate output and income backward linkages proposed by Rasmussen (1956)⁶ and Hirschman (1958).⁷ Backward linkages show changes at the level of the economy produced by one unit change in a sector's final demand.

The calculation of the backward linkages is based on the total requirements matrix, the so-called Leontief-inverse (B), which is computed as the inverse matrix of the direct requirements matrix (A). The direct requirements matrix contains the technical coefficients, which are calculated according to the formula:

6 Cited in: Mattas et al. (2006b, p.104)

7 Cited in: Mattas et al. (2006b, p.104)

$$(3) \quad a_{ij} = x_{ij} / X_j$$

where a_{ij} is the respective element of the direct requirement matrix (A), x_{ij} represents the value of sector i 's production purchased by sector j and X_j represents the total input of sector j .

The total requirements matrix (B) is computed using the formula:

$$(4) \quad B = (I-A)^{-1}$$

where I is the identity matrix.

The *Output Backward Linkage (OBL)* of sector j shows the increase in the total output at the level of the economy which is required for one unit increase in the final demand of sector j .

$$(5) \quad OBL_j = \sum_{i=1}^n \beta_{ij}$$

where β_{ij} is the respective element of the total requirements matrix (B). (Mattas et al., 2006b, p. 104.)

The *Income Backward Linkage (IBL)* of sector j shows the change in the total income at the level of the economy which is required for one unit increase of the final demand of sector j :

$$(6) \quad IBL_j = \sum_{i=1}^n L_i * \beta_{ij}$$

where L_i is the income coefficient of sector i : $L_i = I_i / X_i$ (I – income: the compensation of the employees, X – total output). (Mattas et al., 2006b, p. 105.)

Source of Data

The source of the input-output tables for Romania, Hungary and Slovakia is the official site of the Eurostat.⁸ Most recently available symmetric input-output tables are from the year 2010, including 64 branches. In the study, branches are aggregated for 13 branches:

1. Agriculture, forestry and fishing;
2. Mining and quarrying;
3. Food products, beverages and tobacco products;
4. Manufacturing (excepting food products, beverages and tobacco products);
5. Electricity, gas, steam and air-conditioning; water supply; waste management services;

8 Eurostat -ESA 95 Supply Use and Input-Output tables (Table 17: Input-output table at basic prices), monetary unit: Romania – mio. EUR, Hungary and Slovakia mio. NAC.

6. Constructions;
7. Trade (wholesale and retail);
8. Transport and postal services;
9. Accommodation and food services;
10. Publishing, telecommunication and computer programming services;
11. Financial, insurance and real estate services;
12. Other professional, scientific and technical services (legal, accounting, employment services, travel agencies, a.s.o.);
13. Social, collective and personal services (public administration and defence, educational, health services a.s.o.).

3. Results and Discussion

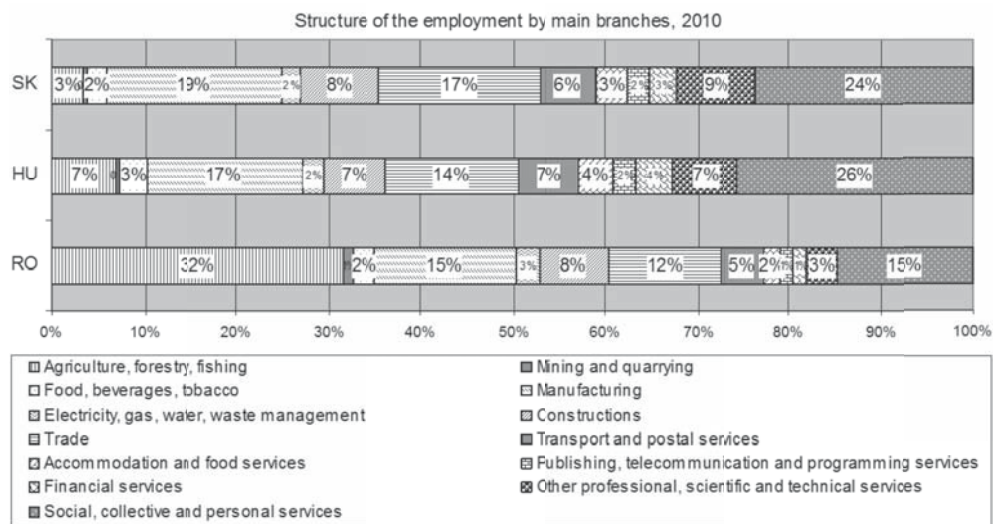
Structure of the Sectoral Employment and Output

In order to analyse the structure of the economy in the chosen countries, first of all, we investigated the structure of the employment by the main branches. As *Figure 1* shows, high discrepancies between the countries can be observed and especially the case of Romania is different because here the share of employment in agriculture is much higher than in the other countries. In Hungary and Slovakia, the proportion of the employment in the *Social, collective and personal services* (in Hungary, especially from the *Public administration and defence*, while in Slovakia from the *Education* sectors) is in the first place. A high share of the employed persons works in this sector in Romania as well, especially in the *Health services*. The other most important sectors in terms of employment shares are the *Manufacturing* and the *Trade* sectors in all three cases.

