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Estimation of Russian constant-price input-output accounts according to NACE and CPA

Abstract

Annual input-output (IO) accounts of the Russian economy for the period of 1995-2003 were constructed on the base of a classification used in Soviet times. The transition of Russian statistics to the use of classifications that are harmonized with NACE and CPA caused a break in construction of IO accounts. It is expected that the first Russian IO accounts for 2011 that are harmonized with NACE and CPA will not appear before 2015. Construction of time series of such IO accounts will require several more years.

However, recent publication of detailed industrial data of production accounts for 2003-2009 at 70 activities level allowed us to make experimental estimation of IO accounts harmonized with NACE and CPA classifications on the base of earlier published IO accounts.

This paper considers the methods for recalculations of use tables at purchasers' prices for NACE activities and CPA products and methods of building harmonized IO accounts at constant prices. Special attention is paid to the estimation of deflators for domestic and imported products, transportation and trade margins, and net taxes on products.

1. Introduction

The globalization process and new patterns in the development of information-communication technologies have resulted in structural changes in different countries' economies and changes in their international economic specialization. These changes have necessitated the creation of integrated databases with which to analyze processes on the cross-country level and have led to the emergence of the major international projects KLEMS[1] and WIOD[2].

The main goal of the KLEMS project is to create a database with which to conduct cross-country comparisons of output, input and productivity dynamics at the industry level[3]. The initial

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[1] The abbreviation KLEMS consists of the initial letters of different types of inputs used for productivity accounting: (capital K, labor L, energy E, materials M and services S).

[2] The abbreviation WIOD stands for World Input-Output Database.

[3] For more information, see http://www.euklems.net.

data for estimating these measures are primarily derived from the system of national accounts (SNA). The methodology of the KLEMS project was determined by a group of researchers headed by D. Jorgenson[4]. This methodology was initially used to analyze the sources of economic growth at the industry level for some countries[5]. The European project EU KLEMS[6] provided the opportunity to conduct cross-country investigations[7].

The aim of the WIOD project is to form a unified database of time- series of national Input-Output (IO) tables connected with the statistics of international trade and satellite accounts to analyze the effects of globalization on social and economic development and the environment for countries and on the cross-country level[8].

Both databases are complementary to each other in terms of methodology[9] and purposes and can be used together to investigate several issues[10]. The potential joint use of the databases is primarily due to the same classifiers of activities (NACE) and products (CPA)[11], which they share in common and partially due to the covered period and the level of disaggregation[12].

The EU KLEMS and WIOD databases provide new opportunities for analyzing the effect of globalization on economic growth and development in the world, but these databases require high-quality statistical information. The construction of these databases would be impossible without time series of national Supply and Use tables (SUTs) that are harmonized with SNA data and comparable with the international NACE and CPA[13]. Despite the progress in harmonizing classifiers in recent years, differences across countries still remain[14].

[4] For more information, see (Jorgenson et al., 1987), (Jorgenson et al., 2005).
[5] See, for example, (Jorgenson et al., 2010).
[6] The methodology of the international project EU KLEMS is the same as the methodology of KLEMS but excludes the section in which the countries are grouped for international comparison. For more information, see (Timmer et al., 2007, p.48–52).
[7] See, for example, (van Ark et al., 2008), (Inklaar, Timmer, 2007).
[8] For more information, see http://www.wiod.org
[9] For more information, see (Timmer, 2010).
[10] For more information, see (Erumban et al., 2010, p. 9).
[11] European countries participating in EU KLEMS are classified (according to the European NACE REVISION 1 and CPA, and Canada and the USA are classified according to NAICS and NAPCS. For more information, see (Timmer et al., 2007), (Federal Register, 2005). In the following discussion, we will use NACE rather than NACE REVISION 1.
[12] Because of the differences in national accounts, the level of industry disaggregation and available time series for EU KLEMS participants differ. Therefore, the project participants are conditionally divided into two groups. The first group consists of countries that have data for 71 industries since 1970. The second group consists of countries that have data for 48 industries since 1970 and for 62 industries since 1995. The level of disaggregation for WIOD participants is presented by 35 industries and 59 products from 1995. These databases have been revised and updated, and their participant lists have been expanded.
[13] SUTs have the first priority; Input-Output tables (IOTs) are secondary in this case. For more information, see. (Erumban et al., 2010, p.6), (Timmer et al., 2007, p.19).
[14] For more information, see (Erumban et al., 2010).

