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«Digital economy non-market components accounting methodology»

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ABSTRACT

An inclusion of non-market goods and services which are core to the digital economy in the system of economic circulation affects the basic socio-economic indicators both in Russian and in international practice. In this connection, the goal of this study is to develop a methodological basis for accounting and measuring non-market components in the emerging digital economy of the Russian Federation.

As methods and methodology of the study, we use the provisions of the 2008 SNA methodological base relating to the accounting of new objects in the system of economic turnover; methods of forming input-output tables in the SNA application system; methods of transforming the indicators of the formation and use of resources into a system of indicators of symmetric input-output tables; methods of matrix calculations in building indicators of intersectoral relations, taking into account the digitalization processes of the Russian economy; methods of accounting the influence of price and hedonistic

The main are: the development of a methodological framework for accounting for non-market components in the formation of a system of indicators of the digital economy; the development of methodological approaches to the valuation of non-market components in measuring the economic effects of digitalization; testing the proposed methodology for accounting and measuring non-market components in the digital economy based on Russian data, and developing recommendations for using the results in the formation and implementation of economic and industrial

Keywords: information and analytical database, matrix calculations, system of national accounts, input-output tables, digital economy, non-market components

JEL classification: O32, O33, E01.

CONTENT

INTRODUCTION

In today's innovative economy, digitalization is seen as a factor influencing the most important socio-economic processes associated, among other things, with progressive structural changes, the development of the social sphere, the increase in the efficiency of public administration and the growth of the population's welfare. One of the most relevant and least developed aspects of taking into account the impact of digitalization on basic socioeconomic indicators in Russian and international practice is the methodology of including non-market goods and services which are relevant to the digital economy in the system of economic circulation. Its development in the framework of the present study will solve a number of pressing problems of measuring the macroeconomic effects of digitalization of the Russian economy, taking into account the components not currently reflected by official statistics, including the statistics of national accounting. Appropriate effects will also make it possible to adjust the basic socio-economic indicators and, on this basis, to develop refined assessments of the impact of digitalization processes on the development of the social sphere, the dynamics of economic growth, labor productivity, etc. These issues are particularly relevant in the context of the ongoing work on the formation of a system of accounting components of the digital economy in Russia.

The purpose of this work is to develop a methodological framework for accounting and measuring non-market components in the emerging digital economy of the Russian Federation.

The main objectives of the study are:

- Analysis and systematization of current promising developments in the methodology of accounting and measurement of non-market components of the digital economy and the development of proposals for their use in Russian practice;

- The development of a methodological framework for taking account of non-market components in the formation of a system of digital economy indicators

- Development of methodological approaches to the valuation of non-market components in measuring the economic effects of digitalization;

- Approbation of the proposed methodology for accounting and measuring non-market components in the digital economy on the basis of Russian data

- Development of recommendations for using the results of this study in the formation and implementation of economic and industrial policy in Russia.

The theoretical and applied results of the study may contribute to the construction of a system of information and analytical support for the processes of strategic planning, management and monitoring of the development of the digital economy in Russia, and the development of a system of analytical indicators and forecasts of the development of the digital economy in Russia and its impact on the basic macroeconomic indicators.

The results of this research may be used in the interests of the Department of Macroeconomic Analysis and Forecasting, the Department of Digital State Development, the Ministry of Economic Development of the Russian Federation, the Ministry of Digital Development, Communications and Mass Media of the Russian Federation, as well as in the interests of the Academy for the development of scientific potential to improve the quality of expert analytical work and the quality of educational programs.

1. Analysis and systematization of recent perspective developments in digital economy non-market components accounting and measurement methodology

1.1 Definition of the non-market components of the digital economy

The concept of digital economy or cryptoeconomics does not imply a parallel digital or "crypto" version of the entire economy, but rather a digitization of the current economy, [1] so its non-market components correspond to those in the current economic model. In other words, the non-market components of the digital economy are almost identical to the non-market components of the market economy.

According to the Classification of Institutional Units by Economic Sectors of the Russian Federal State Statistics Service (Rosstat) [2], non-market components are the output of non-market producers. They include the public administration sector, or the sector of non-profit organizations serving the economy. They can partially include sectors of the economy, in which the production of goods and services is carried out for their own use.

The criterion used to differentiate market and nonmarket production in the classifier of institutional units by sectors of the economy is the ratio between the proceeds from the sale of goods and services and the costs of production, the so-called "50% rule". The essence of it is as follows:

a) If $\geq 50\%$ of the costs of production are covered by the proceeds from the sale of products, the institutional unit is a market producer and belongs to the non-financial or financial corporations sector;

b) If $\leq 50\%$ of the costs of production are not covered by the proceeds from the sale of products, the institutional unit is a non-market producer and belongs to the sector of non-profit organizations serving households, or to the sector of public administration.

The public administration sector includes two types of institutional units:

1) Public authorities and administration at all levels - ministries, departments, services, agencies, as well as state non-budgetary funds, etc.

2) Non-market non-profit organizations financed and controlled by the state (schools, hospitals, cultural organizations, etc.).

The sector is a set of households whose main functions are the consumption of goods and services and the production of goods and services for sale and own use. Costs are recovered from proceeds from the sale of goods and services, wages, transfers, etc.

The household sector also includes unincorporated household enterprises. Unincorporated household enterprises are usually relatively small enterprises producing goods and services for the market or for own use, such as household farms, family farms, restaurants, laundries, etc.

Unincorporated enterprises of households are not independent institutional units, because they do not have independence from their owners (households) and do not have other attributes of institutional units.

Households, just like legal entities, are the center of economic decision-making, they possess and dispose of property and income, enter into economic relations with other units, and are responsible for their decisions under the law. However, unlike legal entities, households and unincorporated household enterprises do not keep complete accounting records.

The household sector also includes the institutional population - the totality of persons who live permanently in institutions and do not have independence in economic matters. For example, members of religious orders living in monasteries, long-term patients in hospitals, prisoners serving long sentences, and patients in nursing homes. Such persons are regarded as forming together a separate institutional unit, i.e., a separate household.

The sector of non-profit organizations serving households (NPOSH) unites non-market non-profit organizations financed and controlled by households. The main function of the NPOSH sector is to provide non-market services and goods to households. The costs are reimbursed by contributions from NPOSH members, donations, sponsorships, and property income.

The NPOSH sector also includes non-market subdivisions of corporations and quasi-corporations that provide their employees with free or almost free services (rest homes, clinics, kindergartens, cultural centers, clubs, etc.) and finance their costs mainly at the expense of deductions from the profit of corporations (quasi-corporations). For more details see the table 1.

Table 1 – Classification of non-market components in digital economy sectoral-operational structure

№	**Households**	**Public administration sector**	
	non-market NCOs financed and controlled by households	Public authorities	non-market NCOs
1	Vacation homes	Ministries (Departments)	Schools
2	Clinics	State agencies	Hospitals

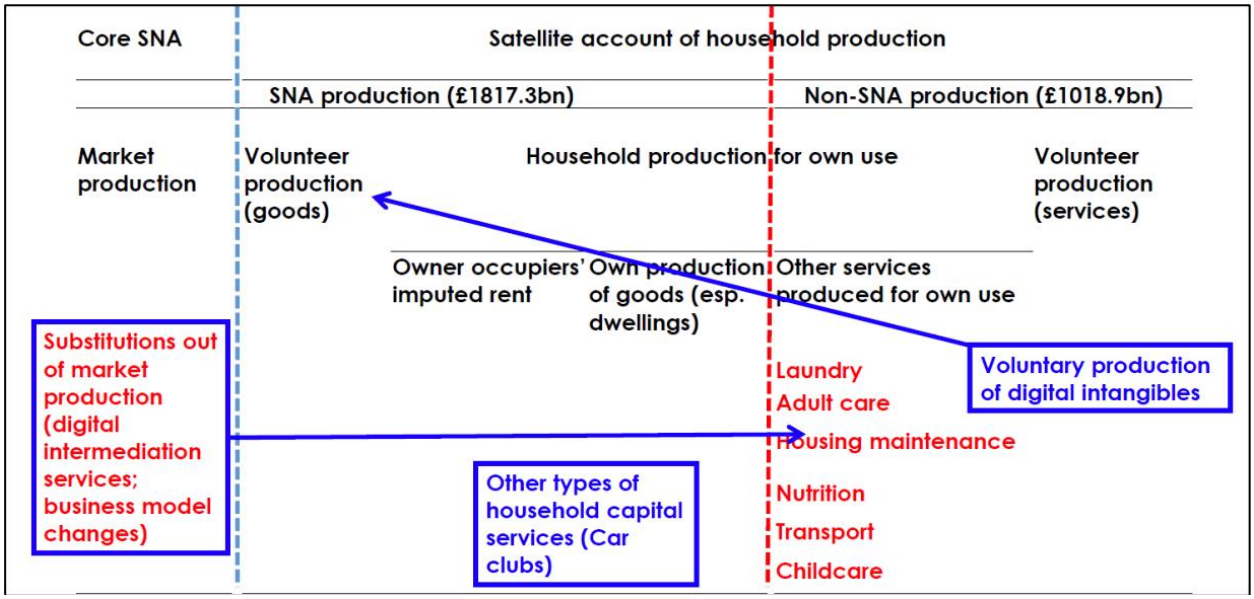
3	Nursery schools (kindergartens)	Services	Cultural organizations
4	Houses of culture	Agencies	Etc
5	Clubs and etc.	State non-budgetary funds	

Note – Source: compiled by the authors on the basis of the Russian classifier of institutional units by sector of the economy (Rosstat) [2]

A wellknown researcher, director of the Stanford Digital Economy Lab Erik Brynjolfsson, points out in an article on measuring the digital economy that one of the shortcomings of the existing methods of measuring the digital economy is the lack of consideration of non-market activities (such as household production), and this is due to the fact that they are not included in the GDP. [3]

The IMF report (IMF, 2018 [4]) on measuring the digital economy notes that indicators of well-being from the use of free digital products can and should be taken into account in the context of measuring non-market production beyond GDP. Productivity from using household time to produce non-market products can increase well-being in a variety of ways that are not measured by consumption or GDP. Therefore, the old debate about measuring non-market household production has now become even more relevant. Thus, according to the IMF, international and national institutions should accelerate efforts to develop measures of welfare growth from non-market production beyond GDP.

GDP was not originally conceived as a comprehensive measure of production. The accountable production framework of GDP, as defined by the System of National Accounts (SNA), includes a specific part of total production, consisting of market and near-market production (figure. 3). Volunteer (volunteer/public) services are not part of its framework, along with non-market production of household services for own consumption, such as cooking, laundry, child care, and home maintenance. Non-market voluntary or self-consumption services accounted for 36% of total production (and 56% of GDP) in the UK in 2014 (Office for National Statistics, [5]) (see Figure 1).



