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Services and structural patterns of a post-transition Romanian economy

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The present paper reflects a first step in exploring in a systematic way the manner in which services are embedded in the economic life in Romania. The authors believe that service industries, in particular knowledge intensive services, are at the core of this transformational process and economic transitions. This article presents the input–output tables and their role for the real GDP and real growth estimations, the importance of correlation between goods and services, an econometrical analysis of some major matrix of correlation developed from data, and a set of conclusions describing the impact of goods-services correlation on the Romanian economic growth. The three sections are the distinct research objectives: (a) the input–output descriptive images, emphasising statistical characteristics of goods-services liaisons; (b) the evaluation of these correlations with the dynamics of real Romanian GDP, based on the *R*-squared matrix; (c) the identification of the impact on the real growth of goods-services liaisons for the Romanian economy as a specificity of its stage of development.

Keywords: input–output tables; intermediate consumption of services; correlation; GDP estimation methodology; matrix of correlation; econometric model

JEL classifications: F43, O47, C67

1. Introduction

This article is a pioneering work in Romania, in the field of services investigated and quantified evaluations and estimations of the different contributions to GDP by some major national services activities, using I-OT data, and based on several uni- and multi-factorial econometric models. The System of National Accounts (SNA) includes data sources, intermediate synthesis tools and tables of general synthesis, among which one distinguishes the Integrated Economic Accounts Table (IEAT) and the Input-Output Table (I-OT). The first regroups the institutional sectors' accounts, while the second depicts the equilibrium between resources and utilizations as interdependence between economic activities. Within the aggregate statistics of SNA/ESA, IEAT and I-OT facilitate a detailed analysis of production processes, use of outputs and income in the economy. They also allow searching for essential structural correlations within an economy that cannot be observed by other means. It is important here to reinforce the fact the I-OT are analytical constructs, not compilations of directly observed phenomena.

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In conformity with SNA methodology 'goods are physical, produced objects for which a demand exists, over which ownership rights can be established and whose ownership can be transferred from one institutional unit to another by engaging in transactions on markets' and 'services are the result of a production activity that changes the conditions of the consuming units, or facilitates the exchange of products or financial assets' (Eurostat, 2008, pp. 95–96). Even in such conceptual delineation the product-service relationship is put explicitly into evidence. The authors of the present paper also accept defining services in antinomy or complementarity with tangible goods, which do not exclude generalising approaches that attempt to remove any boundaries between goods and services as an expression of any needs-satisfying result. The good-service relation involves a lot of associations between material – immaterial, tangible – intangible, non-perishable – perishable, storable – non-storable, materialised or not in a transfer of ownership, etc. Delimiting, by contrast or antinomy, a characteristic terminology leads to different accents in defining services, from their ubiquity, as the dominant activity of the gross domestic product (GDP), and also the destination for most employment in advanced economies (Katzan, 2008; Spohrer & Maglio, 2008), to nuancing their relationship to the economic output (Achrol & Kotler, 2012), from the emphasis on the transformation process that creates a set of outputs from a set of inputs, which are provided as solutions to customer problems (Grönroos, 2008; Grönroos & Ojasalo, 2004), to reconsidering them as the basis of exchange (Edvardsson, Tronvoll, & Gruber, 2011), from the configuration of resources, including people, organisations, shared information, and technology, all connected internally and externally (Spohrer, Vargo, & Maglio, 2008), to such services as important drivers for innovation and technological change (Rubalcaba, Gallego, & Hertog, 2010). More and more marked similarity between services and products (Pilat & Wölfl, 2005) and an excessive antinomy between services and products, redefines a *service* as *the intangible and non-material equivalent of a good* (Săvoiu, Dinu, & Tachiciu, 2012). When conceptually purified, a service is the result of a human activity or of a complex process, identifying itself to the highest degree with utility in its most pure, intangible, perishable, inseparable state, but certainly able to satisfy a personal (individual) or social need or necessity, in a specific trans-disciplinary approach (Săvoiu, Dinu, & Tachiciu, 2013, 2014). For statistical instrumentation, services are defined as outputs produced to order and which cannot be traded separately from their production; ownership rights cannot be established over services and by the time their production is completed they must have been provided to the consumers (*Eurostat Manual of Supply, Use and Input-Output Tables*, 2008). This is the definition that governs the construction of the dataset that will be used within the present paper. The increasing role and impact of services in the Romanian economy represent the major topic of this paper. The aim and the tasks of the research are to underline the importance of estimation values and correlations with significant aggregates from GDP's indicators, using various statistical methods (from the inflate method for transformation of the current prices in the constant prices to the matrix of correlation), and econometrical models of services dynamics in Romania, based on I-OT data and information. Section 3 represents the core of the paper and contains an overview of service sector evolution in the Romanian economy and proposes several econometric models that might be useful initial insights for economic forecasting or for monitoring the structural changes within the economy. Section 3 is preceded by a presentation of the construction of I-OT and discussion about their significance, and it is followed by final remarks.

2. The construction and significance of Input-Output Tables

The traditional I-OT are the means of presenting a detailed analysis of the process of production and the use of goods and services (products) and the income generated in that production, being either in the form of supply and use tables or symmetric I-OT (*Eurostat Manual of Supply, Use and Input-Output Tables*, 2008). The I-OT must portray the physical or technological process of production or the management and know – how efficiency of the services' attainment, showing which products and services were combined, and in what proportions, to make other pure products, to create product-service hybrids or even pure services. There is a vast literature on the presentation and use of I-OT and it is impossible in a brief section to give a full appreciation of the range of complexities of compilation and inventiveness of applications. Essentially a standard I-OT is derived from a use table where either the columns representing industries (services activities) in the two left-most quadrants are replaced by products (services) or where the products in the two topmost quadrants are replaced by industries (services activities).

