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DIGITAL ECONOMY AS A SOURCE OF EMERGENT GROWTH

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Abstract. *The scientific issue "Digital economy as a source of emergent growth" is important because it adds to the development of the general theory of the digital economy. After all, solving this issue necessitates answering important general questions about the scale, structure of the digital economy and its multiplier effect on other sectors. At the same time, this scientific issue is important for the Ukrainian economy, which has to find sources of rapid stabilization and post-war recovery. The purpose of this study is to more precisely identify the concept of "Emergent Growth" and apply the ideas (contents) of this concept in the context of transforming the digital economy into a source of "Emergent Growth" of the Ukrainian economy. Part of the overall goal of this study is to identify the main circumstances that hampered emergent growth before the start of the active phase of the Moscow-Ukrainian war and may hinder growth in the post-war recovery. Accordingly, we are discussing the circumstances that hinder the digital economy and its IT sector from becoming a source of emergent growth. The research uses the tools of the theory of endogenous/exogenous economic growth, structural analysis, analysis based on rating evaluation, analysis of the digital economy and ICT sector economic indicators dynamics. The results of the research were embodied in: determining the content of the emergent growth category based on its connections with the endogenous/exogenous growth, developed/developing economies, sustainable growth categories; judgements about the general conditions for transforming the digital economy into a source of emergent growth; substantiating the potential of the Ukrainian ICT sector as a source of "Emergent Growth" of the Ukrainian economy; the use of the scheme of the digital economy economic cycle to explain the content of "Emergent Growth"; substantiating the potential of the Ukrainian ICT sector as a source of "Emergent Growth" of the Ukrainian economy and outlining some features of the Ukrainian economy and society, which objectively inhibit the real performance of the role of the source (factor) of "Emergent Growth" by the ICT sector.*

Keywords: *digital economy, emergent growth, emerging countries, propensity to use the advantages of the digital economy.*

The scientific issue of this study is related to the identification of sources of economic growth created by the digital economy, in general, and economic growth of the Ukrainian economy, in particular. The importance of solving this issue for Ukraine is increasing, given the need to stabilize the economy during the war and to restore the economic potential after the war. The positive experience of individual countries testifies to the possibility of rapid growth due to the use of special favorable circumstances and sources. According to the authors, the IT industry, which is the core of the digital economy, has the potential to be a source of growth and recovery for the Ukrainian economy. Therefore, the **research hypothesis** is an assumption about the IT sector of the national economy as a source of distinctive "Emergent Growth".

The term "emergent Growth", other concepts related to it, as well as the context in which they are used, denotes the ongoing existence of economic subjects in particular states. These can be, first and foremost, innovative companies at the initial stages of their life cycle, known as "emerging Growth Companies" [1]. Secondly, the term "emergent" is used for investment funds ("Emergent Growth Funds") which support companies dealing with unique products, technologies and having the potential for rapid growth [2]. Thirdly, the concept of "Emerging technologies" is used in those cases when it comes to the adaptation of new technologies in innovative and traditional activities [3]. Fourthly, the term "emerging" refers to countries which are mastering special advantages and opportunities while achieving high growth rates. In particular, the term "emerging" is used for countries - Advanced Emerging and Secondary Emerging - in the Global Equity Index methodology [4]. The investment markets of the countries around the world are evaluated according to the Global Equity Index method. And the term "emerging" is used as a counterpoint to "advanced", precisely to emphasize that high growth rates are achieved by countries with a lower level of development. The McKinsey Global Institute uses the phrase "emerging economies" to distinguish those "developing economies" that have demonstrated high rates of economic growth for a long time. Moreover, the latter are achieved through the use of advantages and opportunities, including technological ones [5].

Taking everything into account, we can conclude that "Emergent Growth" is a phenomenon generated by the successful use of favorable conditions, innovative opportunities and advantages, and successful adaption to new technologies. This kind of growth can be both quick and long-term. At the same time, we are discussing advantageous conditions, opportunities, and advantages that are realized by developing countries rather than the most developed. Such developing countries in the early stages of "Emergent Growth" may be in challenging socioeconomic circumstances that must be overcome through rapid growth.

According to the authors of this section, the concept of "emergent growth" should be described in conjunction with the concepts of "endogenous growth" and "exogenous

growth." Such analysis is especially significant in light of the hypothesis regarding the use of the Ukrainian economy's IT industry as a source of emergent growth.

Ideas for our research are formulated within the framework of the "Endogenous Economic Growth" theory. They include the following:

- Endogenous growth, as opposed to exogenous growth, is dependent on internal factors, the most important of which are human capital and the research and development (R&D) sector;

- Investing in human capital and developing the research and development (R&D) sector creates a distinct type of economy known as a "knowledge-based economy".

Based on the arguments presented in the "Endogenous Economic Growth" idea, we assume that economic growth does not acquire endogenous features until the research and development sector develops. Furthermore, the latter is dependent on human capital, which is developed through education, research, culture, medicine, and the like.

A series of model constructions have been developed within the context of the "Endogenous Economic Growth" theory to explain the impact of human capital on economic growth [6] and the influence of research and development sector on the economic growth [7].

The Endogenous Economic Growth theory reaches the pinnacle in the 1990s. However, in 2022, enthusiasm in the concept of economic growth based on research and development surged once more. This occurred as a result of the approval of "The CHIPS and Science Act" normative act in the United States. The act calls for the greatest investment in the research and development (R&D) sector in the history of the United States, totaling $280 billion [8]. The expediency of such investments is supported by the need to lessen dependence on microcircuits developed in other countries and to boost the development of the own research and development sector.

Thus, Endogenous Economic Growth assumes the existence of a "knowledge-based economy", which relies on significant investments in the research and development (R&D) sector. Such investments are clearly available for advanced economies. It is advanced economies that set the goal of the so-called "sustainable growth" - growth that does not deplete resources, does not harm the environment, and does not exacerbate social problems.

Individual countries with developing economies can, as evidenced by the facts of their economic history, ensure sufficiently high rates of economic growth for an extended period of time, relying on *externa*l factors. Therefore, such Emergent Growth takes on the characteristics of exogenous economic growth.

Fig. 1 depicts the relationships of the examined ideas.