Note – Source: [4]

Figure 1 – Nonmarket production of services and the SNA production boundary (United Kingdom, 2014)

The move of marketplace goods production beyond GDP in the digital age has been cited as a source of downward distortion of the economy. The availability of diverse online information has reduced search and selection costs and enabled households to replace market services with services they produce themselves; for example, households can become their own travel agent. Free digital substitutes (e.g., Skype as a substitute for long distance calls) can also be seen as an opportunity for households to reduce costs through "homegrown" production. [6] Finally, the Internet allows volunteers to provide online content and open-source software.

Part of the "productivity enigma" debate concerns the possible mis-measurement of digital activity. Specific measurement adjustments, studied in a multitude of studies, have little effect on productivity growth estimates. As such, this paper examines additional measurement issues, in particular, the substitution of digitally enabled economic activities across the boundaries of traditional production. All of these substituted activities are broad in scope, so the question of GDP as a measure of well-being comes up again. Deflation and hedonic adjustment to calculate real GDP are inherently about economic welfare. The magnitude of the numerical changes clearly affecting economic well-being is now so great that these issues require additional research.

Nevertheless, shifts are occurring in both directions. The gig economy[1] has lowered the transaction costs of hiring for jobs such as driving a car or assembling a furniture set. Online retailers have shifted the tasks of finding the product on the shelf and transporting it home to

[1] The «gig economy» is a system in which companies prefer not to hire employees, but rather hire independent contractors and freelancers, often not full-time. Examples of the gig economy are those jobs that people find and access through online platforms that post such jobs. These are often one-time jobs or short-term contract jobs. These include shared-use driving, house painting, freelance work, coaching, fitness training and tutoring. The jobs are paid in cash and have no other benefits, such as health insurance.

market makers. In addition, shifts across the production frontier caused by technology, social change, or economic development occurred before the digital age. A discussion of the impact of digitalization on the production frontier must consider the broader context of non-market household production and shifts between market and non-market production caused by social and economic change, not just technological change.

The view that the shift to self-care provided by digital substitutions reduces and distorts GDP ignores consumer behavior and confuses the roles of nominal and real GDP. Free digital substitutions change the structure of GDP, not its level, because households are likely to spend the money they save on something else. In this regard, we can say that GDP remains unchanged while welfare increases. But this critique of GDP assumes that nominal GDP plays a role that it does not have. The question should be whether real GDP reflects welfare growth, that is, whether deflators reflect growth in digital quality. The accuracy of deflation is crucial to measuring productivity because productivity growth often has a downward effect on prices.

Accounting for welfare in GDP through free digital substitution is primarily a price and volume index problem, not a production boundary problem. It seems that adjusting prices for changes in quality is a key step for measuring welfare. Most digital product features that eliminate household spending can be thought of as a change in the quality of some commodity that is priced. For example, a smartphone camera that is so good that it can replace a camera bought separately is an attribute of smartphone quality. Nevertheless, digital products obtained for free and the use of digital products as raw materials for household production for own consumption raise some important questions about the limits of production.

Changing the definition of GDP in any fundamental way can create more problems than it solves. Different issues require different concepts. The current definition of GDP fits well with the key policy questions of income, employment, monetary policy, potential government revenue, investment, and productivity. Non-market household production does not produce income that can be spent or income that can be used to finance investment and easily taxed. Including non-market production in GDP can mask important changes in market production, such as the onset of a recession. Another consideration is reproducibility and objectivity. The current definition of GDP can be estimated from observed transactions and market prices. In contrast, the monetary value of volunteer services, non-market services for own consumption, and free online services can be determined by assumptions and subjectivity.

Indicators beyond GDP can help us understand the welfare implications of digitalization. The rapid growth of free digital services and non-market household production made possible by digitalization has widened the gap between GDP growth and household wealth growth. Indicators of non-market production and other measures of well-being beyond GDP are discussed in the work

of Nobel laureate D. Stiglitz. [7] Such indicators can answer questions such as the impact of digitalization on the well-being of different segments of the population and how digitalization has changed the way households use their time.

Proponents of making changes to the production boundary of GDP argue that these minor changes in definition would allow GDP to better reflect digital well-being. One suggestion is to apply the current approach to owner-occupied housing to consumer durables, including digital devices. To reflect the welfare gains from digitalization in household consumption statistics, [8] would include services of consumer durables in household consumption adjusted for intensity of use. This approach also increases the weight given to changes in the quality of digital devices. In times of rapid proliferation of devices such as smartphones and tablets, and rapid increases in time spent online, the impact on growth in household consumption can be significant. The main obstacles to this approach are practical challenges, including resources and inputs, and the possible obscuring of business cycle events (imputed services of durable goods will be flattened).

Productivity is a measure of changes in the ability of producers to transform inputs into outputs. Productivity statistics cover only market producers. Overestimating deflators for ICT products has been found to underestimate real output and hence productivity. Non-market output does not fall within the realm of standard productivity measures. Digitalization has increased the ability of households to use their own time and other resources to produce non-market services for their own consumption, thereby increasing welfare. Measuring this increase in well-being will help to understand the positive effects of digitalization. However, the development of such indicators is difficult due to the lack of relevant data on time use.

Measuring productivity and real GDP are closely related. Productivity is calculated as the growth of market output, measured in GDP, minus the growth of inputs, either labor or, in the case of total factor productivity (TFP), labor and capital combined. Adjusting real GDP to more accurately reflect digital output has a slightly increased impact on the growth rate of total factor productivity. This is because the base from which the percentage change in productivity is calculated includes only the market production portion of GDP. In the case of TFP, however, adjustments for the output of capital goods, such as computers, may have little or no effect, since capital is also an input.

The fundamental conceptual framework of GDP is still relevant, but the question of how digitalization has affected well-being is relevant in terms of policymaking. The definition of GDP should still be consistent with market and near-market production at market prices where they exist. Linking GDP to market activity allows for a coherent system of three closely related macroindicators: value added (or unduplicated output), income, and (final) expenditure. That said, as already noted, the rapid growth of free digital services and non-market household production

made possible by digitalization has widened the gap between GDP growth and household welfare growth. To understand welfare from non-market production made possible by digitalization, indicators other than GDP are needed.

1.2 International experience of accounting and measuring the non-market components of the digital economy

The term "open Internet," used quite often, but it does not have a universally accepted definition. It is a convenient phrase, like "a level playing field," that hides complexities. It is usually used under the assumption that everyone agrees on its meaning, but that is not entirely true. For some, the term "open Internet" is taken as a technical concept (e.g., global interoperability of transmission protocols). For others, it means an Internet that respects human rights (e.g., freedom from online censorship). Alternatively, it may be used interchangeably with other terms that do not have a commonly accepted definition (e.g., "network neutrality"), or it may be intended to refer to some other consideration (e.g., geographically and/or demographically broad access). As a result, the term causes confusion. Furthermore, speaking of "open Internet" implies that the Internet can either be completely open or completely closed. Even if one considers only the technical aspects, the binary representation does not correspond to how the Internet actually works. The Internet is a multi-layered structure consisting of a physical access and transport infrastructure, an agreed set of packet and transport protocols, a domain name system, an IP address system, and application/content. Together, these layers provide the data flows that move between user devices at the edges of the network. Depending on the conditions at each of these layers, the technical nature of the Internet can be more or less open. Some technical conditions make the Internet more open, others less so. Some even do both at the same time. Some conditions have a stronger impact than others, and they can also affect more than one type of "opening" at the same time. But they don't just turn the Internet from "open" to "closed." For example, one of the conditions affecting the degree of openness of the Internet at the IP address level is the scarcity of IP addresses resulting from the limitations of IPv4, the protocol that identifies devices on the network. The lack of available IP addresses makes it difficult for more users and devices to connect to the Internet (the closure effect). This is why a workaround called network address translators (NATs) was introduced. A NAT translator allows multiple devices to use the same IP address. Many devices that provide fixed broadband Internet access and Wi-Fi in the home have built in NAT translators, allowing all Internet-enabled devices in the home to use the same IP address. Carrier-grade NAT or CGN (Carrier-grade NAT) translators are oversized translators that allow many homes and other end sites to share small pools of IP addresses. CGN translators make the Internet more open by allowing more users and devices to connect to it. However, they cannot provide unlimited access,

and in any case CGN translators simultaneously make the Internet less open by hiding or anonymizing users' actions, which reduces accountability. Consequently, CGN translators neither completely open nor completely shut down the Internet, but they do affect how open it is. In fact, one cannot unequivocally argue that the Internet has ever been either completely open or completely closed. To make it completely open-if such a state is possible at all-would require ending arrangements that are crucial for economic and social reasons, such as the need to pay for equipment and Internet access, as well as compliance with laws about the nonproliferation of uncensored "18+" content. On the other hand, a complete shutdown would turn the Internet into nothing more than a series of isolated nodes, after which it would cease to be a network altogether. The reality is that the Internet has degrees of both "openness" and "closedness" in many ways. So the question is not whether the Internet is open or closed, but how open or closed it is and in what dimensions. In fact, the openness of the Internet is always in flux, constantly becoming more open in some dimensions and more closed in others.

Hence, it is more useful to study the openness of the Internet with a graded multidimensional space in mind than a basic open or closed perspective. It is therefore advisable to avoid using the overly simplistic term "open Internet" and instead use "openness of the Internet. A broad view of Internet openness allows us to go far beyond the purely technical aspects to encompass economic, social and other factors. This view is based on many of the ideas outlined in the 2008 Seoul Ministerial Declaration of OECD countries, which in 2011 were outlined in the OECD Council Recommendations on Guidelines for the Protection of Privacy and Transborder Transfer of Personal Data (The Internet Policymaking Principles - IPP) (OECD, 2014 [9]). Indeed, the concept of openness presented here is quite broad, so although the mentioned OECD report aims to explore all the most important elements of openness, it cannot cover all its aspects. Below we will present brief descriptions of the three main categories of openness, namely technical, economic and social. However, even these brief descriptions make it clear that Internet openness does not mean lawlessness, or inaction. It is something that stakeholders collectively and purposefully create. Technical openness increases when publicly available protocols are used consistently to receive and send data streams across the interacting layers of the Internet, relying on a consistent system of IP addresses and a single agreement for domain names. For example, the more consistently devices connected to the Internet use TCP/IP (Transmission Control Protocol/Internet Protocol, the primary language of communication on the Internet), the greater the technical openness. On the other hand, the more non-standard data flow control algorithms are used, the lower the technical openness.

Economic openness depends on the ability of users to access and use the Internet to expand their economic opportunities and use them productively. For example, economic openness

increases as broadband infrastructure grows, but decreases when access providers lack competition and as a result charge higher prices or provide lower quality services.

