Articles

Algorithm for Balancing the Product-Resource Recurrent Actions in the Economic Development

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Summary:

The paper presents the system-structural content of RPSD algorithm. Subject to balancing are the National Accounts tables: products and resources (of Eurostat) – for Bulgarian economy, in the years between 2004 and 2010 and between 2015 and 2020 (forecast).

Key words: product-resource recurrent action; product-resource tables; structure determining groups of products and resources in the economic development; generation of balancing table for forecast year.

JEL classification: E01, E17, 011

1. System-structural Content of RPSD algorithm

Measuring the development of the economic systems with regard to its reliability is directly associated with the methodological premises of the applied approach. This refers to the type of the numerical parameters of these systems – aggregation degree of the volumes of production, resources and added value, presented as general economic volumes or as tables (matrixes).

Economic science and economic practice use the inertial extrapolation approach for measuring the aggregate numerical parameters of the economic development. The main premise of this approach refers to a stationary development, namely"all else being equal". Thus, the links and recurrent actions between the parameters are ignored in the process of their development.

The system-structural approach, as an alternative to the inertial extrapolation one, is based on the dynamic theory of development of the complex open systems. Such are the economic systems. These systems are presented as numerical parameters in the form of a table (matrix). Such is the product-resource table. Annually every EU member state develops a product-resource table (in compliance with the requirements of the Directorate General on Statistics of the European Commission – Eurostat). This table includes 65 groups of related products and services.

The rows of the above-mentioned table present products and services, and its columns – resources. The sums of the rows show the volumes of products and services throughout the year, while the sums of the columns – the volumes of resources. To determine the volumes of products and services by consumer prices, their summed up column by producer prices is added to the columns of discounts, transport tariffs and net taxes. The latter includes indirect taxes: value added tax, excise duties, fees and other, reduced by the state budget subsidies.

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The development of the product-resource table is related to the input-output tables of Wassily Leontief, winner of Nobel Memorial Prize in Economic Sciences (1973). Another winner of this prize – Richard Stone – has a main contribution to the development of the input-output table.

This table is discussed in greater detail in his book Input-output and National Accounts (1964). The book is developed on assignment by the Organization for European Economic Cooperation, the predecessor of the Organization for Economic Cooperation and Development.

The product-resource table is the most important element of the algorithm for analyzing and forecasting the economic development. It balances the recurrent actions and changes derived from them into numerical parameters between the changes of products and services on one hand, and the changes of resources, on the other. This occurs during the transitions from iteration to iteration for generating the balanced table for the forecast year – as a transformation of this table from the base year.

The abbreviation RPSD consists of four elements.

The first element is *R (Restructuring*). Object of restructuring is the change of the numerical characteristics – in the table and in the desired volumes – of production and services, as well as of the resources for them. It is done through the iterative process, as a manifestation of the development process of the economy. The restructuring in its nature is of production-technological character, but it is presented by the value-price changes.

The second element of the algorithm abbreviation – *P (Productivity)* – refers to the increase of the productivity, achieved through the structural changes. The latter include replacing products and services with lower value added with such with higher one; replacing technologies with lower output with such with higher one; reducing transaction costs, etc.

The other two elements of the abbreviation – *SD (Sustainable Development)* – refer to the sustainable development, as a result of the product restructuring of the economy, in the process of its development. This development is "a process of change, when the resource exploitation, direction of technologies, orientation of investments and institutional management changes, are in harmony with each other and increase the potential for satisfying the human needs and desires" (Our Common Future, 1987).

For the production-technology inter-complementing of products and services and their resources, there is no need to make use of comparable prices from the base year in measuring the rates of increase of the economy. It is reasonable, however, to use the comparable prices concerning products and services by purchasers' prices. It is done for achieving conformity between the changes of prices of goods and real incomes (nominal incomes reduced by taxes and other forms of legal redistributions).

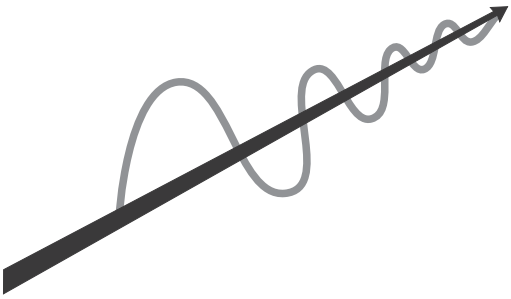
Theoretically, the algorithm is based on the inherent qualities of the open complex systems; dynamics; reverse compensatory links determining product-resource recurrent actions through the development of the economic system; ergodicity – increase of the potential of this system and productivity – anticipating increase of the added value, compared with the costs.

As an economic-mathematical model the algorithm is theoretically based on the mentioned dynamic theory of the open systems. In its frames are used the recurrent links between the input and output variables of the economic system, i.e. between the products and services on one hand, and the resources – on the other. Each group of products and services is a resource at the same time for all groups of products and

services (by the table columns). Thus, the products and services are equally situated with the resources. This equality is by contents, as well as variables, i.e. both are unknown quantities in the model (iterative procedure of the algorithm). The numerical characteristics in the product-resource table are of value nature, which makes them comparable and measurable.

