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A Review of Digital Economy and Digital Economics

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Abstract

Under the burgeoning digital era, most countries around the world are moving to digitalize their economies. Digitalization is fundamentally changing all social and economic sectors. However, existing studies have tended to pay more attention to the digital economy rather than digital economics. Drawing from recent literature, this paper critically reviews the understanding of the digital economy by examining its meaning, main characteristics, scopes, and measurement methods, and identifies how the digital economy differs from the traditional economy. The paper then presents the concept and roles of digital economics and suggests the need for training about digital economics. In this regard, the paper concludes that education policies should be renovated in order to meet the demands of a digital economy. The courses of economics programs should be integrated with digital economics and sharing economics.

Keywords

Digital economy, digital economics, digitalization, digitalized economy, ITC

Introduction

The emergence of the digital era is an outcome of industrial revolutions and mankind's responses to development challenges. Technically, mankind has gone through four industrial revolutions. *The first* started in 1784 with the invention of steam machines, the usage of water and steam power, and all sorts of other machines, which enabled the industrial transformation of society with trains and the mechanization of manufacturing. *The second* encompassed the period between 1871-1914 with the invention of electricity and new manufacturing modes, which led to an era of mass production, assembly lines, and the beginning of automation. *The third* commenced in the late 1960s with the rise of computers, computer networks, robotics in manufacturing, connectivity, the internet, and more advanced automation. *The fourth*, which is currently underway, was triggered by the development of artificial and digital technologies, enabling a move from the client-server model to

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ubiquitous mobility, the bridging of digital and physical environments, and the convergence of information and operational, physical, and biological technologies with full automation and optimization (Chung, 2017; Klaus, 2017). The driving force of this industrial revolution is the fourth generation of technologies. As pointed out by the Boston Consulting Group (2021), this generation includes nine technologies that are transforming all socio-economic sectors of the economy, namely: additive manufacturing, augmented reality (AR), autonomous robots, big data and analytics, cloud computing, cybersecurity, horizontal and vertical system integration, the industrial internet of things (IoT), and simulation. The cornerstone of these technological innovations is digital technologies and artificial intelligence.

Furthermore, the world nowadays faces several global development challenges, namely disease and climate change. The disease known as COVID-19 is an ongoing global pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The virus was first identified in December 2019 in Wuhan, China and spread globally to 222 countries and territories. As of May 09, 2022, more than 517.3 million cases have been confirmed, with more than 6.2 million deaths attributed to COVID-19, making it one of the deadliest pandemics in history (Worldometers, 2022). The COVID-19 pandemic caused most affected countries to lock down and encourage/enforce social distancing, which in turn led to serious stagnations in global travel, traditional trades, and services. This pandemic has had severe negative impacts on the global economy, causing loses of at least 4.5 percent of the gross domestic product (GDP) in 2020, which amounted to almost USD 3.94 trillion in lost economic output, and especially, a loss in business travel revenue of USD 810.7 billion (Szmigiera, 2021). However, the pandemic also created an opportunity for the development of online sectors such as online working, trading, education, telehealth, and services, among others. This pandemic challenge has led to the need to transform economic and social activities into digital contexts.

Moreover, climate change has resulted in warming temperatures, more droughts, changing rainfall and snow patterns, shrinking sea ice, more tropical storms, rising sea levels, and saline water intrusions. Climate change has significant impacts on the physical environment, ecosystems, and human societies. Therefore, there is a need to transform long-term forecasts on climatic change and its impacts on humans and the physical environment into a digital environment.

To reflect the three main perspectives, the digitalization of the economy has been manipulated in both developed countries and developing countries. These new trends have also placed new demands on education and training not only in the fields of information and communication technologies, but also digital economics in other sectors to improve people's ability to adapt to the burgeoning of the digital era. In doing so, discussing the definition, roles, and syllabus of digital economics are key issues for renovating training programs.

