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AGRICULTURAL AND RURAL DEVELOPMENT AND INTERNATIONAL VIEW

AGRÁR- ÉS VIDÉKFEJLESZTÉS, NEMZETKÖZI KITEKINTÉS

ANALYSIS OF THE ROMANIAN AGRICULTURE IN THE PERIOD OF TRANSITION, BASED ON THE NATIONAL ACCOUNTS

VINCZE, MÁRIA – MADARAS, SZILÁRD

Abstract

The purpose of this paper is to present the changes occurred during the transition period in the role and place of agriculture in the Romanian economy. The main methodological instruments used are the national Input-Output Tables for 1999-2004 published in the National Accounts. We have also used figures from the Regional Accounts to put into evidence regional differences in total GDP and the GDP of agriculture. Input-Output analysis is an analytical tool recognized as one of the most significant contributions to the economic theory and applications, but rarely used in agricultural economics for quantifying the structural changes of the economic activities. The first part of the paper presents the general equilibrium situation of the Romanian economy and the interrelations among different sectors for 1999-2004. Based on the Input-Output models we have analyzed the main changes occurred in the position of agriculture compared to other economic activities. We have also put into evidence some regional differences concerning the agricultural sector development.

Keywords: Input-Output model, economic activities structures, regional differences, impact of the new agricultural policy

The changes of the economic activities' structure between 1999 and 2004

In the first part of the paper we analyzed the structural changes of the three main sectors of economy: agriculture, industry and services in total output, (Fig. 1), in final demand (Fig. 2) and in the intermediate consumption (Fig. 3) between 1999 and 2004.

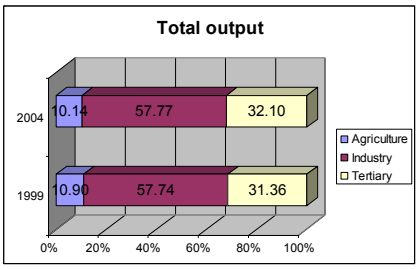

Fig. 1 Distribution of the total output in 1999 and 2004

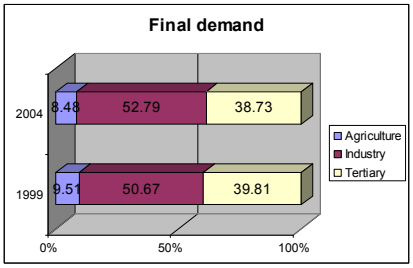

Fig. 2 Distribution of the final demand in 1999 and 2004
Source: Own calculations on the basis of National Accounts 1999, 2004.

In the structure of the output by the main sectors of economy can not be observed real changes between 1999-2004, but concerning the final demand the share of the industry

increased with about 2%, and the share of the agriculture-, and that of the service sector had been decreased, in both cases with about 1% .

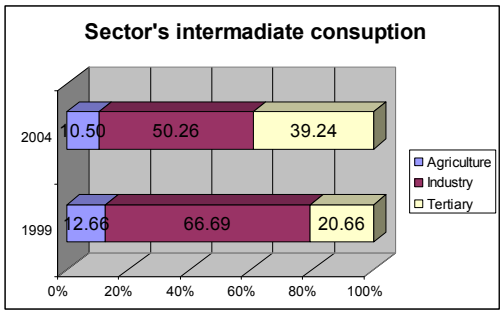

Fig. 3 Distribution of the sector's intermediate consumption in 1999 and 2004
Source: Own calculations on the basis of National Accounts 1999, 2004.