In Russia, after a 16-year hiatus, the process of creating benchmark IO accounts[15] for 2011 is resumed. The decision to resume this process was made in 2009, but the accounts will not appear before 2015[16]. The benchmark IO accounts will be constructed according to the international standards described in the manuals by the United Nations (U.N.)[17] and Eurostat[18] and subject to the peculiarities of Russian data[19].

The most recent benchmark IO accounts of the Russian economy at a disaggregated level were constructed for 1995 (on the basis of a survey of a wide range of enterprises) according to the SNA methodology adopted by the U.N. Afterward, Russian IO accounts had been published regularly for aggregated industries until 2003. However, these accounts used classifiers of industries and products that were inherited from the Soviet period: the All-Union Classifier of Economy Branches (OKONH) and the All-Union Product Nomenclature (OKP), which are not harmonized with international classifiers.

One of the main causes for this long break in constructing benchmark IO accounts is the transition from OKONH to NACE and from OKP to CPA[20]. Other reasons for this long hiatus include crucial changes in the legal base and high inflation in Russia[21].

Regarding the reconstruction of the historical statistics of Russian IO accounts in NACE and CPA (subject to the results of the 2005 revision) at current and constant prices, Rosstat has shown no work in this direction. This lack of progress is due to methodological problems, such as high inflation rates of growth[22], and the resource restrictions in Rosstat.

Experimental estimations of some tables from IO accounts at constant prices have been conducted by a number of research groups, but few papers have been devoted to this issue. In one of these papers, all of the calculations have been conducted using OKONH and OKP; thus, the derived tables cannot be used for international comparisons[23]. In other cases, we believe that the methodological explanations of recalculation tables from OKONH and OKP into NACE and

[15] The IO accounts of the Russian economy are presented in nine tables - supply table, use tables at basic and purchasers' prices, domestic and imported use tables at basic prices, transport and trade margins tables, net taxes on products tables and product-by-product input-output table at basic price. See, for example, (Rosstat, 2006).
[16] The government's decision to finance the elaboration of benchmark IO accounts of the Russian economy in NACE for 2011 was made after the government was informed about the benefits of implementing the KLEMS-project in Russia.
[17] For more information, see (United Nations, 1999).
[18] For more information, see (Eurostat, 2008).
[19] For more information, see (Masakova, 2009).
[20] The Russian analogs of NACE and CPA are the OKVED (Russian classifier of activities) and the OKPD (Russian classifier of products). In the following discussion, we will use NACE rather than OKVED and CPA rather than OKPD.
[21] See, (Masakova, 2011).
[22] For more information, see (Bessonov, 2005, p.85-115).
[23] For more information, see (Kim, 2006a).

CPA, and estimation of transformed tables at constant prices provided by the authors are not sufficient to allow other researchers to repeat these methods[24].

The long hiatus in the construction of Russian IO accounts and the lack of official methodology for these accounts' estimation at constant prices have caused serious difficulties for scientific and applied investigations and have rendered many international comparisons impossible. These factors have increased the urgency of expanding the methodology for estimating published tables according to NACE and CPA at current and constant prices. However, all of the aforementioned problems related to Russian statistics impede the creation of "simple methods". Thus, the algorithmic methodology for the elaboration of Russian IO accounts harmonized with NACE and CPA at constant prices is important strategic step toward improving the overall methodology of Russian statistics and increasing the usefulness of these statistics.

Rosstat experimentally published SUTs for 15 aggregated activities at purchasers' prices, but these SUTs are not sufficient for reliably transforming these tables into NACE and CPA tables. Furthermore, Rosstat has not implemented the FISIM adjustment for the historical time series tables since it moved to an allocation of FISIM to activities in 2010[25]. However, the recent publication of more disaggregated data of production accounts (disaggregation from 15 to 70 activities)[26], administrative data (particularly for 2003) and previously published IO accounts has made the estimation of certain types of tables at constant prices possible. Such calculations will help to estimate the possibilities of constructing time series of output and different intermediate inputs using the published price indices and to provide the primary methodology for this procedure.