Social openness is positively related to people's ability to use the Internet to expand their intangible capabilities, such as more easily keeping in touch with family and friends, getting more information on topics of interest to them, or expressing themselves. For example, social openness increases when laws restricting political expression are relaxed. It decreases when access to online educational material ceases because the government decides to block the entire platform through which that material is available.

In practical terms, openness corresponds to people's ability to do more things online, whether it's starting a business, creating new services or revolutionizing existing ones, expressing opinions, raising capital, sharing knowledge and ideas, conducting research, interacting with government, or using a map.

The elements of Internet openness are shown in the table (see Table 2).

Table 2 – Elements of Internet openness

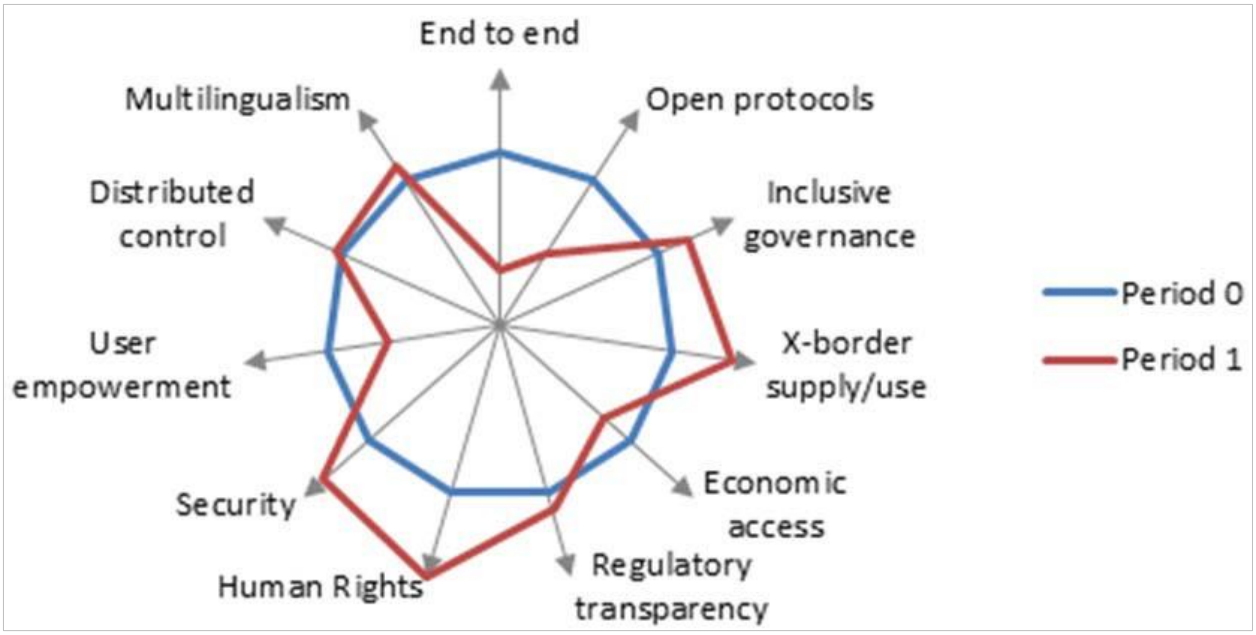
Technical	Economic	Social	Other
End-to-end principle ➢ *consistent use of open standards* ➢ *interoperable* ➢ *consistent address space* ➢ *uniform convention for domain names*	Cross-border supply and consumption	Respect for human rights, e.g.: ➢ *freedom of expression* ➢ *freedom to associate* ➢ *privacy* ➢ *freedom from discrimination* ➢ *education*	Digital security ➢ *availability* ➢ *integrity* ➢ *confidentiality* ➢ *but with some vulnerability*
Open protocols for core functions	Economic accessibility		Empowerment of users over data sent and received
	Regulatory transparency, certainty and capacity		Distributed control Inclusive governance
			Multilingualism

Note – Source: [10]

The idea of openness can also be expressed schematically. The figure presents a basic multidimensional view of Internet openness. Many of the technical, economic, social, and other elements in Table 2, that contribute to openness are depicted as separate vectors. The values along each vector are set to a common reference point in period 0. It is assumed that in period 1 some values increase and others decrease. This is done simply to illustrate the concept; the figure is not based on real data and is not intended to reflect measurements or even casual impressions of actual openness.

The total circumference of the resulting polygon for a given period represents the total openness for that period. Thus, the change in the total circumference of the polygon from period

0 to period 1 reflects the change in total openness. This is a very simplified approach because of the indexing in period 0 and implies that openness measures can be compared across different parameters (see Figure 2).



Note – Source: [10]

Figure 2 – A simplified hypothetical visualisation of Internet openness over time

A major project worth exploring in the future would be to develop methodologies for measuring and indexing the vectors in Figure 2, so that they can evolve from arbitrary schemas for conceptual purposes to data-driven representations of actual openness.

What are the benefits of Internet openness?

The openness of the Internet offers numerous significant benefits to individuals, businesses, governments, and other organizations. It is not always possible to quantify these benefits, but it is possible to identify them and provide illustrative examples. This section describes four main types of benefits, mostly in qualitative form.

The economic benefits of Internet openness in international trade.

There is a growing literature on the positive effects of the Internet on trade and the potential costs to trade due to policies that introduce friction into "normal" data flows on the Internet. Internet openness facilitates international trade for existing businesses by making it easier for suppliers to connect with existing consumers who are outside the supplier's home country (or countries) and by improving control over logistics. Openness can also stimulate trade by giving access to a broader customer base through e-commerce. And it allows new firms to enter more geographic markets and (for the most efficient ones) enter global value chains (GVCs). At the same time, the Internet's openness and digitalization make it possible to transact and deliver products, services and payments faster and more efficiently, replacing some physical trade with

online commerce (e.g. books and music) or more complex products through online delivery of designs followed by local production, such as with 3D printers).

CCCs are central to the history of commerce and the Internet. Behind the aggregated trade data is a myriad of intermediate trade flows, where resources are shipped around the world and production steps are moved from one location to another to complete the final product. Both goods and services can be produced in the GCSS: electronics and automobiles are typical examples where design, raw materials, production and marketing resources are distributed across countries. One can also think of airplanes, clothing, animated films, legal briefs, and medical advice created within the CCCS. The growth of the GCSS has been made possible in part by technological advances, especially information management systems that allow firms to coordinate their participation in the GCSS. The combination of HCSS and the Internet has not only made it easier for firms in developing countries to participate in international trade (specializing in one stage of the chain, such as automotive electronics), but also for small and medium-sized enterprises (SMEs) as digital Platforms allow even tiny firms (microtransnational corporations) to connect with global suppliers and buyers. Given the widespread proliferation of GVCs, the seamless movement of potentially large amounts of data between countries is an important part of supporting intermediate and final trade flows, and enabling firms to participate in GVCs. In other words, reducing the openness of the Internet can create serious obstacles to trade. Small disagreements can grow into large barriers, especially if production is divided into stages that entail multiple border crossings, where imposed disagreements multiply. The Swedish National Chamber of Commerce suggests that policies such as data localization requirements (where firms are either forced to store data and host data centers within a country's borders, or have limited ability to move and process data across borders) can lead to firms reorganizing. their GCSS, either moving or closing parts of their operations, while in some cases limiting service to end users draw a similar conclusion, noting that localization barriers to trade [11]. The Softwar Alliance further emphasizes the trade-constraining effects of country-specific technology standards and other forms of "digital protectionism," such as country-specific IT procurement [12].

The openness of the Internet is especially important for small firms to be able to participate in international trade.

Nicholson and Noonan note that while localization requirements may make cross-border trade difficult for large firms, they can make it "virtually impossible for small businesses that cannot afford to implement separate systems and standards in each country in which they do business." [13]. Moreover, these company-level impacts can add up to significant negative consequences for countries. Authors Kaplan and Rovshankish point out that as banks reduce their operations in countries with stricter data regulation, financial services will grow more slowly,

which could have adverse effects on development [14]. There are also more general concerns that policies adopted to limit Internet openness may create a "slippery slope" for additional interventions and possibly non-tariff barriers (such as local content requirements or efforts to promote "local innovation" through IP restrictions).

2 Development of a methodological framework for accounting non-market components when forming a system of indicators of the digital economy

2.1 The system of digital economy indicators

New processes, the creation of new products, the formation of new chains of market interconnections and business models have resulted from the introduction of information technology in the economy. The existing system of measurement of economic processes, based on the System of National Accounts methodology, with the consistency of its provisions relating to the accounting of market processes, allows only some aspects of the digitalization of the economy to be taken into account, which significantly limits the possibilities of analyzing the impact of the digital economy (DE) on the basic macroeconomic indicators.

Statistics on the digital economy at the current stage of its development, with the exception of certain, mainly technological aspects of digitalization, is not represented by a special system of indicators, but is part of the system formed within the individual sections of national statistics. This determines the relevance of the development of the methodological basis for taking into account its features in the formation of the system of basic indicators that characterize the scale and dynamics of the digital economy.

A specific feature of the digital economy, which is not sufficiently taken into account in the current version of the SNA (2008 SNA), is the presence of non-market goods and services among its components. Their presence has an impact on the formation of the entire system of indicators developed within the main sections of national statistics - statistics of production, investment, living standards, etc., in terms of their composition, principles of formation, and their structure. - in terms of their composition, principles of formation, used quantitative and cost measures, etc.

The consideration of the peculiarities of the digital economy, associated with the presence of non-market components in its composition, in the formation of its system of evaluation indicators can be provided by the implementation of two alternative approaches - the development of the system of digital economy indicators in accordance with the SNA methodology and the use of specialized approaches, which choice depends on the priorities of relevant measurements and the availability of the original information base. The first aspect is associated with the adjustment of SNA indicators to the non-market component, and the second is the development of systems of indicators, which may be formed on the basis of different principles, methodological approaches

and calculation schemes, characterized by different levels of reliability and have different analytical significance.

Within the conceptual provisions of the System of National Accounts (SNA), the possibilities of accounting for non-market components are mainly limited to the specifics of the SNA in determining the boundaries of production. When non-market production is excluded from the SNA accounting, the measurement of non-market components of DE in this case can be carried out on the basis of appropriate adjustments to the system of basic macroeconomic indicators.

Such adjustments, first of all, are necessary for the indicators of production in which non-market components are to be taken into account. For DE, these components are not only part of the production processes carried out within the production sectors of the economy, the public services sector and the household sector, but also the processes which support them (the formation and use of productive assets obtained on non-commercial terms) and the processes of using the results of productive activities. The latter aspect of digitalization is associated with the adjustment of indicators of monetary income and final consumption of households, taking into account the goods and services received by this sector for free or at substantially lower than market prices.