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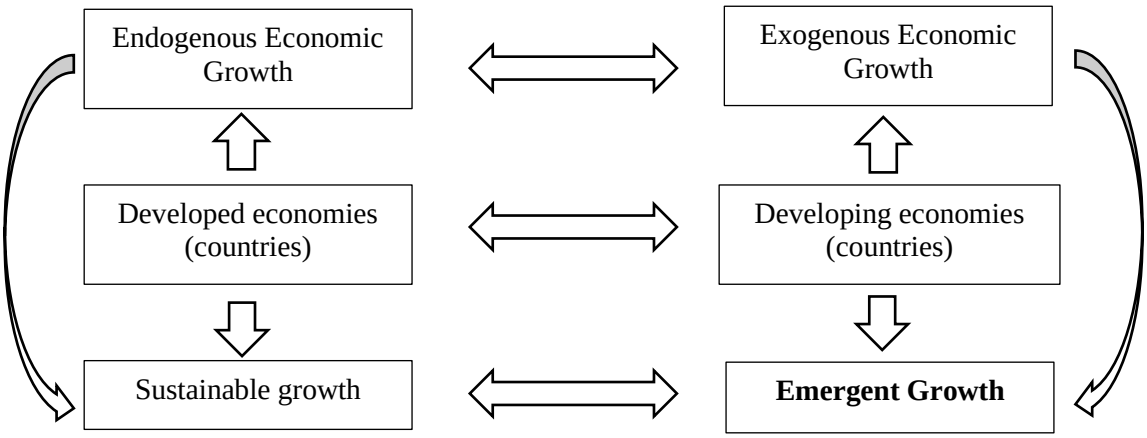

Figure 1. Emergent Growth in the system of categories that explain growth

Sources: developed by the authors

The idea illustrated in Fig. 1 can be formulated as follows: "Emergent Growth is economic growth demonstrated by some developing economies (countries). Furthermore, given the use of external sources without the establishment of an integral "knowledge-based economy" system, this growth is exogenous. With such growth, the goal of sustainable economic growth may not be achieved, but the general standard of living of citizens improves.

We are aware of a specific convention of categorizing countries into developed and developing while discussing the connection of emergent growth and developing countries. This conditionality is particularly evident in the case of Turkey. Turkey is classified as a developing country under the World Bank classification system. Turkey, on the other hand, is classified as a developed country according to the Human Development Index (HDI) criteria. Therefore, when we use the phrase "developing countries" in Fig. 1, we mean those countries that do not formally belong to developed countries based on all criteria and international classifications.

The definition of the digital economy as a source of emergent growth is linked to its boundaries and structural elements. The boundaries, elements of the digital economy, and ways of estimating its scale are still being debated. According to one of the digital economy studies, "the bad news is that there are no specific measures of the digital economy... The foundational minimum is set by measures of the digital (IT/ICT) sector..." [9].

The issue of evaluating the digital economy is being studied by authoritative economic analysis institutions such as the Bureau of Economic Analysis (BEA) USA [10], statistical analysis bodies of the OECD [11], the Statistics Canada [12], and the Chinese Academy of Information and Communication Technologies (CAICT) [13]. One of the most challenging issues is the separation of so-called "digital" and "non-digital" components in the structure of modern economies' final products.

This study requires an examination of the structure of the digital economy for the following reasons. We assume that a sufficiently full (exhaustive) set of digital economy components renders economic growth *endogenous*. Instead, an *insufficient (partial)* set of these elements serves as the foundation for *exogenous* growth, which, given favorable conditions, transforms into emergent economic growth in developing countries.

Regardless of the discussion over the boundaries, structural elements, and ways of assessing the scale of the digital economy, there are several indisputable propositions on which this analysis will be based.

First, it is the recognition of the existence of a special technological core (scope) of the digital economy, which is the ICT sector. The components of this core are defined as: 1) hardware manufacture, 2) software and IT-consultation, 3) information services, 4) telecommunication [14]. According to the approach implemented by the OECD, such components are defined somewhat differently, namely: 1) telecommunications and mobile communications, 2) broadband access and connectivity, 3) internet communication technologies themselves [15].

Secondly, it is a demarcation of the spheres of direct and indirect application of the ICT core and a more or less clear identification of the components of the mentioned spheres. Using research on the areas of the digital economy, which are presented in the sources [14, 16-21], we make a generalization about the structure of the mentioned spheres, which is visualized in Fig. 2.

Fig. 2 shows the idea of distinguishing two interrelated spheres, namely direct and indirect application of the results of the digital economy ICT core development.

The *economy of platforms* and the *economy of digital services* comprise the sphere of ICT direct application. Each of these elements has a substantial impact on the character of economic relations. For example, the term "platform economy" has a different name that captures the nature of these changes: "trust economy." The latter is explained by the fact that technologically advanced IT platforms alter the relationship between product and service manufacturers and consumers.

Relationships become clearer and more sensitive to interests and values. In particular, the *creator economy*, a component of the platform economy, more intimately connects consumers and manufacturers in science, culture, art, journalism, entertainment, and recreation. *Gig-economy* is related to changing relationships in the field of employment, as it creates opportunities for independent, temporary, part-time forms of employment. *Sharing economy* forms more transparent and direct relations of economic subjects in the sphere of use of non-financial and financial assets.

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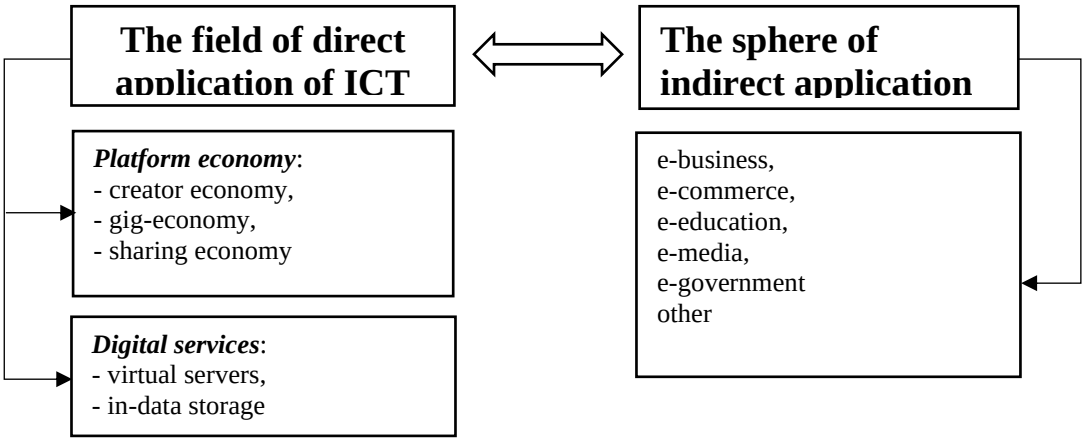

Figure 2. The structure of the spheres of direct and indirect use of the digital economy ICT core potential

Sources: developed by the authors

Digital services, which include virtual servers and in-data storage, such as Google, One Drive, Adobe Creative Cloud, etc., create special opportunities for the formation, storage and transfer of information. This changes the algorithms for making and the quality of economic decisions of all participants in economic relationships.

