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Analyzing The Statistical Relationship between ICTs and Sustainable Development: Evidence from Egypt

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Abstract

In this paper, we aimed to test the causal relationship between information and communication technology and sustainable development in Egypt. The study relied on the hypothesis that information technology causes sustainable development as measured by real GDP, and that sustainable development causes information technology, A standard model was used to test this causal relationship, relying on the Cointegration method, and using the error correction model (VECM). The results of the test model revealed the existence of a bidirectional causal relationship in the short term from information technology to sustainable development and from sustainable development to information technology, Although the causal relationship between information technology and sustainable development has not been achieved in the long term, Egypt must continue in developing and support the information technology sector for it to bear fruit in the long term.

Keywords: *Sustainable Development, Information Technology, Capital Accumulation, Labor Force*

INTRODUCTION

The spread, access, and use of modern technological inventions are the main drivers behind the knowledge-based strategy for economic growth and development today, and as a result, information, and communication technologies (ICTs) are widely seen as an effective force for change across many social, economic, and environmental dimensions around the world, including ICTs. All devices, network components, applications, and systems that collectively allow people and organizations (i.e., corporations, nonprofit agencies, governments, and criminal institutions) to interact and involve in the digital world (Alhassan & Adam 2021).

ICTs have become an inherent aspect of moving the nation towards a more egalitarian, inclusive, productive, and sustainable economy and society. Governments and organizations in developing countries understand the power of ICTs to lead education and health care and promote citizen participation, which supports the widely held view that ICTs will advance a progressive agenda in all sectors of society. Achieving Sustainable Development Goals (SDGs) requires data. The data revolution has created an unprecedented era of information and statistics and a high demand for diverse packages of statistics, data, and indicators characterized by quality, comprehensiveness, comparability, integrity, and credibility at all levels, from global to local (Latif et al., 2017).

It is worth noting that a distinction can be made between digitization and digital transformation, as the European Commission defines digital transformation as the social and economic effects of the use of digital technology and data, as defined by the Organization for Economic Cooperation and Development (OECD), while digitization is defined as the process of using data and digital data technology, thus distinguishing between digitization and digital transformation, where (Nchofoung & Asongu. 2022). described it as "the application of technology to build new business models, processes, software, and systems that lead to more profits, greater competitive advantage, and higher efficiency," while Deloitte defined it as "the use of technology to

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fundamentally improve performance, or transform business in the relationship between digital transformation. (Suryawanshi & Narkhede 2015).

Digital transformation contributes to achieving sustainable development goals. For example, digital transformation gradually transforms governments and companies, making them more competitive. It also provides many opportunities for economic growth and prosperity, enabling countries to include more diverse educational opportunities, universal access to the Internet, and comprehensive and valuable education (Alhassan& Adam 2021). The environment for the development process in the field of poverty eradication, which is one of the main goals in the 2030 Agenda for Sustainable Development; the number of individuals without bank accounts has reached 2 billion worldwide, as new technologies provide access to finance and facilitate financial inclusion that can help lift people out of poverty by enabling mobile access to digital financial services for those without bank accounts. (Chang, et al., 2022).

Digital technologies are expanding healthcare, helping to manage epidemics and infectious diseases, and enhancing the delivery of public healthcare services by supporting universal access to healthcare facilities. It can also develop low-price, large-scale models to expand access to medicines, diagnostic tests, vaccines, nutritional supplements, and family planning in low- and middle-income countries, as e-health applications such as Be Healthy Be Mobile helps governments provide non-communicable disease healthcare services in their countries through mobile phones, for example; in Tanzania, Rwanda and elsewhere, drone technology is being used to transport blood and life-saving medicines to remote areas, drones and repeaters are used to achieve isolation zones, and 5G technology connects doctors with patients to facilitate the diagnosis process. (Mushi, et al., 2022).

In this context, the Egyptian government has committed to achieving the Sustainable Development Goals (SDGs) within its first sustainable development strategy, the Sustainable Development Strategy: Egypt's Vision 2030, launched in February 2016. This strategy is in line with the seventeen sustainable development goals and reflects the dimensions of sustainable development: economic, social, and environmental, and includes projects and programs planned to be implemented until 2030, and the emerging and new data communities in Egypt interact positively with the developments of the data revolution and the Internet to develop their societal and development roles. (Elgohary 2022).