The entries in the standard inter-industry matrix are each divided by the figure for output at the bottom of the corresponding column, and the resulting matrix containing the direct purchase coefficients is designated as **A**; the vector consisting of the industries' gross outputs is written as **X**, the vector of total final demand (including exports) is written as **D** and **O** is a vector containing the intermediate demand for industries' output. The inter-industry transactions or output needed to satisfy a given level of gross output can be shown as:

$$\mathrm{O} = \mathbf{AX} \tag{1}$$

The industries total output (**X**) equals the sum of the intermediate demand for its output and the total final demand for its output:

$$\mathrm{X} = \mathbf{O} + \mathbf{D} \tag{2}$$

The two equations can be combined: AX+**D**=X and then rearranged as follows: D=(**I**–**A**)X leading to: X = $(\mathbf{I}–\mathbf{A})^{-1}$D and thus, finally:

$$\Delta \mathrm{X} = (\mathrm{I}–\mathrm{A})^{-1}\Delta\mathbf{D} \tag{3}$$

The last equation indicates a change in total output is the product of a change in total final demand multiplied by $(\mathbf{I}–\mathbf{A})^{-1}$. The inverse matrix $(\mathbf{I}–\mathbf{A})^{-1}$ is generally referred to as the 'Leontief Inverse' in the input-output model (I-OM). It is the last formulation that gives the analytical power to input–output (Impact) analysis or I-O(I)A (in the two well-known alternatives: simple and complex). The major properties of an I-OT are:

(a) I-OT represents a static depiction of the economy at a point in time;
(b) the linear, fixed-proportion production function implied in an I-OT dictates constant returns to production scale, and no substitution between intermediate goods, capital, and labour inputs;
(c) the assumption of additively (i.e. total output is the sum of the individual output) among industrial sectors excludes the consideration of external economies or diseconomies (Beyers et al., 2012).

Table 1 exemplifies an inverse or Leontief matrix for three-sector aggregate I-OT. The elements in this matrix are total requirement coefficients, and the values in the second data column show that, for a one-euro increase in final demand for the manufacturing/construction sector, local resources/utilities and trade/services industries have demands that raise their output by $0.0404 and $0.5235.

But an I-OM of I-O(I)A, even though it inherits all of the properties or assumptions of an I-OT, imposes some limitations and restrictions on the uses of I-OM for impact analysis: (a) the closer to the year for which the model is constructed the better I-OM will approximate the economy; (b) I-OM provides a snapshot of the complete economy and each detailed industry or services activity is assumed to produce only one type of product, each product is assumed to be the same, each output being produced with a unique set of inputs, without substitutions; (c) I-OM assumes a fixed employment-to-output ratio at the industry level and uses these ratios to calculate employment impact (without moving too much away from the model year); (d) I-OM assumes local supply is perfectly elastic, meaning there is no capacity problem (the activities to be assessed need to be small or marginal relative to the economy's production input system; (e) I-O(I)A estimates straightforwardly total impact from an external change in final demand, but when it is not external, the impact needs to be evaluated on both the activity (positive effect and negative effect on consumption) to derive a 'net' impact.

By their nature, input-output models (I-OMs) are used to identify the best approach to macroeconomics, revealing the role of the real GDP and of the real growth realities and estimations, being descriptive and revealing knowledge about an area's economy that would be impossible to get otherwise, permitting forecasting or estimating the total impact of certain events or policy changes, and assuring assessment of the real impact of the specific goals, scenarios, financial and economic policies. I-OMs can describe the transactions between agriculture, industries, services, sectors of the economy, regions and the rest of the economy or the world, and can be even used at the microeconomics level (Dobrescu, Gaftea, & Scutaru, 2010).

The synthetic "goods and services" account constitutes the informational base for I-OT, at the level or scale of an entire economy. The goods and services account shows the balance between the total goods and services supplied as resources to the economy as output and imports (including the value of taxes less subsidies on products not

Table 1. An example of the inverse (total requirement) coefficients table (total euro of input per euro of output.

	Resources & Utilities	Manufacturing/ Construction	Trade & Services	Personal Consumption
Resources & Utilities		0.0404		
Manufacturing/ Construction		1.1711		
Trade & Services		0.5235		
Labour Income		0.4051		

Source: The Washington Input-Output Tables for Impact Analysis (2007) available at http://www.ofm.wa.gov/economy/io/2007/I-O_2007_chapter_3.pdf

Note: Once a Leontief matrix is derived, total impact of a proposed activity on the economy can be estimated by multiplying this matrix by changes in the final demand caused by the respective activity.

Table 2. Conceptual content of the goods and services account in matrix form.

	Goods and services account or only services	Production account	Use of income accounts	Capital accounts	Total use
Goods and services account	Exports Imports	Intermediate consumption	Final Consumption	Gross capital formation	
Production account	Output				
Total supply					

Source: Eurostat (2008): *Eurostat Manual of Supply, Use and Input-Output Tables*. Office for Official Publications of the European Communities, Luxembourg.

already included in the valuation of output) and the use of the same goods and services (Table 2) as intermediate consumption, final consumption, capital formation and exports (SNA, 2008).