Tab. 1 The aggregation table

Economic sectors	**NEW**	**OLD**
Agriculture, sylviculture, pisciculture and forestry	1	[1]
Coal mining and cokes	2	[2]
Petroleum and related products+ Natural gases	3	[3, 4]
Metalliferous and non-ferrous metal ores	4	[5]
Ores for construction+Other minerals	5	[6, 7]
Food, beverages and tobacco	6	[8]
Textiles and wearing apparel	7	[9]
Footwear and other leather goods	8	[10]
Wood, furniture and other industrial products	9	[11]
Pulp, paper and cardboard; related items	10	[12]
Publishing, printing and reproduction of recorded media	11	[13]
Chemistry and synthetic fibers+Medicines, detergents, cosmetics	12	[14, 15]
Rubber and plastic materials	13	[16]
Glassware+Building materials	14	[17, 18]
Metallurgy and siderurgy	15	[19]
Machinery construction +Machinery and labour saving devices	16	[20, 21]
Electric and electronic products	17	[22]
Means of transport	18	[23]
Electric and thermal energy, gas and water	19	[24]
Construction	20	[25]
Wholesale and retail trade	21	[26]
Hotels, restaurants and tourism-agencies	22	[27]
Transports	23	[28]
Communication	24	[29]
Financial, banking and insurance services	25	[30]
Real estate+Services for enterprises	26	[31, 32]
Public administration and defence, compulsory social assistance	27	[33]
Community, social and personal services	28	[34]

Source: Own calculations on the basis of National Accounts 1999, 2004.

Major changes could be observed in the structure of the intermediate consumption where the proportion of the services sector has grown with more than 18%, while the share of industry and agriculture, has been decreased with 16,43%, respectively 2,16%.
Even in this general phase of the analysis there could be observed a positive change in the industry sector of economy, where the slight increases of the sector's share in total output

and in the final demand have been achieved by significant decreases of the sector's proportion in the intermediate consumption.
Henceforward we made a detailed analysis in order to determine the economic sectors which are responsible for these changes. For the analysis we used the input-output table for 1999 and 2004, the input-output analysis method and the PYIO software for the calculations.
We aggregated the initial 34 sectors of the Romanian input-output table to 28 sectors as the follows:

Analysis of the changes in the agricultural sector

For the analysis of changes in the agricultural sector we used at first the output decomposition method. By this method we can decompose the difference in two-period sectoral output into three different parts. So the output change, ΔX can be stated in the following way:

$$\Delta X = B_t f_t - B_0 f_0 = (B_0 + \Delta B)(f_0 + \Delta f) - B_0 f_0 = B_0 \Delta f + \Delta B f_0 + \Delta B \Delta f$$

$$= \Delta X^f + \Delta X^B + \Delta X^{Bf}$$

- the first component (ΔX^f) is part of the output change that is due to the changes in the final demand;

- the second component (ΔX^B) pertains to the output changes that is due to technological progress (due to the changes in the Leontief inverse matrices);

- the last component (ΔX^{Bf}) is the part of the output changes that is due to the synergistic interaction between the final demand and the technological change.

The decompostition of the total changes in the case of the agricultural sector has three parts:

- the first component (ΔX^f) is part of the output change that is due to the changes of the final demand having a proportion of 90,6%, which is in half-and-half ratio resulted from self-generated and non-self-generated consumption.

- the proportion of the output changes that is due to the technological progress (ΔX^B) is 4,60%, which is entirely caused by the self-generated consumption.

- the part of the changes due to the synergistic interaction between final demand and technological change is 4,8%

We may formulate the conclusion: the growth was caused mainly by the final demand, while the technological progress did not cause real growth in demand for the agriculture.

In the second part of the analysis of the agricultural sector we take in consideration the technical coefficients.

Each technical coefficient shows the input requirements for the production of one unit of the final product, in monetary terms, in other words it shows the value of inputs needed to produce a monetary unit worth of the product. Technical coefficients are computed by dividing the X_{ij} amount of inputs sector j purchases from the selling sector i, by the total output X_j of sector j. $a_{ij} = X_{ij} / X_j$

Connection between agriculture and the other sectors was analyzed by calculating the technical coefficients, using the input-output tables of National Accounts of Romania for 1999 and 2004.