The study tries to test the relationship between information technology and sustainable development in Egypt, especially since Egypt has made remarkable progress in the growth of the ICT sector in recent years with the occurrence of the Covid-19 crisis, as the study is based on the premise that information technology causes sustainable development as measured by real GDP, and sustainable development causes information technology. The study aims to test the validity of the study's hypothesis based on the inductive approach that studies the relationship between information technology and sustainable development in Egypt, as the analysis depends on the inductive approach through data collection and statistics to reach the research goal.

To test the validity of the hypothesis, it is proposed to divide the study into six parts. In addition to the introduction, Part 2 explains the previous analyses, Part 3 Egypt's efforts to develop the ICT sector, Part 4 explains the indicators of development of the ICT sector in Egypt, Part 5 explains the study model, Part 6 describes the study methodology, and Part 7 explains the conclusion and recommendations of the study.

LITERATURE REVIEW

Many previous studies have dealt with the relationship between information technology and sustainable development, in the following part, we investigated the related previous literature.

A study by **(**Nchofoung & Asongu2022)., which tried to analyze the role of information and communication technology in activating sustainable development, relying on the French experience as a model, which reached the French experience occupies a vanguard position in the digital field, which allowed the growth of information and communication technology at an extraordinary pace, and therefore the need for Arab countries to benefit from it.

The study by (El Assar, et al., 2022). tried to analyze and measure the impact of digital services on sustainable

development in Egypt, using quarterly data for some Egyptian economic indicators in the period (2007-2017), starting from the third quarter of 2007 to the fourth quarter of 2017, where it reached that in the case of an increase in the number of Internet lines (terrestrial Internet + mobile) by about 1%, this will lead to an increase in GDP by about 0.6%. In the case of an increase in the number of workers in the ICT sector by 1%, this leads to an increase in GDP of 0.1% by assuming that other variables are consistent in the analysis of variables.

The study of (Nchofoung & Asongu 2022). aimed to shed light on information and communication technology and its role in achieving sustainable development, and to identify the extent to which the Algerian state responds to technological developments and what it has achieved in the field of sustainable growth, and the descriptive analytical approach was used to extrapolate data on the contribution of information and communication technology to sustainable development in Algeria, and the study found the prominent role of information and communication technology in achieving sustainable growth by promoting participation in the processes of making Decision at the institutional, local and national levels, can also be an effective tool to empower individuals, strengthen their initiatives, decentralize management and demonstrate divergent views and interests on the political, social and economic issues facing our societies, as Algeria's development efforts have failed to respond to sustainable economic and social challenges.

Where, the study of **(**Badranet al., (2021). tried to analyze the potential impact of digital transformation on Egypt. The study results concluded that Egypt's digital transformation provides a unique opportunity to transform many economic sectors, such as financial services, retail, healthcare, agriculture, and manufacturing while creating opportunities for individuals and companies and influencing overall development and economic growth. However, while digital transformation can make a big difference in the economy, it should be supported by the required technological infrastructure, human capital, and environments. Appropriate legal, regulatory, and other enabling environments so that digital transformation becomes a platform for equality rather than division.

From other side, the study of (Ghonimi, I. G. 2021). aimed to analyze and test the role of investment in information and communication technology in achieving sustainable development: an applied study in the Iraqi Ministry of Communications, where the study found that investment in information technology has an importance and moral impact on sustainable development in the Iraqi economy.

Furthermore, the study of (Esily, et al., 2023). found that the Palestinian territories lack many features of political, economic, and legal regulation that control the work environment of the Palestinian ICT sector and related topics such as regulating the use of the Internet, the issue of intellectual property protection, copyright, information security, state sovereignty, consumer rights and privacy, which is a scene that weakens sustainable development in the Palestinian territories.

Moreover, the study of (Adel 2020). examined the empirical relationship between ICT development and sustainable development to clarify whether the social impacts of ICTs can play an intermediary role in this linkage. Drawing on data from secondary sources from 143 countries globally for 2016 and using structural equation modeling to examine these linkages, the results of the study concluded that ICT development through ICT access has a dual role in sustainable development, first, by stimulating sustainable development directly and indirectly when the social impacts of ICTs act as a mediator.

In the same stream, The study of (Shehata & Montash 2020). tried to analyze the role of the digital economy in achieving sustainable development goals in the Arab region. Summary. The study found that despite the digital economy and sustainable development of innovation in 2030, the Arab region is still unable to achieve this due to the digital divide between Arab countries, weak absorptive capacities such as limited and problems of digital infrastructure, and then arrange national legal and regulatory strategies for adoption and development and improve research to reach global assurance and innovation.

