I. THE NEW VERSION (2018) OF THE ROMANIAN MACROMODEL - THE SECTORAL MODULE

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Abstract

The paper presents the sectoral block of the 2018 Version of the Romanian macromodel. Similarly to the previous one, this one orbits around the input-output tables. The method of estimating the A matrix in two phases is employed, as follows: a) econometric determination of its row and column sums by longest stable VAR procedure, and b) application of the RAS method for defining the complete matrix of technical coefficients.

The paper also describes the algorithm of estimating the sectoral structure of the economy by a system of equations that involves three categories of exogenous variables: i) the gross value added as a macroeconomic indicator; ii) the A matrix; and iii) the econometric approximation of the final output sectoral distribution.

The adopted conceptual and computational hypotheses are tested on the yearly I-O tables of Romania for 1989-2016. Experimentally, a projected sectoral structure of the Romanian economy for the 2017-2020 period is presented.

Keywords: input-output analysis, A matrix, sectoral structure, VAR

JEL Classification: C67, C82

I. Introduction

Like the previous two versions (2005 and 2012) of the Romanian macromodel, the new sectoral block orbits around the input-output tables. The general principles of the I-O analysis (Leontiev 1938, 1970, and 1986, United Nations 1999, European Commission 2008, Miller and Blair 2009, Commission Regulation-EU 2010) and the specific features of its application to Romania as an emergent economy (Dobrescu 2006a, 2006b, 2013, 2014, Dobrescu and Gaftea 2017) are used.

1. The primary data comes from official surveys of the National Institute of Statistics (INS 2016 among others), which publishes yearly I-O tables for the entire post-socialist evolution of Romania (the 1989-2016 period), according to the NACE Rev.1 - ESA 79 methodology, and after that, to the current European System of Regional and National Accounts - ESA 2010 NACE Rev. 2 (Commission Regulation EU – No. 715/2010, 2010). The current sectoral module uses homogenized series constituted in conformity with ESA 2010 for 88 branches (listed in Appendix 1a).

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2. The Romanian macromodel approached the sectoral profile of economy in two ways. Versions 1996-2004 focused on a few dominant branches, ignoring their inter-flows of I-O type. Beginning in 2005, these problems were interpreted within the I-O analysis framework, step-by-step expanding the number of examined sectors.

2.1. Thus, the 2005 version (Dobrescu, 2006a, 2006b) operated with six sectors (in brackets, their numerical code in the macromodel):

- Agriculture, forestry, hunting, and fishing (1);
- Mining and energy (2);
- Manufacturing industry (3);
- Construction (4);
- Transport, post, and communications (5);
- Trade and services (6).

The aggregation of the expanded branch nomenclature into the six sectors is presented in Appendix 1b. It is easy to notice that the first two sectors correspond to the so-called primary mega-domain, the sectors 3 and 4 to the secondary one, and the last two sectors cover the tertiary zone of the economy. Such a structure has been applied to the macromodel simulations until 2011.

2.2. The 2012 version has advanced significantly, increasing the number of sectors to ten:

- Agriculture, forestry, hunting and fishing (1);
- Mining and quarrying (2);
- Production and distribution of electric and thermal power (3);
- Food, beverages and tobacco (4);
- Textiles, leather, pulp and paper, furniture (5);
- Machinery and equipment, transport means, other metal products (6);
- Other manufacturing industries (7);
- Constructions (8);
- Transport, post and telecommunications (9); and
- Trade, business services, and public services (10).

In this structure, the production and distribution of electric and thermal power is separated, and the manufacturing industries were divided into four items. Appendix 1b describes its concordance with the expanded nomenclature. The successive macromodel simulations for 2012-2017 confirmed the modelling advantages of the ten-sector classification.

2.3. They also showed some limitations, especially concerning the analysis and forecasting of the tertiary mega-domain, represented in a too compact form. Since the tertiarization of the Romanian economy was fast, the 2018 Version adopted a fourteen-sector structure:

- Agriculture, forestry, hunting and fishing (1);
- Mining and quarrying (2);
- Production and distribution of electric and thermal power (3);
- Food, beverages and tobacco (4);
- Textiles, leather, pulp and paper, furniture (5);
- Machinery and equipment, transport means, other metal products (6);

- Other manufacturing industries (7);
- Constructions (8);
- Transports, post and telecommunications (9);
- Trading services (10);
- Financial services and real estate transactions (11);
- Social services (12);
- Creative services (13); and
- Professional services (mainly businesses) (14).

The correlation of this structure with the expanded classification (of 88 branches) is presented in Appendix 1b (available online).

3. Following the methodological line of the previous macromodel versions, the current one is based on the principle of connecting the sectoral block to the aggregate system involving the A matrix.

3.1. The inter-sectoral transactions are monetarily expressed on both the supply-side (resources formation, denoted by R) and the demand-side (resources utilization, denoted by U). A mixed price system is used, as follows:

$$R = Q + NIT + M \qquad (1)$$

where: Q – output (production exclusively by resident units) at producer prices; NIT – net indirect taxes; and M – imports (summing both competitive and non-competitive) of goods and services, at purchaser prices.

$$U = Z + AD + X \qquad (2)$$

where: Z – intermediate consumption (inputs in sector j coming from sector i), at mixed prices (domestic entries preponderantly at producer prices and imports at purchaser ones); AD – domestic absorption, as a hybrid conglomerate including the private and public consumption, gross fixed capital formation, inventory changes (all these positions at purchaser prices); X – export of goods and services, at purchaser prices. Note that usual balancing corrections are incorporated again in AD.

3.2. The equality R=U is valid not only at the sectoral level, but also at the macroeconomic level. The gap between the producer prices and the purchaser ones is compensated by the cumulative indicator NIT (net indirect taxes), containing value added tax, excises, custom duties, subsidies on product, other similar add-ons.

3.3. The primary database describes the inter-branch transactions in current prices and in the previous year prices. The current sectoral module was elaborated only in current prices; the additional analyses in constant prices will be done separately.

3.4. The Leontief variant of the I-O tables, the most used one internationally, was adopted. There are no informational and methodological premises in order to attempt a Ghosh interpretation (1958).

3.5. As usually, the rows of the I-O table quantify the contribution of sectors as suppliers (code i), while the columns characterize their impact as buyers (code j).

4. The equality R=U is satisfied for each sector. If the output is represented by production, the formulas (1) and (2) can be re-written as:

$$R_j = Q_j + NIT_j + M_j = \sum_i z_{ij} + GVA_j + NIT_j + M_j \ (j = fixed) \qquad (1a)$$

$$U_i = \sum_j z_{ij} + DA_i + X_i \ (i = fixed) \qquad (2a)$$

Therefore, the equilibrium between supplied and used resources, for i=j is:

$$\sum_i z_{ij} + GVA_j + NIT_j = \sum_j z_{ij} + DA_i + NX_i \quad (3)$$

where: NX_i means the net export (difference between export and import) at sectoral level.

Introducing the net inter-sectoral flows (NIF):

$$NIF_i = \sum_i z_{ij} - \sum_j z_{ij} \quad (4)$$

the relationship (3) becomes:

$$GVA_j + NIT_j = NIF_i + DA_i + NX_i \quad (3a)$$

The sums of all inter-sectoral transactions by rows and columns being identical, at the macro-level NIF is null. This explains why in determining the gross domestic product neither NIF nor another equivalent indicator appears.

5. Based on NIF_i, the gross value added can be expressed in a form convenient for econometric analysis, which comes from a double accounting relationship of the sectoral output. On one hand, it is about its computation as a sum of the gross value added and the own intermediary consumption of each sector.

$$Q_i = GVA_i + \sum_j z_{ij} \quad (5)$$

On the other hand, the identity:

$$Q_i = NY_i + \sum_i z_{ji} \quad (5a)$$

must be also fulfilled. The part of output resulted after the subtraction of own sectoral productive consumption is considered as the sectoral final output (NY_i). Consequently, the gross value added is computable as:

$$GVA_i = NY_i + \left(\sum_i z_{ij} - \sum_j z_{ij}\right) = NY_i + NIF_i \quad (6)$$

As mentioned above, at the macroeconomic level NIF is null, which means that NY=GVA. In other words, the total gross value added is forecasted within the aggregate system of the macromodel (Dobrescu 2018). Since NY_i=GVA*wny_i, for projecting NY_i it would be necessary to provide a separate forecast of wny_i as sectoral shares in the final output. Owings to such an algorithm, the sectoral structure of the economy is approximated.