Tab. 2 Technical coefficients of the agricultural sector's output and input

Technical coefficients of the agricultural sector's output						Technical coefficients of the agricultural sector's input					
Nr sect	1999	2004	Nr sect	1999	2004		1999	2004		1999	2004
1	0.5617	0.688	**15**	0.0001	0.000	**1**	0.5617	0.688	**15**	0.0023	0.013
2	0.0170	0.008	**16**	0.0003	0.000	**2**	0.0001	0.000	**16**	0.0163	0.016
3	0.0000	0.000	**17**	0.0000	0.000	**3**	0.0333	0.009	**17**	0.0024	0.002
4	0.0021	0.001	**18**	0.0001	0.000	**4**	0.0000	0.000	**18**	0.0077	0.003
5	0.0038	0.001	**19**	0.0002	0.000	**5**	0.0019	0.000	**19**	0.0352	0.029
6	0.4275	0.355	**20**	0.0011	0.001	**6**	0.0713	0.062	**20**	0.0015	0.001
7	0.1023	0.040	**21**	0.0281	0.057	**7**	0.0171	0.013	**21**	0.0000	0.000
8	0.1570	0.160	**22**	0.0116	0.114	**8**	0.0003	0.000	**22**	0.0044	0.002
9	0.1166	0.168	**23**	0.0005	0.000	**9**	0.0024	0.003	**23**	0.0890	0.008
10	0.0496	0.057	**24**	0.0000	0.000	**10**	0.0003	0.001	**24**	0.0072	0.008
11	0.0000	0.000	**25**	0.0000	0.000	**11**	0.0006	0.000	**25**	0.0073	0.008
12	0.0049	0.005	**26**	0.0041	0.004	**12**	0.1083	0.094	**26**	0.0079	0.007
13	0.0001	0.000	**27**	0.0000	0.006	**13**	0.0121	0.025	**27**	0.0000	0.000
14	0.0016	0.001	**28**	0.0029	0.001	**14**	0.0035	0.004	**28**	0.0061	0.004

Source: Own calculations on the basis of National Accounts 1999, 2004.

Figures in the first part of Tab. 2 measure: how the other sectors have used the agricultural production. The highest value among the output coeficients is the own sector's consumption, which grew from the initial 0.562 value to 0.688 in the analyzed time period. Other sectors with soft connection to agriculture are the 6's Food, beverages and tobacco, 7's Textiles and wearing apparel and the 8's Footwear and other leather goods which remains with coefficient 0.16.

In the second part of Tab. 2 it is described how the agricultural sector had been consumed the other sector's production. At the same time, the biggest and increasing consumption is from his own sector, and less and decreasing **from 1999 to 2004 the** consumption from 12's Chemistry, 23's Transports, and 6's Food sectors.

These facts prove the agricultural sector is not well integrated in economy concerning the output and also the input. These pure interconnections of agriculture with other sectors of economy show in the same time the low level of modernization of agricultural sector.

Analysis of changes in the industry sector

In the next part we analyzed the changes of the industry sector, using the input-output tables for Romanian economy for 1999 and 2004.
At first we calculated the structure of the sector's intermediate consumption, the structure of the final demand and that of the total output by the main sectors of economy, detailed for sub-sectors of industry for 1999 and 2004.

Tab. 3 Structure of the sector's intermediate consumption, final demand and total output

