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Measuring and analyzing the impact of digitization on the gross domestic products growth … Iraq case study for the period (2005-2020)

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Keywords: digitization, digital economy, economic growth, sustainable economic development, communications and information technology infrastructure.

Abstract
The study aims to measure and analyse the impact of digitisation on the development of Iraq's GDP. By analysing Iraq's communications and information technology infrastructure as the basis for building a sober digital economy, the importance of the study came as it looked at one of the important topics of concern to all countries of the world. Iraq is one of the countries that is trying to catch up globally in the digital sphere and through its policies is trying to reduce the digital divide between it and the rest of the countries. By monitoring Iraq's challenges in the transition towards a digital economy using a model of economic measurement (ARDL), thus subjecting the model to statistical and econometrics tests to detect the validity of the model in question. The study reached several important conclusions and recommendations that will shape the strategy for the transition towards the digital economy and make it the locomotive driving the process of economic growth and sustainable economic development.

Introduction to the study
Since the 1990s, the world has witnessed developments in the field of technology, communications and information, enhancing the role of the digital economy (Digital Economics) in all walks of life and at all levels, as technical development in the software world has enabled increased efficiency rates by influencing the two components (Costs) and (time), in addition to influencing production levels and creating the right competitive environment for economic enterprises by increasing the productivity of work based on artificial intelligence techniques and the Internet of Things and computerized work on the one hand, On the other hand, today's digital economy has become one of the most important imperatives adopted by countries in their sustainable development strategies and different economic systems, especially as the world today faces many challenges of natural disasters and the spread of pandemics and crises. COVID-19), as well as the events of the war between Russia and Ukraine and its negative repercussions on the global economy, the digital economy has emerged as an ideal solution to the challenges posed by economic crises at all levels. The features of the digital economy have been utilized especially

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in economies with a distinct digital structure. By increasing levels of economic growth and increasing levels of employment among young people, Not to mention, the digital economy works through its mechanisms based on technological development and the development of the telecommunications and information system to bring about a qualitative shift in the levels of economic performance through the restructuring of economic sectors and the creation of a suitable operating environment to ensure the best performance of the operating economic sectors, which in turn will achieve significant increases in GDP and ensure the achievement of sustainable development goals.

In Iraq, the Iraqi Government is working through its national programs to harness the ICT revolution and technical developments to create a working environment based on the idea and concept of the digital economy by modernizing national economic systems and ensuring qualitative transformations in the structure of GDP by improving the level of services provided to citizens by signing a memorandum of understanding with the United Nations in this regard. This note aims to map a road map towards digital transformation by identifying priorities based on an analysis of Iraq's digital landscape. Engaging the private sector as an essential partner in the digital transformation of this Iraqi economy on the one hand, On the other hand, this note aims to provide the basic structure for achieving Goal 17 of the sustainable development goals. (Partnerships to achieve the goals), It is worth mentioning that Iraq is already planning to move towards a digital economy and this is evident by setting the goal of digital transformation as one of the main objectives of the 2030 Sustainable Development Strategy.

The importance of the study: The importance of the study is highlighted in its examination of one of the most important contemporary topics that changed the concepts of work and production. Although the roots of technical development date back to the first decade of the seventeenth century, the results of this development were evident in the twenty-first century. On the other hand, technological development changed the concepts of production and Labor forces and subsequently led to significant changes in the quantitative and qualitative structure of GDP.

Objective of the study: The current study aims to demonstrate the extent to which the digital economy through its technological tools can influence GDP in terms and quality. By measuring and analyzing the impact that the transition from traditional to digital economy will have on GDP by measuring the relationship between digital economy indicators and the development of GDP. The study will also focus on the extent of Iraq's willingness to move towards a digital economy and indicate its readiness in this area by analyzing the reality of its digital architecture and what challenges it faces in this area.

Study Problem: The rapid advancement of technology and the field of information and communication and the new concepts it has generated, including the digital

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economy, which has become the locomotive driving economic growth not only in developed countries but in developing countries alike through its effects on the structure of GDP. From this point of view, the problem of the study can be expressed through the following questions:

• What are the most prominent effects of the digital economy on GDP structure?

• What are the main challenges facing the Iraqi economy in moving towards a digital economy

Study hypothesis: The study will attempt to test the nature of the relationship between the digital economy and the development of the GDP structure, based on a hypothesis that:

(There is a "positive" correlation between the digital economy represented by ICT infrastructure indicators and the development of Iraq's GDP structure).

Study structure: To address the problem of the study and test its hypothesis, the study was divided into three chapters:

Chapter I: deals with the conceptual framework of the digital economy, in terms of the emergence of the digital economy and its concepts, characteristics and measurement indicators.

Chapter II: addresses the reality of the transition towards a digital economy in Iraq by reviewing Iraq's digital transformation strategy and highlighting the challenges facing Iraq towards digital transformation.

Chapter III: examined the measurement and analysis of the effects of economic digitization on the development of Iraq's GDP structure.

Study methodology: The research relied on the historical descriptive approach to illustrate the evolution of the concept of the digital economy and its characteristics. The research also relied on the standard inductive approach by collecting and analyzing available data to demonstrate or negate the study's hypothesis.

Spatial and temporal boundaries:

• Spatial boundaries: The study adopted the Republic of Iraq as its spatial exception.

• Time limits: The period from 2005 - 2020 has been approved as time limits for study based on available data obtained from a variety of sources.

Previous studies:

1- Majdi al-Shorabji's study, 2010 entitled "Impact of ICT on Economic Growth in Arab Countries" The study examined the impact of technological progress and the information and communication revolution on the economic growth of the 17 Arab countries during the period (2000-2009), the effects of the relationship between technical progress and economic growth have been measured through a model The study found a positive and moral impact of technological progress on economic growth.

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2- Cain's study, 2021 entitled "The relationship between the digital economy and economic growth in Egypt" The study analyzed and tested the relationship between Egypt's digital economy and economic growth by using a method (OLS) In estimating the regression function, the duration of the study was (1980-2019). The study found a positive correlation between private investment expenditure and economic growth, reflecting the positive relationship between the digital economy and the Egyptian economy. The study recommended:

• The importance of investing in the digital economy and upgrading this sector, which has become fundamental in today's world, to ensure that the digital divide between the Egyptian economy and other economies is bridged.