The *indirect use of ICT* encompasses a wide range of activities that make use of core products as well as *ICT direct application* sphere products. It is about e-business, e-commerce, e-education, e-media, e-governance, etc. the products of which are manufactured with the help of the Internet, telecommunications and mobile communications, IT platform services, and digital services. The issue of identifying "digital" and "non-digital" components of products made in manufacturing, trade, education, journalism, public administration, and so on is related to the sphere of indirect ICT use. And how the "digital component" is evaluated and separated from the "non-digital" has a considerable impact on establishing the extent and boundaries of the digital economy.

Our assumption about the complete set of elements of the digital economy as a factor influencing the nature of economic growth, in particular, what makes it emergent, can be specified. It is about specification based on the analysis of the structure of the digital economy, as well as the experience of successful developing countries. We specify our assumption as follows:

- emergent growth can be ensured due to the anticipatory development of the *sphere of indirect* application of ICT, namely: e-business, e-trade, etc.

- the platform economy and software production can also become the basis of the emergent growth of individual developing countries.

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Despite the fact that emergent growth is caused by certain elements of the digital economy, it remains external, since high technologies of Internet communications, hardware manufacture, digital services are created in *other countries.*

It is obvious that the assumption about the relationship of emergent growth with only certain elements in the set of elements of the digital economy should be validated by the analysis of the product structure of countries with emerging economies. First and foremost, it is a comparison of the shares of the overall digital economy, its ICT core, the platform economy, the sphere of indirect ICT application, and other components in the GDP of both developed and developing countries. Unfortunately, the current statistical data limits the capabilities of such a study, which takes into consideration all of the specified components of the digital economy.

Figure 3 shows a comparison of countries based on the percentage of the Internet economy in GDP created using one of the most comprehensive data sources [14]. The numbers next to the country names mean the country's place in the ranking, based on the share of the Internet economy in GDP.

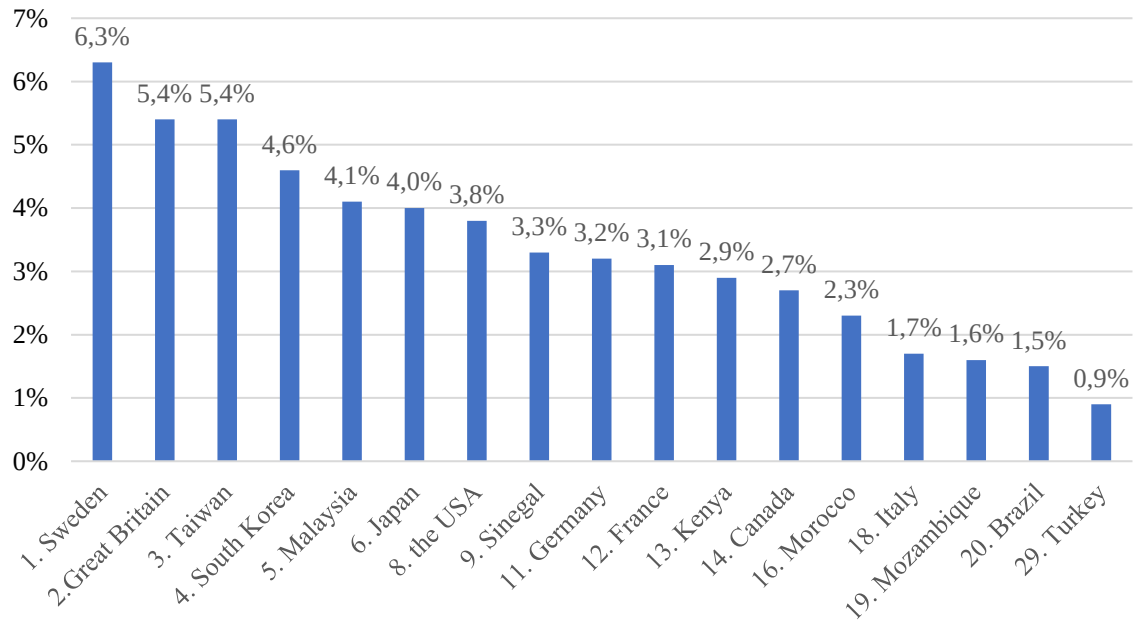

Figure 3. The share of internet economy in % of GDP of some countries of the world in 2012

Sources: developed by the authors on the basis of [14], p. 17]

Data on the share of the Internet economy are significant for our research since, first and foremost, the Internet economy is a component of the digital economy. Therefore, the dynamics of these two economies are interconnected. Secondly, information on the share of the Internet economy became available for analysis in sufficient amounts earlier than information about the share of the digital economy. The internet economy, according to the definition provided in the source

[20], consists of four components: 1) activities like e-comers that use web as support, 2) telecommunication that uses IP and ISP, 3) ICT consulting and software development, 4) computers, smart phones, hardware and servers. It follows from this list that the Internet economy does not cover, at least, such elements of the digital economy as "Platform economy" and part of "Digital services".