Analysing the structure of the output by main branches – shown in *Figure 2* –, it can be observed that it significantly differs from the structure of the employment by main branches, which is related, first of all, to the labour productivity of the sectors. For example, in Romania, the proportion of the agricultural employment in the total employment is five times higher than the proportion of the agricultural output in the total output. In turn, in Hungary and Slovakia, the difference between these proportions is very small.

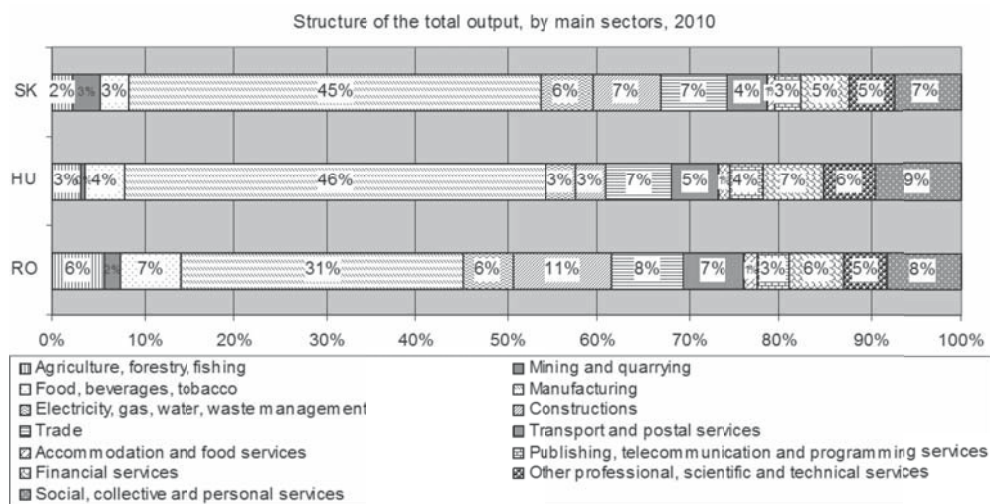
Regarding the structure of the total output, the following aspects can be remarked. The *Manufacturing* sector has the highest proportion in all three countries, and within this sector the following branches have the highest importance: in Romania, the share of the *Motor vehicles*, *Basic metals* and *Textiles, wearing apparel and leather products*, in Hungary, the *Computer, electronic and optical products*, *Motor vehicles*, *Coke and refined petroleum products*, and in Slovakia the *Motor vehicles*, *Computer, electronic and optical products* and *Basic metals*

is the highest. In the second place, we find the *Construction* sector in Romania, the *Social, collective and personal services* in Hungary and Slovakia, and in the third place the *Social, collective and personal services* in Romania and *Trade* in Hungary and Slovakia.



Source: own calculations based on Eurostat data

Figure 1. *Structure of the employment by main sectors in Romania, Hungary and Slovakia*