• Develop all sectors of the national economy and bring them into line with the requirements of the digital economy to ensure the transition from traditional to digital economy.

3. The study of the League of Arab States, 2021 entitled "Arab Digital Economy Index 2020", aimed at building a composite index to follow the developments of the Arab countries' transition towards the digital economy and the achievement of the 17 sustainable development goals. The study reached several results, most notably:

• The United Arab Emirates (UAE) has secured first place among Arab countries in the process of digital transformation through the adoption of focused policies with developmental dimensions to the transition towards the digital economy.

• The need for Arab decision-makers to formulate policies that focus on each country's strengths and review and evaluate existing policies through a multifaceted analysis to measure all dimensions of the digital transformation process.

4- Lukas Haefnar & Rolf Sternberg's study entitled "Spatial implications of digitization: State of the field and research agenda), the study focused on the geographical effects of economic digitization by reviewing the spatial aspects of economic digitization through the idea of distance death that reduces spatial inequalities, benefiting from technological development in the field of communications and information

5- Karim Sabbagh, Roman Friedrich, and others. The study was entitled Digitization for Economic Growth and Job Creation: Regional and Industry Perspective, the study confirmed that developed countries enjoy 25% higher economic growth benefits than the rest of the least developed countries, developing countries' delays in economic digitization are due to many causes and influences, most notably the underdevelopment of the private sector, which reduces job creation opportunities. Developing countries' economic structures are not sufficiently developed for the transition from conventional to digital economies.

• Countries planning a shift towards a digital economy should prepare plans to digitize targeted economic sectors to maximize the effects of economic digitization.

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• Encourage and develop the capacities of public and private sector workers and qualify them for the process of transition towards a digital economy, to achieve the plans developed in this direction.

• The need for developing countries policymakers to create the appropriate legal climate for shifting towards economic digitization and to coordinate efforts between the public and private sectors.

Chapter I

Conceptual Framework for Digital Economy, Genesis, Characteristics and Indicators

1- The emergence of the digital economy: The emergence of the concepts of digitization of the economy dates back to 1830 when the ICT revolution began to emerge, and in 1870 with the discovery of the telegraph and the advancement of the world of acoustics and visuals the idea of digitization of the economy took root more (Havat, 2014, p. 4), and in 1900 with the invention of the first computer, developed countries began to think seriously about linking diverse economic activities to smart computers through the development of some early applications and programs promptly. With the advancement of technical and software systems in the mid-twentieth century, which accompanied the development of political, legislative and economic systems, The idea of digitizing economic activities has taken root through the introduction of computerized work on productive activities such as the automation of factories. In 1990, with the emergence of economic globalization movements, the emergence of transgender companies, the discovery of mobile phones and the development of information and communication systems, the digitization of the economy became not just an idea but a necessity imposed by objective circumstances. On the one hand, digital services have achieved direct returns to the developers of these software by expanding their sales of their technical products. On the other hand, the number of users of technology services has increased both at the individual and institutional level and at the government level.

After this cognitive and technological accumulation that conquered the world with its different economic attractions and doctrines, natural incubators of the digital economy emerged, especially in those countries with advanced technological infrastructure such as Japan, China and the United States of America. The shift towards a digital economy has helped those countries to achieve booms in economic growth rates. The World Bank and the United Nations Development Program (UNDP) reports indicate that the global digital economy's contribution is estimated to be 15.5% of GDP composition for 2019 (World Bank, Digital Development, 2022).

2- Digital Economy Concept: The concept of digital economy dates back to 1995 when Canadian business manager Don Trapscott introduced this concept into business and productive activities. (Trapscott, 2014.p.16), a concept of the digital

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economy as defined by OECD can be given (OECD) (is that technology through which trade deals in goods and services are executed through electronic commerce via the Internet) It can also be defined from another perspective (that branch of the economy is heavily dependent on the tools of the ICT revolution). (Mr. Mustafa, Scientific Journal of Financial and Administrative Studies and Research, 2022, p. 1445), as the digital economy is known as: (The digital information technology economy and the development of the communications system, through the use of information in its management) (Al-Rizzo, 2006, p. 13), as he knew it (That economy-based on digital technology based on several components including, Digital ICT Infrastructure, Mobile Phone Network, Software applications, through which electronic commerce and economic transactions are carried out in an electronic form, are accredited on the Internet, So it's often called a net or web economy (ECA, 11-12, February, 2017).

Through the foregoing, a comprehensive concept of the digital economy can be given (that economy that blends knowledge and technological development in the field of information, communications and online software, through which all economic transactions are conducted in a way that reduces time, effort and costs because it is a transboundary economy).

3- The Digital Economy Characteristics: With the advancement of technology and computer applications, the entry of the economy into the digital world and the emergence of the term digital economy (Digital Economy), several characteristics have emerged that distinguish this type of economy as (Trapscott, 2014, p.4): -

• The digital economy is an economy that tends to open up and renew, in the sense that through the development of digital technology, telecommunications and information have become available to any person or institution to enter and deal with this economy without restrictions or specific conditions. All dealers need is prior knowledge using computer applications and a technical infrastructure that enables customers to secure access to their goals.

• In the digital economy, knowledge is an additional element of production, since all applications and programs employed in the digital economy that are part of the knowledge components become available to everyone and their use becomes free while retaining the right of the discoverer of that knowledge to his legal rights, which means that knowledge replaces part of the raw materials.

• Eliminate the geographical boundaries between customers of the digital economy, facilitating the movement of trade and capital transfer at the domestic and international levels.

• The reliance of the digital economy on information (Information) as a source of strength, the power of information itself depends on many factors, including the extent of technological advances in the field of information itself. This depends on the availability of, among others, updates to the world of communications and the

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technology sector. And dependence on the Internet in various economic dealings, and the extent of culture and technological awareness of the society that deals with the digital economy, In addition to the availability of advanced technological infrastructure that facilitates the functioning of the digital economy (OECD, 2013, P.18).

• Competition in the digital economy has gone from simply being a concept of competitiveness of enterprises and enterprises within the same sector, to the globalization of competition between those economic units across the ether, microwaves and satellites, giving added impetus to global markets and the global business sector.

• Working in the digital economy does not need as many material resources as it needs the knowledge and information resources and keeping abreast of technological developments. This pushes for continuing the learning process and acquiring the technical skills needed to sustain the functioning of the digital economy.