6. Similarly to the previous versions of the Romanian macromodel, the technical coefficients (A matrix) were approximated in two phases.

6.1. First, the econometric estimations of the row/col sums of this matrix were performed. Preliminarily, several model specifications were tested. Finally, the univariate AR with distributed lags was adopted in the form of the longest stable VAR (LSVAR). This involves maximal number of lags (allowed by the length of the available sample), provided that there is a stable auto regression (no root of characteristic polynomials lies outside the unit circle). A discussion on this issue may be found in Dobrescu (2014).

6.2. Subsequently, the row/column sums were further used for obtaining a complete A matrix (14x14 coefficients) through the RAS procedure.

7. The LSVAR procedure was also applied for the estimation of the sectoral shares in the final output of the economy.

8. The paper continues (second chapter) with the examination of the model-building of the A matrix. Problems of after-sample A matrix and final output structure are debated in the third chapter. Based on all these analyses, in the fourth chapter a global projection of the structure of the economy (shares of different sectors in the total output, gross value added, and final output) is computed. Some conclusive considerations finish our work.

II. Modelling the A Matrix

Econometrically, the A matrix is constructed in two phases: i) the estimation of its row and column sums and ii) the calculation – through the RAS method – of a complete technical coefficients table. The current chapter discusses these issues on statistical series. As a checking sample we used data beginning in 2007 - the year when Romania became a full member of the European Union.

1. The row/column sums of the A matrix, after many preliminary trials on uni- and multivariate specifications, were estimated using the longest stable VAR (LSVAR). Besides its simplicity, this technique has other two advantages: i) it is better equipped to take into account specificities of the available statistics, and ii) it satisfies the stability condition. The LSVAR was estimated using continuous yearly series 1989-2016 for the row (sra_i) and the column (sca_j) sums of the technical coefficients.

The LSVAR specification worked satisfactorily with two exceptions – sra8 and sca13 – for which it provided economically implausible outcomes. Consequently, the number of lags was reduced by a unit in both cases. Table 1 presents the lag specification for all row/column sums of the A matrix.

Table 1

Number of lags included in the AR specification of sra_i and $tsca_j$

Sector	sra	sca	**Sector**	Sra	sca	**Sector**	sra
1	8	9	**6**	8	9	**11**	10
2	11	7	**7**	10	4	**12**	6
3	11	8	**8**	7	7	**13**	7
4	10	10	**9**	8	8	**14**	7
5	10	8	**10**	13	2		

Generally, we selected long-memory autoregressive processes, most of the specifications comprising over eight lags, and an important number of specifications ten and more lags.

2. The relationships for the row sums of A matrix are the following:

*sra1=0.971786*sra1(-1)-0.707924*sra1(-2)+0.312294*sra1(-3)+0.119707*sra1(-4)-0.5319200*sra1(-5)+0.815615*sra1(-6)-0.458676*sra1(-7)-0.052014*sra1(-8)+0.335033*

*sra2=1.50274113643*sra2(-1)-1.369890*sra2(-2)+1.206973*sra2(-3)-0.674499*sra2(-4)+0.450632*sra2(-5)-0.111975*sra2(-6)-0.162030*sra2(-7)+0.074515*sra2(-8)-0.109990*sra2(-9)+0.047887*sra2(-10)-0.005106*sra2(-11)+0.096736*

*sra3=0.410418*sra3(-1)+0.079754*sra3(-2)-0.082341*sra3(-3)-0.062638*sra3(-4)-0.050291*sra3(-5)+0.113066*sra3(-6)+0.275094*sra3(-7)+0.010905*sra3(-8)-0.052420*sra3(-9)+0.080805*sra3(-10)+0.174303*sra3(-11)+0.012962*

sra4=0.834977*sra4(-1)-0.085204*sra4(-2)+0.167767*sra4(-3)+0.116427*sra4(-4)-
0.197745*sra4(-5)+0.125376*sra4(-6)-0.039036*sra4(-7)+0.045363*sra4(-8)-
0.012826*sra4(-9)-0.043352*sra4(-10)+0.031191

sra5=0.510315*sra5(-1)-0.127998*sra5(-2)+0.103476*sra5(-3)-0.361488*sra5(-
4)+0.383671*sra5(-5)+0.156227*sra5(-6)+0.097460*sra5(-7)-0.017617*sra5(-8)-
0.053036*sra5(-9)-0.007564*sra5(-10)+0.214847

sra6=0.709115*sra6(-1)+0.046162*sra6(-2)-0.154385*sra6(-3)-0.439082*sra6(-
4)+0.408371*sra6(-5)+0.113356*sra6(-6)-0.098174*sra6(-7)-0.112678*sra6(-
8)+0.487831

sra7=0.469176*sra7(-1)+0.013753*sra7(-2)-0.291001*sra7(-3)-0.240644*sra7(-4)-
0.064727*sra7(-5)+0.073303*sra7(-6)+0.150927*sra7(-7)-0.045250*sra7(-8)-
0.007356*sra7(-9)-0.031914*sra7(-10)+1.477082

sra8=0.835076*sra8(-1)+0.175245*sra8(-2)-0.017942*sra8(-3)-0.558711*sra8(-
4)+0.254545*sra8(-5)+0.183598*sra8(-6)+0.058128

sra9=0.798654*sra9(-1)+0.101964*sra9(-2)+0.038912*sra9(-3)-0.031415*sra9(-4)-
0.068703*sra9(-5)+0.091733*sra9(-6)-0.066323*sra9(-7)+0.021081*sra9(-8)+0.051793

sra10=0.024828*sra10(-1)-0.060343*sra10(-2)+0.195027*sra10(-3)+0.093192*sra10(-
4)-0.055222*sra10(-5)-0.170561*sra10(-6)-0.319883*sra10(-7)+0.049377*sra10(-8)-
0.059840*sra10(-9)+0.366673*sra10(-10)+0.104767*sra10(-11)+0.055252*sra10(-
12)+0.018618*sra10(-13)+0.160270

sra11=0.401030*sra11(-1)-0.536135*sra11(-2)+0.157625*sra11(-3)-0.244497*sra11(-4)-
0.037592*sra11(-5)-0.017108*sra11(-6)-0.292589*sra11(-7)-0.047511*sra11(-8)-
0.060948*sra11(-9)-0.011711*sra11(-10)+0.610716

sra12=1.225396*sra12(-1)-0.936805*sra12(-2)+0.683790*sra12(-3)-0.085450*sra12(-4)-
0.056185*sra12(-5)-0.059580*sra12(-6)+0.014759

sra13=0.392342*sra13(-1)+0.046508*sra13(-2)-0.463445*sra13(-3)+0.547075*sra13(-
4)+0.025266*sra13(-5)-0.141528*sra13(-6)-0.148640*sra13(-7)+0.297575

sra14=0.744372*sra14(-1)+0.219275*sra14(-2)-0.118873*sra14(-3)+0.0199540*sra14(-
4)-0.050710*sra14(-5)+0.100494*sra14(-6)-0.004038*sra14(-7)+0.103325

3. In the case of column sums, the following results were obtained:

sca1=0.697241*sca1(-1)+0.483156*sca1(-2)-0.539547*sca1(-3)-0.291116*sca1(-
4)+0.595069*sca1(-5)-0.117177*sca1(-6)+0.001999*sca1(-7)+0.063538*sca1(-8)-
0.137795*sca1(-9)+0.126665

sca2=- 0.505785*sca2(-1)+0.269051*sca2(-2)+0.678057*sca2(-3)+0.1410903*sca2(-4)-
.185898*sca2(-5)-0.794487*sca2(-6)-0.274609*sca2(-7)+0.991112

sca3=0.598518*sca3(-1)-0.219807*sca3(-2)+0.097229*sca3(-3)+0.082547*sca3(-4)-
0.006683*sca3(-5)-0.298516*sca3(-6)-0.094233*sca3(-7)-0.069165*sca3(-8)+0.674065