The development of a system of digital economy indicators taking into account non-market components implies the solution of a number of urgent methodological and methodological problems, which are mainly related to the shortcomings of the existing system based on the SNA principles, according to which the accounting of these components is limited to some processes only. Prospects for their solution in general can be provided through the implementation of the following aspects of accounting methodology and practice:

– in determining the composition of non-market components of DE;

– in the presence of the model of formalized representation of the mechanisms of their influence on the basic macroeconomic processes;

– the choice of adequate methodological approaches to the measurement of non-market components of DE;

– choice of the most adequate methodological approaches to transformation of estimates of non-market components into monetary estimates;

– inclusion of non-market components in the indicators of production, formation and use of resources in the economy;

– formation of integral indicators taking into account non-market components of DE.

There are two components of non-market goods and services - free digital assets and services - that are mainly taken into account in the international practice in forming the system of indicators of digitalization of the economy. Free digital services can be produced:

– self-services (e.g., vacation arrangements, reservations, etc.);

– volunteers (e.g., Wikipedia);

– on the basis of digital platforms carrying out advertising activities and sales of information about users.

Non-market assets include:

– software;

– information.

These components are currently not taken into account in the construction of basic macroeconomic indicators, including GDP. Also, due to the peculiarities of the SNA methodology, there are no adequate and consistent estimates of price characteristics, estimates of capital and assets, as well as characteristics of the level of welfare of the population for these components.

The main problems in taking them into account when constructing systems of DE indicators are:

– Accounting for these components in the production boundary - with identification of the types of goods and services produced, the production technologies used, and an assessment of the possibilities of including digital production in the SNA production boundary;

– identification of their producers with the allocation of the relevant sectors of the economy - households, non-profit organizations serving households (NPOSH), public administration sector (PAS);

– identification of the types of goods and services produced - economic assets, goods and services of intermediate and final consumption.

These problems are currently the subject area of many studies organized, including those within the framework of authoritative international organizations. Their most relevant areas are related to the consideration of non-market digital goods and services in the formation of basic macroeconomic indicators, including the GDP indicator. The main conclusions on the prospects for their adjustment to the components of the digitalization of the economy relate to the problems of inclusion in the objects of measurement:

– software available from open sources;

– products produced by volunteers;

– free goods and services in the form of content and media supported by advertising services;

– capital in the form of servers, etc.

An example of the use of alternative approaches to the construction of DE indicators is the construction of integral characteristics, which, among other things, take into account non-market components. A typical example of such construction is the Digital Economy and Society Index (DESI), developed by EU statistics. This index integrates the digitalization components of the EU countries, which takes into account 30 indicators grouped according to the following aspects of the policy of formation of an efficient digital economy:

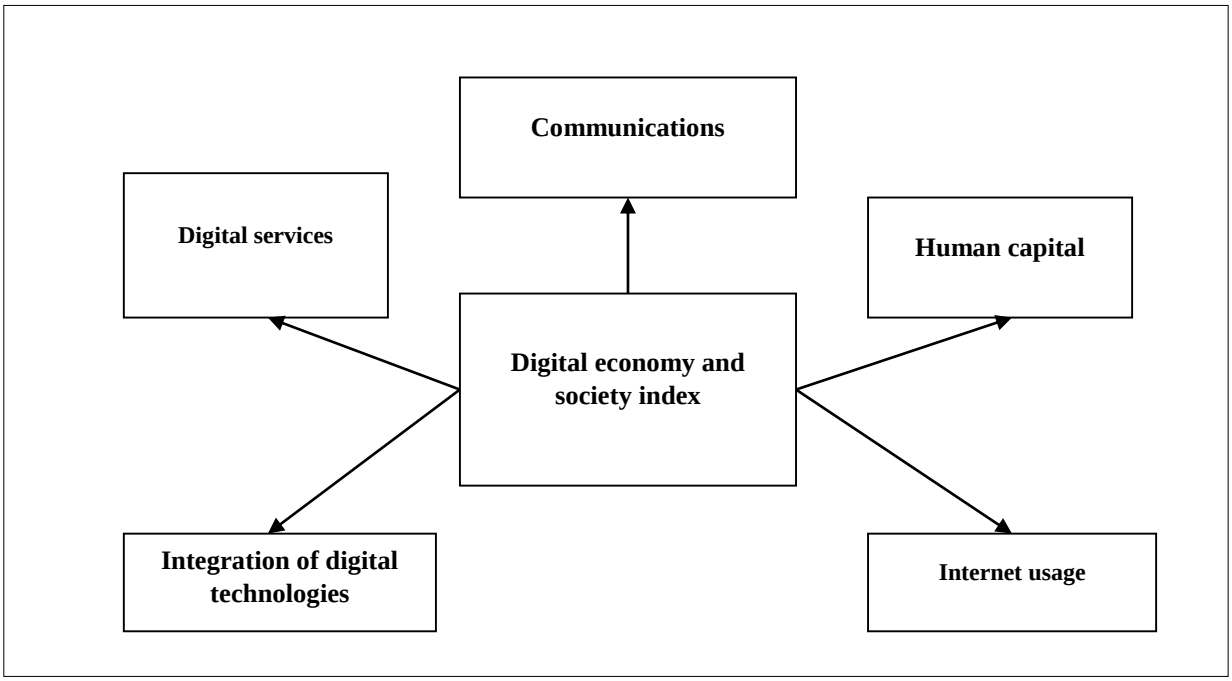
– Broadband penetration, speed and availability;

– the formation of human capital and Internet skills of the population and workforce;

– the extent to which the Internet is used by the public;

– the degree of integration of digital technologies in the commercial sector of the economy;

– the degree of development of digital public services (e-government) (see Figure 3).



Note – Source: compiled by authors

Figure 3 – Basic scheme of the Digital Economy and Society Index

In calculating the integral index for individual countries, each set and subset of indicators is assigned a certain weight. For example, connectivity and digital skills (an element of human capital), are considered the foundation of the digital economy and society and are taken into account in the construction of the index with equal 25% weights (the maximum score of digital efficiency is 1), the integration of digital technology in the commercial sector is considered with 20% weight, online activities (Internet use) and digital public services are considered with equal 15% weights. The DESI index is an example of the construction of integral indicators, allowing,

among other things, to take into account non-market components of CE, which, depending on their importance for a particular economy, can be assigned different weighting coefficients. [15]

2.2 Development of a methodological basis for non-market components accounting

Over the past decade, the global economy has seen dramatic changes with the increased use of information technology in the economy and consumer sector, which has had an impact on business and consumer models. Some services have become available at low prices, and some services have become completely free to consumers. Under these conditions, the prices of goods and services no longer reflect their real value. These aspects of accounting have become especially relevant in the process of development of the Internet and the expansion of opportunities to organize the exchange of large volumes of information on a global scale.

The peculiarity of the digital economy is the presence in its structure of components not reflected in modern statistics, in particular in national accounting statistics. These components are non-market goods and services produced and used in the digital economy.

The development of these processes required solving a number of methodological and technical issues related to their reflection in statistics, in particular in the statistics of national accounting. At the same time, the main problem for accounting became the need to reflect in the accounts the free (or quasi-free) services offered by the digital economy which, according to the SNA methodology, cannot be reflected as direct monetary transactions between producers and end users, which affects the quality of production and consumer statistics, and in general the reliability of estimates of basic macroeconomic indicators, including the GDP.

This situation in international statistics is due to the peculiarities of the methodology of national accounts, which formalize mainly market transactions. At the same time, there are only two exceptions to this rule in the SNA: the production of public services and the inclusion of imputed income from the provision of rental services by their owners. These exceptions are due to the need for international comparability of indicators of production and living standards of the population, which logically should not be lower in countries with a high level of public sector development or with a high proportion of the population who are homeowners. Consideration of these components in statistics is also explained by the existence of methodological approaches to their cost estimation - cost-based estimation for the LSG and market rents for its imputed value. There are no cost estimates for other types of free or non-market services in the methodology of the modern version of the SNA. As for quasi-free services financed through advertising, the SNA also has limitations in accounting, in particular, their exclusion from household consumption and accounting in the system only for advertising costs as intermediate consumption of production companies. In reality, free services are counted only in terms of their fixed production costs without taking into account other types of costs, including any voluntary contributions.

The process of digitalization radically changed the consumption patterns of households and became a factor in the emergence of components not included in GDP, and with the existing accounting system in some cases - a factor in adjusting its value towards underestimation. These factors also determined the recognition of a number of criteria adopted by the 2008 SNA and ESA 2010 as insufficiently correct. Actualization of the problems of accounting of non-market components of CE has revealed the need to adjust the existing methodology of their accounting. In particular, it is necessary to develop a methodological basis for the accounting of services received by households and their recording as final consumption expenditures. In the case of advertising companies, which sponsor such services, it is necessary to adopt the concept regarding the recognition of the relevant expenses as a kind of production costs, accounted as intermediate consumption, or investments, accounted as gross fixed capital formation. In cases where the financing of free services is supplemented by data collection or depends entirely on these activities, a choice is needed between the concepts of accounting for these data as a type of household production or treating them as a by-product whose production is not the object of measurement.

The problems of macroeconomic analysis in the context of the development of CE are also recognized at the level of international organizations. The effects of digitalization include: lower prices and higher quality of computers, cell phones and the use of Internet services, the emergence of new goods and services, innovation in financial markets and new ways of making payments, lower production costs, higher quality of products and production efficiency associated with the use of digital technology. Modern literature defines these phenomena in such terms as the Internet age, the revolution of information technology, the Internet economy, the digital economy, the sharing economy, etc.

Under these conditions, a correct measurement of the digital economy makes it possible to assess the impact of digitalization processes on the dynamics of macroeconomic indicators, as well as to identify their role in ensuring the dynamic development of the economy and the social sphere. The correctness of such measurements depends on the availability of reliable statistical tools for measuring the digital economy, the development of which is currently the subject of discussion by experts in the field of national accounting and other key sections of statistics. In addition, the increasing use of big data provides a fundamentally new information base for solving measurement problems with the digital economy.

Studies related to the measurement of the digital economy and the construction of appropriate estimators are usually based on the identification of industries and products defined as "digital. At the same time, an important condition for increasing the reliability of the estimates being developed is ensuring a balance between the capabilities of the methodological approaches used and the requirements for the original statistical information.

The problems of correctness of the developed estimates have another aspect related to the development of the methodological basis for measuring the production and consumption of digital products in households. The relevance of this aspect is determined by the expansion of households' access to Internet resources, which has made less definite the boundaries between the market production of households, production at their own expense, consumption and leisure. At the same time, households are increasingly involved in processes that used to be carried out through intermediaries and that are traditionally accounted for in GDP.