In addition, The study of (El Gody2021). reviewed an overview of digital transformation globally and in the Arab world in general, based on globally recognized indicators, explaining the classifications of some countries of the world, as well as the classification of advanced Arab nations in the field of digitization, and reviewed the state of digital development in Egypt in particular, based on several indicators, including the e-government index,

the e-participation index, and network readiness, and this study also studied the relationship between digital transformation represented by the network readiness index (NRI) and sustainable development in Egypt characterized by indicators (average GDP per capita at constant prices, life expectancy at birth, average carbon emissions per capita). Using the modern scientific method (ARDL) distributed autoregressive model and time series data covering the period (2000-2020) The results of the study also confirmed the existence of the impact of digital transformation is evident on both the average carbon emissions per capita in the short and long term, as well as life expectancy at birth in the long and short term, which confirms technological and digital progress, and its role in achieving the dimensions of sustainable development in both its environmental and social aspects. However, the impact of digital transformation on the economic dimension is measured by the average per capita output. Real GDP has yet to be achieved in the long run. Still, Egypt must develop and support the digital transformation process to bear fruit on the economic side of GDP per capita in the long run.

Going further, the study of (Hamad & Al-Fadel 2022). aims to study the relationship between information and communication technology, foreign direct investment and trade in the green economic growth of a group of 53 economies within the Belt and Road Initiative using data during the period (1990 and 2020), and the study found that the use of information and communication technology stimulates green economic growth in the countries of the Belt and Road Initiative by supporting the theory of internal economic development, and the interaction of information and communication technology with trade and technology Information and communication with foreign direct investment accelerates the rate of economic growth, in addition to having a positive and vital relationship between trade, i.e. exports, imports and economic development in the economies of the Belt and Road Initiative, and illustrates the positive and significant impact of ICT on foreign direct investment and its effect on long-term economic growth, moreover, it supports the positive influence of ICT on FDI flows in the economies of the Belt and Road Initiative, and more of advances in information and communication technology can stimulate trade. Therefore, the economies of the Belt and Road Initiative should continue to improve ICT as a profound tool that accelerates FDI flows and enables trade for green economic growth.

It is clear from the presentation of previous studies that although they dealt with the relationship between information technology and sustainable development, they still need to resolve this relationship. Then, the current study tries to test the relationship between information technology and sustainable growth in Egypt. The current study differs from previous studies that were presented in that it is applied to the Egyptian economy and uses recent data and a relatively more extended period, which is the period (1990-2022), in addition to its attempt to rely on the error correction model in testing the causal relationship, which is Measurement methods are relatively new.

Egypt's Efforts to Develop the ICT Sector

The Egyptian ICT sector is strong, innovative, and with a broader growth rate, growing by 16% in the fiscal year 2018/2019 to reach about 93 billion Egyptian pounds, one of the fastest expansion rates in all economic sectors, while the GDP growth rate reached 6.5%. This trend was expected to continue, as the Egyptian government predicted in December 2020 that the sector would grow by 15.2% in the fiscal year 2019/2020 to constitute 4.4% of GDP and generate revenues of EGP 108 billion.

The significant expansion witnessed by the Egyptian ICT sector during 2020 is due to the substantial surge in demand for it by companies to address the challenges caused by the health crisis caused by the Covid-19 pandemic, which contributed to the broader digital transformation in Egypt (Khaled et al., 2023), (Ule Prince et al., 2022), and SAKAet al., 2023), in addition to that the Egyptian government has prioritized the development of ICT, as it launched the Ministry of Communications and Information Technology and Communications of Ministry Technology Information Digital Egypt Plan in mid-2020, a comprehensive plan to transform towards a more digital society and encourage innovation.

Digital Egypt also seeks to provide all government agencies with fiber optic cable connections. As of September 2020, 5,300 government buildings have been connected to the fiber optic network, and once completed, the program will connect about 32,000 buildings at an estimated cost of 6 billion Egyptian pounds. Since mid-2021, more than 3.1 million citizens have registered for and accessed government services online, and the ICT

Strategy for 2030 includes the establishment of many Technology parks with a total investment of one billion Egyptian pounds; it is worth noting that as of July 2021, 75 public services have been digitized and provided nationwide, with 170 services planned to be reached by the end of 2021. In mid-2020, Talaat stated that six technology parks will be completed by the end of that year in the governorates of Minya, Menoufia, Mansoura, Suhag, Qena, and Aswan, which will include training facilities, equipment design labs, and co-working spaces to support innovation and entrepreneurship. (Eissa, et al., 2021), (Adbel-Maksoud et al.,2023), and (Shaaban 2022).

