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Digital Economy: Problems and Prospects of Accounting and Measurement in the System of National Accounts

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INTRODUCTION

Despite the recognition of significant influence of digitalization on socio-economic processes, the generally accepted approaches to measuring its impact on basic macroeconomic indicators have not been yet formed in international statistics. Similarly, the accounting systems of the most countries do not reflect the digitalization processes at the micro level. At the same time these processes are not formalized in the existing international standards and systems of primary accounting and financial reporting.

The problems of improving the accounting and measurement of digitalization effects at the macroeconomic level are characterized by a number of aspects, including the development of methodological base and approaches to constructing estimates of its scale, dynamics and impact on the key macroeconomic indicators.

The methodological aspects of research in this area are associated with the development of conceptual framework for the inclusion the digital economy in the system of macroeconomic accounting and formalization of relationship mechanisms between digitalization processes and processes, that determine the dynamics of socio-economic development.

The development of effective *methodological approaches* to digital economy measurement is another topical objective of researches in dominance in modern statistics of estimates, based on the construction of various indices and rating indicators, that have limited use in strategic planning and management.

In *practical aspect* the priority task of improving the digital economy accounting and measurement is construction of estimates, harmonized with the system of basic macroeconomic indicators. Its adequate solution can significantly improve the quality of analytical statistics, related to the impacts of digitalization on the dynamics of key macroeconomic indicators, such

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as GDP, national income and labor productivity. This aspect of researches is of high priority for explanation of so-called «statistical paradoxes», observed in the modern international statistics – fixing the trends, associated with a slowdown in the dynamics of socio-economic development in the countries - leaders in the digitalization of the national economy (USA, UK, France, etc.). Both absence of interpretation of these phenomena and data, that contradicts the existing analytical estimates, are associated by many experts with the incorrect accounting and measurement of socio-economic effects of digitalization.

These topics in the research are considered in the context of digital economy accounting and measurement, based on the System of National Accounts (SNA) methodology. The priorities in the research are the most relevant for the modern statistics issues, related to the identification and structuring of the digital economy as an object of accounting and measurement. Other priorities concern to the problems of accounting for digitalization processes in the 2008 SNA and development of the proposals to include the characteristics of the corresponding object in the system of analytical indicators, harmonized with key macroeconomic indicators of the SNA.

DEFINITION OF THE DIGITAL ECONOMY

The term «digitalization» was first used in Nicholas Negroponte's work (*Being Digital*. London, 1995) in describing the features and prospects of information and communication technologies use in the economy and social sphere. The term «digital economy» was used in the paper of D. Tapscott in analysis of digital technologies impact on the development strategy of companies within the conditions of the Internet use expansion for communication functions [1].

Subsequently the content of this term was constantly evaluating in the process of identifying new areas of Internet resources use in commercial activities, final consumption of the household sector and in the implementation of the general government sector functions.

At the present time in international statistics, despite the existence of numerous methodological and practical developments in the field of the digital economy (DE) accounting and measurement, there is no general consensus on the content and structure of the relevant object. This situation is explained primarily by the multidimensionality of this object, which boundaries and structure depend on the objectives of the analysis and are determined in the modern practice on the basis of subjective approaches. As a result, in international statistics, due to the absence of generally accepted definition of the digital economy, significant differences in its scales estimates developed for different countries and regions are observed.

In defining the DE in international and national statistics various features, relating both to the sphere, in which the digital economy operates, and to the environments (organizational, technical, etc.), that ensure its functioning, are concerned as determinative. According to the combination of these features, DE can be defined as:

- economy, based on digital technologies (DT) (extended definition);
- production activity with DT using;
- economy, based on new methods of data formation, processing, storage and transfer;
- communication environment of economic activity, based on the Internet, forms, methods and results of its implementation.

For example, in the OECD definition of the digital economy the DE functioning environment extends to goods and services markets with e-commerce systems, based on the Internet. In the definition of the World Bank the concept of the DE functioning environment extends generally to the system of economic, social and cultural relations, which implementation is based on the use of ICT. Another key feature of the digital economy underlies the definition by the Boston consulting group (BCG), according to which the DE coverage is limited to commercial activities, carried out on the basis of the Internet and/or the World Wide Web (WWW) [2].