According to the *Eurostat Manual of Supply, Use and Input-Output Tables*, pages 515 and 516, the typology of the I-OT defines two kinds of characteristic tables or matrices: (I) *Product by product tables* (a product by product matrix being derived in two ways: (a) the industry technology assumption where each industry has its own specific means of production irrespective of its product mix; (b) the product technology assumption where each product is produced in its own specific way); (II) *Industry by industry tables* (an industry by industry matrix can be derived in two ways also: (a) the fixed product sales structure where it is assumed the allocation of demand to users depends on the product and not the industry from where it is sold; (b) the fixed industry sales structure where it is assumed that users always demand the same mix of products from an industry). Important contributions to classical dynamic input-output models are included in Leontief (1970), and Meyer (Meyer, 1980). Interesting empirical applications of dynamic I-O Models have been implemented in the studies of Leontief and Duchin (Leontief & Duchin, 1984) and Kalmbach and Kurz (Kalmbach & Kurz, 1990). INFORUM models were initiated by Clopper Almon (Almon, 1991) at the University of Maryland, Bernd Meyer and Georg Ewerhart have developed the Model INFORGE as a member of the INFORUM international system (Meyer & Ewerhart, 1998), and the Norwegian quarterly macroeconomic model KVARTS (Bowitz & Torbjorn, 1989), annual MODAG model (Cappelen, 1992) and MSG model (Holmoy, 1992), abbreviated from Multi Sectoral Growth together with Japanese model 'Multi-Sectoral Models for Medium and Long-term Analysis', in 1999, represent just a few of many other modern alternatives to classical I-O Models.

Another important consequence of I-OT and especially of I-O(I)A is the Input-Output Impact Multiplier (I-OIM). I-OIM can summarise the estimated ripple effects on the state economy, resulting from an external change and is defined as a ratio of an industrial sector and expressed as single number, being used as a reference for a measure of estimated total impact. Classical multipliers typology describes two major types: (a) the type I output multiplier, used for an open model analysis, when the change in final demand is known and the total (direct and indirect) change in production (output) is desired; (b) the type II output multiplier, used for a closed model analysis. It is used when the change in final demand is known and the total (direct, indirect and induced) change in region wide production (output) is desired (Fatemi, 2002). The modern types

of input-output (I-OIM) impact multipliers generated in all activities and sectors of the economy are: (a) total jobs multiplier (per million dollars of the industry's direct output change); (b) total employment multiplier (jobs per direct job); (c) labour income multiplier (total earnings per dollar of direct output); (d) total output multiplier per dollar of direct output; (e) detailed multipliers for all industries, and so on (Beyers et al. 2011). Based on the estimated effects of the exogenous changes of final demand (consumption, investment, exports) another three macroeconomic multipliers are the most frequently used types in input-output analysis of real GDP's structure and contributions in the real growth estimations: (a) outputs of the sectors in the economy; (b) value added and income earned by the households; (c) employment that is expected to be generated by the new activity levels (*Eurostat Manual of Supply, Use and Input-Output Tables*, 2008).

3. Econometric analysis of correlations between the intermediate consumption of services and aggregate indicators of the Romanian economy

The contribution of the services sector to GDP and employment (by gender) in Romania is reflected in Table 3, underlying an ascending trend for more than two decades. This trend was more significant during the period of economic growth, but was affected by

Table 3. The value added (VA) of the services* sector, as a percentage of GDP and the employees of the services* sector as a percentage of total, in Romania.

Year	Economic growth	Value added	Employees female
1990	−5.6	26	29
1991	−12.9	35	33
1992	−8.8	37	33
1993	1.5	35	31
1994	4.0	32	30
1995	7.2	36	30
1996	4.0	37	32
1997	−6.1	41	33
1998	−4.8	48	33
1999	−1.2	51	33
2000	2.1	51	33
2001	5.7	48	33
2002	5.1	49	37
2003	5.2	52	38
2004	8.4	51	42
2005	4.2	55	42
2006	7.9	52	43
2007	6.0	56	44
2008	7.9	55	46
2009	−6.6	54	47
2010	−1.6	54	49
2011	2.5	59	48

Source: *World Development Indicators 2013*, The World Bank, last updated 16 April 2014, available at http://data.worldbank.org/indicator/.

Note: Services correspond to ISIC divisions 50–99 and include value added in wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional, and personal services such as education, health care, and real estate services, imputed bank service charges, import duties, and any statistical discrepancies noted by national compilers as well as discrepancies arising from rescaling.

the impact of recession (Cokelc & Oplotnik, 2013; Săvoiu, Dinu, Tachiciu, 2012). The productivity of services also increased, especially until 2000.

The evolution of the number of employees in services, defined as all persons who principally work, based on a formal or informal agreement, for remuneration in cash or in kind in non-agricultural, non-industrial and non-construction activities, are detailed for Romania during the period of recession (the last semester of 2008 and the period of 2009–2010) in Table 4.

Table 4. Non-agricultural, non-industrial and non-construction employment, by major services activities of national economy NACE Rev.2, in Romania (thousands persons).