To illustrate the size of the expansion and growth in the ICT sector in the Egyptian economy, it is possible to use the indicators of Internet use in Egypt during Ramadan 2022 compared to 2021 as in Figure (1)

Telecom Market Indicators in Egypt 2023

The indicators of the telecommunications market in the Egyptian economy can be clarified by clarifying the development of subscriber indicators by explaining the indicators of the number of mobile subscribers, the number of mobile internet subscribers, the number of fixed telephone subscribers, the number of fixed internet subscribers, the number of subscribers to the electronic wallet. The indicators of subscribers in the Egyptian telecommunications market include about 102.4 million mobile phones, approximately 72.6 million Internet subscribers, approximately 12.6 million fixed telephones, about 10.2 million fixed Internet subscriptions, and about 10.4 million electronic wallets.

Model Characterization

To achieve the objective of the study of testing the causal relationship between ICT and economic development in the Egyptian economy, the variables of the analysis and the formulation of the model were identified using previous studies in this field, which relied on the Cobb-Douglas model in formulating the relationship between the ICT sector and sustainable development.

y_t =A K_t^α L^β (1)

It refers to the rate of economic development in the Egyptian economy (measured in real GDP), y_tA refers to the technological level (which is constant), K expresses natural capital accumulation, L refers to labor power, refers to the coefficient of elasticity of output relative to natural capital accumulation, refers to the coefficient of elasticity of output close to the labor force. αβ

Since the main objective of the study is to test the relationship between ICT and economic development in Egypt, the number of abandoned mobile phone services (T) as an explanatory variable and an indicator for ICT will be added to equation (1) to become as follows:

$$y_t = A\ K_t^{\alpha}\ L^{\beta} T_t^{y} \qquad (2)$$

The logarithm of both sides of equation (2) is taken to obtain the following linear equation.

$$\log y_t = b_0 + b_1 \log K_t + b_2 \log L_t + b_3 \log T_t + \epsilon_t \ldots . (3)$$

Equation (3) is used as a basis to test the relationship between each explanatory variable and economic development bilaterally in the short and long term, and since the variables are in their logarithmic value, partial derivatives express the elasticity of the GDP growth rate relative to the explanatory variables, express the elasticity of real GDP relative to real capital accumulation, express the elasticity of real GDP growth relative to the labor force, express the elasticity of real GDP for the ICT sector, It is the limit of random error assuming that it achieves the traditional statistical properties with an arithmetic mean equal to zero and constant variance. $b_1 b_2 b_3 \epsilon_t$

Concerning the data on the variables used in the tests on the state of the Egyptian economy during the period (1990-2022), it was collected from international sources "World Bank," and the consumer price index (CPI) (2010 = 100), was used to obtain the fundamental values of those variables (real GDP, natural capital accumulation, real value added in the industrial sector).

METHODOLOGY AND RESULTS OF THE STUDY

According to the methodology used in the study, the methods used consist of three tests: "unit root tests, co-integration test, and error correction models."

Unit root test for Time Series Dormancy

Unit Root Test aims to examine the properties of time series for both labor force (L), which is a real variable, and natural, sustainable development as measured by real GDP (y), natural capital accumulation (K), and the information technology sector (T) during the period (1990-2021), to identify the extent of its dormancy, and determine the rank of integration of each variable separately, and despite the multiplicity of unit root tests, but the current study will use two tests: Dickey and Fuller, Philip-perron test, and table shows the results of the ADF test for the unit root of the study variables.