The information presented in Fig. 3 testifies to such facts that are directly related to the emergent growth issue:

- only two developed OECD member countries belong to the five countries, which in the early 2010s were characterized by the world's largest share of the Internet economy in GDP. These are Sweden and Great Britain. The other three countries - Taiwan, South Korea, Malaysia - belonged to another group of countries. These are *emergent economy* countries that demonstrated a tendency to make the most complete use of the opportunities created by ICT technologies;

- in addition to Asian countries, the leading positions in terms of the share of the Internet economy were also occupied by some African countries, namely: Senegal (ahead of Germany and France in terms of share), Kenya (ahead of Canada), Morocco (ahead of Italy), Mozambique (ahead of Brazil);

- only the 29th place of Turkey, which belongs to the OECD countries, is indicative. In terms of the share of the Internet economy in GDP, Turkey lagged behind agrarian countries with much lower per capita GDP indicators, namely the Republic of South Africa (21st position), Cote d'Ivoire (22nd), Tanzania (23rd), Cameroon (24th), Ghana (25th), Vietnam (26th), Egypt (27th).

The aforementioned facts provide reasons for some broad generalizations regarding emergent growth based on use of Internet economy advantages:

- the share of the Internet economy in the country's GDP is determined **not only** by the previously achieved level of socio-economic and technological development of the country, but also by the ability to adapt new technologies,

- the possibilities of new technologies, which, due to globalization processes, become available to all developing countries, are expediently used only by a part of developing countries.

Further research should address the issue of how countries previous levels of development affect the scale of the digital economy, as well as how developing countries may best take advantage of the digital economy's opportunities.

It is evident that for our research, the analysis of the share of the total digital economy in GDP is more significant than the analysis of the share of the Internet economy in GDP. Figure 4 depicts data from the Asian Development Bank on the share of the total digital economy in GDP of countries accessible for analysis.

The numbers next to the names of the countries shown in Fig. 4 represent the country's position in the 15-country ranking. The first number represents the ranking

position in one of the first (2000-2012) period's years, and the second - in one of the second (2014-2019) period's years. For example, "8/10 AUS" indicates that Australia is ranked eighth in the first period by the share of digital economy in GDP (with an indicator of 5.1% digital economy in GDP) and tenth in the second period (with an indicator of 4.9% digital economy in GDP).

The presented country ranking is not global in the sense that it only includes countries for which relevant data is available in open sources. In particular, the information is comparable in Asian Development Bank sources.

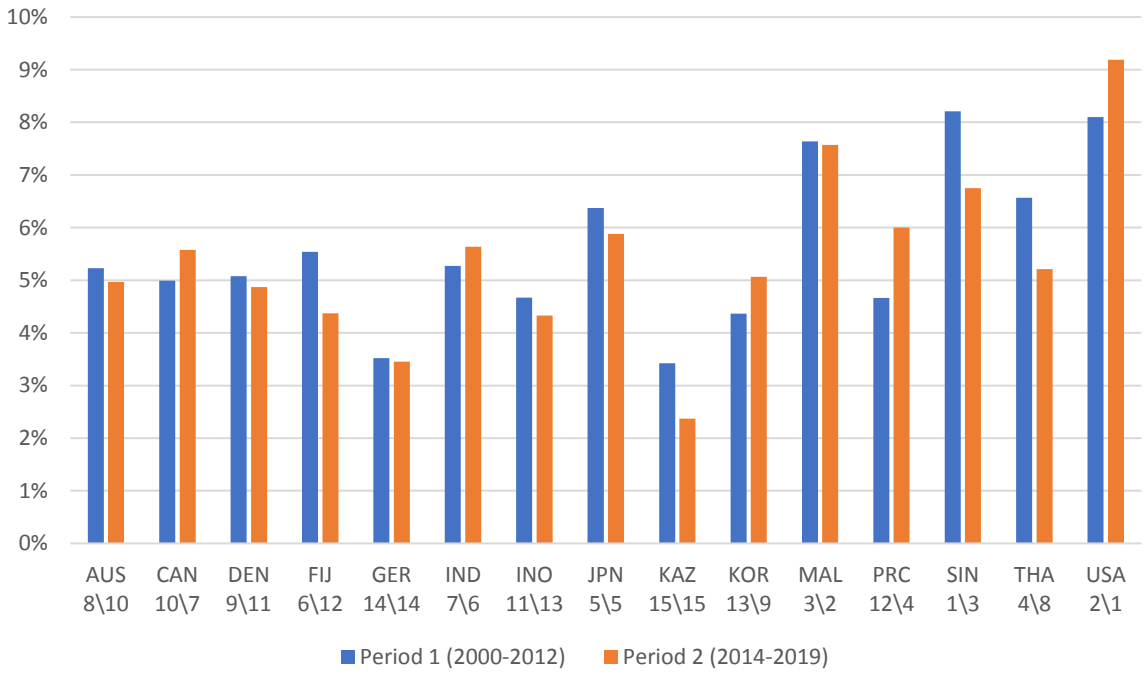

Figure 4. The share of the digital economy in % of the GDP of some countries of the world (data for individual years within period 1 - 2000-2012 and within period 2 - 2014-2019)

Sources: developed by the authors on the basis of [22], [23]

AUS = Australia; CAN = Canada; DEN = Denmark; FIJ = Fiji; GER = Germany; IND = India; INO = Indonesia; JPN = Japan; KAZ = Kazakhstan; KOR = Republic of Korea; MAL = Malaysia; PRC = People's Republic of China; SIN = Singapore; THA = Thailand; USA = United States. **Notes:**

Period 1 = 2000 to 2012. Period 1 for AUS, 2010; CAN, 2012; DEN, 2010; FIJ, 2011; GER, 2010; IND, 2010; INO, 2010; JPN, 2011; KAZ, 2001, 2010; KOR, 2010; MAL, 2010; PRC, 2012; SIN, 2000, THA, 2010; and USA, 2010.

Period 2 = 2014 to 2019. Period 2 for AUS, 2018; CAN, 2016; DEN, 2016; FIJ, 2015; GER, 2016; IND, 2014; INO, 2014; JPN, 2018; KAZ, 2018; KOR, 2018; MAL, 2015; SIN, 2015; THA, 2015; and USA, 2019.

The information presented in Fig. 4 gives grounds for the following generalizations:

- In the first analyzed period (2000-2012), two developed countries - the United States and Japan - and three developing countries - Singapore, Malaysia, and Thailand - made the top five in the list.

- In the second period (2014-2019), China surged to the top five of the rankings. As a consequence, the number of developing countries in the top ranking has increased to four.