	2008	2009	2010
Wholesale and retail; repair of motor vehicles and motorcycles; transport and storage; hotels and restaurants	1756.4	1746.8	1715.1
Information and communication	123.5	122.1	124.5
Financial and insurance activities	98	91.5	91.7
Real estate activities	59.7	46.9	39.4
Professional, scientific and technical activities; activities of administrative services and of support services	274.8	314.8	304.2
Public administration and defence; social insurance of public sector; education; health and social assistance	1083.1	1114.6	1117.1
Shows, culture and recreation activities; repair of household goods and other services	251.6	247.7	234.7

Source: https://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=en&ind=CON108B.

Table 5. Employment by main sectors (% of employment).

Agriculture				Industry				Services			
Male		Female		Male		Female		Male		Female	
1990-1992	2008-2011	1990-1992	2008-2011	1990-1992	2008-2011	1990-1992	2008-2011	1990-1992	2008-2011	1990-1992	2008-2011
28	29	38	31	44	36	30	20	28	35	33	49

Source: *World Development Indicators 2013*, The World Bank, last updated 16 April 2014, available at http://data.worldbank.org/indicator/.

Table 6. The structure of Romanian trade in services.

	Commercial service exports $ millions		Transport (% of total)		Travel (% of total)		Insurance and financial services (% of total)		Computer, information, communications, and other commercial services (% of total)	
	2005	2011	2005	2011	2005	2011	2005	2011	2005	2011
Export	9,649	12,039	17	26	11	12	1	3	71	59
Import	5,363	9,295	37	20	17	21	5	10	41	48

Source: *World Development Indicators 2013*, The World Bank, last updated 16 April 2014, available at http://data.worldbank.org/indicator/.

Table 7. The Romanian output structure (%).

Gross domestic product $ billions		Agriculture % of GDP		Industry % of GDP		Services % of GDP	
2000	2011	2000	2011	2000	2011	2000	2011
37.1	189.8	13	7	36	41	51	52

Source: *World Development Indicators 2013*, The World Bank, last updated 16 April 2014, available at http://data.worldbank.org/indicator/.

Table 8. The Romanian output growth.

Gross domestic product average annual growth		Agriculture average annual growth		Industry average annual growth		Services average annual growth	
1990-2000	2000-2011	1990-2000	2000-2011	1990-2000	2000-2011	1990-2000	2000-2011
0.6	4.4	1.9	2.2	1.2	7.4	0.3	4.7

Source: *World Development Indicators 2013*, The World Bank, last updated 16 April 2014, available at http://data.worldbank.org/indicator/.

In the context of recession, the number of persons employed in service activities has decreased with exception of information and communication and the public sector.

The qualitative restructuring of the Romanian economy is revealed by the average contribution of sectors to employment at the beginning and at the end of the period covering the last two decades. The services sector has now the highest share in employment (Table 5) while the shares of agriculture and industry fall significantly. As we have noted elsewhere, Romania has an unusually high employment in agriculture, and a large share of the informal economy, which calls for caution when making international comparisons.

Table 9a. Input–output table, production account by categories of products and generation of income account by activity of the national economy – limited form (constant prices – millions of RON).

	Services* (in limited form of activities equivalent to Limited nomenclature NACE Rev.2)						
Production account by NACE Rev.2	1997	1998	1999	2000	2001	2002	2003
Agriculture	50.1	54.6	120.3	105.2	363.7	480.9	809.8
Industry	2122.9	5164.6	7815.4	12674.5	17385.7	23908.8	33264.8
Construction	65.5	181.8	343.4	714.2	629.7	951.5	1583.3
Services	1073.6	2176.5	3849.8	6031.9	10,463	15846.9	20347.1
Intermediate Consumption	3312.1	7577.5	12128.9	19525.8	28842.1	41188.1	56,005
Gross Added Value(GAV)	4243.9	10,042	16,502	27439.1	39267.4	56665.6	73064.2

Source: https://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=ro&ind=CON105L Table has been processed and completed to obtain a series of 14 consecutive and comparable annual values for econometrical restrictions.
Note *: Services = Division 45 - Division 99 NACE rev 2.

Table 9b. Input–output table, production account by categories of products and generation of income account by activity of the national economy – limited form (constant prices – millions of RON).

Production account by NACE Rev.2	Services* (in limited form of activities equivalent to Limited nomenclature NACE Rev.2)						
	2004	2005	2006	2007	2008	2009	2010
Agriculture	1349.5	1449.5	1989.9	1819.7	2,474	2169.6	382.9
Industry	44999.7	53739.2	60242.9	75574.4	88751.6	94,729	93283.6
Construction	1769.6	2507.9	3770.9	4283.1	5386.6	6191.8	21645.1
Services	28549.6	36264.8	48386.3	55360.4	68464.9	80983.2	87790.4
Intermediate Consumption	76668.4	93961.4	114,390	137,038	165077.1	184073.6	203,102
Gross Added Value (GAV)	97891.4	122650.6	148785.1	77353.1	215281.9	231576.4	236483.2

Source: https://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=ro&ind=CON105L Table has been processed and completed to obtain a series of 14 consecutive and comparable annual values for econometrical restrictions.
Note *: Services = Division 45 - Division 99 NACE rev 2.

The Romanian trade in services, as reflected by the Balance of Payments (BoP), is also increasing (Table 6). From a certain point of view, the trade in services also exhibits a concerning tendency of structural change in favour of transportation services, which are dominated by low qualified, low income labour, against more advanced services classified under the heading 'Computer, information, communications, and other commercial services'.

Tables 7 and 8 show that during the last decade the industry growth rate was higher than services growth. In the case of Romania, this is explained by the recovery of manufacturing industries after their collapse in the first half of the 1990s. Nonetheless, services have maintained the first contribution to the economic output, while (somehow

Table 10a. The main aggregates per inhabitant – ESA 95, current prices (RON/inhabitant).