	Sector's interm. consumption				Final demand				Total output			
	1999		2004		1999		2004		1999		2004	
Sect	%	%	%	%	%	%	%	%	%	%	%	%
Agr	12.66	12.66	10.50	10.50	9.51	9.51	8.48	8.48	10.90	10.90	10.14	10.14
2	1.64		0.70		0.00		0.05		0.72		0.84	
3	8.10		3.06		3.81		3.98		5.70		5.20	
4	0.96		0.78		0.04		0.08		0.45		0.71	
5	0.49		0.19		0.02		0.04		0.23		0.23	
6	9.54		10.82		14.28		10.98		12.19		10.58	
7	4.85		2.82		6.39		6.13		5.71		5.18	
8	0.64		0.72		2.02		2.06		1.41		1.34	
9	1.90		2.62		3.77		3.56		2.95		2.93	
10	1.42	66.69	0.46	50.26	0.24	50.67	0.29	52.79	0.76	57.74	0.71	57.77
11	1.16		0.64		0.26		0.26		0.66		0.57	
12	5.60		2.93		2.31		2.51		3.76		4.01	
13	2.26		1.18		0.28		0.65		1.15		1.64	
14	2.84		1.74		0.88		0.79		1.74		1.73	
15	3.99		4.88		2.39		3.00		3.10		3.84	
16	3.28		3.23		5.38		5.82		4.45		5.03	
17	3.82		1.68		3.65		4.81		3.72		4.13	
18	2.10		2.53		3.26		5.86		2.75		3.88	
Ind	12.10		9.27		1.67		1.92		6.27		5.20	
Serv	20.66	20.66	39.24	39.24	39.81	39.81	38.73	38.73	31.36	31.36	32.10	32.10

Source: Own calculations on the basis of National Accounts 1999, 2004.

Share of the industry in the total output remains about the same between 1999 and 2004 but there could be observed some changes in different sub-sectors of industry. The proportion of the "hard" sub-sectors slightly increased (18th -Means of transport, 15th- Metallurgy and siderurgy, 16th-Machinery construction and Machinery and labor saving devices). Small decrease can be observed in the proportion of the 6th -Food, beverages and tobacco, in the proportion of the 19th -Electric and thermal energy, gas and water and in the share of the 7th - Textiles and wearing apparel as well.

The proportion of industry had been increased within the structure of final demand with 2,12% between 1999-2004. These changes had been occurred on the account of the following sectors' increase: the 18th -Means of transport and the 17th -Electric and electronic products.
The most significant changes in the proportion of industry have been detected in sector's intermediate consumption, with a decrease of 16,43%. Analyzing the structural changes of sub-sectors, we detect a relative decrease in the followings: 3rd - Petroleum and related products and Natural gases sector, the 19th -Electric and thermal energy, gas and water, the 12th -Chemistry and synthetic fibers and Medicines, detergents, cosmetics, the 17th -Electric and electronic products the 7th Textiles and wearing apparel. In the opposite some increases appear in the case of Food, beverages and tobacco and in the -15th Metallurgy and siderurgy.

The analysis of the interdependence between the sub-sectors of the industry by the technical coefficient matrix in 1999 and in 2004, prove some changes. For example this period was that, when the constructions had been equipped with machines and the technological progress had accentuated and there can be observed increases in the intensive utilization of raw materials for heavy industries, as it is confirmed by the increase in the final demand and connected to the technological progress in industry.

Analysis of changes in the service sector

Using the input-output tables, we calculated the structure for two years, of sector's intermediate consumption, final demand, and total output to service sub-sectors.

Tab. 4 Structure of the service sectors in intermediate consumption, final demand, and total output

	Sector's intermediate consumption				Final demand				Total output			
	1999		2004		1999		2004		1999		2004	
	%	%	%	%	%	%	%	%	%	%	%	%
Agr	12.66	12.66	10.50	10.50	9.51	9.51	8.48	8.48	10.90	10.90	10.14	10.14
Ind	66.69	66.69	50.26	50.26	50.67	50.67	52.79	52.79	57.74	57.74	57.77	57.77
20	1.81		6.94		7.22		7.65		4.83		5.42	
21	0.05		5.59		0.35		0.60		0.22		0.40	
22	1.43		2.14		3.14		2.41		2.39		1.93	
23	6.31		4.59		3.97		4.16		5.00		2.97	
24	3.35	20.66	2.61	39.24	1.62	39.81	1.53	38.73	2.39	31.36	3.03	32.10
25	0.62		0.96		1.72		0.62		1.23		1.35	
26	4.93		8.53		10.20		8.18		7.88		8.22	
27	0.00		1.17		3.48		4.35		1.94		2.52	
28	2.15		6.71		8.11		9.22		5.48		6.26	

Source: Own calculations on the basis of National Accounts 1999, 2004.