This paper aims to present a general review on research focusing on the digital economy and digital economics by identifying the differences between the terms digital economy and digital economics, and the need to renovate education policies. In the next two sections, we synthesize a literature review on the digitalization of the economy, the digital economy, and its characteristics, followed by a section discussing the scopes of the digital economy. The fourth section discusses the fundamental knowledge of digital economics, and the last section presents the conclusions and policy recommendations.

In this research, we used secondary data from peer-reviewed articles in the Web of Science data source. To identify the case studies included in our analysis, we conducted a meta-study in which many academic case studies were selected based on a systematic literature review. We looked for cross-references among articles and conducted a keyword search using "digital economy" or "digital economics" in the aforementioned data source. The criteria for case

inclusion were such that the case was published in a peer-reviewed journal, with the paper providing concrete empirical information and fundamental theories on the digital economy. Based on the screening, 17 peer-reviewed articles were selected for analysis, which covered 21 cases. Moreover, a comparative analysis was used to identify the characteristic features of a digital economy and digital economics. To identify the relationship of these terms, critical synthesis methods and comparative analysis for presenting the results were used.

Digitalization of the economy

Most countries are in the process or will eventually digitalize their economies. Digitalization is fundamentally changing all social and economic sectors. It drives entrepreneurial innovation, productivity, and national and regional economic developments. It has implications for resource re-allocation, new jobs and employment, new education methods, and changes in the labor market. The process of economy digitalization is characterized by the following features: (1) Digitalization and transformation in all socio-economic sectors based on the fourth technological generation; (2) Optimized smart manufacturing with digitalized value chains in the cyber-physical environments; (3) Reflection of business interrelations in cyber systems based on digital platforms and applied to reality; and (4) Fundamental changes in businesses in terms of management and control supported from digital platforms (Chung, 2017). In the digitalization of the economy, the following tendencies of technical changes can be observed: digitalization of manufacturing and services; increased connections through IoT between reality and cyber environments; real time data about the physical world; automatization; multi-functional technology with the completion of different tasks at the same time; increased interactions among humans, between humans and auto-robots, and among auto-robots and cyber and reality worlds; and the use of new nano materials (Chung, 2021).

Digital economy

Due to the aforementioned advantages, digitalization is advancing in most countries, and in many cases the emergence of a "digital economy" is the result**.** Based on the results of the systematic literature review, most of the research discussed *digital economy* rather than *digital economics* (Cameron *et al.*, 2019; Dung, 2020; Sang, 2020). The concepts and meanings of these terms are divergent (Rumana & Richard, 2017; Ha *et al.*, 2020). Definitions are always a reflection of the times and trends from which they emerge. Digital economy was first named by Tapscott (1996). Since then, a number of digital economy definitions have been discussed. Rumana & Richard (2017) reviewed about 21 definitions related to the digital economy. A common meaning of digital economy is that: *Digital economy refers to an economy with a base of digital technologies, and in which business and market transactions are conducted through the internet and world wide web* (Oxford Digital Economy Collaboration Group, 2018; Chohan, 2020). The digital economy is also perceived as the internet economy, new economy, web economy, or sharing economy with billions of everyday online connections among people, organizations, businesses, devices, data, and processes.

Characteristics of the digital economy

The digital economy is intertwined with the traditional economy, but they have *different characteristics* (Tapscott, 1996; Gaspar & Glaeser, 1998; Rumana & Richard, 2017; Avi & Catherine, 2019; Unctad, 2019). These differences are found in terms of the information and economic resources, technology base, main characteristics of the goods and services delivered, market types, economic outputs, public goods provision, time and place-based constraints on economic activities, tracking, matching, governance, market transactions, product and service accessibility, and the costs of research, replication, transportation, and tracking. These differences are represented hereunder (**Table 1**).