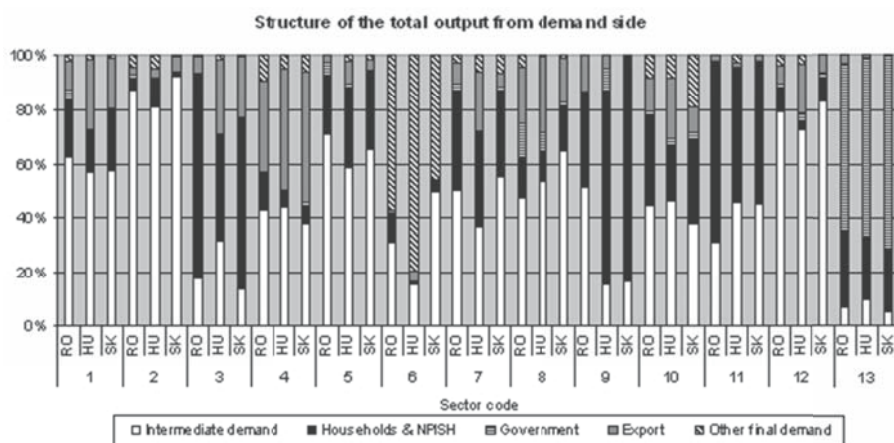


Source: own calculations based on Eurostat data

Figure 2. *Structure of the total output by main sectors*

Structure of the Sectoral Output from Demand Side

The structure of the total output from demand side shows significant differences by sectors and by countries, as well. In the case of the *Agriculture, forestry and fishing* sector, the largest part of the output is consumed by the other sectors (intermediate demand) in all three countries, while about 20% of the products in Romania and Slovakia are consumed by the households. The lowest export activity appears in the case of Romania, which is probably due to the existing inefficiencies in this sector's activity. In Hungary, the share of the household consumption is lower, but the share of exports is higher. Compared to the other sectors, the proportion of the intermediate demand is the highest in the *Mining and quarrying* sector in all three countries. At the same time, a very weak export activity can be observed in all three countries, and especially in Romania. In the case of the *Food sector*, the proportion of the household consumption is the highest in all three countries; however, in Hungary and Slovakia, the relatively high share of the exports must be mentioned. *Manufacturing* products in Romania are used mainly by the other sectors. Although the share of the exports is significant, it is again lower than in the other two countries, where the proportion of the exports is higher than that of the intermediate consumption. The output of the *Electricity, gas, steam and air-conditioning; water supply; waste management services* sector is consumed mainly by the other sectors, but the consumption of the households is also significant in all three countries. In the case of the *Construction* sector, the share of the gross fixed capital formation – especially in Hungary – is the highest. At the *Trade and Transport and postal services*, the proportion of the intermediate consumption is the highest in all three countries and a relatively high share of the export in Hungary must be remarked. In the case of the *Accommodation and food services*, the consumption share of the households is much higher in Hungary and Slovakia than in Romania, which is probably due to the untapped opportunities in Romanian tourism. In the *Publishing, telecommunication and computer programming services* sector, the share of the exports is the highest in Hungary again, but the intermediate consumption has the highest share in all three countries. Regarding the *Financial, insurance and real estate services*, it can be seen that the share of household consumption in Romania is higher than in the other two countries, while in Hungary and Slovakia the structure of this sector's output is almost the same. In the case of the *Other professional, scientific and technical services*, the share of the intermediate demand is very high in all three countries, as these are services rendered mainly for enterprises. At the *Social, collective and personal services*, the share of the government consumption is the most important and, at the same time, the structure of the output is very similar in the analysed countries.



Sector codes: 1. Agriculture, forestry and fishing; 2. Mining and quarrying; 3. Food products, beverages and tobacco products; 4. Manufacturing; 5. Electricity, gas, water, waste management; 6. Constructions; 7. Trade; 8. Transport and postal services; 9. Accommodation and food services; 10. Publishing, telecommunication and computer programming services; 11. Financial, insurance and real estate services; 12. Other professional, scientific and technical services; 13. Social, collective and personal services.

Source: own calculations based on Eurostat data

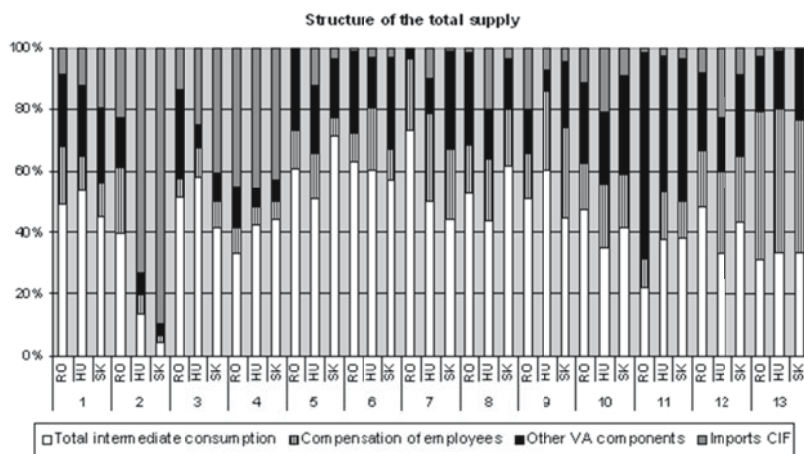
Figure 3. *Structure of the total output from demand side*

Structure of the Sectoral Inputs

Regarding the structure of the sectoral inputs, the following main observations can be made. In the case of the *Agriculture, forestry and fishing* sector, the highest share of the inputs comes from the intermediate resources in all three countries. At the same time, the share of the compensation of the employees⁹ is the highest in Romania, which can be explained by the high level of agricultural employment in this country. Agricultural imports have the highest share in Slovakia, being followed by Hungary. In the *Mining and quarrying* sector, intermediate resources have a relatively high share in Romania, while in the other two countries imports are very significant. Regarding the *Food sector*, it is easy to observe that imports have a significant share in the sectoral inputs in Hungary and Slovakia, while this share is lower in the case of Romania. In the *Manufacturing* sector, the share of the imports is almost the same in all three countries, but the share of the intermediate resources is lower in Romania and the share of the compensation of employees and the proportion of the other value-added components are higher here than in the other countries. In the case of the *Electricity, gas, steam and air-conditioning; water supply; waste management services* sector, the proportion of the imports is the highest in Hungary. The structure of the inputs is almost the same in all