The biggest change appears in the distribution of the **sector's intermediate consumption**. From 20,66% in 1999 the proportion of the service sector growth to 39,24% in 2004. This significant increase was caused by the following sectors: 21s-t Wholesale and retail with 5,55%, 20th- Construction with 5,13%, 28thCommunity, social and personal services with 4,56%, 26th- Real estate+ Services for enterprises with 3,60% higher in proportions. Also we detect, that in two cases the proportion had been decreased: in case of 23rd- Transports with 1,13%, and 24th- Communication with 0,75%.
The proportion of the service sector does not change significantly in **final demand** and in total output between 1999-2004.

Key-sectors analysis of the input-output tables

The key sector analysis is widely used in input-output method, it aims to identify those sectors, whose economic activity exerts a higher then average influence on the whole economy. In this paper, key sectors are identified by calculating backward and forward linkage proposed by Rasmussen (1956), drawing on entires in the Leontief inverse.
Let $B = (I - A)^{-1} = [b_{ij}]$ be the Leontief inverse matrix and let B_j and B_i be the column and row multipliers of this Leontief inverse. The sectos j's backward linkage BL_j and forward linkage FL_i are defined as:

$$BL_j = \frac{\frac{1}{n}\sum_{i=1}^{n} b_{ij}}{\frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} b_{ij}} = \frac{\frac{1}{n}B_j}{\frac{1}{n^2}V} = \frac{B_j}{\frac{1}{n}V} \quad \text{and} \quad FL_i = \frac{\frac{1}{n}\sum_{j=1}^{n} b_{ij}}{\frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} b_{ij}} = \frac{\frac{1}{n}B_i}{\frac{1}{n^2}V} = \frac{B_i}{\frac{1}{n}V},$$

where $B_j = \sum_{i=1}^{n} b_{ij}$, $B_i = \sum_{j=1}^{n} b_{ij}$, and $V = \sum_{i=1}^{n}\sum_{j=1}^{n} b_{ij}$.

If BLj>1, a unit change in final demand in sector j will generate an above-average increase in the activity of the economy.

If FLi>1, a unit change in all sectors' final demand would create an above average increase in sector i.

The backward linkage and the forward linkage coefficients, for all sectors, were calculated using the PYIO program.

Tab. 5 Key sector analysis, backward and forward linkage coefficients (in order)

1999				2004			
Sector	FrwLink	Sector	BckwLink	Sector	FrwLink	Sector	BckwLink
19	2.5565	19	1.43301	6	2.8599	21	6.0396
3	1.6980	2	1.24667	19	1.8283	19	1.1464
23	1.2930	15	1.21532	1	1.7959	23	1.0412
12	1.2682	4	1.11491	3	1.4583	15	0.9949
1	1.2393	20	1.11432	26	1.3549	20	0.9582
26	1.1928	6	1.08365	24	1.3099	4	0.9115
6	1.1491	28	1.07165	12	1.2680	22	0.8890

Source: Own calculations on the basis of National Accounts 1999, 2004.

In 1999 the coefficient of BLi is more than 1, in the case of 14 sectors. It means that these sectors' unit change in final demand could generate an above-average increase in activity in the whole economy. These sectors are the following: Electric and thermal energy, Gas and water, Petroleum and related products and Natural gases, Transports, Chemistry and synthetic fibers and Medicines, detergents, cosmetics, Agriculture, Sylviculture, pisciculture and forestry, Real estate and Services for enterprises, Food, beverages and tobacco, Electric and electronic products, Metallurgy and siderurgy, Communication, Textiles and wearing apparel, Machinery construction and Machinery and labour saving devices, Rubber and plastic materials, Coal mining and cokes .