Table 1. Traditional and Digital Economies

Criteria	Traditional Economy	Digital Economy
Information storage and economic resources	Information stored in atoms, physical resources are limited	Information stored in bits, digital resources
Technology base	Physical resources-based (labor, capital, land, etc.) intensive technologies	Digital technologies
	Slower technology innovation	Faster technology renovation and innovation (*)
Characteristics of goods and services delivered	Goods are rival, goods consumed by one person reduce the amount or quality available to others	Goods are non-rival, goods consumed by one person do not reduce the amount or quality available to others
Market type	Physical markets	Digital markets
Economic outputs (products and services)	Outputs are determined by resource capacity/scale, less diverse	Outputs have unlimited capacity, and are more diverse (digital goods and services)
Public goods provision	Provided mostly by the public sector	Provided by both the public and private sectors (i.e. open resource software and Wikipedia)
Time and place-based constraints on economic activities	Highly constrained in time and place	Unconstrained in time and place Increased prevalence of digital platform-based businesses
Tracking on economic activities	Physical and direct tracking	Continuous tracking with real time data, cyber environments, and the physical world
Matchings (**)	Physically and directly	Based on large digital platforms
Governance	Physically and directly	Online
Comparative advantages	Physical and financial resources	Information, digital technology, and resources
Market transactions	Less transparency	More transparency: customers are aware of prices, quality, and quantity of services/products before transactions
Opportunity for goods/service accessibility	Wider disparity between cities and rural areas	Less disparity between cities and rural areas, enables redistribution of economic benefits among regions
Costs of search, replication, transportation, and tracking	Higher	Lower costs of search, replication, transportation, and tracking (Avi & Catherine, 2019)

Note: (*) In order to measure the diffusion of a technology, some researchers have used the technology diffusion time, which is the time it takes for the number of adopters of a technology to reach 50 million. It was found that, while the diffusion of telephone, radio, and TV were 75, 38, and 13 years, respectively, the diffusion of the current internet and Facebook were only 4 and 3.5 years, respectively (World Economic Forum, 2016).

(**) Matching included business to business (B2B), business to customers (B2C), business to employees (B2E), business to government (B2G), government to business (G2B), government to government (G2G), government to customers (G2C), customers to customers (C2C,) and employees to employees (E2E).

Source: Author's compilation from reviewing literature

Scope of and development of the digital economy

Based on the results of the systematic literature review, we found that only 5 out of the total 17 peer-review publications identified the scopes of the digital economy. Rumana & Richard (2017) pointed out that the digital economy has three scopes of relevance (**Figure 1**). The core of the digital economy is the *'digital sector'*, which includes the information technology (IT) and information communication technology (ICT) sectors. The digital sector provides fundamental digital goods and services. The narrow scope - *digital economy* – consists of digital platforms and digital services that provide economic outputs derived from digital technologies. According to Heeks (2008), the narrow scope of the digital economy is a