Main aggregates	Year						
	1997	1998	1999	2000	2001	2002	2003
Gross Domestic Product (GDP)	1132.3	1646.7	2457.5	3609.7	5263.5	6974.9	9,084
Gross Disposable Income-Total	1139.8	1656.5	2468.6	3,662	5368.6	7290.3	9318.1
Households Individual Final Consumption (HIFC)	902.6	1385.3	2003.2	2781.4	4113.5	5363.5	6,874

Source: https://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=en&ind=CON107A.

Table 10b. The main aggregates per inhabitant – ESA 95, current prices (RON/inhabitant).

Main aggregates	Year						
	2004	2005	2006	2007	2008	2009	2010
Gross Domestic Product (GDP)	11413.5	13362.8	15967.6	19315.4	23934.6	23341.4	24435.9
Gross Disposable Income-Total	11776.9	13534.3	16194.9	19367.9	24323.5	23778.1	24764.5
Households Individual Final Consumption (HIFC)	8835.7	10494.4	12436.8	14543.1	17722.3	16786.3	17845.2

Source: https://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=en&ind=CON107A.

Table 11. The consumer price index used to inflate the constant prices for historical aggregates' values (%).

	Year													
The price index used to inflate	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
The CPI annual value	1056.48	664.05	455.44	312.66	232.52	189.75	164.61	147.13	134.97	126.66	120.81	112.02	106.09	100.0

Source: https://statistici.insse.ro/shop/?page=ipca1&lang=en.

Table 12a. The main aggregates per inhabitant - ESA 95, comparable prices.

Main aggregates	Year						
	1997	1998	1999	2000	2001	2002	2003
Gross domestic product (GDP)	11962.5	10934.9	11192.4	11286.1	12238.7	13217.4	14953.2
Gross disposable income-total	12041.8	10,100	11,243	11449.6	12483.1	13833.3	15338.5
Households Individual final consumption (HIFC)	9535.8	9199.1	9123.4	8696.3	9564.7	10177.2	11315.3

Source: the data from https://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=en&ind=CON107A had been transformed by the authors in comparable prices using CPI from table 11 to inflate.

surprisingly for 2011 when agricultural production was very high) the agricultural value added decreased from 13% to 7% of GDP.

Due to its importance in the Romanian economy, the volatility of agriculture explains the high structural oscillations from a year to another. Under such circumstances for 2012, which was unfavourable for agricultural production, the World Bank has estimated a share of services of 68% of GDP, a figure that has to be considered with reserves before the publication of the final data. The different contributions of services to GDP and Gross Added Value, or as components of the I-OT major activities in Romania are described in Tables 9a and 9b.

This limited form of an input–output table (Tables 10a and 10b) calculated in comparable prices for the Romanian economy is a wide matrix framework used to present detailed and coherent and comparable information on the flows of services as well as to be used in the econometrical models together with the main aggregates per inhabitant – ESA 95, current prices, transformed in constant or comparable prices by the instrumentality of a consumer price index (CPI). The authors used the macroeconomic aggregates because these synthetic values can measure the outcome of the total economy activity from three particular perspectives (e.g. of the gross value added, gross disposable income, final consumption, and so on).

The authors choose to use data in constant prices (even where inter-temporal comparability was not compulsory) in order to assure consistency of the entire modelling process, including, as the case may be, the adequate interpreter ,which for this analysis, based on gross disposable income and household final consumption was CPI and not the GDP deflator index (Table 11).

After the process of transformation of current prices in constant or comparable prices by the instrumentality of a consumer price index (CPI), and by the inflate logic, the results are detailed in Tables 12a and 12b (if, for GDI-T and HFC, CPI is naturally

Table 12b. The main aggregates per inhabitant – ESA 95, comparable prices.

Main aggregates	Year						
	2004	2005	2006	2007	2008	2009	2010
Gross domestic product (GDP)	16792.7	18035.8	20224.6	23334.9	26811.5	24762.9	24435.9
Gross disposable income-total	17327.4	18267.2	20512.5	23398.4	27247.2	25226.2	24764.5
Households Individual final consumption (HIFC)	13,000	14771.7	15752.5	17569.5	19852.5	17808.6	17845.2

Source: The data from https://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=en&ind=CON107A have been transformed by the authors in comparable prices using CPI from table 11 to inflate.

Table 13. Descriptive statistics of major economic indicators during the period 1997–2010, in Romania.