⁹ The compensation of the employees is supplied at current prices.

three countries in the case of the *Construction* sector, and the proportion of the compensation of employees is higher in Hungary than in Romania or Slovakia; however, the share of the employment working in this sector in Hungary is the lowest. In the *Trade* sector, the proportion of the intermediate inputs is the highest in Romania and the value added is lower here. In the case of the *Transport and postal services*, a relatively high share of the imports in Hungary can be observed and the compensation of employees appears with almost the same share in all three countries. In the *Accommodation and food services* sector, the proportion of the import is the highest in Romania, while the share of the intermediate consumption is the highest in Hungary. The compensation of employees in Hungary and Slovakia appears with higher share than in Romania. In the case of the *Publishing, telecommunication and computer programming services*, a relatively high proportion of the imports in Hungary can be observed, while in Romania and Slovakia the structure of the sectoral inputs is very similar. Higher value-added proportion in the case of the *Financial services* can be observed in Romania, while in the other two countries intermediate inputs of this sector have higher shares. Regarding the *Other professional, scientific and technical services*, Romania and Slovakia can be characterized by almost the same input structure, while in Hungary the share of the imports is higher. In the case of the *Social, collective and personal services*, the structure of the inputs is almost the same in all three countries.



Sector codes: 1. Agriculture, forestry and fishing; 2. Mining and quarrying; 3. Food products, beverages and tobacco products; 4. Manufacturing; 5. Electricity, gas, water, waste management; 6. Constructions; 7. Trade; 8. Transport and postal services; 9. Accommodation and food services; 10. Publishing, telecommunication and computer programming services; 11. Financial, insurance and real estate services; 12. Other professional, scientific and technical services; 13. Social, collective and personal services.

Source: own calculations based on Eurostat data

Figure 4. *Structure of the total output from supply side*

Structure of the Export and Import by Main Sectors

The structure of the export and import by the main sectors in Romania, Hungary and Slovakia are presented in *Table 2*. It is easy to observe that the *Manufacturing* sector has the highest proportion in total export and import in all three countries. Entering into details regarding the activity of this sector, the following aspects must be highlighted. In Romania, the highest export appears in the case of the *Electrical equipment* and *Textiles, wearing apparel and leather products*, while in Hungary and Slovakia at the *Computer, electronic and optical products* and *Motor vehicles, trailers and semi-trailers* branches.

Concerning the structure of the import, in Romania, the *Computer, electronic and optical products*, *Machinery and equipment* and the *Electrical equipment*, while in Hungary and Slovakia the *Computer, electronic and optical products* and *Motor vehicles, trailers and semi-trailers products* have the most significant proportion in the *Manufacturing* sector's import.

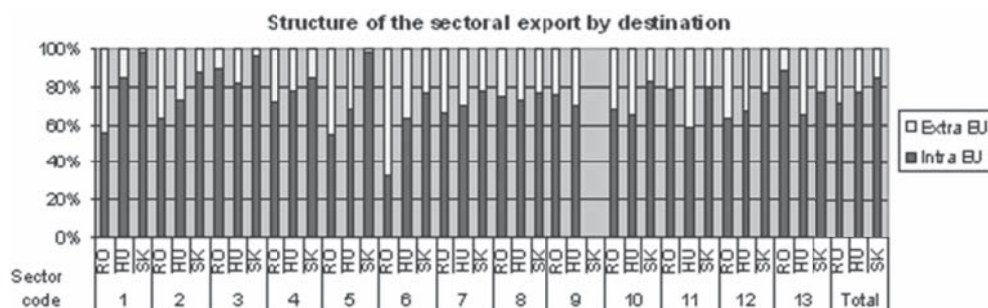
Table 2. *Structure of the regional export and import by sectors*

Sector	Romania		Hungary		Slovakia	
	Export	Import	Export	Import	Export	Import
Agriculture, forestry, fishing	4%	3%	3%	1%	2%	2%
Mining and quarrying	0%	2%	0%	1%	1%	11%
Food, beverages and tobacco	3%	5%	4%	4%	3%	5%
Manufacturing	69%	80%	74%	77%	87%	76%
Electricity, gas, water, waste management	1%	0%	1%	1%	1%	1%
Constructions	1%	1%	0%	0%	0%	1%
Trade	4%	0%	6%	3%	1%	0%
Transport and postal services	9%	1%	5%	4%	3%	1%
Accommodation and food services	1%	2%	0%	0%	0%	0%
Publishing, telecommunication and computer programming services	3%	2%	3%	3%	1%	1%
Financial, insurance and real estate services	1%	1%	0%	1%	0%	1%
Other professional, scientific and technical services	2%	2%	4%	5%	1%	2%
Social, collective and personal services	2%	1%	0%	0%	0%	0%