The instructively presented RPSD algorithm by its theoretical reasoning has its description as an economic-mathematical model. Its analytical description is presented by Kovachev (2014). The block-scheme of the iterative procedure is presented also by Kovachev (2008, 2013). Stefan Tsonev, head of Department "Environment Protection" in the National Statistical Institute (NSI), has developed an updated software for its application. All analytical forecast calculations are made by it.

A mathematical proof is done for this algorithm, like Annex 2 in Kovachev (2008, 2013). In general as a figure this algorithm is presented like this:



The straight line presents the ascending development of the economic system, as increasing volumes of the manufactured production and provided services. The wavy line shows the balanced ensuring with resources of the increasing volumes of products and services. This second line has progressively decreasing deviations from the straight line. The balancing with resources stops when the volumes of the related groups of products and services at the last iteration are equal to the ones at the previous iteration. For the transition from iteration to iteration are solved systems of non-linear integral and differential equations.

In the current management practice the product-resource table is used only for the purposes of the analysis in the past. Its numerical parameters are determined by prices, averaged for a five-year period, thus eliminating the price dynamics. However, the table is not used for the purposes of forecasting, since it lacks algorithm. For this purpose the algorithm discussed here is suitable.

For the forecasts the current management practice relies on the expectations of the businessmen about the future (of subjective character), as well as on different organizations like the World Bank, the International Monetary Fund, etc. The expectations change through the year, and as a rule do not substantiate. The estimates refer to changes of GDP, prices of fundamental resources (mostly oil and other energy resources), as well as currency rates of leading economies.

2. Developing balanced product-resource tables of the national economy – for 2004-2010 and 2015-2020

The balancing of the tables is done with the mentioned software. It is based on the balanced report table for 2003. NSI does not develop such tables for the next years, but there is information for the products and services – by their related groups.

The balanced tables for the mentioned years are developed with the mentioned algorithm. The table for each year is generated by transforming the balanced table for the previous year. Thus, the principle of succession and continuity in the development of the economic system is applied. This balancing of tables concludes with the table

for 2010. For 2011-2014 NSI did not determine the volumes of products and services by their 56 related groups. The reason is that Eurostat changed the number and contents of these groups – from 60 to 65.

This imposed a certain leap between 2010 to the first forecast year 2015.

The forecast of the balanced product-resource tables for the next 2016-2020 is done in the same described iterative way.

For the purposes of the analysis and the forecast, the main results of the developed balanced tables include the volumes of production and services and the necessary resources, as well as the volumes of value added (GDP) as a difference between the volumes of products and services and those of the resources. Graph 1 (see Annex) presents the volumes of products and services in the analyzed period 2003-2010, as well as in the forecast years 2015-2020 for the economy as a whole. Graph 2 in the Annex shows the volumes for the related groups of products, and Graph 3 in the Annex – for the related groups of services.

Unlike these results, when determining GDP for the purposes of the next year's budget, the forecast of the GDP growth is done at a recapitulation level. It is done in the so-called macro-frame for the expected business environment in the next year. The forecast is done using the inertial extrapolation approach.

In this context, interesting are the comparisons between our forecasted GDP volume for 2015 and the volume determined when compiling the 2015 budget by the Ministry of Finance. In our forecasted GDP the volume is 86.572 billion BGN, while the Ministry of Finance (with approval by the Parliament) initially presents it as 82.4 billion BGN. In March 2015 the difference between 2014 and 2015 increased to 1.3%, and the expectations at the end of 2015 are for 3 and above 3% growth. With this expected growth GDP will reach 84.5 billion BGN, a deviation of 0.7 billion BGN from our forecast, or -0.2%. This difference in 2016 is 0.3%.

The accuracy of the balancing calculations in the product-resource tables can be seen from their estimate for 2008 and the forecast 2015. The misbalance of the products and services between the exogenously set volumes and balanced ones for the whole economy in 2008 is 0.55%, and for 2015 – 1.84%. Including the 9 structure-determining groups of products and services, for 2008 it is 0.05%, and for the other 47 – 1.16%. For 2015 these numbers are respectively 1.97 u 1.71%. The mentioned deviations are too small. Such deviations are admissible also by the statistical bodies when developing the balancing product-resource tables. Concerning the misbalance of resources, the last row of this table includes "changes of the reserves of resources". Concerning the products and services, there is an additional column "losses" (operative surplus – net). The higher accuracy of the balancing in 2008 compared with 2015 is due to:

a) Successive continuing balancing of the product-resource table for 2008, which starts with 2003 and covers 2004, 2005, 2006 and 2007. For 2015 there is no such successive continuity for the years between 2010 and 2015.
b) The balancing accuracy would increase if the number of iterations increases (over 14) and the used numbers are rounded to millions and not thousands BGN. In this way, the balancing accuracy should be not to the 4^{th} but to the 7^{th} sign after the decimal point. It is not a problem for the abilities of the modern computers.