• Innovation and knowledge are the most prominent drivers of economic growth in the knowledge economy and this distinguishes it from the traditional economy based on the growth of purely material factors (capital, work, organization, land).

4- Digital Economy Indicators: Measuring digital impact in economic variables is one of the most prominent challenges facing both developed and developing countries at both the micro and macro levels. These difficulties are highlighted by the overlap of concepts between the knowledge economy and the digital economy on the one hand. On the other hand, the difficulty of counting and accounting for the economic dimensions of the digital economy, although there are many indicators relevant to the digital economy, including those related to communications infrastructure and information technology, another science and technology, and another technology balance of payments, however, the current study will rely on indicators based on telecommunications and information technology infrastructure and so on: -

a- Number of telephone lines (fixed): The telecommunications network is the primary gateway to the information world, and although most countries have improved and developed their telephone network services, benefiting from the integrated digital network (Integrated Service of Digital Network), however, after 2003 specifically and with the spread of mobile phones and the development of Internet and telecommunications technologies, reliance on the fixed telephone network for mobile phones decreased, with the percentage of subscribers to fixed phones in the Arab region (10%) in 2008, well below the world's average use of fixed telephone networks (17.3%) This decline is not only in the Arab region but has become a global trend in favour of mobile phones (ESCWA, 2011, p. 38).

b- Mobile Phone Subscriber Index: This indicator is an indicator approved by United Nations organizations such as UNCTAD and ESCWA. This indicator

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measures the number of mobile phone users per (100) people, it is worth noting that the percentage of mobile phone subscribers in some countries of the world exceeds the percentage of mobile phone subscribers (100%) This is due to technical and technical factors related to those countries' policies in dealing with mobile networks (ESCWA, 2011, p. 39), and in the Arab region in particular, Arab countries have experienced an increase in mobile phone usage for the period (2007-2011) Specifically, the percentage of subscribers who own mobile phones has reached (82%) while the global growth rate (70%) Only for the same period, it is worth noting that this indicator varies in proportion from country to country according to its economic progress, and the country's technological readiness (Network readiness), in addition to the country's digital culture.

c-Number of users of the International Information Network (Internet):

This indicator is one of the international indicators approved by the international organizations of the United Nations, and this indicator is also measured as a precedent for each (100) person, there is no accurate data for the preparation of Internet users, but there are estimated surveys for the preparation of International Information Network users. These surveys depend on the number of people who spend part of their access to the Internet, it should be noted that the number of subscribers includes all those who spend money for Internet services and those who receive these services free of charge (ESCWA, 2010, p. 7).

d- Number of personal computers indicator: This indicator is also an indicator for measuring the impact of the digital economy on economic variables but with technological development in computer applications and the spread of computer usage (at home, work, school, universities, formal and informal departments... etc.) It has become very difficult to obtain accurate data on the quantities of computers used in all the joints of daily life, so the international organizations of the United Nations have relied on data (Preparation of computers sold annually) in a given country, in order to arrive at a rough preparation of the quantities of computers used, this indicator also depends on the number of personal computers used for each (100) person.

Chapter II

Transformation towards Iraq's digital economy... Opportunities and challenges

Digital transformation is the main gateway to investing in thought and knowledge and bringing about a real revolution for a pivotal transition towards new ways of working and managing the state. Investing in technological advances in communications and information is the means to achieve those goals. Together, the world's nations have employed all their material and human resources for digital transformation in all aspects of life, including the transition towards a digital

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economy to raise economic growth rates and achieve sustainable development goals. In Iraq, successive Governments have worked to improve the quality of digital services provided to citizens by radically changing the quality of services provided to consumers and beneficiaries at the private and government sector levels.

1- Iraq's digital reality: The Iraqi state has witnessed many tragic events since the change of the political system in 2003, reflecting negatively on its economic and social reality. He led him to lag behind the world especially in the area of ICT, at a time when the world's nations were investing in the enormous technological revolution in the areas of production, distribution, digital marketing, electronic commerce, communications and information technologies, Iraq has suffered from instability at all levels, which has widened the digital divide between Iraq and its regional and international environment. On the other hand, the Iraqi economy continued to suffer from the structural imbalance in its economic structure due to the economy's righteousness and reliance on an almost sole resource to finance economic activities, although the technological diffusion index (*) In Iraq it is (46%) (ESCWA, 2018, p.33). However, it is still classified as a country outside the digital economy. Iraq's digital reality can be reviewed through the analysis of ICT infrastructure indicators as shown in table (1).

(*): an indicator consisting of a subset of indicators related to business indicators, the e-government index and other sub-indicators.

Table (1) Indicators of Iraq's communications and information technology infrastructure for the period 2005-2020

Years	Mobile Subscribers' Index (100)	Internet User Index (100)	Number of personal computers indicator (100)
2005	5.6	0.9	0.1
2006	33.2	1	0.4
2007	48.4	1.9	1.1
2008	58.8	3.7	1.3
2009	64.2	4.5	2.3
2010	75.8	5.6	2.8
2011	78.1	5	3.4
2012	87	5.1	4.2
2013	97.6	5.3	5.3
2014	99.6	5.8	5.9
2015	90.6	4.3	6
2016	92.3	5.2	6.2
2017	107.7	6.2	6.6
2018	102.7	6.7	7.4
2019	101.4	5.8	7.7
2020	97.8	6.9	8.1

-From the researcher's preparation based on data: -

• Economic and Social Commission for Western Asia (ESCWA), Statistical Group for the Arab Region, No. 32, United Nations, New York, 2012, p. 277,278,280.

• Economic and Social Commission for Western Asia (ESCWA), Statistical Group for the Arab Region, No. 33, United Nations, New York, 2013, p. 277,278,280.

• Ministry of Planning, Central Bureau of Statistics, Communications and Mail Reports for the years (2014-2021).