The collective economy has stimulated greater household participation in informal activities and the creation of unincorporated enterprises. Under these conditions, general methodological problems arise in measuring the impact of digitalization on macroeconomic performance, distinguishing between the uses of dual-use consumer durables and fixed assets. The current version of the SNA does not comment on the principles of accounting durables as investments in their parallel use in production. Therefore, when choosing the appropriate approaches to the differentiation of these components, it is advisable to refer to promising solutions in this area, implemented in foreign practice. [16]

In this context, the measurement and incorporation of free digital products and services into macroeconomic indicators is an important way of improving the accounting of innovations in the economy, which is directly related to its digitalization processes. Such products can be created by volunteers, directly by their consumers, or using platforms financed by advertising revenue and user data collection. The growth of households' well-being when using these products in accordance with the methodology of the modern version of the SNA cannot be measured in the framework of national accounting statistics. This determines the relevance of the development of indicators of welfare growth as a result of the use of these products, the use of which in the analysis would allow to assess the impact of digitalization on the welfare of different population groups, as well as its impact on the patterns of households' use of time resources.

Conceptual problems also arise in the analysis of the production of "public goods" carried out with free labor and financed mainly by donations alone (Wikipedia, Linux, etc.). The formation of these assets is not currently accounted for in GDP and their value is estimated as zero, despite the fact that they are economically significant for users. Correctness of estimates of economic benefits in practice in these cases can be provided with the use of satellite accounts, based on the data of which the impact on the indicators of multifactor productivity of use as an alternative to market assets obtained free of charge can be measured.

Another aspect of measuring the impact of digitalization on macroeconomic performance is the treatment of data as an independent SNA asset. This resource is of particular importance when making business decisions, and its accumulation in enterprises was carried out in order to

build a database of information about customers, improve products and increase productivity and profitability of commercial activities. With digitalization, there has been a reduction in the cost of data storage and collection with an increase in computing power (software, IT equipment), which were the main factors in the dynamic growth of data accumulation. This digital data has enabled the creation of knowledge information bases, which have become an additional factor in the growth of production as analogues of physical and intangible capital. [17]

In this part, the concept of databases was introduced back in the 1993 SNA, and additional clarifications were developed in the 2008 SNA, clarifying that databases should reflect only the cost of database management systems and the costs associated with digitizing data. These clarifications were based on the recognition of principles for evaluating the information content of data, which were not capitalized and, therefore, were not treated as a factor of production that had to be reflected in the SNA accounts. In recent years, with the observed dynamic growth of the formation of databases and their use in production processes (in particular, in business models that use advertising), the problem of their accounting has become particularly urgent, which, according to experts, requires the development of appropriate concepts that clarify the need to recognize data as a type of assets, the principles of their attribution to produced or non-produced assets and the valuation of data.

The digital economy has further empowered consumers to purchase individual goods and services, making it difficult to control differences in quality when comparing their price characteristics. This part actualizes the task of reflecting the price changes associated with the transition to the digital economy in order to obtain more reliable and valid estimates of GDP. [16]

The public administration sector and the NPISH sector produce non-market goods and services reflected in their production accounts, in which intermediate consumption is recorded on the use side. The final consumption expenditures of these producers are equal to the value of their output of non-market goods and services minus the proceeds from the sale of non-market goods and services at economically insignificant prices. However, they also include goods and services purchased by the public administration sector and the NPISH sector for direct transfer (without any processing) to households.

The presence of non-market components leads to an increase in the actual final consumption of households, which is associated with the inclusion in consumption of goods and services that are actually provided for individual consumption to households, regardless of who incurred the costs of their acquisition: units of the public administration sector, NPISHs or households themselves. Actual final consumption of the public administration sector and the NPISHs sector in accordance with the SNA methodology is defined as their final consumption

expenditures minus social transfers paid in kind, which corresponds to the estimates of collective consumption in the economy.

3 Development of methodological approaches to the valuation of non-market components in measuring the economic effects of digitalization

3.1 Development of methodological approaches to the valuation of non-market components

Although experts note the complexity of developing an appropriate methodological framework and the need for further improvement, there are currently in practice three different approaches to the measurement of free services in international statistics:

- cost estimates based on advertising revenues for services indirectly financed by advertisers;

- estimates of services provided to users based on the criterion of willingness to pay for them or using standard methods of estimating the time to obtain them using own resources;

- evaluation of the results of the use of these services, taking into account the economic benefits obtained.

The first, the most common approach to measuring the cost of free services is based on the assessment of income from advertising, by which they are financed, which in principle corresponds to the traditional approach using the cost indicator used in the national accounts. This approach is also currently used in the construction of cost estimates for entertainment television programs, which are similarly financed by advertising. In this approach, the relevant accounts are reflected on the sides of advertisers and users who benefit from free services. If extended estimates of the free services received are needed (e.g., taking into account the substitution of the relevant market services), additional adjustments to the SNA accounting methodology are required in terms of estimates of their production and consumption.

The typical measurement scheme under this approach is based on the assumption that the cost of advertising covers the actual cost of advertising and free services and reflects the following processes of interaction between funding sources, producers and consumers of free services:

- Advertisers consume services provided by households in the process of exposure to advertising messages and the services associated with the broadcasting of these messages by television companies;

- television companies provide advertisers with the services of broadcasting advertising programs and the services of broadcasting free programs to households.

- households receive free services in the form of entertainment programs provided by a television company in exchange for providing services to advertisers.

In the more specific case directly related to digitalization processes, free services and information from the Internet funded by advertising revenues exist and are used in practice by time-cost-based schemes. The use of such an approach is due to the existing criticism of the cost-based approach, which does not take into account a number of components economically relevant for measurement, in particular trade margins. In this aspect, differentiating the time spent on familiarity with advertising messages from the income generated by advertising allows households to be viewed as a participant in the production process, paid for by the advertising company, which also shares with the television company the costs associated with television broadcasting. [18]

Such estimates do not include consumer benefits and are based on contingent value estimates in national accounts, similar to contingent rent estimates.

There are other possible approaches to accounting for advertising costs in international practice. With some nuances in the interpretation of advertising costs as a component of intermediate consumption for advertising companies, there are developments that consider the possibility of accounting for these costs as intangible investments.

In this context, the relevant costs allow the formation of distinctive brand attributes of companies that are reference points for consumers. Through these attributes, advertising can elevate the status of the asset as a "brand" and help increase the potential profits of companies. Such intangible assets can strengthen the market position of companies or increase the price positioning of their products. For example, a number of experts note that advertising increases a company's sales in the long term and should be considered a type of investment.

A recognition of advertising as an investment is another alternative to accounting for it in GDP. In practice, this problem is not solved and the corresponding assets in the form of a "brand" are not considered as investments, for example, in ESA 2010 on the grounds that such investments are not associated with the creation of net value and the generation of a corresponding net income stream.

In selecting valuation options for free goods and services, it is appropriate to typologize situations in which their presentation with the participation of advertiser financing can be valued from the perspective of final, intermediate consumption or intangible investment. This choice is not neutral, but has an impact on GDP estimates, given that intermediate consumption is subtracted from gross output in the calculation of value added, and investment is summed with final expenditures. [19]

Another common approach to the measurement of non-market goods and services in the digitalization of the economy, is based on the concept of recognizing the costs of obtaining the relevant digital goods and services. The validity of this approach is determined by its relative simplicity in obtaining relevant valuation information and its interpretation. In international

practice, relevant estimates are based on data from user surveys, in which questions to respondents are formulated in the form of projection estimates. For example, in the surveys, their wording is presented in the form of open estimates of the cost of companies' refusals to use the services of the search engine Google or Wikipedia during a certain time period.

This approach has some justification in connection with the observed increase in the overall time spent on Internet services. In particular, it was found that globally each individual spends about three hours per day using the network services. At the same time, due to the fact that many types of network services are provided free of charge, according to the existing methodology they are not taken into account in official indicators of economic activity, including indicators of GDP and productivity in the economy. This situation has particularly negative implications for analytical practices based on indicators generated according to the established methodology. This also explains to a large extent many contradictions in the interpretation of basic analytical indicators. For example, according to international statistics, the share of the information sector in GDP has remained virtually unchanged over the past 40 years and varies between 4-5%, reaching a maximum of 5.5% at the end of 2018. The fixed stagnation of this sector at high dynamics of its other parameters (number of employees, level of technological equipment, etc.) is explained by the peculiarity of calculations of GDP indicator, in the construction of which transfers in the form of payments for goods and services are considered, which excludes from accounting free goods and services, receipt and use of which is not connected with the corresponding compensating transfers. Therefore, the prospects for measuring, for example, the contribution of the Internet to the economy, are associated with adjustments to the existing methodology of accounting the results of production and use of non-market goods and services provided by the network.

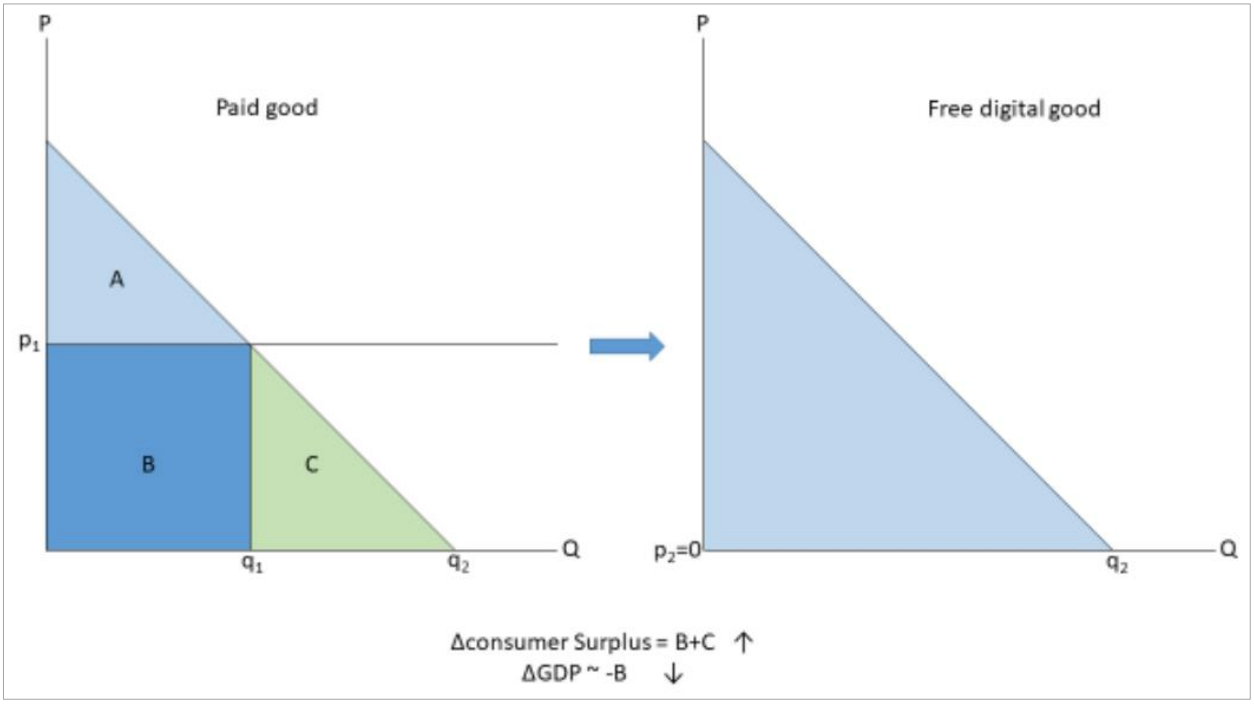
One of the promising directions in the construction of appropriate estimates are adjustments to GDP, which measures only the monetary value of all final goods produced in the economy and does not measure the level and dynamics of the level of welfare of users of non-market goods and services. At the same time, the differences between GDP and welfare estimates become more and more evident and significant as digitization is introduced into various spheres of the economy. [20]