*sca4=0.775159*sca4(-1)-0.441251*sca4(-2)+0.0176850*sca4(-3)+0.244955*sca4(-4)-0.062803*sca4(-5)-0.370388*sca4(-6)+0.686935*sca4(-7)-0.382125*sca4(-8)+0.296531*sca4(-9)-0.060292*sca4(-10)+0.176905*

*sca5=0.665541*sca5(-1)-0.375268*sca5(-2)+0.045361*sca5(-3)-0.103781*sca5(-4)+0.122030*sca5(-5)+0.054437*sca5(-6)+0.216772*sca5(-7)+0.293184*sca5(-8)+0.031622*

*sca6=1.118682*sca6(-1)-0.565340*sca6(-2)+0.425467*sca6(-3)-0.520412*sca6(-4)+0.084868*sca6(-5)-0.160066*sca6(-6)-0.0169714*sca6(-7)+0.236600*sca6(-8)-0.254960*sca6(-9)+0.397935*

*sca7=1.057492*sca7(-1)-0.155737*sca7(-2)-0.047378*sca7(-3)+0.113399*sca7(-4)+0.017970*

*sca8=1.012894*sca8(-1)-0.583206*sca8(-2)+0.798756*sca8(-3)-0.836334*sca8(-4)+0.884018*sca8(-5)-0.870418*sca8(-6)+0.351261*sca8(-7)+0.140428*

*sca9=0.961569*sca9(-1)-0.253825*sca9(-2)-0.221138*sca9(-3)-0.163143*sca9(-4)+0.194523*sca9(-5)-0.175084*sca9(-6)+0.331456*sca9(-7)-0.137032*sca9(-8)+0.533627*

*sca10=0.904719*sca10(-1)-0.008359*sca10(-2)+0.038852*

*sca11=-0.0654957*sca11(-1)-0.008558*sca11(-2)+0.227525*sca11(-3)+0.005409*sca11(-4)+0.074099*sca11(-5)-0.051283*sca11(-6)+0.044399*sca11(-7)+0.030203*sca11(-8)+0.135537*sca11(-9)-0.263963*sca11(-10)+0.000300*sca11(-11)-0.40178*sca11(-12)+0.356425*

*sca12=0.309629*sca12(-1)+0.033694*sca12(-2)+0.260085*sca12(-3)-0.118321*sca12(-4)-0.011158*sca12(-5)+0.172153*sca12(-6)+0.098041*sca12(-7)-0.066641*sca12(-8)+0.063627*sca12(-9)-0.031616*sca12(-10)+0.004580*sca12(-11)+0.081264*

*sca13=0.670002*sca13(-1)-0.014414*sca13(-2)+0.179665*sca13(-3)-0.495030*sca13(-4)+0.612692*

*sca14=0.154352*sca14(-1)+0.327449*sca14(-2)-0.094288*sca14(-3)-0.160301*sca14(-4)+0.044665*sca14(-5)+0.072134*sca14(-6)-0.320353*sca14(-7)+0.099086*sca14(-8)+0.127331*sca14(-9)-0.043482*sca14(-10)+0.0197071*sca14(-11)-0.248156*sca14(-12)+0.542381*

4. The estimations generated by the above-described relationships suffered two final adjustments.

4.1. The first derives from the equality:

$$\sum_i sra_i = \sum_j sca_j \qquad (7)$$

Since the coefficients resulted from the above-described relationships (denoted by suffix f) do not always observe condition (7), they are corrected with the balancing parameter b_a. This parameter is computed on the assumption that $b_a \sum_i sraf_i = {}^{1}\!/_{b_a} \sum_j scaf_j$, which means:

$$b_a = \left(\sum_i scaf_i \Big/ \sum_j sraf_j\right)^{0.5} \qquad (8)$$

As a result, the new values of the row sums become $srafb = sraf / b_a$ and of column sums $scafb = scaf \cdot b_a$.

4.2. Another correction is made in order to maintain a connection as tight as possible between the econometric estimations and the ensemble used in the regressions data. A supplementary LSVAR specification is defined for the sum of all coefficients included in the matrix (sscra=ssra+ssca). As an econometric estimation (sscraf) is, in our case, approximated by the relationship:

*sscraf=0.808688*sscra(-1)-0.113797*sscra(-2)-0.177345*sscra(-3)+0.303902*sscra (-4)-0.125236*sscra(-5)+0.011874*sscra(-6)+5.050596*

All the srafb and scafb values are divided by the parameter ρ_a:

$$\rho_a = (ssrafb + sscafb)/sscraf \qquad (9)$$

obtaining the final values of row (srafc) and column (scafc) sums of the technical coefficients.

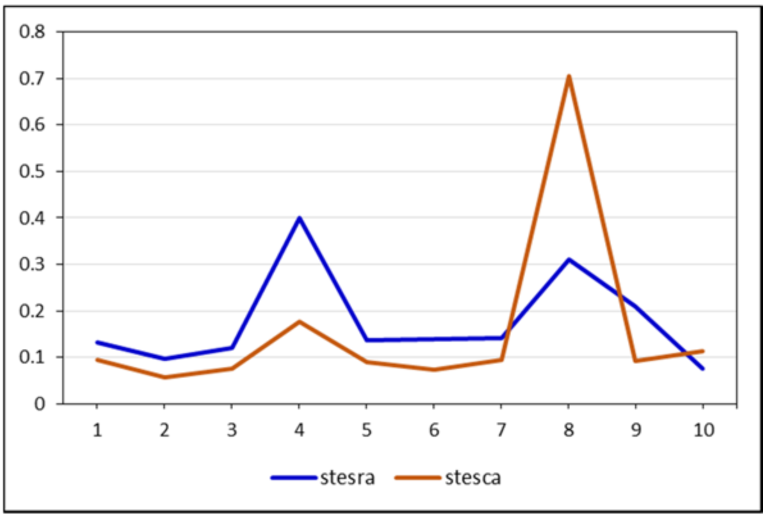
5. These values were compared with the checking sample (2007-2016), and for each sector we calculated:

- squared relative errors (sre): $sre = (y_e/y_s - 1)^2$, where subscript e signifies the estimated value and s the statistical ones; and
- standard errors (ste): $ste = (\sum sre_i/14)^{0.5}$, distinctly for row sums (stesra) and column sums (stesca).

The results are displayed in Figure 1.

Figure 1

Standard error of estimated row (stesra) and column (stesca) sums comparatively with statistics



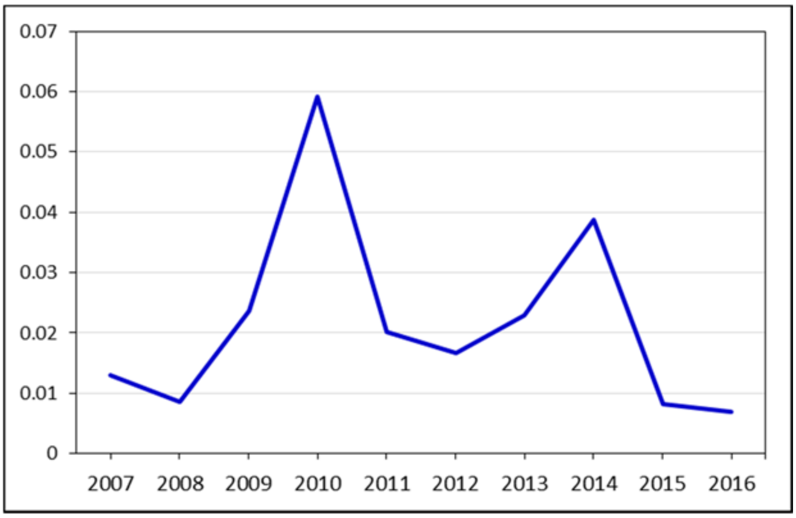
“Responsible” for the larger deviations in the case of sca are especially the sectors 3, 5, 10, and 13 in 2010 (over 71% of total sre), and 9 and 13 in 2014 (almost 98% of total sre). In this regard, dominant for row/sums are the sectors 8, 9, 12 (approximately 84% of total sre) in 2010, and the sectors 8, 12, 13, 14 (more than 85% of total sre) in 2014. Partly responsible for the large deviations is the model specification, but an important part is also due to the structural changes induced by the last global crisis.