The present paper proceeds as follows.

- We give the description of available official publications tables for Russian IO accounts.
- We briefly explain the procedure for the transformation of published Russian IO accounts taking into account the changes in the methodology and recent publication of detailed data from production accounts. In particular, allocating FISIM among the activities is considered.
- We discuss the construction of OKONH/OKP-NACE/CPA concordance tables for intermediate consumption with parameters identified on the basis of production account by the activities in a detailed breakdown for 2003.

[24] See, for example, (Uzyakov, 2010).
[25] For more information, see (Eurostat, 2007, p 373-379).
[26] See (Rosstat, 2010).

- We derive the methods of recalculating the use tables at purchasers' prices into NACE format for activity-level data, and into CPA format for product-level data.
- Finally, we explain the transition of the use table at purchasers' prices for 2003 to the use table at basic prices and the further division of the table into the use table of domestically produced products and the use table of imported products.

Continuing this work will enable us to obtain quantitative estimates of some tables for Russian IO accounts at constant prices.

2. Official Russian publications of IO accounts

The IO accounts constructed according to the SNA 93 have been published regularly since 1995. For the year 1995, benchmark symmetric (product-by-product) tables were constructed at two levels of aggregation – with 110 and 22 groups of industries[27]. For 1996 and 1997, only the symmetric tables for 22 groups of industries were published. For 1998 and 1999, Rosstat published SUTs and symmetric tables for 22 groups of industries, and for the period from 2000 to 2003, SUTs and symmetric tables for 24 groups of industries were published.

Two price systems are used simultaneously: basic prices and purchasers' prices. For each inter-industry flow in Quadrant I and Quadrant II, the components of domestic and imported products, transport and trade margins, and net taxes on products are distinguished. The composition of tables differed each year (see Table 1), but some missing tables can be constructed[28]. For the period from 2004 to 2006, Rosstat experimentally published SUTs distinguishing between 15 activities at purchasers' prices.

The scheme of publications for the period from 1995 to 2003 is presented in Table 1.

Table 1. Key elements of input-output tables officially published by Rosstat since 1995

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Classification System	OKONH, 22(24) industries						OKVED, 15 activities					
Symmetric IO table ("product-product") at basic prices	+	+	+	+	+	+	+	+	+			
Symmetric IO table ("product-product") at purchasers' prices and symmetric matrices for domestic and import products, taxes and margins.	+	+	+									
Supply table	+			+	+	+	+	+	+	+	+	+
Use table at purchasers' prices				+	+	+	+	+	+	+	+	+

[27] The version with disaggregated data was not published.
[28] For more information, see (Kim, 2006b).

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Classification System	OKONH, 22(24) industries						OKVED, 15 activities					
Matrices for domestic and import products, taxes and margins.				+	+	+	+	+	+			
Use table at basic prices				+	+	+	+	+	+			

Note: In the table, + means that the data is available, and empty cell refer to the absence of data.

We use the IO accounts for 2003 as the benchmark accounts because of data completeness for 2003. Additionally, there are disaggregated production accounts for 70 activities[29] constructed subject to the methodological changes of their elaboration published by Rosstat. These accounts form a reliable basis for such recalculations. In addition to officially published tables, Rosstat has also provided administrative (non-published) information that is used to construct Russian IO accounts for 2003.

3. Estimation of Russian use table at purchasers' prices according to NACE for 2003

The transformation of the use table for 2003 from OKONH to NACE has become possible due to Rosstat's publications of the disaggregated data on production accounts (output at basic prices, intermediate consumption and value added) for 70 activities in 2010. This level of disaggregation is the most appropriate for the data used in KLEMS.

The administrative information used to construct Russian IO accounts for 2003 provides an elaboration of concordance tables for OKONH–NACE at a more disaggregated level than in the correspondent tables published by Rosstat in 2006. However, when comparing these tables for 2003, we should be careful because the data in these tables for 2003 published by Rosstat in 2010 differ slightly from the data for 2003 published in 2006. This difference is the result of adjustments of the SNA's data after its first publication and the change in methodology of constructing the production accounts. In contrast with earlier publications of production accounts for 2003 through 2009, the data published by Rosstat in 2010 show that the FISIM is allocated among the activities[30] (previously, they were included together as one lump sum in the intermediate consumption).