The focus in the product-resource table is on the different related groups of products and services, as products and services and their resources, since it corresponds to the principle of the market economy. It is so because the highly productive activity

of the economic subjects is a premise for the competition between them, as a moving power for a sustainable economic growth.

In this sense the structure determining related groups of products and services in the economy are important. Table 1 shows them for the national economy.

- Their huge volume of manufactured products and services. Their summed volume is over 50% of the one of the entire economy, while the other 47 groups are under 50%.
- The stronger compensatory (set-determining) role in the economic system,

Table 1. Products and services, as a value added of structure determining groups of products and services (% in the entire economy)

Structure determining groups of related products and services	2003		2008-2010		2015		2020	
	Products and services	GDP	Products and services	GDP	Products and services	GDP	Products and services	GDP
1. Construction	6.0	10.8	9.1	9.8	10.8	13.0	10.9	13.3
2. Agriculture, hunting and related services	9.6	17.5	5.9	4.7	6.1	4.9	6.2	5.1
3. Food and beverages	5.1	4.2	5.8	4.9	5.7	4.6	5.8	4.8
4. Wholesale trade excluding SME	5.8	11.5	5.8	6.9	5.4	6.0	5.3	5.8
5. Road and gas transport	5.3	9.5	5.4	6.5	5.2	6.0	5.1	5.6
6. Real estate operations	5.7	18.7	4.9	8.8	4.7	8.2	4.6	8.0
7. Production and distribution of electrical and heat energy	4.9	6.9	4.6	3.9	4.3	3.3	4.3	3.4
8. Production and founding of metals	-	-	4.3	2.5	3.9	2.2	4.0	2.3
9. Other activities in business services	-	-	3.7	3.8	3.5	4.3	3.9	3.2
10. Posts and communications	8.9	9.6	-	-	-	-	-	-
11. State governance and defense, including insurance	9.5	11.3	-	-	-	-	-	-
Total	52.0	58.5	49.5	51.6	49.9	52.4	50.0	51.6

The comparison of the shares for the volumes of manufactured products and provided services and the ones for the added value in the mentioned years shows an increasing productivity for both groups of related services also for the construction – from the groups of related products. For all nine groups there is an increasing productivity.

The structure-determining role of these groups is defined by:

at the level of aggregating the 56 related groups of products and services.

In this respect, it is important to define the dominating roles in the development of the economy of the groups of related products and services, estimated on the basis of the changes in the elements (coefficients) in the product-resource tables – between the base and the forecast year. For this purpose the balance table for 2020 is separate from the one for 2015. The

following related groups of products and services have biggest excess (increase) compared with the average for the economy:

1. Manufacturing chemical products – 75, including by row (of manufacturing) 56 and by column (used resources) 19;
2. Agriculture, hunting and related services – 62, respectively 51 and 11;
3. Other services for the population – 53, respectively 41 and 11;
4. Manufacturing tobacco products – 24, respectively 10 and 14;
5. Extraction of metal ores – 21, respectively 9 and 12;
6. Products from rubber and plastics – 19, respectively 19 and 0;
7. Manufacturing of cars, trailers and semi-trailers – 18, respectively 15 and 3;
8. Other activities in business services – 17, respectively 17 and 0;
9. Extraction of oil and gas – 12, respectively 0 and 12.

The total number of the mentioned groups by rows (manufactured products and provided services) are 177, and by columns (used resources) – 100. This content of the mentioned groups has the biggest influence in the transition from the balanced table for the previous year to the generated one for the forecast year.

Totally for the economy, of 3136 coefficients in the product-resource table 1377 (44%) have 0 value. Of them 289 have numerical value over the average index for the economy, including 186 (14%) by rows and 91 (7%) by columns. This ratio shows the dominating role for the restructuring and balancing of the economy – of the manufacturing over its resource ensuring.

The aforementioned related groups of products are mostly from the primary sector of the economy. They are closely connected with its resource base. Concerning the secondary sector, as a main engine of the productive restructuring of the economy, it consists only of manufacturing cars, trailers and semi-trailers, manufacturing chemical products, and food and beverages. The other groups are from the tertiary sector of economy – services. It produces 2/3 of GDP of Bulgaria.

Thus, there is no potential of huge progressive, highly productive restructuring of the national economy.

The following conclusions are imposed as a generalization:

The studied algorithm for balancing the manufactured products and provided services with the necessary for them resources, in the relevant tables, proves as a reliable management instrument both in the analysis and in the forecast of the development of the economic system.

The detailed balance calculations with the software of the algorithm show high accuracy. This algorithm is a fundamentally more reliable alternative, as information managing instrument, compared with the one applied now.

In the frames of the mentioned algorithm for developing management decisions, as a rule the effectiveness of the development can be measured. This should be done with the indicator productivity of resources, as a ratio between added value (GDP) and costs value of the used resources. This indicator can be used generally for the economy, as well as for each group of related products and services. It is more reliable for this estimation than the indicator labour productivity. The reason for this is that the latter has no clear differentiation between results and costs in the production economic activity.

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