6. The computed row/column sums of the A matrix were then introduced as restrictions in the RAS algorithm (Stone 1961, Stone and Brown 1962, Bacharach 1970). An integral A matrix was deduced from the previous one and row/column sums estimations for the given year. In our application, ten successive iterations of the so-called bi-proportional correction proved sufficient for obtaining relatively stable results.

6.1. The standard errors for all technical coefficients (steA) are presented in Figure 2.

Figure 2

Standard error of estimated A matrix (all coefficients) comparatively with statistics



The striking similarity of Figure 1 and the previous one suggests that the RAS procedure did not essentially influence the accuracy of the technical coefficient estimations. In other words, the ways for improving the computational performance of the entire algorithm lays in finding alternative econometric estimations of the row/column sums of the A matrix.

III. After-sample A Matrix and Final Output Structure

Projecting the sectoral structure needs a beforehand projection of the A matrix and of the sectoral structure of the final output.

1. Consequently, the LSVAR relationships must be after-sample extrapolated. A sensible question was raised with regard to the determination of the column sums. More specifically about the possibility of some column sums of the matrix A (sca) to exceed unity, which implicitly means a negative gross value added ($GVA_i=(1-sca_i)*Q_i$). Among our series, there were two sectors facing this problem: the 9th (transports, post and telecommunications) and the 13th (creative services).

Economically, such a situation cannot be excluded (for instance, Government restrictions on producer prices accompanied by corresponding subsidies). Some incoherencies in the data collecting system could also induce the mentioned "anomaly" even statistically. Further research has to better clarify this question.

For the moment, it was important to overcome this impediment in our application. An unambiguous fact has been decisive in this sense. In the recent years (2014-2016) both sectors were characterized - as the rest of the economy - by below-unity column sums. The ex-ante LSVAR forecast for 2017 has also generated plausible results. Under these circumstances, despite the above-unity sca LSVAR extrapolations after 2017, the sectors 9 and 13 were kept with the sca and sra defined for 2017. This above-described rectification was performed exclusively on the primary LSVAR outcomes, and because of the corrections introduced by the coefficients described by equations (8) and (9) in order to ensure that the estimated coefficients fulfil equation (7), the final data for these sectors differ from those of 2017.

2. The row/column sums projected for 2017-2020 are those given in Table 2.

Table 2

Row and column sums projected for 2017-2020

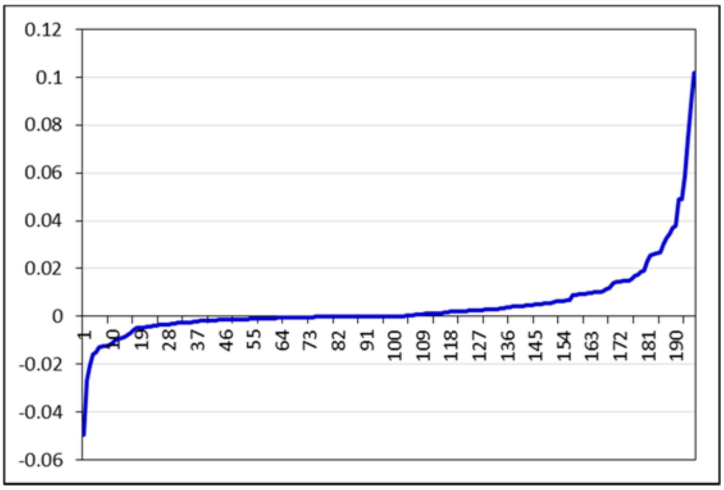
	2017		2018		2019		2020	
Sectors	sra	sca	sra	sca	sra	sca	sra	Sca
sect1	0.65316	0.54308	0.64546	0.52488	0.57018	0.54749	0.558	0.54813
sect2	0.5501	0.55473	0.51703	0.69171	0.47487	0.6734	0.4614	0.60682
sect3	0.70353	0.81779	0.70442	0.82121	0.76905	0.82991	0.7772	0.82416
sect4	0.37609	0.62223	0.33828	0.62635	0.34607	0.64204	0.35	0.64183
sect5	0.68148	0.54807	0.73957	0.49237	0.75492	0.50625	0.7242	0.55416
sect6	0.96427	0.64636	1.0052	0.60337	0.92408	0.58261	0.8891	0.58269
sect7	1.49129	0.6786	1.47599	0.67334	1.59311	0.68921	1.6133	0.68172
sect8	0.28932	0.58316	0.42429	0.62748	0.49181	0.62094	0.5118	0.60929
sect9	0.29257	0.89779	0.27394	0.89667	0.28092	0.92075	0.2849	0.91465
sect10	0.2091	0.52895	0.20132	0.51383	0.19308	0.51433	0.2047	0.4991
sect11	0.34133	0.27251	0.34331	0.22684	0.3525	0.29062	0.324	0.26769
sect12	0.11036	0.31159	0.09626	0.3199	0.04584	0.30645	0.0342	0.3154
sect13	0.48253	0.68597	0.45181	0.68512	0.46333	0.70351	0.4699	0.69886
sect14	1.0824	0.53673	1.01277	0.52657	1.10324	0.53553	1.1013	0.55931

The projected changes of the column sums are limited enough. The changes are more significant in the case of row sums.

3. The projected row/column sums are transformed with the RAS algorithm into a complete A matrix. The 2016 statistical matrix was used as starting matrix for bi-proportional iterations for estimations on 2017, which were used for 2018 and so on. Computational results are presented in Appendix 2 (available online). In order to offer a synoptic image of the forecasted changes in the 196 technical coefficients, the algebraic differences between their levels at the beginning (2016) and the end of interval (2020) were computed. They are plotted in Figure 3.

Figure 3

Forecasted algebraic differences in technical coefficients (2020 against 2016)



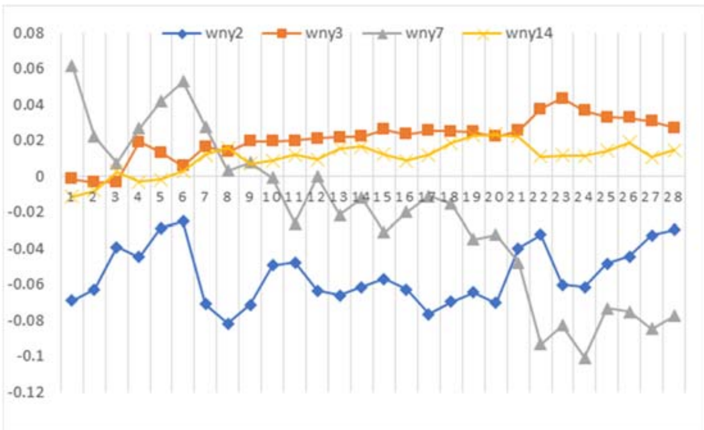
The differences follow a logistic distribution with a very large median zone (more than 78% of differences are ranked between -0.01 and +0.01. Model simulations suggest, therefore, that the structure of inter-sectorial transaction flows remains volatile, but within relatively narrow margins.

4. As mentioned above, the second pillar of estimating the sectoral structure of the economy is represented by the econometric projecting of the final output structure. The statistics concerning sectoral shares in total final output for 1989-2016 reveal several features of the Romanian economy.