In 2004, this coefficient of BLi is more than 1, in case of 3 sectors, the 21st, 19th, and the 23rd. It means that the number of key-sectors had been reduced.

In 1999 the coefficient of Fli>1, in case of 11 sectors, it means that, a unit change in all sectors' final demand would create an above average increase in these sectors: Electric and thermal energy, gas and water, Petroleum and related products and Natural gases, Transports, Chemistry and synthetic fibers and Medicines, detergents, cosmetics, Agriculture, sylviculture, pisciculture and forestry, Real estate and Services for enterprises, Food, beverages and tobacco, Electric and electronic products, Metallurgy and siderurgy, Communication, Textiles and wearing apparel, Machinery construction and Machinery and labour saving devices.

In 2004 the coefficient of Fli>1, in case of the following sectors: Food, beverages and tobacco, Electric and thermal energy, gas and water, Agriculture, sylviculture, pisciculture and forestry, Petroleum and related products and Natural gases, Real estate and Services for enterprises, Communication, Chemistry and synthetic fibers and Medicines, detergents, cosmetics, Machinery construction and Machinery and labour saving devices, Metallurgy and siderurgy.

As we mentioned above, the demand for emission of the construction sector had been increased significantly, and we can formulate, that all the backward linkages, and the forward linkages coefficients for this sector show the highest values in 1999 and 2004.

National and regional progress between 2000 and 2004

In the next part we will put in evidence what kind of changes appears in national and regional levels, due to economical progress, and how affect these, the regional growth in agricultural sector.

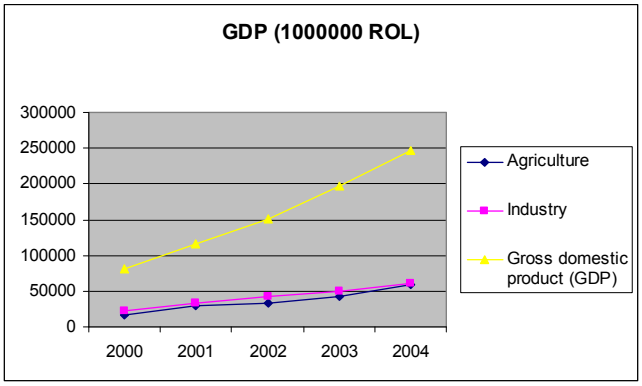

Fig. 4 The evolution of GDP, in agriculture and in industry between 2000 and 2004
Source: Own calculations based of Territorial Statistics 2004

Fig. 4 shows the changes in GDP total, GDP in industry and in agriculture between 2000 and 2004.
In the next part we show the structure of GDP on the main sectors of economy for the years between 2000 and 2005.

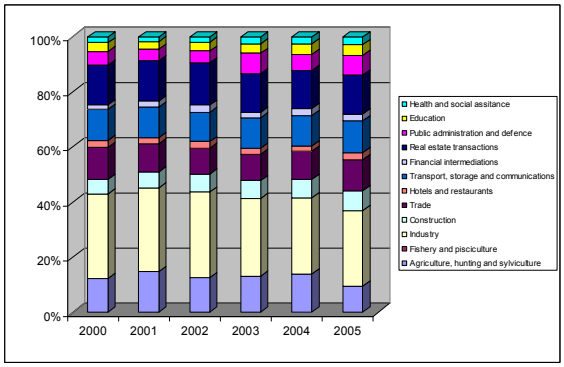

Fig. 5 The distribution of GDP, in sectors
Source: Own calculations based of Territorial Statistics 2004.