Table (1)

Unit root ADF test results for levels and first variances of variables ADF-test								
The first difference				Level				Time series
General trend		Cross-section		General trend		Cross-section		
Prob.*	t-Stat.	Prob.*	t-Stat.	Prob.*	t-Stat.	Prob.*	t-Stat.	
0.07	-3.40	0.03	-3.18	0.84	-1.39	1.00	1.06	log(Y)
0.03	-3.74	0.02	-3.41	0.88	-1.25	0.42	-1.70	log(L)
0.04	-3.63	0.02	-3.46	0.72	-1.71	0.99	0.90	log(K)
0.00	-5.19	0.00	-5.25	0.05	-3.53	0.73	-1.03	log(T)

Source: Researcher preparation based on the outputs of the EViews program

Table (1) shows the results of the Dickey-Fuller test, which indicates the instability of the all-time series for both the real GDP growth rate, the labor force growth rate, and the growth rate of natural capital accumulation at the level by section or section and general trend, i.e., the hypothesis of the absence of the existence of the unit root was accepted, meaning that the time series is unstable at the plane, whether by a section or section and a general trend. In contrast, for the ICT series it is stable at the level assuming the presence of a section only. With a significant level of 5%, the stability of the all-time series of the model when taking the initial difference to it, whether only a section or a section and a general trend at a significant level of 7% or less, for the Philip-Bern test, Table (2) provides the results of the PP test for the root of the unit on the variables of the study:

Table (2) Unit root PP test results for levels and first differences of variables

PP_test								
The first difference				Level				Time series
General trend		Cross-section		General trend		Cross-section		
Prob.*	t-Stat.	Prob.*	t-Stat.	Prob.*	t-Stat.	Prob.*	t-Stat.	
0.10	-3.21	0.03	-3.19	0.94	-0.95	0.99	0.77	log(Y)
0.03	-3.76	0.02	-3.39	0.97	-0.64	0.26	-2.07	log(L)
0.09	-3.30	0.02	-3.44	0.89	-1.21	1.00	0.96	log(K)
0.00	-10.20	0.00	-10.41	0.05	-3.60	0.43	-1.68	log(T)

Source: Researcher preparation based on the outputs of the Eviews program

It is clear from the results of Table (2) that the results of the Philip Peron test agree with the Dickie Fuller test in the instability of all-time series for both the real GDP growth rate, the labor force growth rate, and the real

capital accumulation growth rate at the level with a section or a section and a general trend, i.e., the hypothesis of the non-existence of the unit root was accepted, meaning that the time series is unstable at the plane, whether by a section or section and a general trend, as for the ICT series, it is stable. At the level assuming that there is only a section with a significant level of 5% and the stability of all-time series of the model is observed when taking the initial difference for it, whether by a section only or a segment and a general trend at a significant level of 7% or less.

Johansen-Gisses Cointegration Test Results

The Angel-Granger test can be used to find out the existence of a standard integration between the variables under study or not, but the Engel-Granger test does not aim to find out the number of cointegration vectors that exist between the variables under study, which distinguishes the Johansen test from other joint integration tests, through its ability to test the number of vectors of the standard integration between the variables under study, and the Johanssen test is considered a support for the results obtained from the Engel-Granger test, in the event that the Johanssen-Jessel test (Johansen- Juselius Cointegration test) the existence of a single integration vector between the variables under study, and when it is confirmed that there is a single integration vector between the variables under study using the Johansen-Jessel test, then the equations of error correction models can be estimated, and Table (3) shows the results of the Johanssen-Jessel test.

Table (3) Johansen-JSLS test results

Trace Test										
Impose the number of cointegration vectors (r)	Intrinsic Value		Statistical or calculated value		Critical values of the test at a significant level of 5%		Critical values of the test at a significant level of 1%		Possibility	
	Eigen Value		Statistic		Critical Value 5%		Critical Value 1%		Pro.	
	Cross-section	General trend	Cross-section	General trend	Cross-section	General trend	Cross-section	General trend	Cross-section	General trend
No	0.72	0.75	56.90	73.70	47.86	63.88	54.68	71.48	0.01	0.01
One at most	0.33	0.46	17.30	31.06	29.80	42.92	35.46	49.36	0.62	0.44
Two at most	0.15	0.23	5.06	11.91	15.49	25.87	19.94	31.15	0.80	0.82
Three at most	0.00	0.12	0.12	3.97	3.84	12.52	6.63	16.55	0.72	0.75
Maximal Eigen value Test										
No	0.72	0.75	39.60	42.64	27.58	32.12	32.72	37.49	0.00	0.00
One at most	0.33	0.46	12.23	19.15	21.13	25.82	25.86	30.83	0.52	0.30
Two at most	0.15	0.23	4.94	7.94	14.26	19.39	18.52	23.98	0.75	0.83
Three at most	0.00	0.12	0.12	3.97	3.84	12.52	6.63	16.55	0.72	0.75

(r) Refers to the number of vectors of cointegration.