In terms of content, the indicator of the share of the digital economy in GDP appears contradictory, at least when it (the indicator) is roughly the same in a highly developed country as in a developing one that did not show signs of rapid growth. This is true for both Germany and Kazakhstan. In both periods, the quantitative values of the share of the digital economy in GDP in Germany and Kazakhstan were roughly the same and the lowest in the ranking for both countries. In attempts to "expand the boundaries" of the digital economy, the inconsistency of the indicator of the digital economy's share of GDP is also highlighted. We're talking about China, for example. The data source we used, the Asian Development Bank, fails to provide information on China's digital economy's share of GDP in the second period (2014-2019). Instead, the Chinese Academy of Information and Communication Technologies (CAICT) provides a disproportionately large value for this share. In 2018, the digital economy accounted for 34.8% of GDP [24, p. 3].

At the same time, CAICT uses the so-called "broad interpretation" of the digital economy. In view of this, the authors of this chapter were forced to use another source of information about China in the second period. Figure 4 illustrates data for China in the second period based on the so-called "narrow definition" (based on the OECD framework) [23].

We began with the fact that China had only achieved a 6% digital economy in GDP for the second period:

- the places of countries in the ranking of 15 countries changed in a special way. Only in two countries - Malaysia (7.6% in both periods) and Germany (3.5% in both periods) - the share of digital economy in GDP did not change. However, with this share unchanged, Malaysia improved its position in the ranking by one point. More than half of the countries - eight out of fifteen - *worsened* their positions in the ranking in the second period due to a decrease in the share of the digital economy in the country's GDP. Among such countries there are both developed and developing countries, namely: Singapore, Thailand, Japan, Australia, Fiji, Denmark, Indonesia, Kazakhstan. It is clear that such a decrease in the share could occur due to the outpacing growth rates of the product of the entire economy in comparison with the growth rates of the digital economy. The latter can be interpreted as a certain inhibition in the

development of the digital economy. However, this can also be interpreted as the result of an increase in the multiplier effect of the influence of the digital economy on the entire national economy;

- it is indicative that only in five countries - the USA, India, Canada, China, Korea - the share of digital economy in GDP increased. Such changes in the share can be interpreted either as a result of higher growth rates of the digital economy product compared to the GDP growth rate of the entire economy, or as a result of a decrease in the multiplier effect of the influence of the digital economy on the entire economy.

Based on the analysis of the data presented in Figure 4, we make the following generalizations about the digital economy as a source of emergent growth.

First, the actual indicator of the share of the digital economy in the country's GDP ($d_{dig} = \frac{Y_{dig}}{Y}$) is not a convincing characteristic of emergent growth. It is not even when this share is considered in dynamics. As an argument, we will use the fact that developing countries can demonstrate both rapid growth of this share and its rapid reduction. For example, in 6 years (from 2012 to 2018), China had an increase in the share of the digital economy in GDP by 1.3 percentage points (from 4.7% to 6.0%). On the other hand, in Thailand, this share decreased by 0.8 percentage points (from 6.6% to 5.8) over 5 years (from 2010 to 2015). A reduction in the share of the digital economy in GDP also took place in Singapore - by 1.4 percentage points (from 8.2% to 6.8) over 15 years (from 2000 to 2015), and in Indonesia - by 0.4 percentage points (from 4.7% to 4.3%) for 4 years (from 2010 to 2014), etc.

Secondly, since the dynamics of the share of the digital economy in the country's GDP is affected by the growth rate of the GDP itself, the sensitivity of changes in the country's national product to changes in the digital economy product can be considered as a more relevant indicator for explaining emergent growth. This sensitivity is reflected in the values of the multiplier of the impact on changes in the country's GDP of digital economy changes ($m_{dig} = \frac{\Delta Y}{\Delta Y_{dig}}$). It is likely that the value of the multiplier m_{dig} is determined by a special propensity to use the technological opportunities generated by the digital economy (c_{dig}).

According to the logic used in the Keynesian macroeconomic theory, it is possible to assume the existence of the following dependence: $Y = Y^* + c_{dig} Y$. From this we can derive the so-called multiplier of the digital economy: $m_{dig} = \frac{\Delta Y}{\Delta Y_{dig}} = \frac{1}{1-c_{dig}}$ (where Y is actual GDP, Y^* is autonomous (independent) of the propensity to use digital economy GDP).

In the economic history of developing countries, which belong to the group of emerging countries, there are facts that, in addition to the intensive use of digital technologies, they carried out reforms in the social and public spheres. We are talking,

first of all, about reforms in education, medicine, social security, public administration, etc. Therefore, it is likely that the behavioral factor - "propensity to use the advantages of the digital economy" - is derived from the level and quality of education, culture, public administration, and the development of the entire social sphere. Therefore,

$c_{dig} = f(educ, public\ admin, \ldots)$. It is possible that under the conditions of unstable democracies, when reforms in the social and public spheres are inhibited, such a propensity may fade over time. Therefore, the potential of emergent growth will also be lost.

The multiplicative effect of the digital economy on the overall economy in relation to a special behavioral factor - the "propensity to use the advantages of the digital economy" - and the conditions for implementing this propensity in developing countries should be the subject of further research.

The idea of emergent growth based on certain components of the digital economy can be interpreted in terms of "economic circuits". The toolkit of "economic circuits" is a technique recognized in economic science for interpreting and visualizing economic relations. Moreover, the latter are presented in the form of interrelated movement of *products* (and corresponding production resources), *expenditures* (and corresponding incomes) of the subjects of these relationships.

Figure 5 depicts the scheme of economic circulation between subjects of the digital economy, which allows us to evaluate emergent growth while taking into consideration the components of the digital economy.