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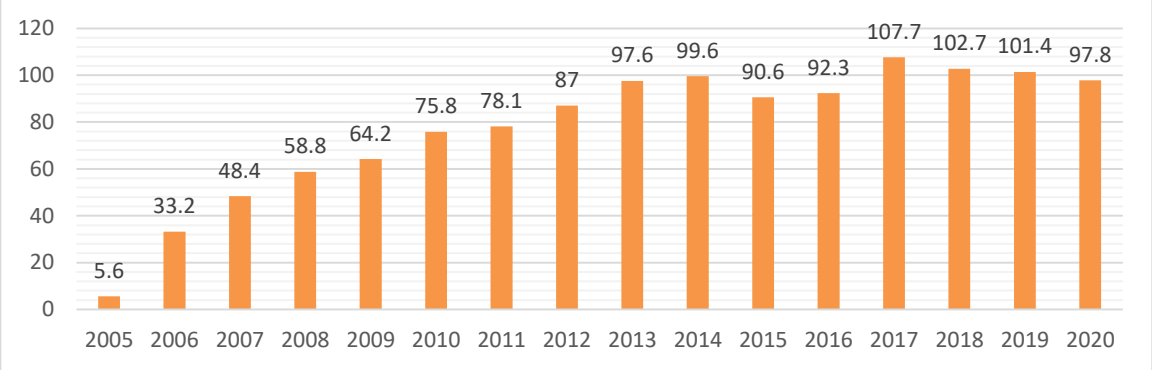
• Ministry of Planning, Central Bureau of Statistics, ICT use survey reports in manufacturing facilities (large, medium and Dwayne ministries and departments not associated with the Ministry, for the years 2008 and 2011.
• Ministry of Communications, Postal and Communications tables for the years (2005-2020).

Note from Table (1) that the number of mobile phone subscribers has increased from (5.6) per (100) people in 2005 to (107.7) For every (100) people in 2017, this demonstrates the desire of citizens whether they are individuals or governmental or non-governmental institutions and services to possess modern technology in communications, a good indicator that paves the way for digitization of the economy, and the form (1) The development of the cellphone subscriber index for each (100) person.

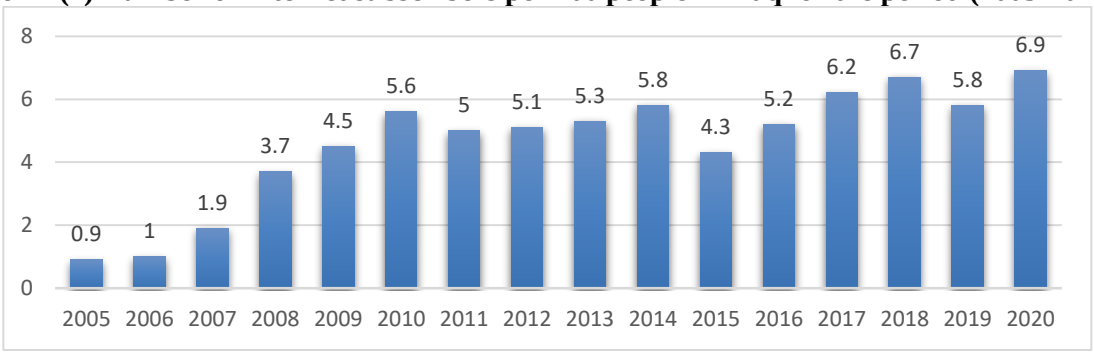
Form (1) Number of mobile phone subscribers per 100 people in Iraq for the period 2005-2020



- from the searcher's preparation based on the data in table (1).

Table (1) notes that the number of Internet subscribers has increased from (0.9) per (100) people in 2005 to (6.9) For every (100) people in 2020, this demonstrates the desire of citizens whether they are individuals or governmental or non-governmental institutions and services to communicate through the digital space, a good indicator that paves the way for the digitization of the economy, and the form (2) Shows the evolution of the Internet subscriber index per 100 people.

Form (2) Number of Internet subscribers per 100 people in Iraq for the period (2005-2020)



- **from the searcher's preparation based on the data in table (1).**

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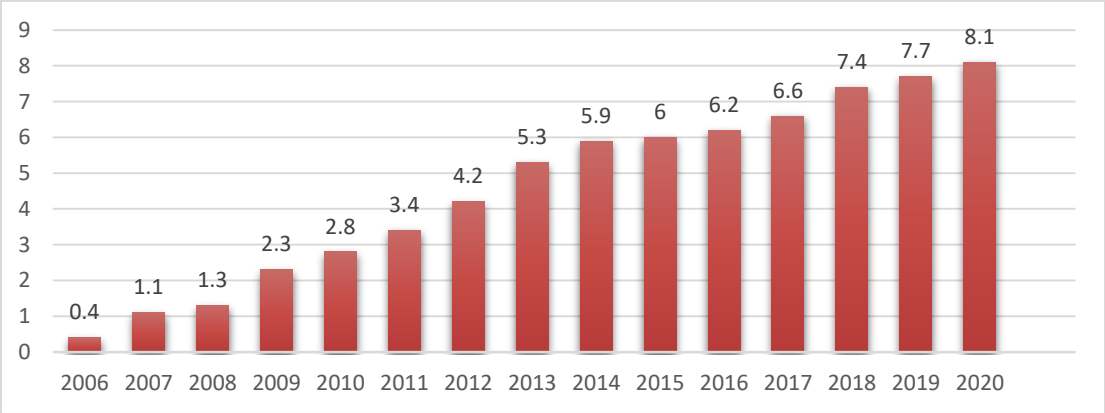
The indicator of the number of personal computers per 100 persons is observed from the table data (1) Increased index value since 2005 when indicator value (0.1) per (100) person, down to (8.1) For every (100) person in 2020, increasing the desire of the Iraqi citizen to have a personal computer is a good indicator added to the previous indicators to build the technological capabilities of the Iraqi citizen on the one hand, and on the other hand to facilitate the process of transition towards the digital economy, and the form (3) The following indicator shows the development of the number of personal computers per 100 persons during the study period.

Form (3) Indicator of the number of personal computers per 100 persons in Iraq for the period 2005-2020



- **from the searcher's preparation based on the data in table (1).**

2- Iraq's challenges in the transition towards a digital economy: Despite the growing indicators of Iraq's telecommunications and information technologies technology infrastructure, it is still lagging behind the world in this area, The most significant challenge facing Iraq's economy is moving towards a digital economy can be illustrated by:

• Digital architecture indicators remain low by global standards, which constitutes a major obstacle to the transition towards a digital economy, since the availability of digital infrastructure is the necessary condition for facilitating the transition towards the digitization of the economy, as we have explained earlier.

• Weak financial allocations in public budgets geared towards the development of Iraq's digital sector, and this sector is not considered essential to the transition towards a digital economy.