Due to methodological changes, the data pertaining to intermediate consumption in OKONH for 2003 are preliminarily adjusted. The FISIM is allocated among industries in proportionally to their total intermediate consumption and is added to the row of "Financial intermediation services".

[29] See (Rosstat, 2010).
[30] For more information, see (Rosstat, 2010, p.13).

The comparison of the intermediate consumption of industries in OKONH and activities in NACE for 2003 is conducted at the most disaggregated level available. The comparison is conducted using the OKONH–NACE transition key (correspondence tables)[31]. This key includes several cases of OKONH–NACE concordance:

- One industry in OKONH corresponds to one or more activities in NACE (the simplest case).
- One industry in OKONH is divided into several activities in NACE. For example, the "Fishing" industry is divided into the following activities: "Fishing, operation of fish hatcheries and fish farms / service activities incidental to fishing" (NACE code 05) and "Manufacture of food products and beverages" (NACE code 15).

The second case requires determining the proportions of allocation among activities that are absent in the OKONH–NACE transition key. In this paper, we determine these proportions by comparing measures of total intermediate consumption for OKONH industries with the measures for activities in NACE at the most disaggregated level available. If we examine the previous example, we find that the portion of the intermediate consumption for the "Fishing" industry is equated to the intermediate consumption for the activity with the NACE code 05, and the remainder is attributed to the activity with the NACE code 15.

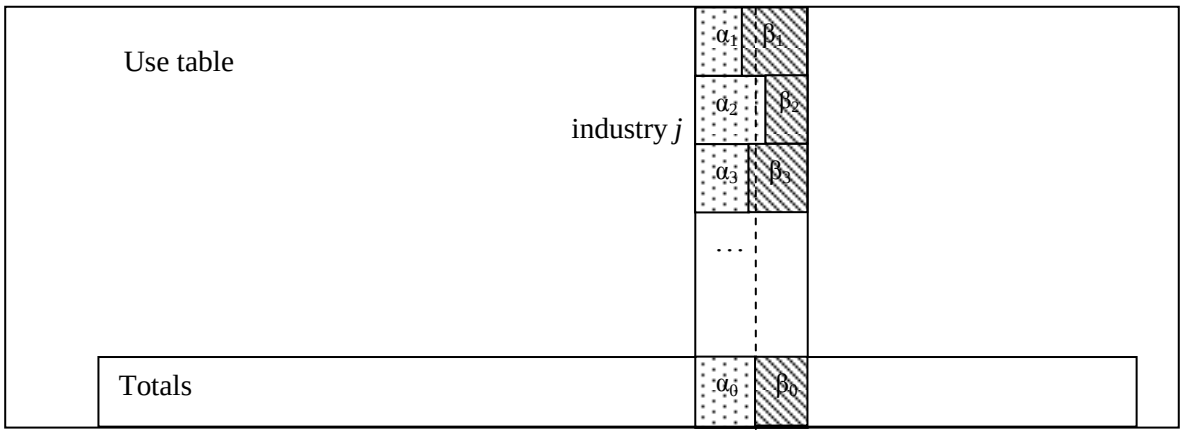
In more complex cases (in which the OKONH industry is divided into three or more activities in NACE), accurate equality between the intermediate consumption for the OKONH industry and the summation of regrouped (partially or completely) measures for the intermediate consumption of correspondent activities in NACE is not always achieved. However, if the difference between these values is marginal, this procedure is sufficient for the purposes of transforming IO accounts from OKONH to NACE.

The main goal is to ensure resemblance between the structures of intermediate consumption in OKONH and NACE. Unfortunately, the available data for 2003 do not allow us to obtain the variables of the use table for 70 activities because the data pertaining to intermediate consumption are not disaggregated at the required level. In particular, all of the activities in the group with NACE codes 29-35 (excluding NACE code 34) are aggregated; only NACE code 34 is presented separately. As a result, the construction of the use table for 40 activities becomes possible (see the Appendix).

[31] For more information, see (Economy Ministry of Russia, 2002).