4.1. Some sectors are characterized, at least in some years, by negative contributions to the final output (Figure 4a).

Figure 4a

Sectors with at least partially negative wny

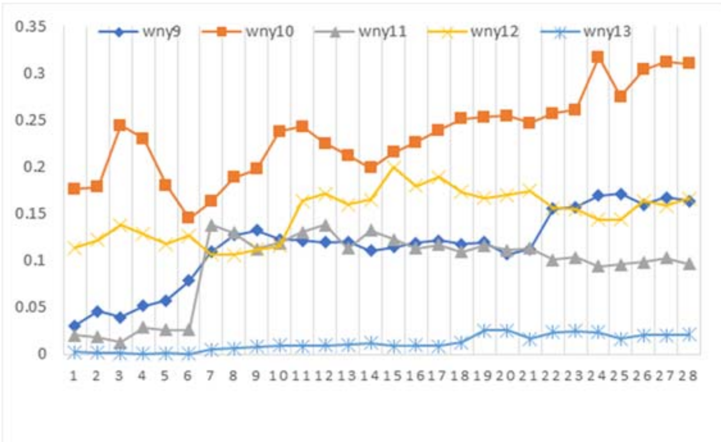


The second sector (mining and quarrying industries) was constantly in deficit, while the third (production and distribution of electric and thermal power) and seventh (other manufacturing industries sectors) moved from positive to negative positions; the fourteenth one (professional services, mainly businesses) had an inverse trajectory.

4.2. An important group of sectors revealed an ascending trend (Figure 4b).

Figure 4b

Sectors with positive ascending wny

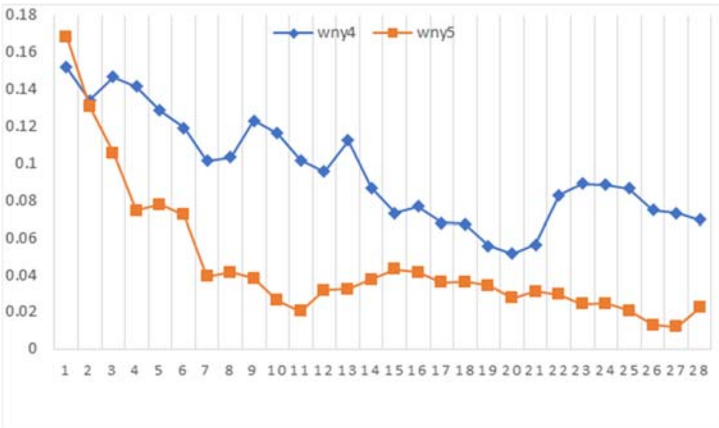


This group includes preponderantly the sectors belonging to the service mega-domain: transports, post and telecommunications, trading services, financial services and real estate transactions, social services, and creative services.

4.3. Two sectors had a positive, but descending share in the final output.

Figure 4c

Sectors with positive descending wny

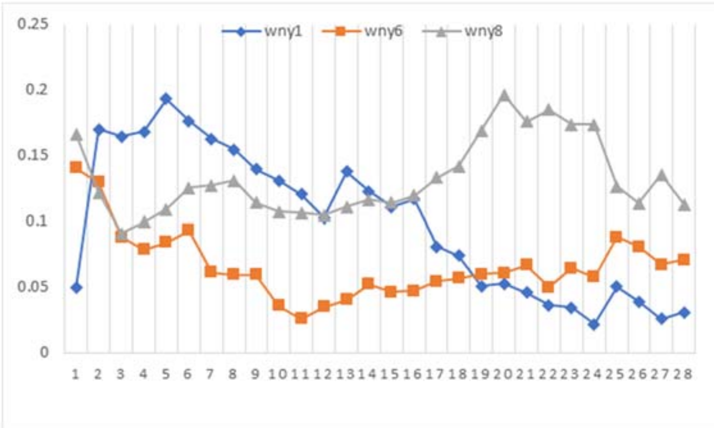


They are the food, beverages and tobacco, and the textiles, leather, pulp and paper, furniture.

4.4. Finally, several sectors displayed an alternating evolution of wny.

Figure 4d

Sectors with positive alternating evolution of wny



Besides agriculture, forestry, hunting and fishing, this category comprises also machinery and equipment, transport means, other metal products, and constructions.

5. In line with the technical methodology adopted in building the 2018 Version of the Romanian macromodel, we employed again the longest stable VAR method for estimating wny.

5.1. According to this procedure, the number of lags included in the model specification of the sectoral weights in the final output of the economy is shown in Table 3.

Table 3

Number of lags included in the AR specification of wny_i

	Number of lags		Number of lags		Number of lags
wny1	12	wny5	12	wny10	4
wny2	12	wny6	10	wny11	11
wny3	8	wny7	7	wny12	12
wny4	11	wny8	8	wny13	8
		wny9	10	wny14	9

5.2. The estimators for all sectoral relationships are the following:

*wny1 = 0.811877*wny1(-1) - 0.131598*wny1(-2) + 0.418480*wny1(-3) - 0.445431*wny1(-4) + 0.558837*wny1(-5) - 0.614545*wny1(-6) + 0.543065*wny1(-7) - 0.572023*wny1(-8) + 0.557764*wny1(-9) - 0.198483*wny1(-10) + 0.261705*wny1(-11) - 0.412934*wny1(-12) + 0.017697*

*wny2 = 1.178062*wny2(-1) - 1.234801*wny2(-2) + 1.365993*wny2(-3) - 1.195286*wny2(-4) + 1.140440*wny2(-5) - 0.600151*wny2(-6) + 0.348968*wny2(-7) - 0.284047*wny2(-8) + 0.160592*wny2(-9) - 0.224652*wny2(-10) + 0.106490*wny2(-11) - 0.227652*wny2(-12) - 0.024515*

wny3 = 0.915797*wny3(-1) - 0.373840*wny3(-2) - 0.148637*wny3(-3) + 0.164915*wny3(-4) - 0.057477*wny3(-5) - 0.087002*wny3(-6) + 0.038764*wny3(-7) + 0.253946*wny3(-8) + 0.010297

wny4 = 0.819089*wny4(-1) - 0.405497*wny4(-2) + 0.290387*wny4(-3) + 0.026314*wny4(-4) - 0.174219*wny4(-5) - 0.243287*wny4(-6) + 0.157879*wny4(-7) - 0.488768*wny4(-8) + 0.663155*wny4(-9) - 0.257366*wny4(-10) + 0.189904*wny4(-11) + 0.026549

wny5 = 0.901314*wny5(-1) - 0.053893*wny5(-2) - 0.113395*wny5(-3) + 0.099504*wny5(-4) - 0.746389*wny5(-5) + 0.685323*wny5(-6) + 0.095985*wny5(-7) - 0.233538*wny5(-8) + 0.072284*wny5(-9) - 0.339885*wny5(-10) + 0.079745*wny5(-11) + 0.182159*wny5(-12) + 0.008984

wny6 = 0.272565*wny6(-1) + 0.200584*wny6(-2) - 0.144492*wny6(-3) + 0.001951*wny6(-4) + 0.0937001*wny6(-5) + 0.022727*wny6(-6) + 0.047913*wny6(-7) + 0.071720*wny6(-8) - 0.144564*wny6(-9) - 0.224745*wny6(-10) + 0.049224

wny7 = 0.497629*wny7(-1) + 0.286387*wny7(-2) - 0.009284*wny7(-3) - 0.100713*wny7(-4) + 0.094712*wny7(-5) - 0.025479*wny7(-6) + 0.183368*wny7(-7) - 0.015300

wny8 = 0.861494*wny8(-1) - 0.043388*wny8(-2) + 0.174397*wny8(-3) - 0.084899*wny8(-4) - 0.208069*wny8(-5) - 0.062268*wny8(-6) + 0.069236*wny8(-7) + 0.038333

wny9 = 1.010950*wny9(-1) - 0.140751*wny9(-2) + 0.134559*wny9(-3) - 0.498466*wny9(-4) + 0.497746*wny9(-5) - 0.116832*wny9(-6) - 0.147099*wny9(-7) - 0.137921*wny9(-8) + 0.393555*wny9(-9) - 0.116297*wny9(-10) + 0.019689

wny10 = 0.942715*wny10(-1) - 0.121254*wny10(-2) - 0.144797*wny10(-3) + 0.311437*wny10(-4) + 0.008440