• The lack of political awareness among Iraq's ruling political class of the importance of developing digital infrastructure and its failure to include it in the priorities of the government programs of successive Iraqi governments from 2003 to date.

• Due to the volatile economic, social and political conditions experienced by Iraq, which have led to an increase in the index of weak digital and cognitive awareness,

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which for many years has had a significant impact on the outside world and has been reflected in the poor keeping up with developments in ICT and the digital revolution in general.

• Weak government management and poor planning of government decision makers which has created a challenge added to previous challenges in the field of transition towards a digital economy. In addition to the growing phenomenon of digital illiteracy in government circles, it has created fears of possession of modern technology and a shift towards a digital economy based on the technological infrastructure of communications and information. This is evident through the decline in business indicators, which has reached (34%), and the e-government index which reached (33%) in 2018 (Mehdi Dwaye and Abdul Ali Hussein, 2018, p. 26).

• Weak investments in the ICT sector, which is the backbone of digital infrastructure, are due to the lack of rule of law and the security needed to attract both external and domestic investments towards this sector, posing a real challenge that prevents a rapid transition towards the digital economy

• The weakness of the strategic vision of the transition towards the digital economy of the Iraqi Government is evident through the weakness of policies designed to shift towards the digital economy on the one hand. The weakness of funding for Iraq's digital sector, on the other hand, Government funding for the telecommunications sector is only financing that provides the basic structure for the growth of this sector to facilitate citizens' access to digital services. This is insufficient for the transition towards a digital economy.

• The increasing obstacles to the transfer of modern technology to Iraq the lack of use of countries' experiences and plans in the field of transition to the digital economy, and the weakness of scientific curricula, especially universities that mimic the information and communication revolution, artificial intelligence and technological globalization, all have resulted in Iraq's failure to catch up globally in the transition to the digital economy.

One of the reasons for the widening digital divide between Iraq and the rest of the world is the weakness of government legislation and decisions in support of Iraq's digital sector that will facilitate the process of transition towards a digital economy. Not to mention the weak measures taken by government agencies to combat financial and administrative corruption, which would weaken the basic technical structure and thus weaken and delay the transition to the digital economy.

Chapter III

Measuring and analyzing the impact of communications and information technology infrastructure indicators on Iraq's GDP development

To prove or deny the hypothesis of the study that there is a relationship of positive impact between the digital economy based on ICT indicators and Iraq's GDP, the study will adopt a standard model to illustrate that impact.

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Economic theories have confirmed that work is the basis of value but with technological advances, especially in the areas of communications and information and the emergence of e-commerce terminology, e-banks, e-health, e-education, and other terminology that asserts that at present work is not the basis of value and economic growth to the extent that knowledge and technological development constitute and their impact on economic growth. Given the paramount importance of the technological culture of workers in developing and innovating new methods of production that will improve economic growth rates and increase the level of productive efficiency and economic competitiveness, The digital economy has become the main locomotive driving economic growth and achieving sustainable economic development conditions.

Consequently, objective circumstances indicate a positive relationship between the digital economy expressed by variables (telecommunications infrastructure and information technology) and developments in GDP, which can be expressed in the following relationship: **GDP = f (NMS, NIS, NPC)**

The Econometrics model can therefore be formulated with the following formula: -GDP = α + β1NMS + β2NIS + β3NPC + ei

Where:

- GDP at constant prices

- α Fixed limit

- NMS Number of mobile subscribers per 100 people

- NIS Number of Internet subscribers per 100 people

- NPC Number of personal computers per 100 people

The variable number of subscribers to telephone lines was excluded from the study model for poor use of telephone lines based on land allowances during the study period.

1- Autocorrelation Test: Correlogram test results showed a subjective correlation between the sequential values of the study variables

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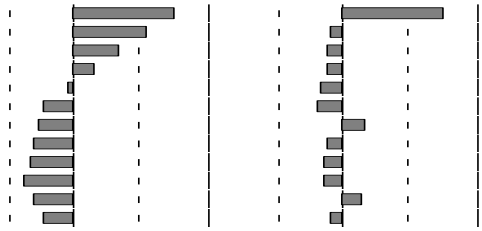
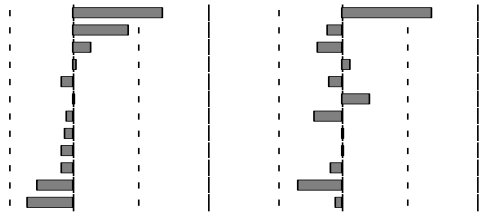
Date: 05/13/23 Time: 22:25
Sample: 2005 2020
Included observations: 16



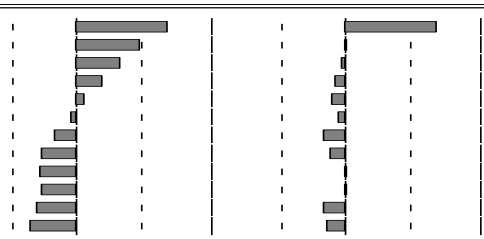
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.776	0.776	11.555	0.001
		2	0.563	-0.097	18.085	0.000
		3	0.357	-0.121	20.901	0.000
		4	0.162	-0.121	21.529	0.000
		5	-0.033	-0.168	21.558	0.001
		6	-0.223	-0.186	22.984	0.001
		7	-0.260	0.180	25.139	0.001
		8	-0.297	-0.111	28.304	0.000
		9	-0.333	-0.137	32.880	0.000
		10	-0.371	-0.142	39.472	0.000
		11	-0.296	0.149	44.505	0.000
		12	-0.227	-0.093	48.227	0.000

Date: 05/13/23 Time: 22:28
Sample: 2005 2020
Included observations: 16



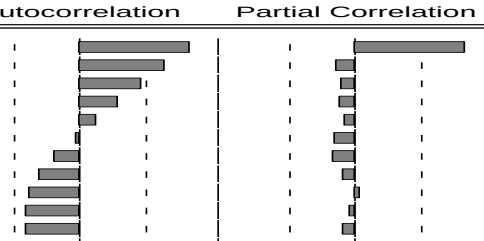
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.694	0.694	9.2577	0.002
		2	0.419	-0.122	12.873	0.002
		3	0.146	-0.188	13.346	0.004
		4	0.022	0.064	13.357	0.010
		5	-0.083	-0.099	13.538	0.019
		6	-0.007	0.209	13.540	0.035
		7	-0.053	-0.219	13.630	0.058
		8	-0.059	0.002	13.755	0.088
		9	-0.086	0.016	14.059	0.120
		10	-0.096	-0.094	14.504	0.151
		11	-0.285	-0.343	19.188	0.058
		12	-0.358	-0.046	28.431	0.005