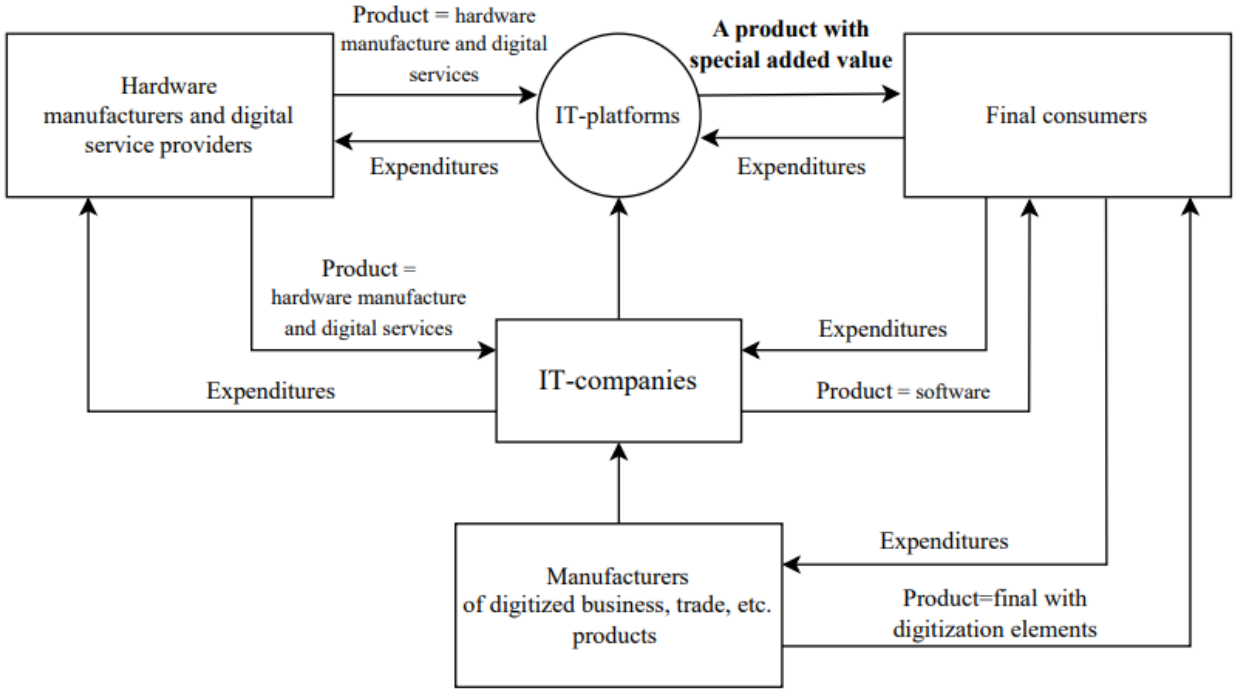

Figure 5. Scheme of the economic circulation of the "digital economy".

Sources: developed by the authors

Fig. 5 illustrates a fragment of the national economy that is specifically related to the functioning of the digital economy sector. This fragment clearly does not cover all economic relationships, but it does illustrate economic flows between the key subjects of relationships.

Figure 5 depicts the interrelated movement of products and expenditures amongst five subjects within the digital economy. We are talking about producers of hardware manufacture and digital services, IT companies, owners of IT platforms, manufacturers of digitized final products containing elements of digitalization, on the one hand, and consumers of these products, on the other. Moreover, each of the subjects creates a product based on special resources at its disposal. It is obvious that these products exist in special forms, namely: hardware manufacture and digital services, software, IT platform products with special added value, final consumption products with digitalization elements. Consumers of the mentioned products incur expenses that form the income of digital economy producers.

Using the scheme depicted in Fig. 5, we generalize that developing nations' exogenous emergent growth can occur without their own hardware manufacture and digital services, but rather through national digitized business, trade, education, and so on. All national manufacturers can use software from external and internal IT companies, as well as services from external and internal IT platforms. Endogenous growth, on the other hand, presumes the presence in the national economy of all elements of the IT core of the digital economy, which may be lacking in a country with emergent growth.

The suggested scheme of economic circuit within the boundaries of the digital economy, like any other scheme, is a simplification of actually existing relationships. It is particularly lacking in financial system subjects that are relevant to the activities of all actors in the digital economy. The scheme also lacks the state as an economic entity, with the participation of which the digital economy's manufacturing infrastructure, etc., is being developed. However, the authors believe that such a scheme and simplification has some theoretical significance since it allows them to explain the meaning of emergent growth.

Another limitation of the given scheme of economic circulation is that it does not reflect the internal (in-house) product of the digital economy. This is software created not by IT companies, but by IT divisions of enterprises of traditional or innovative business. The existence of such products objectively complicates the accounting and assessment of the digital economy scale.

As previously said, the purpose of this research, among other things, is to find an answer to the question of what is preventing the digital economy from serving as an emergent growth factor for the Ukrainian economy.

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Are there reasons to believe that the components of the Ukrainian digital economy have the potential to become a source of emergent growth and, accordingly, a source of economic stabilization during the war and accelerated growth during post-war recovery? According to the authors, there are such grounds. The following arguments can be used in favor of this.

First, the IT sphere of the Ukrainian economy exhibits exceptional adaptability particularly during the active phase of the Moscow-Ukraine war. Figure 6 shows data to support this assertion.