	Services in GAV SER01	GDP/person SER02	GDI-T/person SER03	HIFC/person SER04	Agriculture SER05	Industry SER06	Services in construction SER07	Services SER08	IC* SER09	GDP total SER10
Mean	104089.0	17155.96	17373.76	13157.99	972.8357	43832.65	3573.171	33256.31	81634.97	73942.62
Median	85477.80	15872.95	16332.95	12157.65	645.3500	39132.25	1676.450	24448.35	66336.70	56820.21
Maximum	236483.2	26811.50	27247.20	19852.50	2474.000	94729.00	21645.10	87790.40	203102.0	139765.4
Minimum	4243.900	10934.90	10100.00	8696.300	50.10000	2122.900	65.50000	1073.600	3312.100	31485.41
Std. Dev.	84883.34	5770.157	5918.238	3994.289	875.6660	34127.54	5571.757	30175.18	69013.38	39196.43
Skewness	0.378230	0.417904	0.368211	0.335593	0.419756	0.292893	2.643837	0.582521	0.476695	0.483446
Kurtosis	1.678374	1.638209	1.668056	1.538083	1.639223	1.612568	9.225692	1.953785	1.839366	1.623713
Jarque-Bera	**1.352707**	**1.489280**	**1.351229**	**1.509487**	**1.491289**	**1.323065**	**38.91926**	**1.430268**	**1.316015**	**1.650277**
Probability	0.508468	0.474905	0.508844	0.470131	0.474428	0.516060	0.000000	0.489127	0.517882	0.438174
Sum	1457246.	240183.5	243232.7	184211.8	13619.70	613657.1	50024.40	465588.4	1142890.	1035197.
SumSq.Dev	9.37E+10	4.33E+08	4.55E+08	2.07E+08	9968281.	1.51E+10	4.04E+08	1.18E+10	6.19E+10	2.00E+10

Source: Created by the authors.
Note: Services in IC*= Services Intermediate Consumption Software used: EViews. All data series are normally distributed, in accordance with the values of the Jarque–Bera test (except SER07).

Table 14. Matrix of correlation.

	Services in GAV SER01	GDP/ person SER02	GDI-T/ person SER03	HIFC/ person SER04	Services in Agriculture SER05	Services in Industry SER06	Services in Construction SER07	Services in services SER08	Service in IC* SER09	GDP total SER10
SER01	1.000000	0.984001	0.984822	0.973024	0.768864	0.998351	0.736527	0.994133	0.997581	0.973252
SER02	0.984001	1.000000	0.998525	0.994575	0.820781	0.985289	0.665736	0.968467	0.974843	0.988948
SER03	0.984822	0.998525	1.000000	0.991127	0.824984	0.986653	0.662269	0.968142	0.975149	0.983892
SER04	0.973024	0.994575	0.991127	1.000000	0.839646	0.976240	0.640169	0.952823	0.961704	0.986457
SER05	0.768864	0.820781	0.824984	0.839646	1.000000	0.790919	0.154539	0.707554	0.725648	0.799424
SER06	0.998351	0.985289	0.986653	0.976240	0.790919	1.000000	0.710162	0.987437	0.993620	0.972536
SER07	0.736527	0.665736	0.662269	0.640169	0.154539	0.710162	1.000000	0.790535	0.779526	0.667599
SER08	0.994133	0.968467	0.968142	0.952823	0.707554	0.987437	0.790535	1.000000	0.998331	0.956405
SER09	0.997581	0.974843	0.975149	0.961704	0.725648	0.993620	0.779526	0.998331	1.000000	0.963142
SER10	0.973252	0.988948	0.983892	0.986457	0.799424	0.972536	0.667599	0.956405	0.963142	1.000000

Source: Created by the authors.
Note: Services in IC*= Services Intermediate Consumption Software used: EViews. All data series are normally distributed, in accordance with the values of the Jarque–Bera test.

Table 15. The main categories of unifactorial econometric models for the services indicator of the I-OT Table.

Theoretical models	Specified models (the restricted 14-term series)
Services in Agriculture$_i$ = $\alpha + \beta \times$ GDP total$_i$ + ε_i	Services in Agriculture$_i$ = −347.74 + 0.0179 × GDPtotal$_i$ + ε_i
Services in Agriculture$_i$= $\alpha + \beta \times$ GDP/ person$_i$ + ε_i	Services in Agriculture$_i$= −1164.11 + 0.1246 × GDP/ person$_i$ + ε_i
Services in Agriculture$_i$ = $\alpha + \beta \times$ GDI-T/ person$_i$ + ε_i	Services in Agriculture$_i$ = −1147.90 + 0.1221 × GDI-T/person$_i$ + ε_i
Services in Agriculture$_i$ = $\alpha + \beta \times$ HIFC/ person$_i$ + ε_i	Services in Agriculture$_i$ = −1449.22 + 0.1841 × HIFC/person$_i$ + ε_i

Source: Created by the authors. Software used: EViews.

Table 16a. The most competitive categories of unifactorial econometric models for services indicator of the I-OT, limited form.

Theoretical models	Specified models (the restricted 14-term series)
Services in Agriculture$_i$ = $\alpha + \beta \times$ HIFC/ person$_I$ + ε_i	Services in Agriculture$_i$ = −1449.22+0.1841× HIFC/ person$_I$ + ε_i
Services in Industry$_i$= $\alpha + \beta \times$ GDI-T/ person$_i$ + ε_i	Services in Industry$_i$=-55016.01+5.6895×GDI-T/ person$_I$ + ε_i
Services in Construction$_i$ = $\alpha + \beta \times$ GDP total$_i$ + ε_i	Services in Construction$_i$ =-3443.90+0.0949×GDPtotal$_I$ + ε_i
Services in Services$_i$ = $\alpha + \beta \times$ GDP/ person$_I$ + ε_i	Services in Services$_i$ = −53632.22+5.0646×GDP/ person$_I$ + ε_i
Services in IC$_i$= $\alpha + \beta \times$ GDI-T/person$_i$ + ε_i	Services in IC$_i$=-115,928+11.3713×GDI-T/person$_I$ + ε_i
Services in GAV$_i$= $\alpha + \beta \times$ GDI-T/person$_i$ + ε_i	Services in GAV$_i$= −141315.1+14.125×GDI-T/ person$_I$ + ε_i

Source: Created by the authors. Software used: EViews Note: Services in IC*= Services Intermediate Consumption.