Date: 05/13/23 Time: 22:28
Sample: 2005 2020
Included observations: 16



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.701	0.701	9.4452	0.002
		2	0.494	0.003	14.456	0.001
		3	0.339	-0.016	17.001	0.001
		4	0.198	-0.069	17.940	0.001
		5	0.058	-0.104	18.028	0.003
		6	-0.038	-0.045	18.070	0.006
		7	-0.166	-0.164	18.953	0.008
		8	-0.267	-0.110	21.527	0.006
		9	-0.284	0.013	24.849	0.003
		10	-0.266	0.003	28.237	0.002
		11	-0.310	-0.160	33.775	0.000
		12	-0.351	-0.139	42.658	0.000

Date: 05/13/23 Time: 22:29
Sample: 2005 2020
Included observations: 16



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.829	0.829	13.201	0.000
		2	0.645	-0.135	21.769	0.000
		3	0.463	-0.104	26.529	0.000
		4	0.287	-0.108	28.501	0.000
		5	0.131	-0.068	28.951	0.000
		6	-0.027	-0.152	28.973	0.000
		7	-0.184	-0.159	30.058	0.000
		8	-0.311	-0.088	33.544	0.000
		9	-0.373	0.034	39.262	0.000
		10	-0.397	-0.033	46.824	0.000
		11	-0.406	-0.083	56.302	0.000
		12	-0.400	-0.070	67.813	0.000

- **Results based on EViews 12**

After taking the first discrepancies, the time series of the study variables stabilized.

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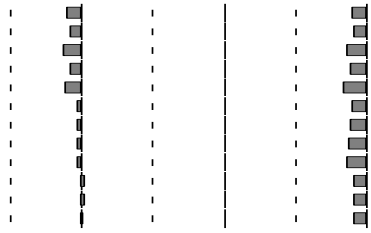
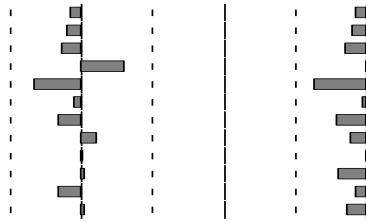
Date: 05/13/23 Time: 22:31
Sample (adjusted): 2006 2020
Included observations: 15 after adjustments



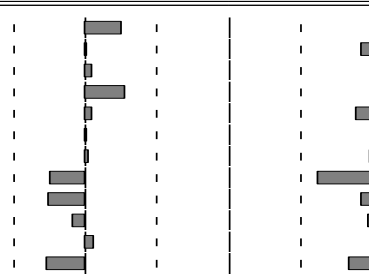
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.103	-0.103	0.1938	0.660
		2	-0.074	-0.086	0.3022	0.860
		3	-0.126	-0.146	0.6390	0.887
		4	-0.075	-0.118	0.7684	0.943
		5	-0.113	-0.171	1.0944	0.955
		6	-0.017	-0.105	1.1022	0.981
		7	-0.020	-0.109	1.1143	0.993
		8	-0.022	-0.126	1.1325	0.997
		9	-0.025	-0.134	1.1587	0.999
		10	0.026	-0.094	1.1924	1.000
		11	0.020	-0.087	1.2170	1.000
		12	0.015	-0.086	1.2368	1.000

Date: 05/13/23 Time: 22:33
Sample (adjusted): 2006 2020
Included observations: 15 after adjustments



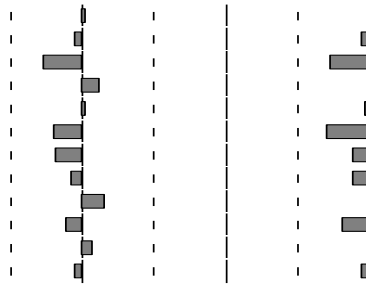
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.075	-0.075	0.1031	0.748
		2	-0.100	-0.106	0.2993	0.861
		3	-0.135	-0.154	0.6879	0.876
		4	0.316	0.291	3.0055	0.557
		5	-0.341	-0.371	5.9699	0.309
		6	-0.055	-0.023	6.0563	0.417
		7	-0.170	-0.213	6.9724	0.432
		8	0.107	-0.108	7.3868	0.496
		9	0.009	0.206	7.3900	0.597
		10	0.025	-0.199	7.4212	0.685
		11	-0.159	-0.067	9.0339	0.619
		12	0.029	-0.135	9.1033	0.694

Date: 05/13/23 Time: 22:33
Sample (adjusted): 2006 2020
Included observations: 15 after adjustments



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.261	0.261	1.2440	0.265
		2	-0.002	-0.076	1.2441	0.537
		3	0.053	0.080	1.3044	0.728
		4	0.284	0.269	3.1722	0.529
		5	0.042	-0.117	3.2179	0.666
		6	0.008	0.056	3.2196	0.781
		7	0.021	-0.009	3.2335	0.863
		8	-0.247	-0.392	5.4529	0.708
		9	-0.255	-0.080	8.2073	0.513
		10	-0.085	-0.027	8.5728	0.573
		11	0.058	0.055	8.7881	0.641
		12	-0.276	-0.160	15.277	0.227

Date: 05/13/23 Time: 22:34
Sample (adjusted): 2006 2020
Included observations: 15 after adjustments



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.025	0.025	0.0117	0.914
		2	-0.046	-0.047	0.0536	0.974
		3	-0.283	-0.281	1.7522	0.625
		4	0.127	0.149	2.1284	0.712
		5	0.017	-0.019	2.1354	0.830
		6	-0.204	-0.304	3.3167	0.768
		7	-0.195	-0.111	4.5237	0.718
		8	-0.078	-0.112	4.7434	0.785
		9	0.168	0.009	5.9364	0.746
		10	-0.108	-0.196	6.5335	0.769
		11	0.072	0.066	6.8598	0.810
		12	-0.045	-0.051	7.0282	0.856

- **Results based on EViews 12**

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Using the methodology of Autoregressive distributed time lags (ARDL) and using the statistical program EViews 12 to test the relationship between the digital economy and GDP developments, the following results were achieved: -

1- Time series Stability Test: Before starting to estimate the study form, a series of tests must be carried out to ensure the stability of the time chains in the form.