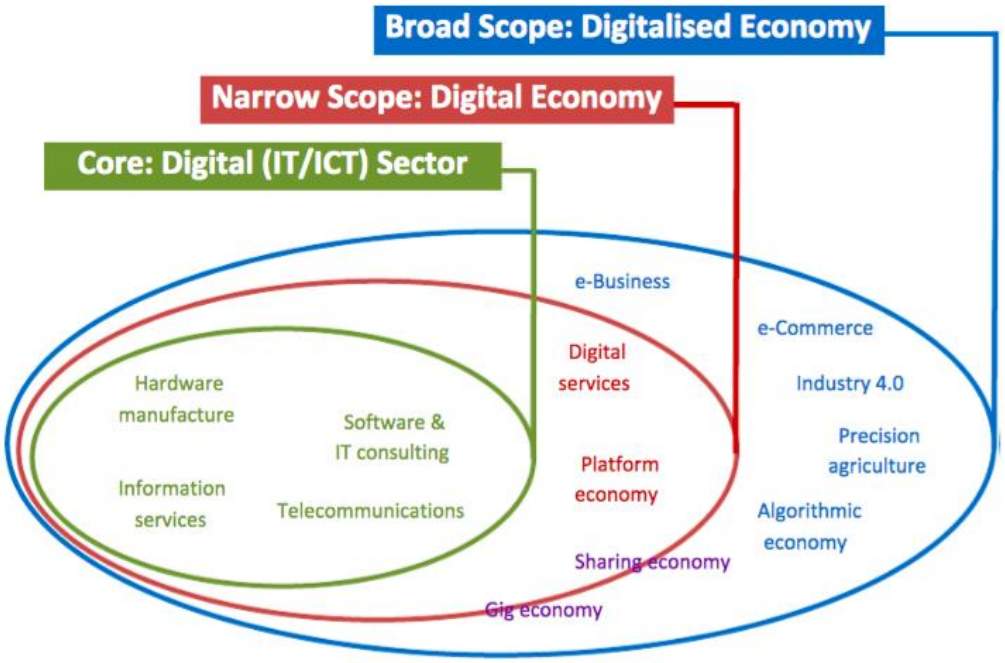

Figure 1. Scopes of the digital economy
Source: Adapted from Rumana & Richard (2017)

combination of (i) Goods: the production of ICT consumer goods such as computer hardware and digital telecommunications, plus ICT producer goods: both capital goods (e.g., automated machinery for manufacturing PCs) and intermediate goods (chips, motherboards, hard disk drives, DVD drives, and so on used in computer manufacturing); (ii) Software: design, production, marketing, etc. of packaged and customized software; (iii) Infrastructure: development and operation of enabling network infrastructure for both foundational telecommunications and value-added networking services; (iv) Services: professional services not covered in other categories such as consulting, training, and technical services; (v) Retail: sale, re-sale, and distribution of ICT goods, software, and infrastructure and related services; and (vi) Content: production and distribution of data content, including back-office processing and digitization.

Most contemporary literature about the digital economy tries to add some component of the "ICT consumption/application" category. Thus, the digital economy should be identified as being broader than simply the digital sector or digital economy. At their broadest, the overall definitions of the digital economy cover all digitally-enabled economic activity. But this argument is a problematic clarification as the increasingly digital economy has become intertwined with the traditional economy making differences between them less clear. According to the European Parliament (2015), the digital economy is increasingly linked with the physical or offline economy making it more and more difficult to clearly portray the digital economy. Moreover, there is also a problem of scope: as more and more services, manufacturing, and even primary production activities rely on ICTs, the scope of the digital economy under this idea increasingly becomes just "the economy".

To partly skirt these issues, Rumana & Richard (2017) refer to the widest scope of the *digitalized economy* where ICTs are employed in all socio-economic fields such as agriculture, manufacturing, construction, transportation, trade, and many other important sectors. Sharing and gig economies are intersected between the narrow and broader scopes.

Gig and sharing economies are becoming popular in providing digital goods and services (Kalleberg & Dunn, 2016; Sarah *et al.*, 2016). The sharing economy is an economic model defined as a peer-to-peer (P2P) based activity of acquiring, providing or sharing access to goods and services that is often facilitated by a community-based online platform (Puschmann & Alt, 2016). Stephany (2015) defined the sharing economy as markets that provide unused or gently used resources and services to customers on online platforms to satisfy the demands of customers, resource owners, and goods and services providers. The role of the sharing economy is increasing by over USD 15 billion a year by people renting and selling what they own: from cars and homes to money and time. As observed in many countries around the world, fast-moving tech startups like Grab, Uber, and Airbnb have become popular.