In the international statistics many other definitions of DE, based on combinations of its characteristics, are used. As a result, in some cases it leads to the formation of artificial objects, the accounting and measurement of which on a regular basis seem to be unpromising due to the limited possibilities of using the developed estimates in analytical practice. Such estimates as a rule tend to lose their relevance due to formation of new objects, the number of which can be significant and determined by new possible combinations of the digital economy characteristics.

At the same time most of the existing DE definitions are associated with the *use of the Internet and its resources*, which is a defining feature, that allows for differentiation of this object from other objects, the digitalization of which has other forms with *more limited communication functions*. Such objects may include systems of technological processes automation, logistics systems, organization of accounting and management in enterprises, etc., which functioning is *not directly connected* with the Internet resources use.

The correct definition of DE is of fundamental importance for the accounting of this object in the System of National Accounts in formalizing the main aspects of its economic

activity in accordance with the SNA methodology – defining of DE structural elements, kinds of economic transactions, types of goods and services produced, etc. Orientation to the SNA methodology in the DE accounting and measurement also implies compliance (or non-contradiction) identified characteristics of the object with the basic concepts of the System.

CURRENT INTERNATIONAL PRACTICE

The differences in the concepts underlying the definitions of the digital economy are key factor in determining the content of all subsequent stages, related to the measurement of its size in the national economy. The lack of common methodology for determining the boundaries and structuring of this object largely explains the use of various approaches to the construction of appropriate estimates in the modern international practice.

The system of indicators, used in international practice for DE scales measurement, includes their following main groups:

- quantitative characteristics of the digitalization scale, which reflect the extent of digital technologies penetration into the economy;
- index constructions, combining components, that characterize the level of digitalization and the potential for use of digital technologies by different groups of users;
- value indicators, which are represented by specialized characteristics and characteristics, developed on the basis of the SNA methodology.

Quantitative characteristics of the digital economy are mainly represented by absolute and relative *physical indicators*, which reflect the digitalization level for various groups of the DE services potential users - commercial structures, households and general government sector. With some nuances, that take into account the peculiarities of different groups of users, the general quantitative characteristics of the DE scale include: fixed and mobile broadband penetration, broadband speed, international Internet bandwidth, mobile cellular network coverage, etc.

This group of indicators is usually dominant in the system of indicators, produced by national statistics and relates to the section «Statistics of the digital economy».

The main disadvantages of such system are: the subjectivity of key indicators selection from the general system of digitalization physical characteristics, necessity to constant updating the indicators compositions, as the use of DT by different groups of users expands, problems of

using in analytical practice and practice of macroeconomic modeling, due to the uncertainty of the mechanisms of their influence on the macroeconomic basic indicators, etc.

In international comparisons in the measurement of DE development *the index constructions*, combining different indicators of digitalization level, are in widespread use. Such indices are developed by different organizations using different approaches. These facts explain the significant variation in estimates, developed for countries and regions being compared. Accordingly, the use of such indicators for analytical purposes requires a mandatory preliminary analysis of the methodology, used for their construction.

The most common indices in the international statistics, formally related to the DE development indicators and developed as well for the Russian economy, are:

- ICT Development Index (IDI) (International Telecommunication Union) – composite index, that combined 14 indicators, integrated in access, use and skills sub-indices. In 2017 Russia ranked 45th with the index value of 6.95, the dynamics were negative. Leaders – Iceland, South Korea, Switzerland.
- International Digital Economy and Society Index (I-DESI) (EU 28) comprises 5 dimensions and 30 indicators. In 2017 Russia – 36th position out of 100. The leaders are Scandinavian countries and the Netherlands.
- BCG e-Intensity Index (Boston Consulting Group) consists of 3 components – fixed and mobile infrastructure development, activity of Internet use and online retail and advertising expenses. In 2015 Russia ranked 39th with the index value of 113. The leader of the ranking is Denmark.
- IMD World Digital Competitiveness Ranking (IMD Business School) consists of 3 components – knowledge, technology and future readiness, comprises 50 criteria. In 2017 Russia – 42nd position. Leaders - Singapore, Sweden, USA.
- E-Government Development Index (EGDI) (UN Department of Economic and Social Affairs) comprises 3 dimensions of e-government. In 2016 Russia ranked 32nd position out of 193 countries. Leaders: Denmark, Australia, South Korea.