Source: own calculations based on Eurostat data

The structure of the sectoral export by destination and the structure of the sectoral import by origin are shown in figures 5 and 6. It is easy to observe that in Romania the share of the export to non-EU member states in most cases is

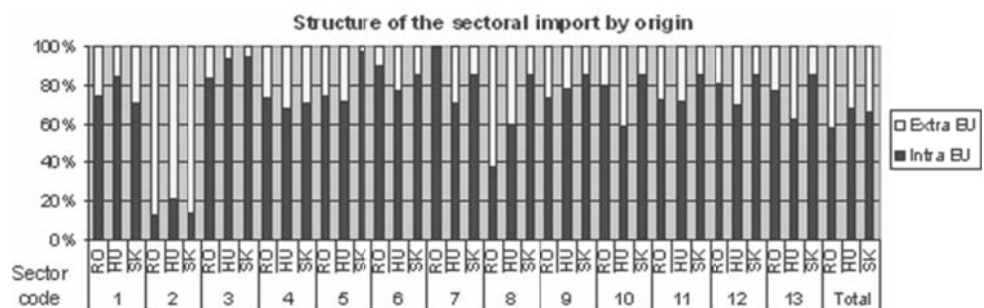
higher than in the other two countries, which probably has to do mainly with the geographical position of the country. The highest proportion of the extra EU exports in Romania appears in the case of the *Construction and Electricity, gas, steam and air-conditioning; water supply; waste management services* sectors, in Hungary, for *Financial, insurance and real estate services* and *Construction* sectors, while in Slovakia for *Social, collective and personal services*.



Sector codes: 1. Agriculture, forestry and fishing; 2. Mining and quarrying; 3. Food products, beverages and tobacco products; 4. Manufacturing; 5. Electricity, gas, water, waste management; 6. Constructions; 7. Trade; 8. Transport and postal services; 9. Accommodation and food services; 10. Publishing, telecommunication and computer programming services; 11. Financial, insurance and real estate services; 12. Other professional, scientific and technical services; 13. Social, collective and personal services.

Source: own calculations based on Eurostat data

Figure 5. The structure of the sectoral export, by destination



Sector codes: 1. Agriculture, forestry and fishing; 2. Mining and quarrying; 3. Food products, beverages and tobacco products; 4. Manufacturing; 5. Electricity, gas, water, waste management; 6. Constructions; 7. Trade; 8. Transport and postal services; 9. Accommodation and food services; 10. Publishing, telecommunication and computer programming services; 11. Financial, insurance and real estate services; 12. Other professional, scientific and technical services; 13. Social, collective and personal services.

Source: own calculations based on Eurostat data

Figure 6. The structure of the sectoral import, by origin

Regarding the origin of the sectoral imports, it can be observed that in the case of the *Mining and quarrying* sector the value of the imported products purchased from non-EU member states is much higher in all three countries than those purchased from EU members. A relatively high share of the extra EU imports can be observed in Romania in the case of the *Transport and postal services*. In the case of the other sectors, the value of the imported goods and services from EU member states is higher than the value of the imports coming from non-EU member states.

Intersectoral Transactions

We estimate the relationships between the main sectors of the economy using flow indexes. Figures 7, 8 and 9 depict the most important direct linkages between the sectors of the economy in Romania, Hungary and Slovakia. Arrows on the figures represent flow indices greater than 0.1, and the direction of the arrows shows the backward or forward character of the intersectoral transactions.

In the case of Romania, the relationships covered by the arrows represent 51% of the value of the intersectoral transactions. It is easy to observe that in Romania intersectoral transactions are axing mainly on the *Trade* and *Manufacturing* sectors.