Source: Researcher preparation based on the outputs of the EViews 10 program

The results of Table (3) indicate that all the values calculated for the impact test and the maximum value test exceed the critical values of this test at the first hypothesis at a significant level of 5% and a significant level of 1% by assuming the presence of a section or section with a general trend, which indicates the possibility of rejecting the null hypothesis ($r = 0$) that there is no standard integration, and accepting the alternative hypothesis ($r \neq 0$), which means that there is a joint integration between the real GDP growth rate and its determinants of communication and information technology, and the strength of labor, natural capital accumulation.

It also appears from the results of Table (3) that the second hypothesis is statistically significant in the case of the impact test or the maximum value by assuming the presence of a section or section and a general trend at a substantial level of 5% or 1%, and it is also noted that all the calculated values Statistic for the impact test do not exceed the critical values of this test, which indicates the acceptance of the null hypothesis that the number

of cointegration vectors does not exceed one, which indicates the absence of a second vector for the joint integration between the variables of the study, It is also clear that the results of the impact test are consistent with the results of the maximum value test, but in the event that the results of the impact test (Trace test) differ with the results of the ultimate latent value test (Maximal eigenvalue), the value of the results of the impact test can be relied upon, according to what some studies indicate.

Error Correction Model Estimation Results

The error correction model assumes the existence of two types of relationships between real GDP and its determinants: a long-term relationship and a short-term relationship, which is the immediate or direct relationship that appears between the real GDP growth rate and its determinants in each period, measured by the changes between them in each period.

Through the error correction model test, the null hypothesis is tested that there is no causal relationship between the model variables versus the alternative hypothesis that there is a causal relationship between the model variables, where the t-statistic value of the slow error correction limit coefficient is used to infer the existence of a long-term causal relationship between the variables. The F-statistic value of the explanatory variables in error correction equations is used to identify a short-term causal relationship between the variables. The error correction equations were estimated for the variables between which there was a typical integration relationship, namely real GDP, ICT, real gross capital accumulation growth rate, and labor force growth rate, and the results were prepared in Table (4).

Table(4) Causality test results using error correction models

Estimated regression equation	F-value statistic Short Run	Pro.	value :- statistic Long Run	Pro.	slowdowns	Direction of causality
The equations for the change in the logarithm of real GDP and the change in the logarithm of information technology						
D(logY)=D(logT)	5.24	0.01	-1.71	0.10	(1)(1)	D(logY) ⟵ D(logO)
D(logT)=D(logY)	3.70	0.02	1.02	0.32	(1)(1)	D(logO) ⟵ D(logy)
The equations for the change in the logarithm of real GDP and labor supply						
D(logY)=D(logL)	5.37	0.00	-1.99	0.06	(1)(1)	D(logY) ⟵ D(logL)
D(logL)=D(logY)	3.31	0.04	1.56	0.13	(1)(1)	D(logL) ⟷ D(logY)
The equations of change in the logarithm of real GDP and real capital accumulation						
D(logY)=D(logK)	4.63	0.01	1.44	0.16	(1)(1)	D(logY) ⟵ D(logK)
D(logK)=D(logY)	5.40	0.00	3.09	0.00	(1)(1)	D(logK) ⟷ D(logY)

Source: Researcher preparation based on the outputs of the EViews 10 program

Table (4) shows the causal relationships between real GDP and its determinants in the short and long term for the causal relationship between real GDP and ICT. It is noted that the value of the T-test for the error correction limit coefficient is statistically insignificant at a significant level of 1% in the equation of change in the real GDP and the equation of change in ICT, which indicates that there is no causal relationship between technological progress and sustainable development in the long term. The calculated value of the F test is statistically significant at a significant level of 1% in the equations of change in the growth rate of real GDP and the equation of change in ICT, which means that there is a two-way causal relationship in the short term from ICT to real GDP and from real GDP to sustainable development, i.e., a bidirectional causal relationship between sustainable development and ICT in the short term only.

It is also noted from the results of Table (4) to test the causal relationship between real GDP and labor force, that the value of the test for the slow error correction limit coefficient in the equations of change in the real GDP growth rate is not different from zero and is not statistically significant, which means that there is no causal relationship in the long run between labor supply and real GDP, The calculated F test is statistically significant in the equations of change in real GDP and change In the short term, this means that there is a two-

way causal relationship in the short term from supply in labor to real GDP and from real GDP to supply from labor, that is, the causal relationship between real GDP and supply from labor is bidirectional in the short term.