Form (4) A graphic showing the stability of the estimated model's time series

The **preparation of the researcher using EViews12 based on table data (1), and the Ministry of Planning, Central Statistical Agency national accounts data for the years (1960-2021).**

The previous figure shows that the time chains in the study model are unstable at a level other than the variable (NMS) and appear to be stable at the level, as evidenced by the model's lack of a time vector.

To perform dormancy tests according to ARDL methodology, we first need to identify the length of slowing of study variables: -

Using EViews 12, Schwartz (SC) test results for study variables showed slowing periods as follows: -

Table (2)Time Lags periods of study variables for 2005-2020

Variables	Time Lags
GDP	7
NMS	7
NIS	6
NPC	7

- **See Test Results (SC) in Supplement.**

- **Unit Root Test:** After the Time lag period tests of the study variables and determining the time lag periods of each variable, we resort to the unit root tests, and when the unit root tests of the variables using the Philips-Perron test the following results emerged:

• From the test results it is clear that the time series of all variables are unstable (see index), and this is why we refuse the null hypothesis (H0) accept alternative-Hypothesis (Hi) and say that time chains are unstable.

• Time series for all variables stabilized at the first difference (see index) Except for the variable (NMS), it was stable at the level and with a constant limit, so it is stable at zero degrees. (I0), in which case we accept the null hypothesis (H0) We reject the alternative – Hypothesis (Hi) and there is a common complementarity relationship between grades (I0) and (I1).

2- Test Bonds and Co-integration using Johansen Cointegration Test: The bonds test of the estimated model was conducted and the results showed the following:

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Table (3) Bonds Test Results

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
			Asymptotic: n=1000	
F-statistic	5.146477	10%	3.17	4.14
k	2	5%	3.79	4.85
		2.5%	4.41	5.52
		1%	5.15	6.36
Actual Sample Size	14		Finite Sample: n=35	
		10%	3.393	4.41
		5%	4.183	5.333
		1%	6.14	7.607
			Finite Sample: n=30	
		10%	3.437	4.47
		5%	4.267	5.473
		1%	6.183	7.873

t-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
t-statistic	-2.984034	10%	-2.57	-3.21
		5%	-2.86	-3.53
		2.5%	-3.13	-3.8
		1%	-3.43	-4.1

- **EViews 12.**

The previous table shows that there is a long-term joint integration relationship at a significance level (5%), so we decided not to null hypothesis (H0) and accept the alternative – Hypothesis (Hi).

As the previous table also shows, the absolute value of (t) is greater than (I0) values at a significance level (5%), thus we refuse the Null-Hypothesis (H0) and there is a logical relationship between the study model variables.

• The joint integration test was conducted using the "Johansen Cointegration Test" methodology as the study variables stabilized at the first difference so it is a first-class integrated (I1). The results highlighted the existence of four vectors, and this calls for us to accept the alternative hypothesis that there is a common integration and refuse to impose nowhere. (For more details see Supplement)

Table (4) Co-integration test results using the Johansen Cointegration Test

Date: 05/14/23 Time: 02:14		
Sample (adjusted): 2007 2020		
Included observations: 14 after adjustments		
Trend assumption: Linear deterministic trend		
Series: GDP NIS NMS NPC		
Lags interval (in first differences): 1 to 1		

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Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.951365	84.86702	47.85613	0.0000
At most 1 *	0.794218	42.53935	29.79707	0.0010
At most 2 *	0.651116	20.40621	15.49471	0.0084
At most 3 *	0.332737	5.663986	3.841465	0.0173
Trace test indicates 4 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

- **EViews 12**

3- Test for Serial Correlation Problem between Residuals: By testing the problem of serial Correlation between the residuals the test results showed no serial correlation between the residuals

Table (5)Test results of the serial Correlation problem between the Residuals of the estimated model

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	0.372866	Prob. F(2,9)	0.6989
Obs*R-squared	1.147782	Prob. Chi-Square(2)	0.5633
Test Equation:			
Dependent Variable: RESID			
Method: ARDL			
Date: 05/14/23 Time: 02:02			
Sample: 2006 2020			
Included observations: 15			
Presample missing value lagged residuals set to zero.			

- **EViews 12.**

4- Heteroscedasticity Test: By conducting the heteroscedasticity test to detect the existence of a problem (Heteroscedasticity) or not and using the ARCH method to detect the existence of the problem in the study model, the test results showed the absence of the problem, thus we accept the Null-Hypothesis (H0) and reject the alternative Hypothesis (Hi).

Table (6)Results of the ARCH test of the estimated study model

Heteroskedasticity Test: ARCH			
F-statistic	0.356104	Prob. F(1,11)	0.5628
Obs*R-squared	0.407653	Prob. Chi-Square(1)	0.5232
Test Equation:			
Dependent Variable: RESID^2			
Method: Least Squares			
Date: 05/14/23 Time: 21:10			
Sample (adjusted): 2008 2020			
Included observations: 13 after adjustments			

- **EViews 12.**

5- correlation matrix:

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Table (7)Correlation matrix for estimated model variables

	GDP	NIS	NMS	NPC
GDP	**1.000000**	**0.799914**	**0.878775**	**0.973398**
NIS	**0.799914**	**1.000000**	**0.928452**	**0.863156**
NMS	**0.878775**	**0.928452**	**1.000000**	**0.909620**
NPC	**0.973398**	**0.863156**	**0.909620**	**1.000000**

-from the researcher's preparation based on the data in Table (1) and the results of the EViwes12 program.

The previous table shows a positive correlation of (0.79) between variable (NIS) and affiliate variable (GDP), there is also a positive correlation reported (0.87) between variable (NMS) and affiliate variable (GDP), either the relationship between variable (NPC) GDP has a strong positive correlation of 0.97.