The methods that have been developed in the research allow us to assess the contribution of the Internet to the economy using new and different approaches from traditional ones. These approaches are simple enough to be used in research as well as by policymakers when measuring the dynamics of the economy. At the same time, the objectives of their developers were not focused on replacing the GDP indicator, which is incorrectly used as an indicator of the level of welfare, but on the development of new approaches, allowing to obtain indicators that are more reflective of its level and complementary to GDP. [21]

As an example of an innovative approach to the measurement of non-market services, for example, the concept of consumer benefit is based on determining the difference between the amount that individuals are willing to pay for a product and the amount of their actual expenditures to purchase it. While relatively logical and easy to use, the main problem in applying this approach is related to obtaining reliable cost estimates of consumer benefits. Unlike GDP, which depends on actual payments for goods and services, and which can be recorded in the statements of companies, consumer benefits cannot be recorded in the existing systems of accounting and statistics. This thesis is also fully true for the digital economy, the measurement of non-market components of which also requires the development and use of fundamentally new tools. For these purposes, in particular, international practice used methods of online surveys of consumers to assess their preferences and the subsequent use of these estimates of consumer benefits from the use of various types of goods and services, including those obtained on a non-commercial basis. The studies usually use the method of direct measurement of consumer benefits with the formulation of offers to consumers to make a choice between retaining access to specific types of goods and services and abandoning them in exchange for a specific monetary compensation. [21]

The indicator of consumer benefits seems to be a more adequate assessment of the impact of the consumption of relevant goods and services on the welfare of consumers. Its use in assessments is of particular importance in measuring situations where previously commercially available products pass into the category of digital and obtained for free or at prices significantly lower than market prices. (figure 4).

In such an approach, the exclusion of goods and services from the market circulation leads to a decrease in GDP while consumers receive additional economic benefits. To measure consumer benefits, for example, from the use of Facebook, a representative (based on random selection) sample of its users in the United States was formed, who were asked to indicate the amount of money they would need to compensate if they stopped using Facebook for a period of 1 month.



Note – Source: [20]

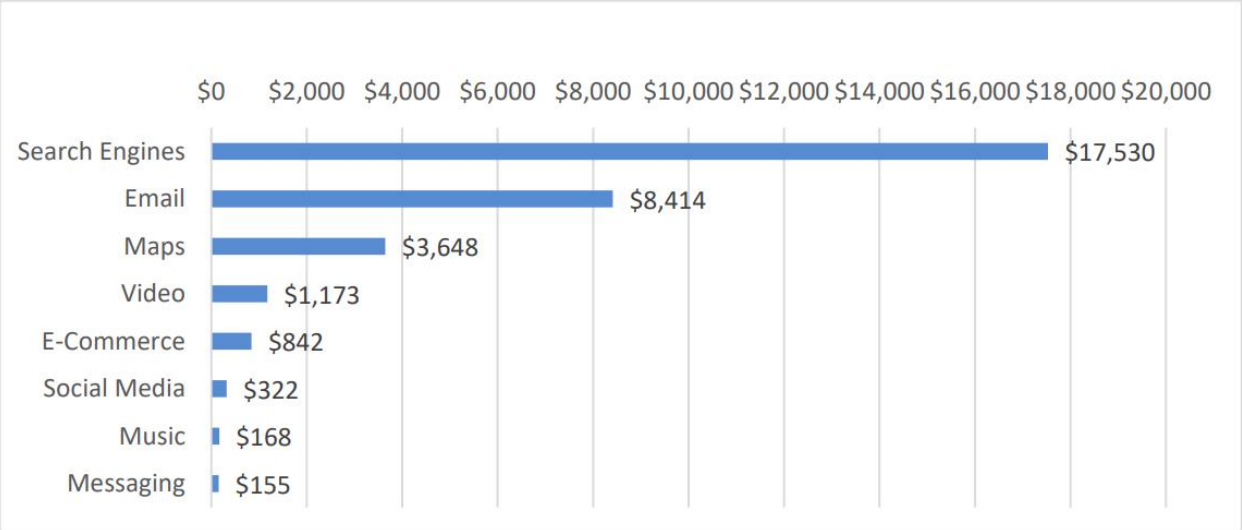
Figure 4 – Changes in GDP vs. Consumer Surplus for goods transitioning from paid to free

According to the research, the amount of compensation for a Facebook user in the U.S. averaged about $50 for giving up using the service for one month, 20% of respondents would give up using it for $1, and a significant portion of users (20%) indicated an amount of more than $1,000 as appropriate monetary compensation. Overall, experts estimated that consumers' annual benefits from using Facebook averaged $16 billion from its inception in 2004 through 2017. However, these amounts were not reflected in the U.S. GDP.

A similar study was also conducted in the EU, the results of which also yielded roughly similar estimates of relevant consumer benefits. It was estimated that the average user identified a compensation of 97 euros for quitting Facebook for 1 month. At the same time, users with greater socialization and intensity of socio-economic ties valued the benefits of using Facebook to a greater extent, which suggests that social effects are a key factor determining and higher estimates of consumer benefits for the respective populations. It is also noted that Instagram and YouTube users assess the benefits of using Facebook to a lesser extent, which can be explained by the possibility of replacing it with alternative social networks. The study also identified socio-demographic characteristics of Facebook users, among which women gave a higher estimate of the size of compensation payments for not using the program compared to men, similarly a higher estimate was given by the elderly, who had problems replacing Facebook with alternative social media platforms (Snapchat, Instagram) compared to younger age groups of the population.

Experts conducted additional research to measure consumer benefits generated when using the most popular categories of digital goods in the U.S. and European countries. Similarly,

respondents were surveyed to measure the monetary equivalent of compensation for giving up certain types or groups of goods for 1 month or 1 year. As the results of the study showed, the obtained amounts of monetary compensation significantly exceed the amounts that respondents would pay for these goods under market conditions (see figures 5, 6).



Note – source: results of annual surveys of representative groups of U.S. users

Figure 5 – Annual valuation of median user in US

Note – source: results of annual surveys of representative groups of users in EU (Netherlands)

Figure 6 – Monthly valuation of median user in our sample in Europe (NL)

Overall, the findings suggest that digital goods provide an additional and significant component of economic well-being, as evidenced by the estimates of consumer benefits. Meanwhile, search engine services, as estimated by respondents in the U.S., are characterized by the highest value with estimates of more than $17,000 per year, followed by email services and the use of mapping services. These services have no substitutes and are necessary for both work and daily life.

In general, research has shown that users have more difficulty rejecting groups of digital goods compared to rejecting certain types of goods that can be substituted. For example, the importance for users of search engines is determined by the need to use them when accessing the Internet before going to the right address, platforms that provide access to video content and e-commerce are also quite highly valued by users, to a lesser extent users value the benefits of social media, music content and messaging. Users may also pay for access to some services, such as those that provide services related to accessing video content (e.g., Netflix, Hulu, HBO, etc.). It is estimated that the consumer benefits even in this case are 5-10 times higher than the amounts users pay to access these services.

In Europe, the benefits of using WhatsApp were estimated in the sample to be more than five times higher than Facebook. When respondents were surveyed to determine the reason for this high score, it was revealed that WhatsApp in European countries is the most popular means of communication and is widely used to coordinate the activities of community groups, organize their interactions and inform their members about ongoing and planned events. However, the corresponding WhatsApp scores were quite low in the U.S. due to the fact that most U.S. users traditionally use SMS as their primary means of messaging and their losses from not using WhatsApp are estimated to be relatively small.

While recognizing the significant economic benefits of digital goods and services in the consumer sector, it is recognized at the expert level that the commercial sector currently accounts for only a small portion of the total value generated by CE. For example, experts estimate that the commercial sector received only 2.2% of the total economic benefits from technological innovation while the rest was received by the consumer sector.

Methods for assessing the effectiveness of digitalization processes based on measurements of consumer benefits can also be used at the level of individual structures engaged in the production of digital goods and services. The resulting estimates can be seen as theoretical maximum values of the value they create for consumers, and the availability of such estimates is important for developing general and investment strategy, pricing and marketing strategies. Retention of digital products in the marketplace is more likely if they generate large amounts of consumer benefits. Therefore, monitoring consumer valuations provides operational data on market conditions and, on this basis, enables the most informed current and strategic decisions to be made.

Estimates of the non-market components of digitalization in modern statistics are carried out on the basis of various methodological approaches. The most common of them are:

- market approach, based on the use of market prices in constructing appropriate estimates, in the absence of which the use of prices of analogues or comparable products is recommended;

- the approach based on cost accounting and indicators of the cost of production;

- income approach, using discounted and present value discounting of future expected revenues.

When evaluating data, price lists of databases obtained from brokers, data from statistics of mergers and acquisitions of information companies, insurance statistics, etc. are used. When evaluating free digital products, data from advertisers, data on in-kind payments, government expenditures on their production or acquisition, etc. are used.

3.2 Development of an analytical system of indicators to measure the impact of the Russian economy's digitalization processes on basic macroeconomic indicators

The digitalization of economic activity is most generally defined as the use of data and the Internet in the production processes and production of goods and services, the realization of new forms of household and SGI consumption, the accumulation of basic digital capital, digital cross-border flows and finance. The dynamic rate of development of digitalization processes with the observed slowdown of economic development in many countries was a factor in the recognition by many experts of the probability of underestimation of economic activity and the level of economic well-being in the context of the growing scale of production and consumption of digital products. For the GDP indicator, these factors were further argued to be a problem of low productivity growth during periods of dynamic technological change in the global economy. For the consumer sector, for example, the use of Internet platforms and smartphones has given consumers access to many new types of services whose growth since the mid-2000s in advanced economies has not been matched by similar growth in GDP and productivity.