Such measures generally differ in the composition of accounting components and in models, used for their combinations, and therefore are not comparable. Typical problems for index constructions are subjectivity in selection of the combined elements and definition of

assigned weights in the aggregate models. The subjectivity of estimates in this case also due to use of expert surveys results for these purposes.

In the *analytical aspect* the index constructions are also characterized by a number of disadvantages (use of ranking scales, regular revision of the elements compositions, incompatibility with the system of basic macroeconomic indicators, etc.), which limit their practical use in analysis of the DE development and complicates economic interpretation of the estimates obtained.

Another direction in the DE measurement in international practice is based on the construction of *value estimates*. This direction is characterized by the following features:

- difference of DE estimation objects (production, transactions, consumption, etc.);
- difference of value indicators used (output, value added, cost characteristics, mixed estimates, etc.);
- dependence of the estimates quality on the level of national statistics development (national accounting statistics, ICT statistics, statistics of innovations, etc.);
- difference in approaches, used to formalize the mechanisms of DE impact on the macroeconomic indicators;
- necessity of estimates adjustments to provide their comparability.

In general, the lack of consistency in the DE indicators, developed by international statistics, limited possibilities of their use in national analytical practice. Upon request of relevant information there is a need for searching the alternative approaches to the accounting and measurement of this object.

For the macroeconomic level the development of such information base by a number of experts is associated with the use of the SNA, providing the adaptation of its certain methodological concepts in accordance with the DE characteristics as the object of accounting and measurement. Existing examples of the SNA methodology use in measuring the DE scale in international practice demonstrate wide possibilities of building appropriate estimates. In addition, this approach has a number of advantages over alternative approaches to the DE measurement, based on construction of physical indicators and specialized indices [3].

ACCOUNTING AND MEASUREMENT DIGITAL ECONOMY IN SNA

In the SNA 2008 the possible accounting of elements, related to the DE, is based on general methodological principles, that can be extended to almost any objects and processes, included in the sphere of economic turnover.

Theoretically the SNA methodology allows for inclusion in the macroeconomic accounting the following operations, related to the functioning of the DE components:

- production, distribution and use of DE goods and services;
- formation and distribution of income, obtained in DE;
- fixed capital formation in DE.

The SNA 2008 methodology does not directly refer to the digital economy as an integrated object of macroeconomic accounting. This situation is explained both by the lack of systematic understanding of the digital economy during the System methodology developing and its composition and interrelations of DE elements with other objects and processes, taken into account in the SNA. This explains the existing restrictions in the DE macroeconomic accounting, which can only be extended to its elements, identified in the *system of SNA classifiers*, allowing for structuring the relevant sector of national economy by groups of institutional units employed, performed types of economic activities, types of goods and services produced, etc. [4].

In practice the choice of classifiers for DE accounting and measurement depends on the approaches, used to the calculation of basic macroeconomic indicators (GDP, national income, etc.). In statistics of most countries the dominant approach to GDP calculation is the *production approach*, based on rather simple calculation schemes and information base used, developed on a regular basis within the existing official systems of primary data collection.

According to the production approach the structuring of the DE in the SNA can be carried out on sectorial, product or transactional grounds. In the first case the basis for classifier is International Standard Industrial Classification - ISIC, in the second - Central Product Classification – CPC. In statistics these classifications are assigned to «general-purpose classifications» category and in both cases the main problem of the DE structuring in the SNA is the choice of industries and groups of goods and services, related to this object of accounting and measurement.

Analysis of existing practice shows that the choice of such groups is carried out mainly on the formal grounds of association with relevant DE industries and goods. At the same time in many cases other terms are used in determining the DE, in other cases the DE is understood as artificial objects, accounting and measurement of which within the SNA requires significant adjustments to its methodological framework.

In the *transactional approach* DE structure in the SNA should theoretically be determined by the relevant classification groups of operations, which include: productive, distributive, capital, financial and balancing transaction. In practice the relevant groups are formed according to the characteristics different from those, adopted in the SNA - types of sales transactions, conducted with the use of ICT networks (digitally ordered, digitally delivered), functional systems used (platform enabled), combinations of entities, participating in transactions (B2B, B2C, B2G, etc.), etc.