6- Short- and long-term causality test: By conducting a causality test for Granger to discover whether there is a one-way or two-way short-term causal link, the results of the test are explained as follows: -

Table (8) Granger's causality test to detect a one-way or two-way causal link to the study model

Pairwise Granger Causality Tests			
Date: 05/14/23 Time: 22:13			
Sample: 2005 2020			
Lags: 2			
Null Hypothesis:	**Obs**	**F-Statistic**	**Prob.**
NIS does not Granger Cause GDP	**14**	**1.01574**	**0.4002**
GDP does not Granger Cause NIS		**1.06105**	**0.3857**
NMS does not Granger Cause GDP	**14**	**2.23832**	**0.1625**
GDP does not Granger Cause NMS		**7.41950**	**0.0125**
NPC does not Granger Cause GDP	**14**	**1.67572**	**0.2406**
GDP does not Granger Cause NPC		**0.98422**	**0.4106**
NMS does not Granger Cause NIS	**14**	**0.38889**	**0.6887**
NIS does not Granger Cause NMS		**0.00651**	**0.9935**
NPC does not Granger Cause NIS	**14**	**0.38473**	**0.6913**
NIS does not Granger Cause NPC		**1.07729**	**0.3807**
NPC does not Granger Cause NMS	**14**	**0.10724**	**0.8994**
NMS does not Granger Cause NPC		**2.34995**	**0.1510**

- **From the researcher's preparation based on the data in Table (1) and the results of EViews12.**

The results of the previous table show that there is no short-term causal link between the independent variables of the model and the dependent variable and vice versa, thus we reject the null hypothesis and accept the alternative – Hypothesis, that there is no short-term causal correlation between the variables of the study model.

As for the long-term causal link test, the study will follow the method (Toda-Yumamoto). One of the conditions of this test is the selection of variables that have

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the highest rank of highest integration, after which this class combines with the optimal period Lags and the following table shows the results of the test: -

Table (9) Tuda-Yamamoto causality test to detect long-term causal link between model variables less than 5%.

VAR Granger Causality/Block Exogeneity Wald Tests			
Date: 05/14/23 Time: 03:39			
Sample: 2005 2020			
Included observations: 14			
Dependent variable: GDP			
Excluded	Chi-sq	df	Prob.
NIS	0.544977	2	0.7615
NMS	1.161129	2	0.5596
NPC	0.180513	2	0.9137
All	3.459927	6	0.7493
Dependent variable: NIS			
Excluded	Chi-sq	df	Prob.
GDP	6.732509	2	0.0345
NMS	3.626391	2	0.1631
NPC	5.362840	2	0.0685
All		4	---
Dependent variable: NMS			
Excluded	Chi-sq	df	Prob.
GDP	16.14595	2	0.0003
NIS	0.710782	2	0.7009
NPC	3.154461	2	0.2065
All		4	---
Dependent variable: NPC			
Excluded	Chi-sq	df	Prob.
GDP	12.17370	2	0.0023
NIS	8.044150	2	0.0179
NMS	6.069701	2	0.0481
All		4	---

The results of the previous table show that there is a one-way long-term causal link between the autonomous variables of the study model and the dependent variable, as Prob results indicate that it is significance less than 5%.

Analysis of the results of the study's estimated model

1- The results of the self-correlation test show a subjective correlation between the consecutive variables of the variables, and when taking the first difference the problem of self-association was resolved.

2- The Co- integration tests demonstrated that the relationship between the independent variables (NIS, NMS, NPC) and the dependent variable (GDP) is an integrative relationship of the grades (I0) and (I1) and therefore the Autoregressive of the distributed time lags methodology (ARDL) was selected to analyze the nature of the relationship between the study model variables.

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3- The model suffered from a unit root problem and was detected using the unit root tests specifically the Philips-Perron test (see index), and all the data stabilized when taking the first difference except the variable (NMS) was stable at the level.
4- Statistical tests demonstrated that the model is significant, showing the results of a statistic (t) calculated from the estimated model and when compared to the table values the significance of the estimated parameters of the model, and the value of the determination coefficient (R2) (98%), That is, the model can explain (98%) of changes to the dependent variable, test (F) was valued at (35.61828) and this is evidence of the overall significant of the estimated model (see annex).
5- The econometrics tests have demonstrated that the model is free of the problem of serial – correlation between the vesicles (see table 5) and that the model is free of the problem of Heteroscedasticity (see table 6).
6- The results of the estimate demonstrated a correlation between all the independent variables and the dependent variable, meaning that increased numbers of mobile phone subscribers per (100) person (NMS) will lead to real GDP increases by (2.03%), as well as an increase the number of internet subscribers per (100) person (NIS) will lead to GDP increases by (8.62%), either increasing the number of personal computers per (100) people (NPC) increase GDP by (7.59%) (see annex), hence telecommunications and information infrastructure indicators as the basis for the digital economy influence GDP.
7- From Table (7) which shows the correlation matrix, it is clear that there is a correlation between the study variables and the GDP, since the correlation ratio between the (NMS) and (GDP) (87%) The correlation ratio between (NIS) and (GDP) was (79%), and the correlation ratio between (NPC) and (GDP) was 97%.
8- When conducting a causality test to detect a short-term causal relationship in one or two different directions using (Granger), test results proved no short-term causal link between the independent variables of the estimated study model and the dependent variable (see Table 8), and when conducting a causation test to detect the presence or absence of a long-term causal link between the study model variables using a test (Toda-Yamamoto) The test results established a long-term and one-way causal link between the independent variables and the dependent variable (see table

Conclusions: - From the previous analysis, the study reached several conclusions:
1- Despite the development and growth of Iraq's telecommunications and information technology infrastructure indicators (ICTs), Iraq's regional and international environment continues to fall behind the requirements of the transition towards a digital economy owing to its economic, political, social and security challenges.
2- The results of the study have demonstrated a unilateral impact of communications and information technology infrastructure variables on Iraq's GDP structure, an indicator that encourages increased investment in the areas of the digital economy.

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3- The results of the study demonstrated a long-term and one-way causal relationship between independent variables and the GDP variable. This confirms that increased government and private investment in the telecommunications and information technology sector as the basic structure of the digital economy will in the long run influence the development of the GDP structure.

Recommendations: - The study recommends the following:

1−The need to increase financial allocations geared towards the telecommunications and information technology sector to develop and improve this vital sector as the fundamental basis for the transition to the digital economy.

2-Sustainable development indicators should be linked to indicators of the digital economy and the digital economy should be the driving force behind development and economic growth.

3-The need to design a national strategy for the transition towards the digital economy, to involve the private sector in this strategy and to educate in this direction on the material and human returns that are reflected in the quantity and quality of GDP.

List of sources: -

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