Papers written by Dung (2020) and Sang (2020) discussed different concepts of digital economy development. A common view is that more applications of digital technologies in all economic sectors is a key point. *With a broader view, the development of a digital economy can be defined as a process in which an economy devotes more efforts to developing human resources, digital technologies, digital resources, digital services, and digital infrastructure to digitalize all socio-economic sectors based on smart business and management practices to best meet market demands, ensuring sustainable socio-economic development.*

Measurement of digital economy development

To measure digital economy development, Rumana & Richard (2017) pointed out a number of measurement challenges such as various and different definitions of the term "digital economy, absent and poor quality [data], price problems, and digital economy invisibility". They used the GDP to measure the digital economy with three scopes (core, narrow, and widest scopes as discussed above). Development of a digital economy implies the process of how an economy changes and results from these transformations. Ideally, to measure the value of the digital economy, we should cover all three levels: the core digital sector, the digital economy, and the digitalized economy. A country should be able to assess their implications in terms of different economic variables, such as value added, employment, wages, income, prices, and trade, as well as for different agents, at these three levels. However, comparable statistical data are available mainly for just the core digital sector, and even in this case there are significant gaps, particularly concerning developing countries. The lack of statistical data and other measurement difficulties increase as an analysis moves from the core to the broad scope of the digital economy. Moreover, it is also difficult to capture statistically the ways in which digitalization is having an impact on activities outside the production boundaries of the pure core digital sector. Some activities in the digital economy, such as the creation of content or exchange of digital data, is monetized only indirectly by selling targeted advertising space online. This applies to many online platforms that provide online services for the right to use the data generated by users of these online services. Some relevant international statistical definitions and classifications do exist, such as for the ICT sector, trade in ICT goods and services, and ICT occupations. However, for many other relevant areas (such as IoT devices), universally accepted definitions have yet to be established. But even in areas for which there are agreed definitions, there is often a glaring lack of statistics. This is particularly true in developing countries.

To deal with the issues above, metrics of digital economy development should include two sets of indicators: indicators measuring the process of the economy's digitalization and outputs of the digitalization process. The first set of indicators to assess *a digitalization process of an economy* consists of followings: improvement or renovation of policies and mechanisms for the digitalization of all socio-economic sectors; e-government administration implementation, digital infrastructure (such as 5G), number of digital businesses entering the core scope (IT and ICT), number of businesses and organizations in all fields of the economy adopting digital

technologies; and number and scale of smart cities, smart regions, and smart nations. It should be mentioned that a process to digitalize government administration consists of following: (1) Renovations of national policies to harmonize with international legal and digital trade laws, intellectual rights, and prioritizing the core scope of the digital economy; (2) Implementation of e-government mechanisms containing digitalized inhabitant data, online provision of public services, and smart tracking; and (3) A modern digital communication infrastructure system.

The second set of measurements to *evaluate the outputs of the digitalization process* is comprised of the follow: proportion of the GDP from the digital economy by core, narrow, and widest scopes in the whole economy, and productivity, resource utilization, public expenses saved from digitalization, and producer and consumer surpluses. With these measurements, the contributions of the digital economy at the core, narrow, and widest scopes in the whole global economy were shown to account for 4.5%, 15.5%, and 80%, respectively (Unctad, 2019).

Digital economies

The need for digital economies education

The digitalization process has changed the world economy. It is estimated that the digital economy accounts for around 5% of the global GDP and 3% of global employment (Rumana & Richard, 2017). It has had different effects at the country, region, firm, and consumer levels (Avi & Catherine, 2019). However, a number of economic development issues have emerged (Zu Xiaoming, 2018). New jobs and services have appeared. It was found that one-third of current jobs did not exist 25 years ago. Within the 25 years, 60% of the jobs will be those that currently do not exist (World Economic Forum, 2016; Chung, 2017). Digital transformation is taking place in both the public and private sectors. This leads to a need to innovate operation and management systems in these sectors. In the digital transformation context, governments have to change their roles and interventions in all socio-economic sectors (Dung, 2020). Technology levels in most developing countries are low. Thus, the development of human resources for an economy's digitalization is important. Economy digitalization places new demands on education and training not only in the fields of information and communication technologies, but also digital economics to other sectors to improve people's ability to adapt to the changing world. With this regard, some universities and institutions have started educating people in digital economics. In doing so, discussing the definition, roles, and syllabus of digital economics have become key issues for renovating training programs.