Table 16b. The most competitive multifactorial econometric model for services in GAVi indicator of the I-OT, limited form.

Theoretical model	Specified model (the restricted 14-term series)
Services in Construction$_i$ = $\alpha + \beta \times$ GDP/ person$_i$ + $\gamma \times$ GDI-T /person$_i$ + $\delta \times$ HIFC / person$_i$ + $\theta \times$ GDP total$_i$ + ε_i	Services in Construction$_i$ = −665.09+4.6011 × GDP/person$_i$ −1.9010 × GDI-T/person$_i$ - 3.5004 × HIFC/person$_i$ + 0.0593 × GDP total$_i$ + ε_i

Source: Created by the authors. Software used: EViews.

the most adequate choice, certainly this is not the case for GDP). Nevertheless we opted to use CPI instead of the deflator in order to use a consistent conversion, the same for all aggregate indicators. In this case the error in transforming in constant prices GDP/inhabitant is less than 3%.

The descriptive statistics of the economic indicators using a restricted and available 14-term series, during the period 1997–2010, revealed normal distributions, and this methodological aspect can authorise the construction of some econometric models (the values of Jarque-Bera tests describe only normal distribution in Table 13, even these data series are in many cases heterogeneous, but moderately asymmetric).

Table 17. The detailed competitive unifactorial econometric models for estimating services indicators of I-OT, limited form.

Dependent Variable: SER05 Method: Least Squares Sample:1997-2010				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	−1449.221	471.2311	−3.075394	0.0096
SER04	0.184075	0.034373	5.355242	0.0002
R-squared	0.705005	Mean dependent var		972.8357
Adjusted *R*-squared	0.680422	S.D. dependent var		875.6660
S.E. of regression	495.0249	Akaike info criterion		15.37866
Sum squared resid	2940596	Schwarz criterion		15.46995
Log likelihood	−105.6506	F-statistic		28.67862
Durbin-Watson stat	1.293341	Prob(F-statistic)		0.000172
C	−55016.01	4956.732	−11.09925	0.0000
SER03	5.689536	0.271070	20.98921	0.0000
R-squared	0.973483	Mean dependent var		43832.65
Adjusted *R*-squared	0.971274	S.D. dependent var		34127.54
S.E. of regression	5784.222	Akaike info criterion		20.29522
Sum squared resid	4.01E+08	Schwarz criterion		20.38651
Log likelihood	−140.0665	F-statistic		440.5468
Durbin-Watson stat	1.657125	Prob(F-statistic)		0.000000
C	−3443.902	2536.716	−1.357622	0.1996
SER10	0.094899	0.030551	3.106198	0.0091
R-squared	0.445688	Mean dependent var		3573.171
Adjusted *R*-squared	0.399495	S.D. dependent var		5571.757
S.E. of regression	4317.679	Akaike info criterion		19.71039
Sum squared resid	2.24E+08	Schwarz criterion		19.80168
Log likelihood	−135.9727	F-statistic		9.648463
Durbin-Watson stat	1.055312	Prob(F-statistic)		0.009085
C	−53632.22	6782.969	−7.906894	0.0000
SER02	5.064625	0.376110	13.46579	0.0000
R-squared	0.937929	Mean dependent var		33256.31
Adjusted *R*-squared	0.932757	S.D. dependent var		30175.18
S.E. of regression	7824.827	Akaike info criterion		20.89955
Sum squared resid	7.35E+08	Schwarz criterion		20.99085
Log likelihood	−144.2969	F-statistic		181.3275
Durbin-Watson stat	1.033027	Prob(F-statistic)		0.000000
C	−115928.0	13637.68	−8.500570	0.0000
SER03	11.37134	0.745806	15.24705	0.0000
R-squared	0.950915	Mean dependent var		81634.97
Adjusted *R*-squared	0.946824	S.D. dependent var		69013.38
S.E. of regression	15914.39	Akaike info criterion		22.31940
Sum squared resid	3.04E+09	Schwarz criterion		22.41069
Log likelihood	−154.2358	F-statistic		232.4726
Durbin-Watson stat	1.180252	Prob(F-statistic)		0.000000
C	−141315.1	13140.73	−10.75398	0.0000
SER03	14.12498	0.718629	19.65546	0.0000
R-squared	0.969875	Mean dependent var		104089.0
Adjusted *R*-squared	0.967364	S.D. dependent var		84883.34
S.E. of regression	15334.47	Akaike info criterion		22.24516

(*Continued*)

Table 17. (*Continued*).

Dependent Variable: SER05 Method: Least Squares Sample:1997-2010				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Sum squared resid	2.82E+09	Schwarz criterion		22.33645
Log likelihood	−153.7161	F-statistic		386.3369
Durbin-Watson stat	1.428211	Prob(F-statistic)		0.000000

Source: Created by the authors. Software used: EViews.

Table 18. The values estimated for services indicators of I-OT, limited form, based on major aggregates, during the period 2011–2014.