In this regard, the problems of measuring the digital economy in macroeconomic statistics - GDP and labor productivity statistics - have become the subject of special discussions in the expert community. Some experts attribute the recorded slowdown in the dynamics of the relevant macroeconomic indicators to an incorrect assessment of the impact of the processes of digitalization of the economy on their level and dynamics. At the same time, the main explanations for this phenomenon, among others, are: the lack of consideration in their construction of free digital products, changes in the quality of digital products, the effect of globalized production, the presence of new types of financial services, etc.

In general, the main problems in measuring the dynamics of macroeconomic indicators, and in particular the measurement of GDP, under the digitalization of the economy include:

- The problems of determining the conceptual boundaries of GDP;
- the problems of setting prices for new and improved digital products;

– the problems of determining unaccounted output in the digital sector.

Under the conditions of the dynamic digitalization of the economy, the problems of measurement and data generation for statistics of foreign economic activity, statistics of the monetary and financial sectors are also relevant. At the same time, ensuring a more correct measurement of digital products and transactions can also improve the quality of estimates of inflation processes in the economy, balance of payments indicators, estimates of financial resources and cross-border and shadow flows, etc.

Experts associate the correctness of GDP measurements in the context of digitalization with the problems of accounting for digital products, and, above all, for products obtained on a non-market basis. For example, free products for consumers may be produced by volunteers, by consumers themselves, or using digital platforms financed by advertising and consumer data collection. To address these, experts suggest, among other things, changing the definitions and boundaries of traditional output, consumption, and income indicators. For example, the addition of free digital products to production and consumption in GDP calculations implies the inclusion of two transactions that increase the gross income of consumers and producers of relevant products in the components to be taken into account. Technically, these transactions are recorded as the presentation by the producer of imputed (imputed) income to the consumer in the form of a transfer or the purchase of advertising viewing services, which were provided for the subsequent purchase of free products. However, this approach to the accounting of digital goods and services seems rather conditional from the economic point of view of the procedure of receipt and simultaneous return of imputed income by the consumer, which is significantly different from his actual monetary income, and the producer's imputed income is also significantly different from his actual income.

The problems of counting digital goods and services in GDP are also associated with the specifics of measuring nominal GDP, which, according to many experts, is not a measure of well-being, which is measured by the growth of real consumption or (with appropriate adjustments) real GDP).

The growth of total welfare from digital products is associated with consumption benefits, which are not reflected in GDP and which are characterized by a significant scale. Therefore, comparisons of total welfare from digital products with measures of actual household final consumption or GDP in some cases also capture significant magnitudes of potential measurement error. For example, estimates derived from data from surveys of U.S. Internet users regarding the terms of their abandonment of online services have adjusted household consumption figures. According to such estimates, U.S. GDP was adjusted upward by about 30 percent for their overall consumption benefits.

Currently, there are no unified and universally recognized methodological and methodological approaches in international statistics to account for the influence of non-market components of CE on the basic macroeconomic indicators. The existing developments in this area are usually based on different principles, specific for different countries depending on the objectives of relevant measurements and the level of development of this area of national statistics.

When estimating the contribution to GDP of non-market goods and services of CE, international statistics widely uses the concept of welfare improvement and consumer surplus in the sectors of the economy resulting from the use of relevant non-market goods and services. At the same time, according to the existing methodology, some free products are already included in GDP, in particular, free products produced by LGUs and non-profit institutions serving households, using the total cost method, are included in the price of advertised products as a value added component. The impact of non-market components of CE on macroeconomic indicators can also be assessed using price indices for its goods and services. For example, based on price and physical volume indices, consumer features added for free to existing digital products can also be taken into account, e.g., adding a camera to smartphones can be taken into account when adjusting the price of a smartphone to reflect changes in its qualitative characteristics.

In terms of software, current estimates include items purchased on commercial terms or produced at their own expense. At the same time, software received from other entities for free or at prices significantly lower than market analogues is excluded from accounting. This approach generally does not correspond to the logic of using free software as production assets.

In terms of free information as an element of gross fixed capital formation (GPC), current statistical approaches to its recording are based on the principles of capitalization of databases organized to ensure efficient access to and use of information resources. Existing statistics tend to capture commercially purchased data, but do not capture data produced from own funds, which can also be seen as a special type of knowledge-based assets. In this part, the problems of their measurement and the construction of a generally accepted system of indicators for economic assets - the costs of their acquisition, prices of their acquisition, indicators of their use in production (depreciation), etc. are relevant for the current practice.

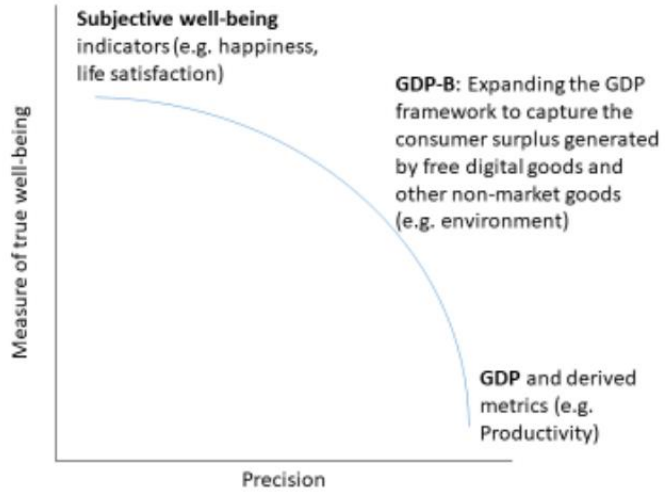
Of particular importance in the system of indicators of digitalization of the economy are indicators of the macroeconomic level. The shortcomings of traditional assessments of the impact of digitalization processes on macroeconomic processes explain the expansion of the subject area of research aimed at improving methods of measuring the economy, taking into account the characteristics of digital goods and services.

The most promising areas of such developments are associated with the formation of indicators considered as an alternative to traditional macroeconomic indicators, including GDP.

An example of such indicators is GDP-B (GDP-B), which is a modification of the traditional indicator of GDP, adjusted for the economic benefits received by consumers from the use of new and free digital goods. Experts recommend, in particular, to take into account the dynamics of this indicator in measuring the level and dynamics of the population's well-being, and to combine the corresponding estimates with production indicators. For example, it is estimated that taking Facebook benefits into account adjusts the annual growth of U.S. GDP upward by 0.05-0.11 percentage points. Despite the fact that GDP-B estimates are admittedly insufficiently accurate and less correct than the GDP indicator, their use in analytical practice makes it possible, at least at a rough level, to measure the economic well-being of society in the digital age.

The GDP-B indicator, while remaining generally within the framework of traditional macroeconomic estimates, reflects only the private economic benefits associated with the processes of digitalization. In international practice, there are other approaches to quantify the impact of digitalization on basic socio-economic indicators.

Another direction of assessments developed is related to the measurement of the subjective aspects of well-being, which are determined by the criteria of satisfaction with living conditions. This aspect of assessments has a certain conceptual basis, according to which the measurements should take into account not only the economic benefits of digitalization, but also the effects (including negative ones), realized at the level of subjective perceptions of its impact on the level and quality of life. However, such estimates, according to experts, remain insufficiently reliable and currently cannot be used in analytical practice or taken into account in the development of effective policies in the field of digitalization of the economy and the social sphere. In the range from developing current macroeconomic indicators, including the GDP indicator, to indicators reflecting the level of well-being taking into account the effects of digitalization, the GDP-B indicator is positioned in its middle part and can be used by analysts and other users (including policy makers) to comprehensively assess the results of digitalization (see figure 7).



Note – source: [20]

Figure 7 – Positioning of the GDP-B indicator on the scale of assessing the effects of digitalization

In general, the results of studies of the effects of digitalization record a significant increase in the level of well-being, which is not accounted for by traditional macroeconomic indicators, including indicators of GDP and productivity. Accordingly, it is possible to recognize the validity of the conclusions of many experts concerning the fact that the slowdown in the growth rate of macroeconomic indicators in the world economy over the last decade and a half is not an objective pattern, and the observed trends can be corrected if the effects of digitalization are adequately taken into account. At the current stage of development of the methodology of relevant measurements, accurate quantitative estimates in this case cannot be developed due to the existence of other sources of consumer benefits, including free and quasi-free goods and services not directly related to digital, and which existed before the development of CE.

One of the key aspects of measuring non-market goods and services related to the digitalization of the economy and social sphere is the formation of appropriate valuation indicators for such a key sector of production and consumption of digital goods and services as households.

International practice currently uses two main approaches to measuring the value of production of non-market household services. The first approach uses market price equivalents of non-market goods and services produced by households, which are adjusted for differences in their qualitative characteristics. However, this approach has a number of disadvantages associated primarily with the need to develop a system of equivalent market prices for new and qualitatively different characteristics of digital goods and services. The second and most commonly used approach in practice is based on measuring the total costs associated with the production of non-

market goods and services. These costs include the intermediate consumption of resources associated with their production, labor costs, and the cost of capital services used in production.

Existing estimates of the value of non-market production of goods and services by households tend to characterize the amounts of value added generated by the factor components of the respective activities (labor and capital services components). This is partly explained by the fact that goods and services used as intermediate consumption in the production of non-market services are already included in the estimates of households' final consumption. It is also due to the lack of information on the structure of households' final consumption expenditures with the separation of expenditures used for the production of non-market services related to the components of intermediate consumption. [22]

That is why in general all estimates of the value of non-market services produced by households should be interpreted as components of the value added of relevant goods and services with the exception of the value of services provided by homeowners, which are already included in the estimates of household final consumption in the SNA. [23]

A special subject area of research is methodological approaches to the measurement of non-market production based on the use of factors of production - labor and capital.

In practice, two approaches are used to estimate labor costs for the production of such goods and services. The first approach is based on the replacement cost approach, according to which the average hourly wage at the labor market (after tax payments) of an employee engaged in the production of non-market goods and services is used as their equivalent. This approach is, in principle, universal and can be applied to various types of economic activities carried out within the framework of production of non-market goods and services by the household sector, and, as a rule, is provided with relevant statistical information. The second more simplified approach, which partially eliminates the problems associated with the search for information on substitution costs for certain types of activities, is based on the use of the average hourly wage (after taxes) of labor in the economy or in the areas of activities, producing analogues of goods and services produced by households, as the cost equivalent of alternative costs.