Examples from international practice demonstrate a variety of approaches to the accounting and measurement of objects, formally related to the DE, which are in varying degrees oriented towards the SNA methodology.

Typical example of ISIC classification (Rev. 3) use in DE sector structuring is OECD approach. According to specified approach manufacturing (7 items) and services (4 items) industries are defined as part of the ICT sector, considered as the equivalent to the DE. The combined groups according to their content only conditionally or partially can be attributed to the DE as an object, which functioning is connected with the Internet use. For example, the manufacturing industries include such aggregated and multi-purposed positions as «Office accounting and computing machinery», «Insulated wire and cable», «Television and radio transmitters and apparatus for line telephony and line telegraphy», «Television and radio receivers, sounds or video recording or reproducing apparatus, and associated goods», etc.

The similar problem is typical for attributed to DE services industries, which, for example, include: «Wholesaling of machinery, equipment and supplies», «Renting of office machinery and equipment (including computers)», «Telecommunications» and «Computer and related activities» [5].

Regarding *producers* digital economy also could be broken down into traditional SNA institutional sectors (corporations, government, households, NPISH) or into different groups, formed in accordance with functional characteristics - digital-enabling industries, digital platforms, etc. Concerning *products* - into digital and non-digital goods and services, information/data in non-monetary transactions [6].

In international practice there are many examples of DE accounting and measurement, based on more complex combinations of its structural elements². For example, in the IMF approach in the DE composition the industries, represented in standard classifications, and industries, formed by functional characteristics, are combined. In addition the relevant groups are combined on the basis of their accounting as part of GDP (gross value added). In particular, the item «Included in GDP on a value-added basis» contains the following elements: ICT equipment, semiconductors and software, telecommunication and Internet access services, online platforms, including e-commerce platforms and platform-enabled services. The item «Conceptually not included in GDP, or missed for procedural reasons» comprises: Wikipedia and open source software, free media from online platforms funded by advertising, «do-it-yourself» fixed capital formation of online platforms [7].

The use of SNA methodology in the DE accounting and measurement also implies compliance (or non-contradiction) of the specified object characteristics with its basic concepts. By analogy with other economic objects the main problems of DE adequate accounting and measurement in the System of National Accounts are connected to focus of the SNA methodology mainly to the processes, related to the *market economy*. In addition the SNA methodology does not provide an accounting and measurement of the processes, implemented outside the market production boundaries, which is typical for the digital economy. In particular, the SNA methodology is not fully adapted to accounting of non-market services, services produced in the household sector, etc. Accordingly, all estimates of the DE scales and its impact on basic macroeconomic indicators without taking into account these factors will be incorrect and, as a rule, biased towards their underestimation.

In general the existing international practice of the DE accounting and measurement on the basis of the SNA has the following disadvantages:

- estimates being developed refer to individual components and scarcely can be integrated within the constructed aggregated indicators;
- use of aggregated classification groups (ISIC, CPC) as the basis of DE structuring, detailed and corrected on the basis of subjective evaluation ratios;
- preferential use of production approach in the DE estimation with formal adjustments with estimates, obtained on the basis of alternative approaches;

² The problems of DE structuring are studied in detail in the paper by A. S. Abroskin, Y. K. Zaitsev, G. I. Idrisov, A. Y. Knobel, E. A. Ponomareva. Economic development in the digital age. Delo, M., 2019.

- following up on the recommendations of international organizations, intended for countries with high level of technological development and developed system of macroeconomic statistics;
- lack of adjustments procedures, related to the changes in quality (hedonic) characteristics of goods and services, driven by DE functioning.

According to many experts at the core of solution for the most of these problems are the SNA methodological particularities, which need for adjustment, taking into account new factors of the world economy development in the context of its total digitalization. High relevance of such adjustments for the DE accounting and measurement is associated with observed trends of increasing use in statistical practice methodological and methodical approaches, totally different from SNA concepts. In specified approaches DE boundaries and its structure are determined on the basis of subjective perceptions, using of non-standard classifiers and accounting schemes for measurement of its scales, inconsistent with the SNA. In general this explains the chaotic nature of the DE macroeconomic statistics, availability of contradictory estimates and lack of balanced systems of indicators, covering the main complex of processes, associated with its functioning.