In theory, it is necessary to do recalculations on the basis of individual parameters for each row and column and thus for each cell of the table. The following example illustrates this procedure (see Figure 1).

Figure 1



Let the industry *j* in OKONH in the use table correspond with the activities α and β in NACE. Even if the transition key determined the specific proportion in which the intermediate inputs of the industry *j* are divided into the intermediate inputs of the activities (α_0 and β_0), the proportion will not necessarily be the same for the products used as intermediate inputs for the industry *j*.

In this case, we divide the column into parts using the constant proportion of α_0 and β_0 due to the lack of information. Similarly, we must use the constant proportion for dividing the row with the usage of a product of type *i* by OKP into the values with the usages of products of types by CPA.

Let the matrix M_{OKONH}^{NACE} contain the quantitative transition proportions: the number of rows equals the number of OKONH industries, and each row represents the share of the correspondent OKONH industry(ies) for the NACE activity(ies). The sum of the row's elements is equal to 1 (in the case of a mismatch between the intermediate consumption in OKONH and NACE, the required adjustment is made). The matrix M_{OKP}^{CPA} is constructed similarly, and in this case, the sum of the column's elements is equal to 1. The transformed matrix in NACE, U', is derived from the following equation:

$$U' = M_{OKP}^{CPA} \cdot U \cdot M_{OKONH}^{NACE}.$$

To transform only the rows or the columns of the initial matrix into the new classification, one should multiply the rows or columns by only one of the two mentioned matrices.

A similar method of transformation was used for the supply table for 2003.

4. Estimation of other elements of Russian IO accounts on the basis of the use table for 2003

Ideally, constant-price SUTs are compiled with the current price tables[32]. However, this compilation not feasible when we begin with the existing tables at current prices. Therefore, we used a sequential approach[33] by deflating the SUTs at current prices without feedback to the current price tables.

Because the most complete data for creating the OKONH–NACE transition key are only available for purchasers' prices, we obtain the use table for purchasers' prices in NACE; on the basis of these data, we construct the table for basic prices.

Our aim is merely to fill the gaps in this table to ensure that our results do not conflict with the data in the official publications. Conducting this work is inevitably based on simplifying assumptions. The sequence of our actions includes the following steps. First, as described in the previous section, we obtain the use table in NACE at purchasers' prices for 2003. Second, in Quadrant I and Quadrant II, the main flows are determined. In Quadrant I, the main flows are those flows that exhaust at least 95% of the industry's intermediate inputs. In Quadrant II, the main flows are the flows with absolute values of at least 2% to 3% of the values of different components of GDP by expenditure (e.g., household final consumption expenditures, government final consumption expenditures).

For these main flows, we attempt to find the closest analog in the published use table in OKONH[34] and to divide this analog into the components of domestic and imported products, transport and trade margins, and net taxes on products according to the structure of this analog. We rely on the available publication of Russian IO accounts for 2003 because this publication contains the necessary information for this division (see Table 1). If there are some analogs of the flows, we use the weighted-average structure. For all remaining flows, this structure of division is assumed to be equal to the structure of the sum of secondary flows of the initial tables for 2003.

The information for Quadrant III of the use table can be based on of the national accounts (production accounts, generation of income accounts). The total value of the intermediate consumption for NACE activities is also used to control the accuracy of the conducted

[32] See, for example, (Simpson, 2005).
[33] For more information, see (Eurostat, 2008, p 251).
[34] Other sources of information were also used (for example, administrative tables of Rosstat for 2003).

transformation. The other method of controlling the accuracy is based on the degree to which the balanced equations are satisfied. We use the RAS method to remove the inaccuracies[35].

After constructing the SUTs at purchasers' and basic prices for 2003, we use these tables to construct the SUTs for subsequent years at constant (2003) prices.

The 2010 publication by Rosstat[36] includes data that can be used to estimate the measures of output and the value added (and consequently intermediate consumption) for 70 activities and estimate the expenditure components of GDP at constant (2003) prices.