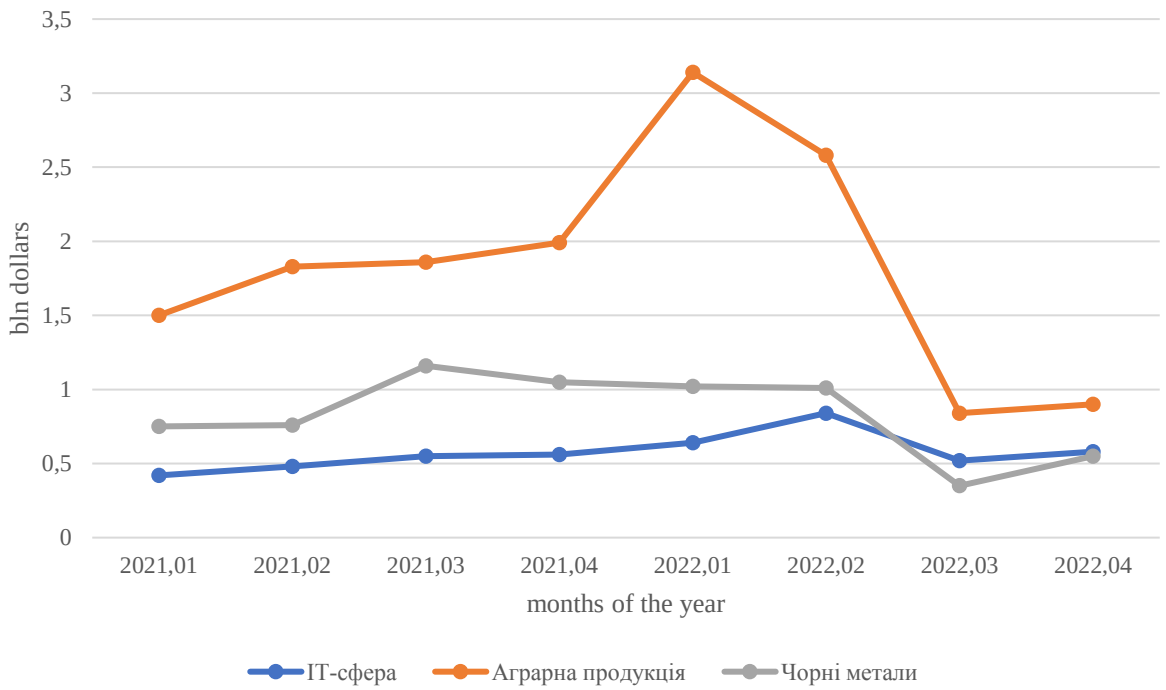

Figure 6. Dynamics of foreign currency receipts from the three main branches of Ukrainian exports

Sources: developed by the authors on the basis of [25] based on the data itself refers to the NBU, State Customs, State Statistics Service, Ministry of Agrarian Policy

Figure 6 demonstrates that during the start of the active phase of the Moscow-Ukraine war in February 2022, the three primary exporters of Ukrainian goods - agriculture, ferrous metallurgy, and information technology - saw a reduction in foreign exchange earnings. Only the IT industry, however, restored its export levels to the beginning of 2021 three months later.

Secondly, the Ukrainian IT sector showed significantly higher growth rates than the average in the economy as a whole, according to key economic indicators, in the period before the start of the active phase of the war. This is evidenced by the data in fig. 7 and fig. 8.

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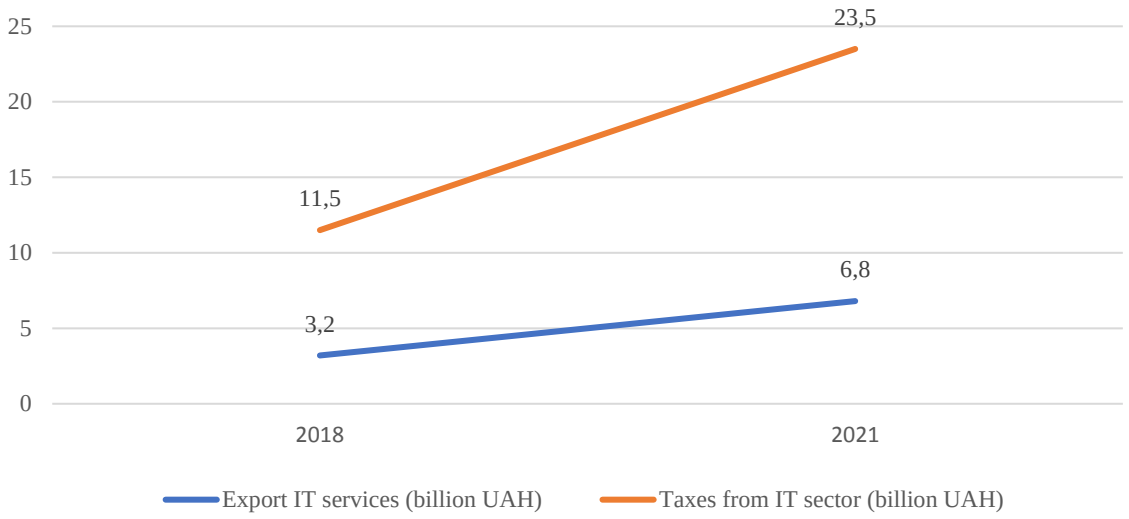

Figure 7. Export revenues and tax revenues from the Ukrainian IT sector

Sources: developed by the authors on the basis of [26]

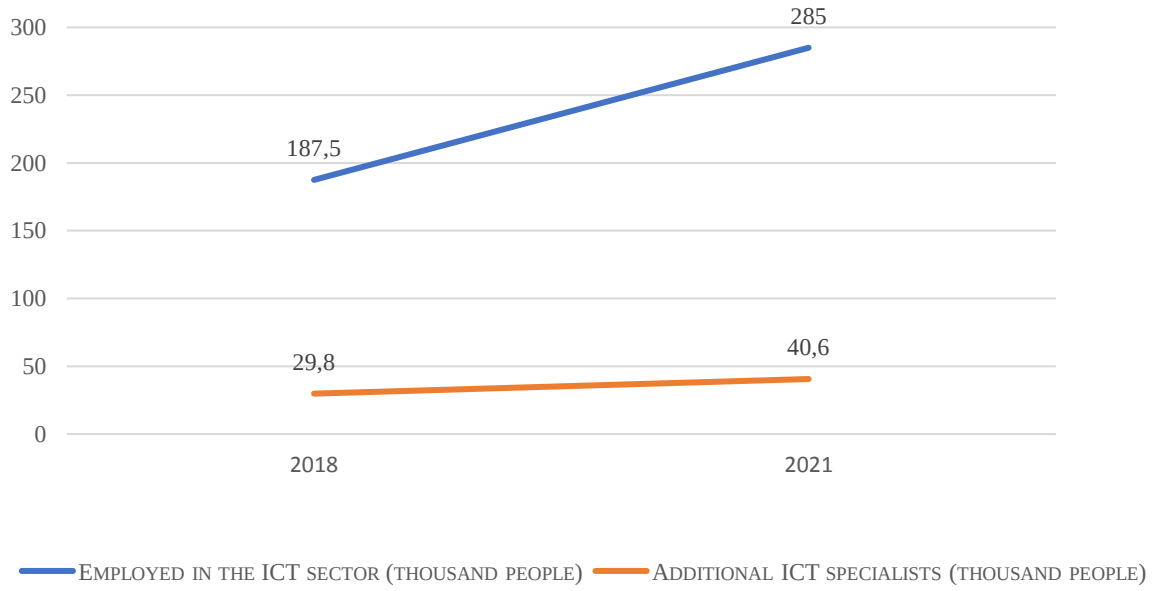

Figure 8. Employment in the Ukrainian ICT sector and the growth of specialists in the ICT sector

Sources: developed by the authors on the basis of [26]

Fig. 7 illustrates a very rapid - more than two-fold - increase in the volume of exports and tax revenues to the budget from the IT sector in the three years before the active phase of the Moscow-Ukraine war.