ALTERNATIVE APPROACHES

Inclusion of the DE in the macroeconomic accounting system in accordance with the SNA methodology is currently one of the priorities of many researches, carried out within the national statistics of some countries. The results of such developments for the Russian Federation, in particular, are estimates of the DE scales, formed for sectors and functional objects, determined inside the boundaries of traditional structure of production industries and sectors of the national economy. In parallel the approaches, main objective of which is to adjust the developed estimates according to additional information, contained in the SNA applications (supply and use tables), are being developed.

Other directions of researches are based on the new principles of the DE accounting in the system of economic turnover.

Peculiarities of digitalization processes and dominance of various types of goods and services, related to the DE in various sectors of national economy, make approaches, oriented to measuring its scales using the *single aggregated indicators*, unjustified.

Possible alternative approach – using different methods for different structural objects with subsequent integration of the estimates obtained. This thesis is argued by fundamental differences in the DE value estimates, developed for commercial, government and households sectors, in which market and non-market goods and services, respectively, dominate in their

production and use. Foundation for such approach is consistent with the expert's opinion, that DE «includes doing business, conducting communications and providing services *across all sectors...*» [8].

Suggested «modified industrial method» relates only to the *commercial sector* and, taking into account the inclusive concept, the digital economy is defined as a set of digital segments (DS), functioning within each industry of the national economy and whose functions are connected with the provision of Internet services to other units. The requirement to the functioning of digital segments is availability of relevant infrastructure. In international practice it is defined as «digital – enabling infrastructure», which components are: «computer hardware, software, telecommunications equipment and support services that form and facilitate the use of computer networks» [9].

It is assumed that the set of digital segments, distributed by industries of the national economy, is characterized by *common structure of components*. Their activities are related to ensuring the functioning of the relevant industries and are part of the industrial economic turnover. In this case the DE accounting can be based on the general principles of the SNA and traditional system of macroeconomic statistics indicators can be used to measure its scales.

The proposed approach is similar to the approach, used in practice of accounting for the activities of non-core groups of establishments (accounting services, marketing and transport units, etc.), ensuring the functioning of core production units. In this case the activities of these groups are taken into account in the activities of the profile groups and industry-wide proportions can be extended to their indicators.

CONCLUSION

The SNA methodology being an open and developing system can theoretically be the basis for accounting of economic transactions, related to the functioning of the digital economy and its structural elements.

Existing limitations in the DE macroeconomic accounting in international statistics are mainly connected with typical problems of applying of SNA classifiers in its structuring. In this regard further development of statistical classifications and their detailization for defining the kinds of economic activities, goods and services, associated with DE, is required.

The developments, connected with construction of an adequate system of price statistics for different digital economy segments, are another priority for further development of DE accounting methodology in the SNA. Specific areas of research in this field include the development of methodology for the construction of consumer price indices for the DE sector

products. In this part the international statistics orients the national statistical organizations, first of all, to obtain more complete information on such products, related to DE (video content, music, video games, etc.), access of potential users (primarily households) to which is currently carried out mainly on digital basis. In solving this problem international statistics has been focused on both using of new sources of primary information, including network information resources, and the improvement of traditional data collection systems, including data from budget household surveys, marketing research data, etc.

Other actual problems in macroeconomic accounting of DE elements are associated with incorrect estimates of digital assets, which, in turn, lead to an underestimation of impact of the digital economy on the dynamics of key macroeconomic indicators, including labor productivity. The necessity of additional measurements of digital assets, clarification of their types, recognized as assets in the SNA definition, is justified.

Special problem in DE elements accounting in the SNA is the development of methodology for measuring the scales of production within the segments, that support its development. In national statistics its solution is associated with fundamental changes in the system of primary observation in the field of information and communication technologies (ICT). In particular, such changes relate to the clarification for the scope of surveys of commercial resident institutional units, engaged in the ICT sector activities.

In the longer term improving the quality of the initial information base for the DE analysis is associated with the formation of satellite accounts, as well as with the development of methodological approaches and specific schemes to assess its direct and indirect impact on key SNA indicators - gross output, value added, national income, etc.

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