We will use several approaches for constructing deflators for the estimation tables at constant prices:

- The deflation of the activities' outputs will be conducted using deflators constructed on the basis of volume indices of output from the national accounts. These deflators can be used for non-industrial products and services because Rosstat does not differentiate between the non-industrial activities and products.
- The deflators for the domestic products can be obtained from producers' price indices for different types of products and services[37]. These indices will be used for various products according to CPA (codes 10-41).
- The deflators for the imported products can be constructed based on the import price indices transformed from the product nomenclature of foreign-economic activity at CPA using the correspondent transition key.
- The deflation of transport and trade margins will be conducted using deflators for correspondent activities.
- The net taxes on products at constant prices are estimated using the tax rates of 2003.

5. Conclusion

This paper focuses on methodological problems of transformation of SUTs for 2003, published in Soviet classifications, into the ones that are harmonized with NACE and CPA. Further, based of these transformed tables we will build harmonized SUTs in constant 2003

[35] See, for example, (Miller, Blair, 2009, p.313-332).
[36] See (Rosstat, 2010).
[37] Because producer price indices (PPI) are estimated for the end of month and Russian IO accounts are constructed for annual average prices, the recalculation of PPIs into deflators is conducted using the following equation: $\overline{I}_t = \sum_{m=1}^{12} I_m^t \Big/ \sum_{m=1}^{12} I_m^{t-1}$, where I_m^t (I_m^{t-1}) is the base PPI for month *m* of the year *t (t-1)* relative to the month of December of the year *t-2*.

prices. The year choice of 2003 is driven by the availibility of rather full and disaggregated data compared to other years.

Recalculations include several steps. First, after allocating FISIM among activities, the published use table at purchasers' prices and supply table for 2003 given in Soviet classifications are transformed into the corresponding tables that are harmonized with NACE and CPA. Next, on the base of the transformed use tables at purchasers' prices and detailed data of domestic and imported use tables, trade and transport margins tables and net taxes on product table, which are based on Soviet classifications, we build use table at basic prices. In the last stage, based on the derived 2003 tables, the harmonized SUTs in constant prices for the period 2004-2009 will be estimated.

Constructing Russian SUTs for 2003 and subsequent years at current and constant prices in such a way allows us to fill the existing gaps, which is necessary for applied policy-relevant research. Retrospective adjustments of the derived results will be possible once the benchmark IO accounts for 2011 will be published. There is still room for improving the methodology of compiling IO accounts at constant prices, which is left for future research.

Appendix

Classification of the constructed Russian IO accounts for 2003 according to NACE

01	Agriculture
02	Forestry
05	Fishing
10	Mining of coal and lignite; extraction of peat
11	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying
12+13+14	Other mining
15	Manufacture of food products, including beverages and tobacco products
17+18	Manufacture of textiles; manufacture of wearing apparel
19	Manufacture of leather and leather products; manufacture of footwear
20	Manufacture of wood and of products of wood
21	Manufacture of pulp, paper and paper products
22.1	Publishing
22.2	Printing and service activities related to printing
23.1+23.2	Manufacture of coke and refined petroleum products
24 except 24.61	Manufacture of chemicals and chemical products, except explosives
25	Manufacture of rubber and plastic products
26	Manufacture of other non-metallic mineral products
27+28	Manufacture of basic metals; manufacture of other non-metallic mineral products
34	Manufacture of motor vehicles, trailers and semi-trailers
29+30+31+32+33+35 +23.3+24.61	Manufacture of machinery and equipment n.e.c.; manufacture of electrical and optical equipment; manufacture of other transport equipment; processing of nuclear fuel; manufacture of explosives
36+37	Manufacture n.e.c.; recycling
40+41	Electricity, gas and water supply
45	Construction
50+52	Retail trade; repair of motor vehicles, motorcycles and personal and household goods
51	Wholesale trade, except of motor vehicles and motorcycles
55	Hotels and restaurants
60+61+62+63	Transport
64	Communication
65+67	Financial intermediation; activities auxiliary to financial intermediation
66	Insurance
70	Real estate activities
72	Computer and related activities
73	Research and development
71+74	Renting of machinery and equipment without operator and of personal and household goods; other business activities
75+91	Public administration and defence; compulsory social security; activities of membership organizations n.e.c.
80	Education
85	Health and social

90	Sewage and refuse disposal, sanitation and similar activities
92	Recreational, cultural and sporting activities
93	Other service activities

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