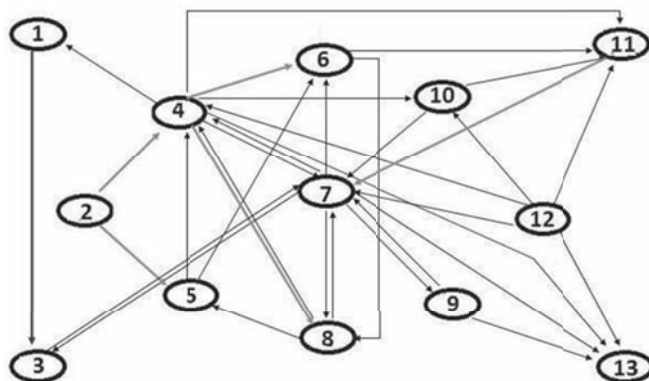
The strongest relationships (where the flow index is above 0.35) can be considered between the *Agriculture* and *Food sector*, where the first one is highly forward interrelated with the second one. Other strong relationships (where the flow index is between 0.2 and 0.34) can be observed in the following cases: *Manufacturing* and *Electricity, gas, steam and air-conditioning; water supply; waste management services* sectors are highly backward interrelated with the *Mining and quarrying* sector. The *Manufacturing* sector is highly forward interrelated with the *Construction* and the *Transport and postal services* sector, and the *Trade* sector is highly backward interrelated with the *Financial services* sector.

As it is revealed in the followings, in Romania, the transactions with relatively high flow index cover a larger part of the intersectoral transactions than in the other two countries.

Another important aspect worth to be mentioned is that the self-consumption of the sectors covers 26% of the value of the intersectoral transactions.

In Hungary, the intersectoral relationships with the flow index above 0.1 represent 32% of the total intersectoral transactions. The sectors characterized by the largest number of flow indexes having value above 0.1 are the *Manufacturing* and the *Other professional, scientific and technical services* sectors. The strongest intersectoral relationships can be observed in the following cases: similarly to Romania, the *Agriculture, forestry and fishing* sector is highly forward interrelated with the *Food sector* and – what does not appear in the case of Romania – the *Food sector* is highly forward interrelated with the *Accommodation and food services* sector (in

both cases, the flow index is above 0.35). Other important relationships (with flow indices between 0.2 and 0.35) are observed in the case of the *Manufacturing* sector, which is highly backward interrelated with the *Mining and quarrying* and *Trade* sectors, and it is highly forward interrelated with the *Construction* sector. The self-consumption of the sectors covers 48% of the total intermediate consumptions.



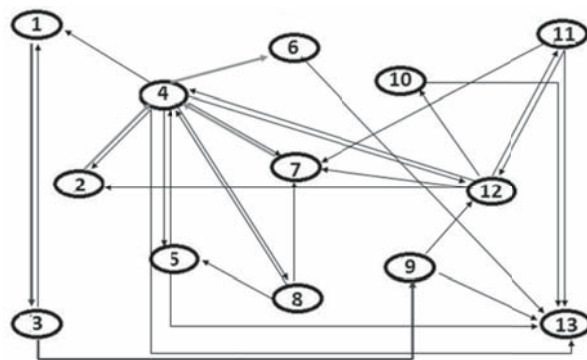
Sector codes: 1. Agriculture, forestry and fishing; 2. Mining and quarrying; 3. Food products, beverages and tobacco products; 4. Manufacturing; 5. Electricity, gas, water, waste management; 6. Constructions; 7. Trade; 8. Transport and postal services; 9. Accommodation and food services; 10. Publishing, telecommunication and computer programming services; 11. Financial, insurance and real estate services; 12. Other professional, scientific and technical services; 13. Social, collective and personal services.

Source: own edition based on Eurostat data

Figure 7. Flow index, Romania

In Slovakia, intersectoral transactions characterized by a flow index above 0.1 cover only 30% of the total intersectoral transactions. Similarly to Hungary, *Manufacturing* and *Other professional, scientific and technical services* sectors can be characterized by the largest number of the flow indices above 0.1. The strongest relationships (with flow indices above 0.2) can be seen in the following cases: similarly to the other two countries, the *Agriculture, forestry and fishing* sector is highly forward interrelated with the *Food* sector, while *Mining and quarrying* sector is highly forward interrelated with the *Manufacturing* and *Electricity, gas, steam and air-conditioning; water supply; waste management services* sectors. The *Manufacturing* sector is backward interrelated with the *Trade* sector and the *Trade* sector is backward interrelated with the *Other professional, scientific and technical services*. The *Construction* sector is highly forward interrelated with the *Financial, insurance and real estate services* and *Accommodation and food services* are forward interrelated with the *Social, collective and personal services*. It is also worth mentioning that although the

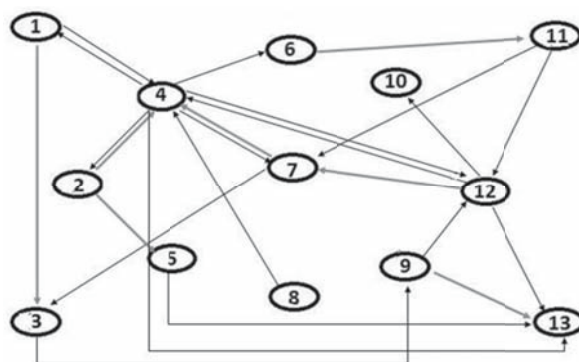
flow index is below 0.2 an important relationship appears between the *Food sector* and the *Accommodation and food services* sector, which can be seen in Hungary, too, and cannot be observed in the case of Romania. The proportion of the self-consumption in the intermediate transactions is 51%.