Definition of digital economies

To educate people in digital economics, there is a need to define digital economics. As of now, very little research has discussed digital economics at an in-depth level. Martin (2001) described only a transition from industrial economics to digital economics. Avi & Catherine (2019) in their *digital economics* paper discussed the effects of digital technology on the economy and perceived that the field of digital economics explores how standard economic models change economic activities and costs. Harald & Jan (2018) pointed out that digital economics details the evolution of contemporary economics within digital *platforms* and highlights the complex ecosystem that makes up the field of digital economics including models, issues, and tools that are essential for analysis and better understanding of the digital economy. Based on the fundamental economic theory, *digital economics can be defined as a multidisciplinary science concerned with the production, distribution, and consumption of goods and services based on digital platforms. It studies how businesses, organizations, individuals, governments, and nations make choices about how to allocate and utilize resources in digital platforms*. While contemporary economics is a social science, digital economics implies not only the social sciences but is also multidisciplinary, converging information, communication, operations, management, physical and biological technologies in

production, and the distribution and consumption of goods and services. This science studies physical and digital resources and markets. This is considered as applied economics.

Roles of digital economies

Digital economics plays an important role in socio-economic development. Science helps learners improve their knowledge and skills to adapt to the changing world. Science accelerates digital transformation in both the private and public sectors. Accompanied with other sciences, it speeds up digitalization of the whole economy, increasing business and nation competitiveness in order to better meet society's market demands. In this regard, understanding the digital economy does not merely promote the development of information technology but also strengthens the process of comprehensive digitization of all human life aspects. Furthermore, digital economics should shift research and development activities from focusing on digital infrastructure to the application of digital technologies in all sectors (i.e., industries, agriculture, and services).

Conclusions and Recommendations

Economic and political imperatives are combined with technological innovation to spur the growth of the digital economy, with growth levels particularly high in developing countries. This growth must be strategized by the private sector, guided by the government, and analyzed by civil society and academics. Yet the foundations for these actions are missing, with the definitions and concepts of the digital economy currently in rather a mess.

This paper has charted different definitions of the digital economy and digital economics. The digital (IT/ICT) sector is the core of the digital economy, but the scope of the digital economy is argued to stretch beyond this, encompassing a set of emerging digital business models. Though included by many digital economy definitions, we differentiate the wider applications of digital technologies in existing businesses, seeing these as within the scope of the broader "digitalized economy". Moreover, economy digitalization places new demands on education and training not only in the fields of information and communication technologies, but also digital economics and other sectors to improve people's ability to adapt to the changing world. This paper emphasizes that digital economics can be defined as a multidisciplinary science concerned with the production, distribution, and consumption of goods and services based on digital platforms.

To educate people in the field of digital economics, training programs should be renovated in order to best meet the demands of the digital economy. With this regard, aside from contemporary macro and microeconomics courses, there should be digital economics and sharing economics in the curriculums of economics, economic development, and so on. These courses should provide a base for learners to study other specialized courses serving the private sector, such as e-commerce, e-business, e-banking, smart operations and management, smart sale management, big data analysis, blockchains, online services, and digital start-ups, or public sector, including digital public management and digital public service provision.

Moreover, digital economics should pay much more attention to the impacts of the digital economy such as identifying the occupations that will disappear or emerging occupations in the digital era; the interests of consumers in virtual platforms; the issues of network/information security; and the conflicts between traditional business activities and new ones.

Finally, mobilization of the financial resources for digital economics should incorporate the investments of both the private and public sectors. In other words, both the government and private sectors should devote more efforts in human resource development of digital economics. In doing so, public universities and institutes should provide fundamental theories, while high-tech companies should support practical labs for students, thereby helping learners get acquainted with various working environments, and gain more knowledge and skills to meet the needs of human resource quality in the accelerated digital era.

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