With regard to the causal relationship between real GDP and natural capital accumulation, it is noted from the results of Table (4) that the value of the test t for the slow error correction limit coefficient in the equation of change in natural capital accumulation differs from zero and statistically significant, which means that there is a one-way causal relationship in the long term from real GDP to natural capital accumulation, while in the short term the significance of the calculated F test value is significant at a significant level of 1% in the two equations of change in Real GDP and change in natural capital accumulation, which means that there is a two-way causal relationship in the short term from real GDP to natural capital accumulation, and from natural capital accumulation to real GDP, that is, the causal relationship between real GDP and natural capital accumulation unidirectional in the long term and bidirectional in the short term, and the results of the above can be summarized in Table(5)

Table(5) Error correction model results

Real GDP and Industrial Output	Causal direction	Short term	Bidirectional	ICT causes sustainable development, and sustainable development causes information technology in the short term.
		Long term	No causal relationship	ICT does not cause sustainable development; just as sustainable development does not generate information technology in the long run.
Real GDP and intense labor	Causal direction	Short term	Bidirectional	Labor force growth causes real GDP, and real GDP causes labor force growth.
		Long term	Unidirectional	Labor force growth causes real GDP in the long run
Real GDP and Capital Accumulation	Causal direction	Short term	Bidirectional	Natural capital accumulation causes real GDP, and real GDP causes natural capital accumulation.
		Long term	Unidirectional	Real GDP Causes Real Capital Accumulation

CONCLUSION AND RECOMMENDATIONS

The main objective of this study is to test the causal relationship between information technology and sustainable development in Egypt. To achieve this goal, the study was divided into six parts. In addition to the introduction, the second part explains previous studies, the third part explains Egypt's efforts to develop the ICT sector, the fourth part describes the indicators of the development of the ICT sector in Egypt, the fifth part explains the study model, the sixth part explained the study methodology, the seventh part presented the conclusion and recommendations of the study.

The second part is an explanation of previous studies. It has become apparent from the last presentation of prior studies. However, it dealt with the relationship between information technology and sustainable development. Still, it did not resolve this relationship. Then, the current study tries to test the causal relationship between information technology and sustainable growth in Egypt, using recent data and a relatively more extended period, which is the period.(2022-1990)

The third part explained Egypt's efforts to develop the ICT sector, the fourth part explained the indicators of the development of the ICT sector in Egypt, and it became clear that there is a tremendous development in the field of ICT in the Egyptian economy, especially in the recent period after the Corona pandemic, which confirms Egypt's commitment to digital transformation by the 2030 goals for sustainable development.

The fifth part explained the study model. It included the description of the production function of the Douglas Cup to test the causal relationship between information technology and sustainable development in Egypt, measured by real GDP. In contrast, the fifth part included the study's methodology and results. According to the methodology used in the analysis, The methods used consist of three tests: unit root tests, joint integration tests, error correction models, and unit root tests have been relied upon to ensure the stability of time series despite There being many unit root tests, but the current study used two tests: the Dickey-Fuller test and the Philip-Perron test, which are the most used in econometric studies in general, and the extent to which there is a standard complementarity between the real GDP growth rate as an indicator of sustainable development and its determinants was tested.

The results of the test model found a two-way causal relationship in the short term from information technology to sustainable development and from sustainable development to information technology. Although the causal relationship between information technology and sustainable growth has yet to be achieved in the long term, Egypt must continue to develop and support the information technology sector until it bears fruit in the long term.

The causal relationship between real GDP and supply of labor is two-way in the short term, the causal relationship between real GDP and natural capital accumulation is one-way in the long term from real GDP to natural capital accumulation and bidirectional in the short term, and finally, the study recommends the following:

Adopting innovation, developing education, and investing in scientific research led to improving the quality of infrastructure and digital institutions.

Facilitating access to digital services creates highly digitally competitive communities, leading to sustainability, which is shaped by creating new jobs and contributing to the growth of local digital services products.

Digitalization has an environmental impact that contributes to reducing carbon emissions and conserving resources (especially non-renewable), bringing prosperity, and improving the quality of life.

Digital illiteracy needs more attention to increase the proportion of Internet users and promote digital awareness.

Providing databases for all sectors that help them achieve the sustainable development strategy.

Activating the use of information technology and artificial intelligence in all sectors to benefit from them in data analysis and cost reduction.

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