Fig. 5 shows the yearly changes in GDP composition, between 2000 and 2005. The proportion of the agricultural sector had been increased from 12.36% in 2000 to 13.9% in 2004, but in 2005 the percentage is 9.58%. Major increase we observed in 2001, when the proportion was 14.72%. Evident, the share of agriculture in GDP depends not only on technological progress, but on the climate condition too. So, for example 2000 and 2002 are the years with heavy droughts and 2004 is with bumper crops.

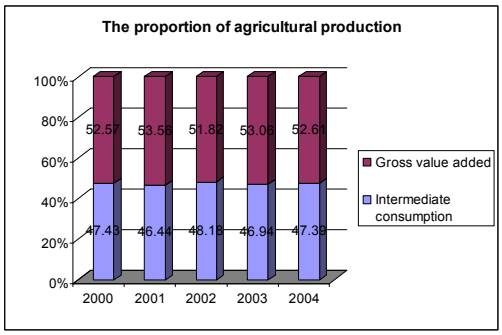

Fig. 6 Distribution of the agricultural production
Source: Own calculations based of Territorial Statistics 2004.

It was calculated the proportion of the intermediate consumption, from the agricultural production (Fig. 6). The proportion is about 47%, and it remains constant in the measured period of time, lower than in case of industry, as it can be observed at Fig. 7.

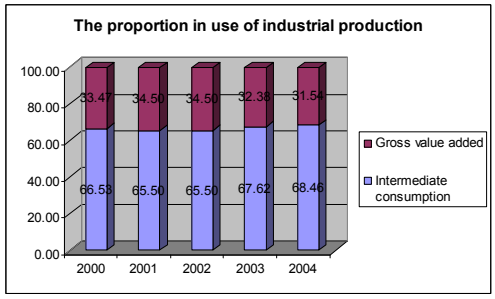

Fig.7 Distribution of the industrial production
Source: Own calculations based of Territorial Statistics 2004.

In the final part of the paper we try to evidence the territorial differences of the total gross domestic product and the agricultural gross domestic product.

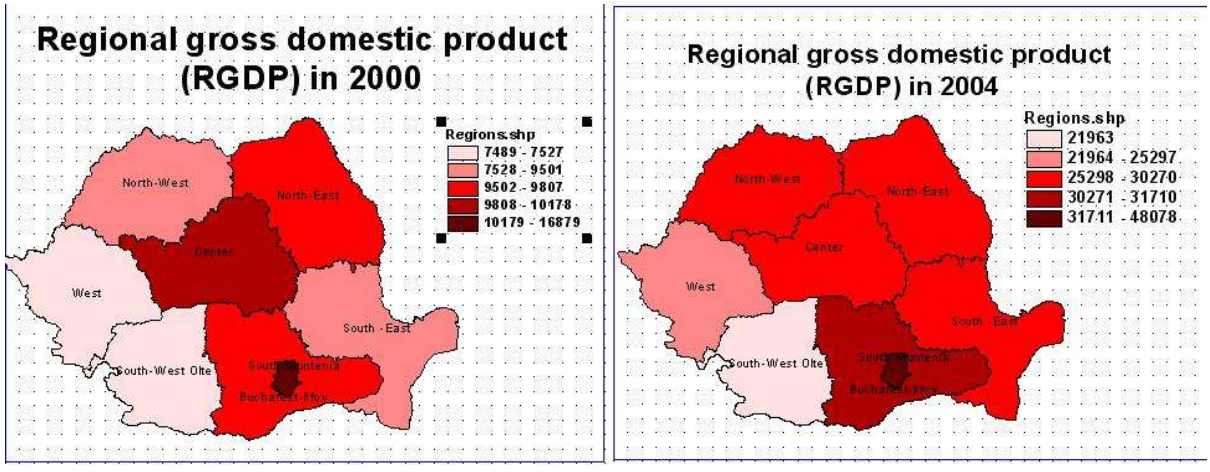

Fig. 8a, 8b Regional gross domestic product
Source: Own calculations, using the ArcviewGIS program, based on Territorial Statistics 2004.