wny11 = 0.277944*wny11(-1) + 0.280212*wny11(-2) - 0.160733*wny11(-3) + 0.209844*wny11(-4) + 0.193157*wny11(-5) - 0.157473*wny11(-6) + 0.194476*wny11(-7) - 0.086461*wny11(-8) - 0.115017*wny11(-9) + 0.077145*wny11(-10) - 0.052803*wny11(-11) + 0.032995

wny12 = 0.251289*wny12(-1) - 0.175235*wny12(-2) - 0.129211*wny12(-3) + 0.461898*wny12(-4) - 0.274911*wny12(-5) + 0.346175*wny12(-6) - 0.407171*wny12(-7) - 0.193503*wny12(-8) + 0.159105*wny12(-9) - 0.431371*wny12(-10) + 0.452965*wny12(-11) - 0.181222*wny12(-12) + 0.182316

wny13 = 0.678217*wny13(-1) - 0.201429*wny13(-2) + 0.187266*wny13(-3) + 0.185308*wny13(-4) - 0.223873*wny13(-5) + 0.078525*wny13(-6) - 0.110505*wny13(-7) + 0.250437*wny13(-8) + 0.004279

wny14 = 0.664913*wny14(-1) - 0.295548*wny14(-2) + 0.188520*wny14(-3) - 0.514058*wny14(-4) + 0.525061*wny14(-5) - 0.176068*wny14(-6) + 0.211257*wny14(-7) - 0.203956*wny14(-8) + 0.042352*wny14(-9) + 0.008249

5.3. As expected, the results obtained with the above-presented estimators do not always observe the compulsory equality $\Sigma wny_i=1$. Consequently, these results were preliminary adjusted in order to ensure the fulfilment of the above-mentioned equality. The difference between unity and the sum of all wny_i was proportionally distributed among all the wny_i coefficients.

6. Table 4 presents the sectoral shares in the final output of the economy, extrapolated for the four post-sample years.

Table 4

Sectoral shares in the final output of the economy forecasted for 2017-2020

Sector	2016	2017	2018	2019	2020
wny1	0.030842	0.025161	0.039259	0.034032	0.043128
wny2	-0.02961	-0.04753	-0.04504	-0.03913	-0.04101
wny3	0.026991	0.028977	0.033724	0.039899	0.040135
wny4	0.069744	0.065212	0.044946	0.04787	0.054327
wny5	0.022511	0.025384	0.029803	0.034074	0.031966
wny6	0.070732	0.068843	0.069023	0.067287	0.067068
wny7	-0.07739	-0.10452	-0.10356	-0.11024	-0.10654
wny8	0.112822	0.115692	0.121763	0.125963	0.11952
wny9	0.164093	0.170074	0.159895	0.155105	0.147603
wny10	0.310727	0.33736	0.333261	0.331432	0.322744
wny11	0.096537	0.104816	0.102946	0.101783	0.097075
wny12	0.166514	0.173814	0.177039	0.168958	0.184489
wny13	0.021029	0.021439	0.023929	0.024641	0.02457
wny14	0.014456	0.015282	0.013016	0.018329	0.01492
Sum	1	1	1	1	1

As against to 2016, the algebraic signs did not change. The annual rates modified within plausible limits since it is a short-run prediction.

IV. Sectoral Structure of the Economy from 2017 to 2020

The 2018 Version of the Romanian macromodel maintains the global output (Q_i) as the benchmark of the sectoral structure of economy. The proxy for global output is the "production" indicator recorded in the I-O tables. The aggregated system (Dobrescu, 2018) does not provide direct estimations of this indicator. The estimation has to be obtained by combining the A matrix with supplementary information about the final output. The current chapter describes formally this algorithm and discusses the problems of projecting its structure during the 2017-2020 period.

1. The A matrix allows us to estimate the sectoral gross value added (GVA_i) through a simple relationship:

$$GVA_i = Q_i - \sum a_{ji} Q_i \quad i\text{=fixed} \qquad (10)$$

$$GVA_i = Q_i(1 - sca_i) \qquad (10a)$$

The A matrix also allows us to determine a symmetrical to GVA variable that is the final output provided by each sector (NY_i):

$$NY_i = Q_i - \sum a_{ij} Q_j \qquad (11)$$

At the macroeconomic level, NY defines the final resources of the economy under the condition of a null foreign trade balance. In other words:

$$NY_i = FC_i + GFCF_i + STOCK_i + X_i - M_i - NIT_i \qquad (12)$$

where: FC means final consumption, GFCF – gross fixed capital formation, STOCK – inventory change, X – export, M – import, and NIT – net indirect taxes, all these indicators concerning the sector i. By aggregation, the relationship (12) becomes:

$$NY = \sum NY_i = \sum FC_i + \sum GFCF_i + \sum STOCK_i + \sum X_i - \sum M_i - \sum NIT_i \qquad (12a)$$

The identity $NY = GVA$ results from the national accounting identities $GDP = FC + GFCF + STOCK + X - M$, and $GDP - NIT = GVA$. GVA is determined by the aggregate system.

However, the identity $NY = GVA$ holds only at the level of the entire economy, and not at a sectoral one. At this level, while the value added is in general positive, NY_i can get any algebraic sign (positive, negative or null), depending on the proportion in which the intermediary consumption of different sectors is supplied by the national production or the imports.

2. The aggregate system of the Romanian macromodel estimates the gross value added (GVA) and, implicitly, the total final output *(NY)*. In order to compute the sectoral structure of the output, the current version maintains the solution adopted in the 2012 Version, namely combining the A matrix interdependences with the data on the structure of the final output (wny_i). The algorithm for computing the sectoral structure of the output is:

2.1. The output is computed from the gross value added and the technical coefficients using the formula (10a).

2.2. The gross value added for each sector is expressed also as a function of matrix A, sectoral intermediary consumption (own sector and for the entire economy), and the final output.

$$GVA_i = NY_i + \sum_j z_{ij} - z_i = NY_i + \sum_j a_{ij} \left({GVA_i}/{(1 - sca_j)} \right) - {GVA_i}/{(1 - sca_i)} \qquad (13)$$

2.3. To compute NY_i we use the coefficients wny_i determined previously and the identity $NY = GVA$ which holds at the macroeconomic level. GVA was estimated within the aggregate system. Therefore:

$$NY_i = NY \cdot wny_i = GVA \cdot wny_i \qquad (14)$$

This way, the sectoral block is integrated into the macromodel as a unitary ensemble.

2.4. Computationally, the above algorithm is written as a system of 14 equations and an identical number of unknowns (the sectoral gross value added GVA_i). The sectoral outputs are easily obtained through the relationship:

$$Q_i = GVA_i/(1 - sca_i)$$

3. The model forecast of the output structure is presented in Table 5.

Therefore, in the after-sample period the evolution of the weights of sectors 2, 3, 5, 13, and 14 in the economy is ascending; it is somewhat stable for sectors 10 and 11; diminishing for sectors 1, 4, 6, 8, and 12; and oscillating in the case of sectors 7 and 9.