Each of the approaches used has certain advantages and disadvantages. In practice, most studies develop estimates based on measurements of the market value of production of non-market goods and services in similar volumes and with similar quality characteristics. At the same time, according to a number of experts, the labor cost of any individual will come close to the alternative costs determined by the notional amount of income from the use of time spent on the production of non-market goods and services, when participating in market production. In this case, it is logical that the concept according to which non-market activities are paid equivalent to the professional qualification characteristics of specific individuals. At the same time, there is also a

logical position that the production of similar types of goods and services in households also implies equal labor inputs regardless of the professional and qualification characteristics of their producers. This approach, in particular, corresponds to the principles of household accounting in the national accounts. Another argument in favor of this approach is the hypotheticality of the assumption that every individual employed in non-market production (housewives, pensioners, etc.) can, in the current situation on the labor market, find a job that fully matches his qualifications. Therefore, for some individuals the opportunity cost may be zero, for example, in the case when their competences have no value on the labor market.

The existence of these problems also determines the general conclusion with respect to the choice of cost equivalents in estimates of hourly labor costs, which should be adjusted for the quality of work using the productivity and quality of non-specialists as the basis for adjustments. For example, some experts estimate that the average hourly wage in a number of economic activities used as a replacement cost indicator is about 75% of the hourly wage of a specialist. (Landefeld and others, 2008).

Estimates of hourly wages for the main methods of estimating the value of non-market goods and services are usually made with deductions for taxes and social security contributions. Also in some studies such estimates are made on a gross basis, consistent with the recognition of labor cost equivalence in informal sector and non-market production.

Another factor considered in measuring non-market production is the services of capital used in the production process. This factor, by analogy with other activities, can be interchangeable in household production of non-market services with labor inputs.

The theory of capital services has primarily to do with national accounts. Capital in the form of non-financial assets in the SNA refers to objects that benefit from their use in production or their possession over a period of time. Digital assets as factors in the production of non-market goods and services do not differ in principle from other productive assets in accounting methods.

In general, the assessment of the value of capital stocks in accordance with the SNA methodology is based on a number of concepts, the purpose of which is to develop a scheme for calculating the total value of asset stocks, the assessment of which, even for similar assets, but with different characteristics and different age parameters, is a rather complicated methodological and technical problem. In cases where there are new accumulations, the formed assets for a certain (annual) period can be directly evaluated and aggregated. Theoretically, if there are developed markets for previously used assets with different characteristics, the prices fixed in these markets can be used to revalue them in the prices prevailing in the current period. However, due to the fact that in practice such information is usually not developed in statistics, it is necessary to use indirect methods to estimate capital stocks. In this part, a possible approach widely used in international

statistics is the approach based on the hypothesis that the price of an asset decreases over time, and its practical implementation is the Continuous Inventory Method (CIM).

According to CIM, the calculations take into account the decline in value of all assets existing at the beginning of the current period during the analyzed period and the exclusion of assets that have reached the end of their useful life in this period. Also, the use of MSI provides for the addition of the residual value of assets acquired during the year. [23] For households as the main producers of non-market goods and services, digital assets can refer to consumer durables. Existing approaches to the estimates of the value of digital capital services are based on measurements of the production stock of the relevant types of consumer durable goods (DDP) using the method of continuous inventory (perpetual inventory method). Using this approach makes it possible to estimate the net stocks of consumer durables at a certain point in time, taking into account their receipts over a certain period and their depreciation. (see formula 1):

$$K^t = K^{t-1}(1-\delta) + I^t. \quad (1)$$

where K^t – net stock of consumer durables at the end of the period,

I^t – the purchase of consumer durables during the period *t* in constant prices,

δ – depreciation rate (for the main types of TDP is set at 20%).

The cost of capital services is measured as the product of the unit price of capital services per unit of its stock and its net stock. There are three elements in the price of capital services: income on capital, consumption of fixed capital (analog of depreciation), and the revaluation component of capital goods.

According to the simplified methodology, the price of capital services for digital consumer durables can be determined on the basis of the expression (see formula 2):

$$P_K^t = P_I^t [r+\delta], \quad (2)$$

where *r* – annual profit rate (set at 4%);

P_K^t – service capital price;

P_I^t – price index of consumer durables.

The cost of capital services from the use of digital consumer durables in households can be estimated based on the expression (see formula 3): [22]

$$P_K^t K^t = [r+\delta]P_I^t K^t \quad (3)$$

Digital technology has brought significant changes to the nature of production, expanding the production of goods and services with fundamentally new qualitative characteristics. But at the same time the system of measuring economic growth and well-being of the 1930s remained intact. At the same time, GDP as a measure of the cost of acquisition of final goods by households, the commercial sector and the SGI has remained a key indicator of the level of economic activity, which is taken into account by policymakers when setting strategic goals. Similarly, this indicator is often used as the main characteristic in assessing the level and dynamics of the welfare of the population.

Criticism of GDP as an indicator of well-being has stimulated the development of research focused on the development of alternative indicators. The studies considered such factors, arguing the need to develop new indicators, as production of new types of goods and services, expansion of intangible assets, production in the sector of households, etc. The estimates given in the studies also confirm the hypothesis, according to which the GDP indicator is not an adequate measure of well-being and underestimates the real growth of production, income and labor productivity in the economy ([42], pp. 6-14).

The use of GDP as an indicator of well-being is particularly problematic for the conditions of CE when there are groups of goods and services with zero prices, which is usually observed in the digital economy, a feature of which is the production of digital goods with almost zero marginal cost and in many cases zero price. As a consequence, these factors do not allow us to assess their impact on the level of well-being in the framework of calculations of traditional macroeconomic indicators, including GDP.

The issue of valuation of digital services provided by online platforms at zero monetary cost of their production remains a matter of debate in the expert community. The key in this case is the issue of determining the benefits of the information generated by the relevant transactions. One of the most common approaches to constructing such estimates is the approach based on the hypothesis of recognizing the information resources generated as an investment by companies in organizational capital. This approach allows to take into account the commercial and social value of consumer information, which can be used, inter alia, when choosing the optimal market strategy, determining the priority areas of investment, etc. Such information also makes it possible to improve the quality of indicators developed as part of national accounting statistics.

Many online platforms provide consumers with digital goods and services at zero monetary cost. And regardless of the characteristics of consumers, receiving free digital services essentially represents exchanging them for personal data. Therefore, according to some experts, there is no such thing as "free goods and services" in the digital economy. In particular, large data holders, online platforms can reap significant economic benefits through the monetization of information.

However, there are unresolved methodological problems in assessing information resources formed in exchange for free digital goods and services provided to users, which include:

- Conceptual problems in understanding the mechanisms of data value creation on online platforms, which is related to the difficulties of obtaining information from companies operating on these platforms;

- empirical problems related to the characteristics of data as intangible capital, which tends to be difficult to measure due to the lack of free markets for most intangible assets and the specific development purposes of much of the data, intended mainly for own use by commercial entities. [24]

In international practice, there are examples of data valuation using different conceptual and methodological approaches. For example, for the main types of online platforms based on different business models, using data on information flows, consumer benefits, value generated by third parties and information on the monetization mechanisms of online platform companies, the features of the main business models implemented by the relevant business entities were studied. With this in mind, data value chains were defined, formalizing the processes of its creation by companies operating on online platforms.

The problem with estimating the value of user data is the inapplicability for this purpose of common approaches to measuring the value of economic goods: based on cost estimates, market equivalents and revenue estimates. All of them have shortcomings and limitations that do not allow their use without adjustments in the valuation of data related to the capital of online platforms. For example, the cost-based approach, and in particular the analyst salary and data center cost metrics, have been estimated to result in significant underestimation of data value.

Another common approach to valuing data as a type of firm investment in organizational capital is based on empirical data reported by large companies operating online platforms (Amazon, Booking Holdings, eBay, Google, etc.) from 2000 to 2017. That said, research has shown that the most value in the chain is created when companies use data-driven business models.

Measurements of investment in organizational capital in this case are based on commercial, general and administrative expenses reported in the companies' annual profit and loss statements. Models for estimating the depreciation rate of organizational capital for online platforms are also used in the construction of estimates.

In general, the idea of measuring non-market components of CE is based on the hypothesis that consumers exchange their personal data for free digital goods and services. In this case, the barter transaction can be the basis of data value - the availability of a transaction record for a single consumer has zero or negligible value, while the availability of data sets allows statistical patterns to be identified and in this part can represent potentially significant or substantial value.

CONCLUSION

In the digital environment, there can be both market and non-market spaces. Market spaces are focused on the exchange of goods and services, regulated by prices, profits and losses. In contrast, non-market spaces are platforms, software, communities of people, and even small collections of infrastructure that are managed without the desire to sell goods.

International experts argue that the development of digitalization has had a negative impact on the monetization of many economic factors of production and, as a consequence, has led to a drop in aggregate market productivity. In turn, the measurement of the digital economy is distorted by the failure to capture non-market and intangible assets that are used by households and have a significant impact on the real economy.

That is compounded by the fact that, in the digital age, some of the goods of the market sector go beyond GDP, distorting the economy in a downward direction. The availability of a wide variety of online information has reduced search and selection costs and enabled households to substitute market services for their own produced services.

In general, the idea of measuring non-market components of CE is based on the hypothesis that consumers barter their personal data for free digital goods and services. That said, bartering transaction can be the basis of data value - having a transaction record for a single consumer has zero or negligible value, while having data sets reveals statistical patterns and in this part can be potentially of significant or substantial value.

Meanwhile, the view that the shift to self-service provided by digital substitutions reduces and distorts GDP fails to take into account consumer behavior and confuses the roles of nominal and real GDP. Free digital substitutions change the structure of GDP, not its volume, because households are likely to spend the money they save on something else. In this regard, we can say that GDP remains unchanged while welfare increases. But this critique of GDP assumes that nominal GDP plays a role that it does not have. The question should be whether real GDP reflects welfare growth, i.e., whether deflators reflect growth in the quality of digital goods. The accuracy of deflation is crucial to measuring productivity because productivity growth often has a downward effect on prices.

However, changing the definition of GDP in any fundamental way can create more problems than it solves. Different issues require different concepts. The current definition of GDP fits well with the key economic policy questions of income, employment, monetary policy, potential government revenues, investment, and productivity. Non-market household

production does not produce income that can be spent or income that can be used to finance investment and easily taxed. Including non-market production in GDP can mask important changes in market production, such as the onset of a recession.

The current study has attempted to develop a methodological framework for taking non-market components into account in the formation of a system of indicators of the digital economy and some methodological approaches to the valuation of non-market components in measuring the economic effects of digitalization.

Prospects of inclusion non-market digital services in the production boundary are associated with the adjustment of the existing SNA methodology, which will allow taking into account the significant scale of profile for the digital segment of goods and services produced in the sectors of public administration, non-profit organizations, serving households and households. Such an approach will also make it possible to adjust the values of the basic macroeconomic indicators, which, when additional types of digital goods and services produced in the relevant sectors are taken into account, will lead to their growth, which, according to experts, may be quite significant, which, in turn, may require a revision of the entire system of national accounting statistics indicators.

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