Sector codes: 1. Agriculture, forestry and fishing; 2. Mining and quarrying; 3. Food products, beverages and tobacco products; 4. Manufacturing; 5. Electricity, gas, water, waste management; 6. Constructions; 7. Trade; 8. Transport and postal services; 9. Accommodation and food services; 10. Publishing, telecommunication and computer programming services; 11. Financial, insurance and real estate services; 12. Other professional, scientific and technical services; 13. Social, collective and personal services.

Source: own edition based on Eurostat data

Figure 8. Flow index, Hungary



Sector codes: 1. Agriculture, forestry and fishing; 2. Mining and quarrying; 3. Food products, beverages and tobacco products; 4. Manufacturing; 5. Electricity, gas, water, waste management; 6. Constructions; 7. Trade; 8. Transport and postal services; 9. Accommodation and food services; 10. Publishing, telecommunication and computer programming services; 11. Financial, insurance and real estate services; 12. Other professional, scientific and technical services; 13. Social, collective and personal services.

Source: own edition based on Eurostat data

Figure 9. Flow index, Slovakia

Key Sector Analysis

We identify key sectors in the Romanian, Hungarian and Slovak economy by comparing their backward multipliers. *Table 3* presents the output backward linkages calculated for all three countries as well as the ranking of the sectors according to the value of their linkage indicators. The following aspects can be remarked: in Romania, the *Trade* and *Electricity, gas, steam and air-conditioning; water supply; waste management services* sectors are ranked in the first place regarding their output backward linkage. This means that these are the sectors that can trigger the largest change in the output on the level of the whole economy if one monetary unit change in their final demand (due, for example, to the increase of the households' or the government's demand for their output) occurs. It has to be mentioned that the magnitude of the output backward linkages depends on several factors like the magnitude of the sectoral output compared to the other sectors' output, the structure of the sectoral output from the demand side, how strongly the sector is interrelated to the other sectors and so on. The *Agriculture* and *Food sector* also has relatively large output backward linkages. In the case of Hungary, the largest output backward linkage appears in the *Food* sector, being followed by the *Accommodation and food services* sector, the *Constructions* and the *Agriculture, forestry and fishing*. In Slovakia, in the first place, the *Electricity, gas, steam and air-conditioning; water supply; waste management services* are ranked, followed by the *Transport and postal services*, *Construction* and *Accommodation and food services*. The lowest output backward linkages in Romania appear in the *Financial services* sector, while in Hungary and Slovakia in the *Mining and quarrying* sector. We can conclude that there are significant differences between the countries regarding their key sectors.

Table 3. *Output Backward Linkages by sectors*

Sector	OBL					
	RO		HU		SK	
	Value	Rank	Value	Rank	Value	Rank
Agriculture, forestry, fishing	1.88	5	1.98	4	1.80	5
Mining and quarrying	1.68	10	1.22	13	1.07	13
Food, beverages and tobacco	1.96	4	2.08	1	1.77	8
Manufacturing	1.55	11	1.72	7	1.77	9
Electricity, gas, water, waste management	2.08	2	1.84	5	2.35	1
Constructions	2.07	3	2.00	3	2.11	3
Trade	2.21	1	1.80	6	1.79	7
Transport and postal services	1.87	6	1.70	8	2.21	2
Accommodation and food services	1.80	9	2.07	2	1.81	4

Sector	OBL					
	RO		HU		SK	
	Value	Rank	Value	Rank	Value	Rank
Publishing, telecommunication and computer programming services	1.80	8	1.55	10	1.73	10
Financial, insurance and real estate services	1.37	13	1.56	9	1.69	11
Other professional, scientific and technical services	1.83	7	1.53	11	1.78	6
Social, collective and personal services	1.53	12	1.49	12	1.58	12

Source: own calculations based on Eurostat data

In the case of the income backward linkages, shown in *Table 4*, *Social, collective and personal services* are ranked in the first place in all three countries. This means that one monetary unit increase in the final demand of this sector can generate the largest increase in total income at the level of the whole economy. In Romania and Hungary, the second highest income backward linkages appear in the case of the *Trade* sector, which in Slovakia is ranked fourth. In Slovakia, the *Accommodation and food* sector is in the second place. In the third place, we find the *Agriculture, forestry and fishing* sector in Romania, while the *Accommodation and food services* in Hungary and the *Transport and postal services* in Slovakia. On the last place, we find *Financial services* in Romania and the *Mining and quarrying* in Hungary and Slovakia.