The data presented in Fig. 8 indicate a 1.5-fold increase in employment in the Ukrainian ICT sector in just three years and a 1.36-fold increase in the employment of specialists in the sector over the same three-year period.

The "gap" between the average wage in the entire economy of Ukraine and the average wage of specialists in the IT sector is impressive, in favor of the latter. In pre-

war 2021, the average monthly wage in the Ukrainian economy (17,453 hryvnias) was approximately 2 times lower than the median wage of the lowest-paid IT workers (QA Manual) and 6 times lower than the median salary the highest paid employees of the IT sphere (Project Manager) [27, p 15].

The high incomes of employees and companies in the IT sphere have quite obviously influenced, first of all, the development of the residential and commercial real estate market in large cities of Ukraine. Particularly in those where so-called "IT clusters" have emerged and the greatest number of IT specialists and companies are located. And this is only the connection that "lies on the surface". Further research is anticipated to find additional channels of real influence of the digital economy IT sector on the whole Ukrainian economy. This effect is clearly exercised through individual markets and other sectors of the Ukrainian economy.

Given the very high development rates of economic indicators - export products, tax revenues, population employment, and rising demand for professionals, a much higher level of wages - the Ukrainian IT sector has the potential to become a source of emergent growth. Furthermore, this expansion has been ongoing since the mid-2000s.

Unfortunately, the IT sector of the Ukrainian economy has not become a source of emergent growth. After all, the entire Ukrainian economy has traditionally demonstrated much lower rates of economic growth than the ICT sector. So, we are talking about the unused potential of the Ukrainian IT sector, the entire digital economy as a source of emergent growth.

In the analysis of the Ukrainian situation, according to the authors, it is appropriate to rely on the assumption that the transformation of the digital economy into a source of emergent growth occurs due to the "propensity to use the advantages of the digital economy." If this assumption of ours has grounds, then it is necessary to analyze the circumstances that give rise to this propensity in Ukraine. We concentrate primarily on the two most essential factors: education level and public administration quality.

According to the World Education Rankings [28], in 2021, Ukraine ranked 40th in the world in terms of education level and was ahead of 8 EU countries - Lithuania, Croatia, Slovakia, Romania, Bulgaria, Latvia, and Slovenia. Therefore, education cannot be considered as the main factor limiting the "propensity to use the advantages of the digital economy". Accordingly, education is not the main factor inhibiting the process of transforming the digital economy into a source of emergent growth.

According to the World Competitiveness Index, Ukraine ranks substantially lower than in education in terms of indicators of the quality of public administration used in country rankings. Ukraine ranks 53rd and 59th in the parameters of Governance efficiency and Institutional framework, respectively [29]. Other global rankings, such as the Economic Freedom Index (EFI), Worldwide Governance Indicators (WGI), and Fragile States Index (FGI), identify Ukraine's low quality governmental institutions,

high level of corruption, and judicial system shortcomings. If the quality of public administration is a factor influencing the "propensity to use the advantages of the digital economy", then low indicators of this quality, with a high probability, limit the transformation of the digital economy into a source of emergent growth in Ukraine.

Identification of the reasons for the unused potential of the ICT sector to ensure the emergent growth of the Ukrainian economy should be the subject of many theoretical and applied studies. In our opinion, the most common cause of unused potential is the economic model formed in Ukraine, which is defined as "oligarchic economy". A more detailed answer to the question of the causes involves the analysis of the inhibiting effects of the components of this "oligarchic economy"

Conclusions. We draw the following concluding generalizations based on our findings.

- Emergent growth, which is a growth enabled by external factors, in particular, digital technologies created in other countries, is an undeniable fact of the development of dozens of developing countries. Evaluating the contribution of the digital economy to the emergent growth of developing countries has theoretical and applied value. After all, comparing these contributions across countries makes it possible to identify the conditions under which the contribution becomes larger or, conversely, smaller, as well as to make management decisions.

- A relevant definition of the digital economy's boundaries (scales) is a fundamental requirement for an adequate assessment of the digital economy's contribution to emergent growth. Determining the boundaries of the digital economy only on the share of the IT/ICT sector in the country's GDP does not fully correspond to the real content of the digital economy and the concept of emergent growth. After all, developing countries which lack the technological core of the digital economy (the IT/ICT industry) might attain faster growth rates through the development of other elements of the digital economy.

- The scheme of economic circulation can be used to theoretically identify the digital economy as a component of the national economy. The following circumstances explain the expediency of using the scheme of economic circulation of the digital economy to describe emergent growth. First, the scheme makes it possible to focus attention on the subjects of economic ties, related to the digital economy technological core, on the one hand, and to the spheres of its (core) direct and indirect influence, on the other. Secondly, a circuit diagram can be used to depict the movement of the product of the digital economy, which ensures the emergent growth of developing countries.

- The Ukrainian economy has the capacity to develop the digital economy into a source of emergent growth that is currently untapped. The presence of this potential may be seen in the continually high growth rates of the ICT sector's output,

employment in it, and tax revenues from it, among other things. The absence of correlation between the growth of the overall national economy and the growth of the Ukrainian ICT sector confirms that the potential is not being used.

- The poor quality of public administration is likely one of the most powerful limiting factors in the transformation of the digital economy into a source of emergent growth for the Ukrainian economy. As you are aware, the quality of state institutions, the extent of corruption, and other factors are required components for measuring the quality of public administration in all countries throughout the world. There are reasons to believe that the quality of public administration influences emergent growth because of a unique "propensity to use the benefits of the digital economy." It is this propensity that determines the multiplicative effect of the influence of the digital economy on the entire national economy. Therefore, the increase of this propensity in the Ukrainian economy and society can play the role of a contributing factor in the transformation of the IT-sector of digital economy into a source of emergent growth.

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