Table 5

Sectoral shares in total output during 2017-2020

	2016	2017	2018	2019	2020
sect1	0.045605	0.043828	0.044978	0.038108	0.037452
sect2	0.007186	0.009891	0.010873	0.012228	0.012557
sect3	0.048826	0.055921	0.066386	0.066244	0.067794
sect4	0.060817	0.055033	0.044688	0.041396	0.041479
sect5	0.051924	0.061319	0.070607	0.071115	0.068249
sect6	0.10046	0.104369	0.106195	0.098094	0.095765
sect7	0.071226	0.069101	0.06643	0.075063	0.077397
sect8	0.086534	0.069626	0.087373	0.089307	0.091138
sect9	0.094846	0.092731	0.103352	0.08444	0.085051
sect10	0.166671	0.1585	0.16088	0.153352	0.15422
sect11	0.078308	0.07364	0.07255	0.072527	0.070108
sect12	0.082541	0.079887	0.078314	0.073104	0.072285
sect13	0.031044	0.04515	0.015092	0.044006	0.044604
sect14	0.074012	0.081003	0.072283	0.081014	0.0819
Sum	1	1	1	1	1

4. The same evolution of the sectoral shares in the total gross value added appears in Table 6.

Table 6

Sectoral shares in total gross value added (gvaw) during 2017-2020

	2016	2017	2018	2019	2020
sect1	0.045786	0.048177	0.050553	0.041597	0.040865
sect2	0.005511	0.010595	0.007929	0.009634	0.011921
sect3	0.029029	0.024513	0.028078	0.02718	0.028786
sect4	0.048982	0.050014	0.039501	0.035745	0.035874
sect5	0.048004	0.066668	0.084789	0.084701	0.073475
sect6	0.071303	0.088793	0.099641	0.098765	0.096499
sect7	0.052502	0.053429	0.051334	0.056274	0.059484
sect8	0.066454	0.06982	0.076997	0.08166	0.085984
sect9	0.092935	0.022802	0.025263	0.016142	0.017528
sect10	0.167767	0.179616	0.185029	0.179657	0.186533
sect11	0.128001	0.128881	0.132694	0.124106	0.123971
sect12	0.123848	0.132304	0.125996	0.122301	0.119494
sect13	0.041123	0.03411	0.011242	0.031472	0.032435
sect14	0.078755	0.090278	0.080953	0.090768	0.087152
Sum	1	1	1	1	1

Regarding the structure of the gross value added, the evolution of sectoral weights is slightly different: the sectors 2, 5, 7, 8, and 16 expand, the sectors 3, 6, and 11 remain quasi-stationary, the sectors 4, 9, and 12 decrease and the sectors 1, 10, and 13 oscillate.

5. The third structural indicator provided by the model has been already discussed, namely the sectoral shares in the final output of the economy. (Table 7).

Table 7

Sectoral shares in final output of economy (wny)

	2016	2017	2018	2019	2020
sect1	0.02618	0.025161	0.034032	0.034032	0.034032
sect2	-0.03319	-0.04753	-0.03913	-0.03913	-0.03913
sect3	0.019849	0.028977	0.039899	0.039899	0.039899
sect4	0.068539	0.065212	0.04787	0.04787	0.04787
sect5	0.012866	0.025384	0.034074	0.034074	0.034074
sect6	0.073287	0.068843	0.067287	0.067287	0.067287
sect7	-0.07426	-0.10452	-0.11024	-0.11024	-0.11024
sect8	0.128716	0.115692	0.125963	0.125963	0.125963
sect9	0.161586	0.170074	0.155105	0.155105	0.155105
sect10	0.309311	0.33736	0.331432	0.331432	0.331432
sect11	0.100145	0.104816	0.101783	0.101783	0.101783
sect12	0.16699	0.173814	0.168958	0.168958	0.168958
sect13	0.023869	0.021439	0.024641	0.024641	0.024641
sect14	0.016118	0.015282	0.018329	0.018329	0.018329
sum	1	1.000004	1.000003	1.000003	1.000003

Therefore, the sectors 2 and 7 maintain a negative contribution to the final output: 2 relatively stable and 7 with an increasing share in module. On the positive side, the sectors 1, 3, 5, and 10 increase their contribution, while 4 and 6 decrease it, and the shares of sectors 8, 9, 11, 12, 13, 14 remain relatively constant.

6. Undoubtedly, it would be of great interest to examine the predictive simulations concerning the sectoral net return of the economy. Since it measures the proportion in which the output effectively contributes to the national income, the ratio of gross value added to output (gvao) could be relevant. The ratio is normalized, the position of different sectors is expressed against the national mean (equalised to unity). The simplest modality to compute it is $gvao = wgva/wq$. Table 8 presents these estimations.

Table 8

Normalized ratios of the gross value added to output (gvao) from 2017 to 2020

	2016	2017	2018	2019	2020
sect1	1.003963	1.099231	1.123962	1.091534	1.091131
sect2	0.766912	1.071206	0.729289	0.787826	0.949403
sect3	0.594543	0.438355	0.422955	0.410301	0.424606

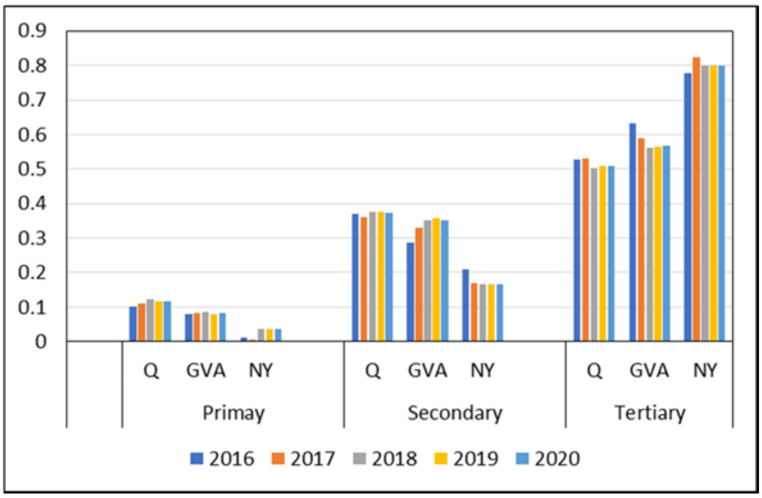
	2016	2017	2018	2019	2020
sect4	0.805409	0.908807	0.883917	0.863476	0.864859
sect5	0.924507	1.087229	1.200858	1.191029	1.076574
sect6	0.709766	0.850766	0.938284	1.006838	1.007667
sect7	0.73711	0.773197	0.772757	0.749688	0.768549
sect8	0.767956	1.002789	0.881243	0.914368	0.943443
sect9	0.979848	0.24589	0.244438	0.191168	0.206085
sect10	1.006574	1.133219	1.150108	1.171538	1.209523
sect11	1.634581	1.750139	1.829007	1.711165	1.768294
sect12	1.500445	1.656131	1.608856	1.672969	1.65309
sect13	1.32465	0.755466	0.744898	0.715184	0.727168
sect14	1.064093	1.114507	1.119955	1.120392	1.064132
National mean	1	1	1	1	1

The sectors 10, 11, 12, and 14 are firmly placed above the national mean. As expected, since these sectors belong to services. From such a viewpoint, the dynamics of sector 13 is somehow unclear. The position of the first sector can be explained by the still high degree of labor intensity in agriculture and the other branches assigned to this sector.

7. We finish the presentation of the anticipated sectoral changes in the Romanian economy during 2017-2020 period by a synthesis characterization of the mega-domains evolution. The primary mega-domain is represented by the sectors 1-3, the secondary mega-domain by the sectors 4-8, the rest of the economy (sectors 9-14) belongs to tertiary one. Figure 5 displays their dynamics.

Figure 5

Mega-domains shares evolution during the 2017-2020 period



The model simulations predict, therefore, the continuation of the tertiarization process in the Romanian economy, but as the final product, not as output or gross value added. Somehow distinctly from the standard scheme, the primary mega-domain slightly improves its position, especially with respect to the final output. Instead, the secondary mega-domain, with a relative constant share in output, becomes more important as supplier of GVA, but loses some percentage in the final output.

V. Concluding Notes

1. The new Version of the Romanian macromodel, as well as the simulations already operated on the previous version during the 2012-2017 period, prove the correctness of building the sectoral block around the I-O tables. This decision opened important opportunities for the examination of the inter-sectoral transaction complexity. Among these, the structure of economy is essential.

Until now, the meanings of the A matrix were revealed, but a lot of supplementary analytical opportunities could be obtained from its transformation into the Leontief one ($L=(I-A)^{-1}$).

2. When a macromodel is constructed from several blocks, one needs to address a not very simple question of "how to ensure their compatibility?" In our case, the aggregate system and the sectoral block needed to be compatible. Different solutions were possible, but the adopted one – the estimation of the GVA at the economy level in the aggregate system and structurally in the sectoral block – proved not only tractable, but also robust.

It allowed us to estimate satisfactorily the sectoral structure of output, of gross domestic product and of final output.