Fig. 8 shows the structure of GDP by region. We observed that the growth is different in the regions, but the biggest value remains to Bucharest-Ilfov region. The agricultural sectors' regional GDP evolution didn't follow the total GDP distribution in regions.
To illustrate the changes of GDP total and GDP of agriculture in regions, we used the ArcviewGIS program, and ordered the regions by these values.

The economic maps (Fig. 8a, 8b and 9a, 9b) highlight the changes of the regional disparity. In 2000 (Fig. 8a) the first one, with the highest values was Bucharest-Ilfov region followed by the Center region and South-Muntenia.

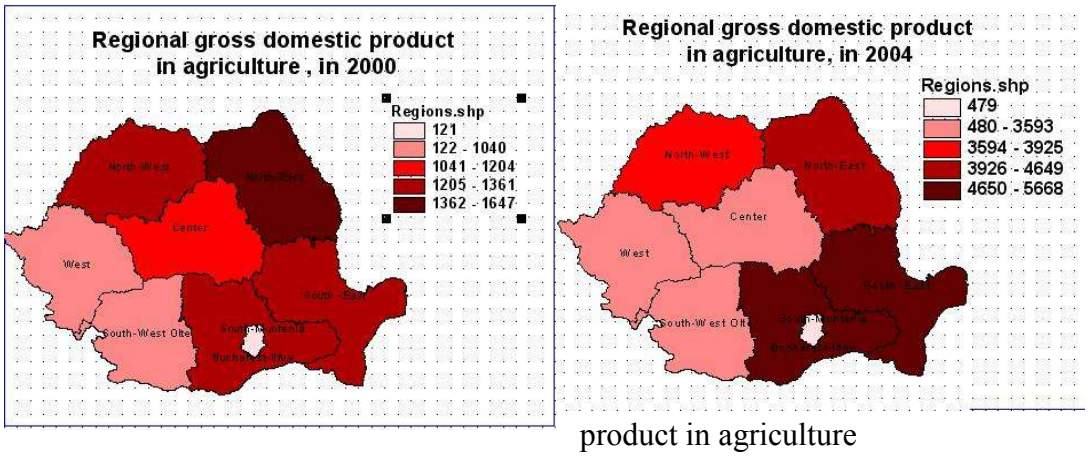

Fig. 9a, 9b Regional gross domestic product in agriculture

Source: Own calculations, using the ArcviewGIS program, based on Territorial Statistics 2004.

In 2004 (Fig. 8b) the order had been changed: Bucharest-Ilfov, South-Muntenia.

The distribution of the regional gross domestic product in agriculture had been changed in way. The order in 2000 was: North-East, South-Muntenia and North-West, in 2004 South-Muntenia, South East, and North East regions. This means, that here the technological progress was higher than in the other regions.

Conclusion

We made the analysis of the Romanian economy in the period of transition, based on the national accounts database, using the input-output methodology. The precondition was the fact, that the growth of the agriculture didn't follow the general national economy progress. We used three from the input-output methods to analyze the changes in structure of economic sectors:

- the output decomposition method, in order to find the structure of the output. Our conclusion is that only a small part of output changes was caused by technical progress in agriculture production;
- he technical coefficients method, to find the relations of intermediate consume by economy sectors. We detected which sectors are connected with agriculture, and how they developed the proportions of consumes in time. We formulate the conclusion that the self-consume of the agricultural sector growth and the other sectors consume by agriculture became more less.

- the key sector analysis, calculating the backward-forward linkages, in order to find the key-sectors of the economy. Our conclusion is that the increase of the key-sectors are independent from the changes in the agriculture;

We made the calculations using the PYIO program software, created by Regional Economics Applications Laboratory, University of Illinois at Urbana-Champaign. To represent the regional structure of GDP total and GDP of the agriculture and their progress between 2000 and 2005, we used the ArcViewGIS program software, to create informational maps.

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