Annual value of exogenous variable		The most competitive estimated values for endogenous variables in uni- and multi-factorial models					
Year	E.g. Value of GDP total**	Services in Agriculture HIFC/ person** (table 16a)	Services in Industry GDI-T/ person** (table 16a)	Services in Construction GDP total** (table 16b)	Services in services GDP/ person** (table 16a)	Service in IC* GDI-T/ person** (table 16a)	Services in GAV*i*,GDI-T/person** (table 16a)
2011	131,327.03	2035.14	92333.79	9019.04	75566.28	178572.18	224501.91
2012	131,747.00	2042.92	92688.76	9058.89	75875.98	179281.64	225383.18
2013	139,364.78	2183.89	99127.39	9781.82	81492.73	192150.20	241368.02
2014	147,940.27	2342.60	106375.53	10595.63	87815.68	206636.66	259362.56

Note: Services in IC= Services Intermediate Consumption.
**Note: The exogenous variable used in the models.

Finally, a matrix of correlation allows selecting some models of services evolution in Romania, based on I-OT data and other macroeconomic information (Table 14).

The main information regarding the correlation among indicators resulting from I-OT indicate a very strong relationship with major aggregates or the outcomes of the total economy activity (except for SER07). By the rank of the intensity of the correlation the highest interdependencies are in relation with GDI-T/person or inhabitant (SER03), GDP/person or inhabitant (SER02) and HIFC/person or inhabitant (SER04).

SER10 values (GDP total) have offered a good signal of adequacy or suitability as the inflate method for transformation of the current prices to constant prices. As a methodological control, this method has generated a low level of error in the analysis because GDP total variable is correlated with all of the other major aggregates with similar values in the correlation matrix placed between 0.984 and 0.989.

Finally we propose several econometric models for evaluations and estimations of the different contributions to GDP employment or GAV, of the major services activities in Romania for the period 2011–2014 using the real or estimated values of GDP for these years (Tables 15, 16a, 16b and 17 for the models and Tables 18 and 19 for the major aggregates estimations).

After several iterations similar unifactorial econometric models can be built for the remaining indicators (Services in Industry$_i$, Services in Construction$_i$, Services in services$_i$, Service in IC$_i$ and Services in GAV$_i$), and thus, from these models the most competitive models have been selected, using the criterion of *R*-squared value (see Table 16a for unifactorial models and Table 16b for multifactorial models).

Table 19. The estimated values for the exogenous variables from data series (2011–2014).

	SER10	SER02	SER03	SER04
2011	131,327.03	25510.11	25898.55	18926.46
2012	131,747.00	25571.26	25960.94	18968.69
2013	139,364.78	26680.28	27092.61	19734.46
2014	147,940.27	27928.74	28366.56	20596.50

Source: Created by the authors. Software used: EViews.
Note: The models of estimations for the variables are based on the Eurostat GDP values (SER10).
(a) SER 02 = 6,391 + 0.145584 × SER10.
(b) SER 03 = 6,389 + 0.148557 × SER10 and
(c) SER 04 = 5724.95 + 0.100524 × SER10.

In the specific case of the Services in Construction indicator, the value of *R*-squared is below the threshold of 0.5, a multifactorial model can be described as valid and more competitive:

To ensure optimal estimation or optimal selection from the completion models the authors have used some neutral sources for exogenous variables in the most competitive econometrical models (GDP from *Eurostat series of data*).

The closer to the year for which the model is constructed the better I-OM will approximate the economy. The error significantly increases from one year to the following. Thus, the models require updating of parameters once new real data are available (Appendix 1). Constructions and agriculture are more volatile activities and this fact also influences the evolution of services used as inputs by these activities.

4. Conclusions

We have found striking evidence that input–output tables are a good source of information for analysing any structural change and estimating the main indicators, because of the following three major advantages: (a) the data are comprehensive and consistent, I-OT including the service sector and play a fundamental role in the construction of the System of National Accounts (SNA); (b) the nature of I-O(I)A makes it possible to examine, understand and forecast the economy as an interconnected system of agricultural, industrial and service activities, analysing an economy's reaction to changes in the economic environment, and the ability to capture the indirect effects of the changes; (c) the I-OT and I-O(I)A allow a decomposition of structural changes, identifying the sources, the direction and the magnitude of these changes (Fatemi, 2002).

In Romanian statistical and econometrical literature, this paper is one of the first scientific articles dedicated to the importance of estimation values of national services evolution, based on I-OT data and information, and the authors will continue their modelling and forecasting approaches in the proximal future, focusing on aggregates from GDP evaluations. Our findings confirm the increasing role of services in the Romanian economy not only as a factor of economic growth, but also as a vector of competitive advantage, an important estimation value resulting from the correlations with major aggregates and with I-OT information. Good comprehensive services policies, explaining the new paradoxes of the Romanian economy (Săvoiu & Dinu, 2015), should be well informed and new managerial instruments based on econometric models and statistical tools can optimise the balance between goods and services and between major aggregates from GDP and the services indicators of I-OT source.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix 1. Abbreviations

BoP	Balance of Payments
CPI	Consumer Price Index
ESA	European System of national and regional Accounts
GDI-T	Gross disposable income-total
GDP	Gross Domestic Product
GAV	Gross Added Value
HIFC	Households Individual Final Consumption
IEAT	Integrated Economic Accounts Table
I-O(I)A	Input–Output (Impact) Analysis
I-OIM	Input–Output Impact Multipliers
I-OM	Input–Output Model
I-OT	Input–Output Table
ISIC	International Standard Industrial Classification of all Economic Activities (United Nations)
NACE Rev.2	Nomenclature générale des Activités économiques dans les Communautés Européennes (Statistical classification of economic activities in the European Communities) Revision 2
NSI	National Statistics Institute
SNA	System of National Accounts