3. Obviously, as for the sectoral profile of the economy, significant problems remain unsolved for the moment. For example, the distribution of domestic absorption (household and public consumption, gross capital formation) and of export and import. Some structural aspects of social labor productivity, capital intensity, other efficiency variables are also of great interest. Our intention is to extend this thematic perimeter of the macromodel in its future versions.

4. Combined with the RAS technique, the LSVAR proved to be a promising econometric procedure, providing economically plausible results. Concerning this issue, two question must be commented.

a) One was already mentioned, namely the possible estimations of over-unity column sums, which would imply negative gross value added. Further research is needed to clarify the sources of such cases (sectors 9 and 13) in our application: is it due to measurement or to econometric causes, or due to the real processes themselves?

b) The other refers to the univariate specification. Obviously, the simplicity and high maneuverability are non-negligible advantages of this approach. Nevertheless, it compresses excessively the causal zone of the I-O coefficients dynamics. A more exact modeling of the sectoral inter-dependencies of the economy cannot avoid multivariate specifications. It is important that such an attempt should be carefully prepared by further investigations, including at microeconomic level, of the technological and market behavioral sectoral interactions.

5. The current Version of the macromodel estimates the complete A matrix, which is used as such for the estimation of some sectoral indicators. The L matrix is also computed through inverse matrix operations, but only as an additional analytical tool. It would be preferable to involve the L matrix as such in the diversification of the structural outcomes of the Romanian macromodel.

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Appendix 1: Classification of the Economic Activities

Appendix 1a

The expanded classification of economic activities (88 branches) included in the I-O Tables

The industries in NACE Rev.2 – ESA2010

Code	Branch
1	01 Crop and animal production, hunting and related service activities
2	02 Forestry and logging
3	03 Fishing and aquaculture
4	05 Mining of coal and lignite
5	06 Extraction of crude petroleum and natural gas
6	07 Mining of metal ores
7	08 Other mining and quarrying
8	09 Mining support service activities
9	10 Manufacture of food products
10	11 Manufacture of beverages
11	12 Manufacture of tobacco products
12	13 Manufacture of textiles
13	14 Manufacture of wearing apparel
14	15 Manufacture of leather and related products
15	16 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
16	17 Manufacture of paper and paper products
17	18 Printing and reproduction of recorded media
18	19 Manufacture of coke and refined petroleum products
19	20 Manufacture of chemicals and chemical products;
20	21 Manufacture of basic pharmaceutical products and pharmaceutical preparations
21	22 Manufacture of rubber and plastic products
22	23 Manufacture of other non-metallic mineral products
23	24 Manufacture of basic metals
24	25 Manufacture of fabricated metal products, except machinery and equipment
25	26 Manufacture of computer, electronic and optical products
26	27 Manufacture of electrical equipment
27	28 Manufacture of machinery and equipment n.e.c.

Code	Branch
28	29 Manufacture of motor vehicles, trailers and semi-trailers
29	30 Manufacture of other transport equipment
30	31 Manufacture of furniture
31	32 Other manufacturing n.e.c.
32	33 Repair and installation of machinery and equipment
33	35 Electricity, gas, steam and air conditioning supply
34	36 Water collection, treatment and supply
35	37 Sewerage
36	38 Waste collection, treatment and disposal activities; materials recovery
37	39 Remediation activities and other waste management services
38	41 Construction of buildings
39	42 Civil engineering
40	43 Specialized construction activities
41	45 Wholesale and retail trade and repair of motor vehicles and motorcycles
42	46 Wholesale trade, except of motor vehicles and motorcycles
43	47 Retail trade, except of motor vehicles and motorcycles
44	49 Land transport and transport via pipelines
45	50 Water transport
46	51 Air transport
47	52 Warehousing and support activities for transportation
48	53 Postal and courier activities
49	55 Accommodation
50	56 Food and beverage service activities
51	58 Publishing activities
52	59 Motion picture, video and television programme production, sound recording and music publishing activities
53	60 Programming and broadcasting activities
54	61 Telecommunications
55	62 Computer programming, consultancy and related activities
56	63 Information service activities
57	64 Financial service activities, except insurance and pension funding
58	65 Insurance, reinsurance and pension funding, except compulsory social security
59	66 Activities auxiliary to financial services and insurance activities

Code	Branch
60	68 Real estate activities
61	69 Legal and accounting activities
62	70 Activities of head offices; management consultancy activities
63	71 Architectural and engineering activities; technical testing and analysis
64	72 Scientific research and development
65	73 Publicity, advertisement
66	74 Other professional, scientific and technical activities
67	75 Veterinary activities
68	77 Rental and leasing activities
69	78 Employment activities
70	79 Travel agency, tour operator and other reservation service and related activities
71	80 Security and investigation activities
72	81 Services to buildings and landscape activities
73	82 Office administrative, office support and other business support activities
74	84 Public administration and defense, compulsory social security
75	85 Education
76	86 Human health activities
77	87 Residential care activities
78	88 Social work activities without accommodation
79	90 Creative, arts and entertainment activities
80	91 Libraries, archives, museums and other cultural activities
81	92 Gambling and betting activities
82	93 Sports activities and amusement and recreation activities
83	94 Activities of membership organizations
84	95 Repair of computers and personal and household goods
85	96 Other personal service activities
86	97 Households activities
87	98 Private households' activities
88	99 Activities of extraterritorial organizations and bodies

The branches 4, 34, 40, 48, 54, 57, 67, 76, 81, 89 miss from the list of the 'NACE Rev.2' industries, and the structure used was agreed by the National Institute of Statistics (INSSE) according to EUROSTAT.

Appendix 1b

Aggregated I-O classifications of economic activities included in the Romanian macromodel

Aggregate sectors	Corresponding codes in expanded branch (88) classification
I. 6-sectors classification	The structure can be translated into three-sectors: primary (a+b), secondary (c+d), and tertiary (e+f). The rule was adopted for next versions[1]
1-a) agriculture, forestry, hunting, fishing and food;	6 branches; 1,2,3,9,10,11
2-b) mining and energy;	10 branches;4,5,6,7,8,33,34,35,36,37
3-c) manufacturing industry;	21 branches; 12-32,
4-d) construction;	3 branches; 41,42,43
5-e) transport, post, and communications;	6 branches; 44-48, 54
6-f) trade and services.	42 branches; 41-43, 49-53, 55-88.
I. 10-sectors classification	
1 Agriculture, forestry, hunting and fishing	3 branches; 1,2,3,
2 Extractive industry	5 branches; 4,5,6,7,8,
3 Production and distribution of electricity and heat	5 branches; 33,34,35,36,37
4 Food, drinks and tobacco	3 branches; 9,10,11
5 Textiles, leather, pulp and paper, furniture industry	9 branches; 12-17, 30,31,32
6 Equipment industries, machinery, transport	6 branches;24-29
7 Other manufacturing industries	6 branches; 18-23
8 Construction	3 branches; 38,39,40
9 Transport, post, of telecommunication	6 branches; 44-48, 54
10 Services	42 branches; 41-43, 49-53, 55-88
I. 14-sectors classification	In the extended aggregation to 14 sectors the ten sector “10 Services” was divided in other five sectors:
1 Agriculture, forestry, hunting and fishing	3 branches; 1,2,3,
2 Extractive industry	5 branches; 4,5,6,7,8,
3 Production and distribution of electricity and heat	5 branches; 33,34,35,36,37
4 Food, drinks and tobacco	3 branches; 9,10,11
5 Textiles, leather, pulp and paper, furniture industry	9 branches; 12-17, 30,31,32
6 Equipment industries, machinery, transport	6 branches;24-29
7 Other manufacturing industries	6 branches; 18-23
8 Construction	3 branches; 38,39,40
9 Transport, post, of telecommunication	6 branches; 44-48, 54
10 Trading services	15 branches; 41-43, 49-50, 79-88.

Aggregate sectors	Corresponding codes in expanded branch (88) classification
11 Financial services and real estate transactions	4 branches; 57-60
12 Social services	5 branches; 74-78
13 Creative services	5 branches; 51-53, 55,56
14 Professional services (mainly businesses)	13 branches; 61-73

[2] *http://www.cnp.ro/user/repository/b6139a4ae94e801847b4.pdf*