It needs to be mentioned that in the case of the income backward linkages the value of the linkage depends not only on the backward character or on the magnitude of the sector's output, but also on the number of the employees and the income level in the respective sector.

Table 4. *Income Backward Linkages by sectors*

Sector	IBL					
	RO		HU		SK	
	Value	Rank	Value	Rank	Value	Rank
Agriculture, forestry, fishing	0.33	3	0.23	11	0.20	8
Mining and quarrying	0.33	4	0.10	13	0.03	13
Food, beverages and tobacco	0.22	10	0.24	10	0.18	10
Manufacturing	0.15	12	0.13	12	0.13	11
Electricity, gas, water, waste management	0.28	6	0.27	8	0.17	12
Constructions	0.22	11	0.34	5	0.22	7
Trade	0.39	2	0.42	2	0.34	4
Transport and postal services	0.27	8	0.32	6	0.35	3

Sector	IBL					
	RO		HU		SK	
	Value	Rank	Value	Rank	Value	Rank
Accommodation and food services	0.28	7	0.42	3	0.39	2
Publishing, telecommunication and computer programming services	0.26	9	0.31	7	0.28	6
Financial, insurance and real estate services	0.15	13	0.25	9	0.20	9
Other professional, scientific and technical services	0.31	5	0.36	4	0.33	5
Social, collective and personal services	0.56	1	0.56	1	0.51	1

Source: own calculations based on Eurostat data

4. Concluding Remarks

Summing up the results of the analysis of the sectoral employment, output and input, the intersectoral transactions and the key sector analysis, we draw the following conclusions.

The structure of the employment by the main branches is significantly different in Romania than in the other two countries, as in Romania a high proportion of the employees work in the *Agriculture, forestry and fishing* sector and in Hungary and Slovakia the highest proportion of the employees belongs to the *Social, collective and personal services* sector.

Regarding the structure of the output, the *Manufacturing* sector stays in the first place. The structure of the output from the demand and supply side shows significant differences in the analysed countries. It can be remarked that the share of the export is generally higher in the case of Hungary.

Analysing sectoral interdependencies, it is easy to observe that – as the value of flow indices shows – in Romania there is generally a larger number of intensive intersectoral relations than in the other two countries. In turn, the proportion of the self-consumption (summed up for the sectors) in the intersectoral transactions is higher in Hungary and Slovakia than in Romania. The sectors characterized by the strongest intersectoral relationships in Romania are the *Trade* and *Manufacturing* sectors, while in Hungary and Slovakia the *Manufacturing* and *Other professional, scientific and technical services* sectors. A number of similarities regarding the character of the intersectoral connections can be observed in the analysed countries:

- *Agriculture* is strongly forward interrelated with the *Food* sector and it is backward interrelated with the *Manufacturing* sector;

- the *Mining and quarrying* sector is forward interrelated with the *Manufacturing* sector;
- the *Manufacturing* sector is forward interrelated with the *Construction* sector and backward interrelated with the *Transport and postal services* sector;
- the *Trade* sector is backward and, at the same time, forward interrelated with the *Manufacturing* sector, and it is backward interrelated with the *Financial services* and *Other professional, scientific and technical services* sectors, too;
- the *Accommodation and food services* sector is forward interrelated with the *Social, collective and personal services*;
- the *Publishing, telecommunication and computer programming services* sector is backward interrelated with the *Other professional, scientific and technical services* sector;
- the *Social, collective and personal services* sector is backward interrelated with the *Manufacturing* and *Accommodation and food services* sector.

At the same time, there can be considered some connections that are important in two countries and they are not as strong in the third country. For example, a strong forward relationship between the *Food sector* and the *Accommodation and food services* sector can be observed in Hungary and Slovakia, while this connection in Romania is not so strong, or the *Construction* sector is forward interrelated with the *Financial and real estate services* in Romania and Slovakia, while this connection is not so strong in Hungary.

The key sector analysis also reveals interesting similarities and differences between the countries. Regarding the output, the demand-driven effects in Romania may be the largest if they are triggered by the *Trade sector*, in Hungary, by the *Food sector* and in Slovakia by the *Electricity, gas, steam and air-conditioning; water supply; waste management services*. In the case of the income linkages, *Social, collective and personal services* are ranked first.

In this study, mainly the primary results of the input-output analysis carried out for the Romanian, Hungarian and Slovakian economy are presented and the analyses refer to aggregated sectors. Thus, some main aspects regarding the economic structure and intersectoral connections in these countries are presented. Further, more detailed results can be obtained by analyses carried out with not aggregated sectoral data and by using some metadata regarding the activity of the sectors.

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