

Concept, Determinants, and Measures of Information and Communication Technology (ICT) Competitiveness

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Abstract

Competitiveness is an old term from the classical word "Petere," meaning striving, attacking, aiming, desiring, and the Latin prefix "Com," which together denotes the aim of placing a nation. This research aims to crystallize the understanding of the information and communication technology sector from the perspective of its competitiveness, as the secret of the backwardness of nations lies in the backwardness of this sector, and the secret of the greatness and prestige of nations lies in its progress. The ICT sector is now the dominant sector in the development and prosperity of countries. To obtain the benefits of ICT, there are important determinants such as infrastructure improvement, quality of institutions, education, innovation, and investment, which must all develop in order to enhance the country's standing in front of the rest of the world in the era of globalization. The significance of the "ICT sector" lies in its ability to improve the other sectors. Different measures are used in order to evaluate the efficiency of determinants at macro and regional levels. At the macro level, various measures were used,

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such as the Global Competitiveness Index, the Global Sustainable Competitiveness Index, the Information and Communication Technology Development Index, and the Global Knowledge Index. Among the measures used at the regional level, the EU Regional Competitiveness Index and the European Competitiveness Index were used. The research findings showed that if there are a number of positive competitive features such as multiple policies, a strict legal system, wise leadership, highly trained employees, as well as a strong Internet connection, the ICT sector will help to compete.

Key Words: Competitiveness, Productivity, Innovation, Technology, Information and Communication Technology (ICT), Infrastructure, Entrepreneur, Information

مفهوم ومحددات ومقاييس القدرة التنافسية لتكنولوجيا المعلومات والاتصالات

ملخص

إن مصطلح التنافسية مصطلح كلاسيكي قديم مأخوذ من كلمة "Petere" و هي كلمة لاتينية تعني السعي، أو الهجوم، أو الهدف أو الرغبة و عند مزجها بالسابقة "com" تشير إلى المعنى التكاملي لمفهوم النهوض بالأمة. وإن هذا البحث يهدف إلى بلورة مفهوم التنافسية فى قطاع تكنولوجيا الاتصالات و المعلومات؛ لأن سرّ تأخر الأمم يكمن في تخلف هذا القطاع ، وسر عظمة ورفعة الأمم يكمن في تقدمه. عُرفت تكنولوجيا المعلومات و الاتصالات على نطاق واسع و بات استخدامها هو الأساس الذي ترتكز عليه الأمم فى تطورها و ازدهارها و طبقاً لذلك كان لابد من وجود مقومات محدّدت رئيسية لنيل الفوائد المرجوة منها و هذه المحددات هي تحسين البنية التحتية و جودة المؤسسات و التعليم و تنمية الابتكار و الاستثمار. وترجع أهمية هذه المحددات إلى أنها تعزز من مكانة الدولة أمام العالم أجمع في عصر العولمة. والأهمية الكبرى في تقدم "قطاع تكنولوجيا الاتصالات و المعلومات" لا تكمن في قيمته فقط كقطاع مستقل بذاته بل في قدرته على تحسين القطاعات الأخرى. ولقد استخدمت مقاييس مختلفة لتحديد كفاءة المحددات الاقتصادية على الصعيدين الكلى و الإقليمي. فعلى المستوى الكلى تم استخدام العديد من المقاييس كمؤشر التنافسية العالمية، ومؤشر التنافسية المستدامة العالمية، ومؤشر تنمية تكنولوجيا المعلومات والاتصالات، ومؤشر المعرفة العالمي. أما على المستوى الإقليمي فقد تم استخدام مؤشر التنافسية الإقليمية للاتحاد الأوروبي، ومؤشر التنافسية الأوروبية. و قد بيّن البحث أنه إذا ما توافر عدد من سمات التنافسية الإيجابية كالسياسات المتعددة، والنظام القانوني الصارم، والقيادة الحكيمة، والموظفين المدربين ذوي الكفاءات العالية، و كذلك شبكة اتصال إنترنت قوية ستساعد قطاع تكنولوجيا الاتصالات و المعلومات على المنافسة.

1. Introduction:

Competitiveness is one of the most prevalent concepts in economic research. The origins of competitiveness can be traced back over three centuries to trade theories from the 15th–17th centuries when mercantilism was a common economic thought. Nevertheless, there is no generally approved definition by the authors that fits the current notions of competitiveness. (Siudek & Zawojnska, 2014, p.92; Benzaquen, Carpio, Zegarra & Valdivia, 2010, p.68; Ochoa, Lara & La Parra, 2017, p.793)

The term "competitiveness" is interpreted in different ways. A group of researchers argued that "competitiveness" refers to productivity, innovation, or market share. (Siudek & Zawojnska, 2014, p.94)

To achieve long-term competitiveness, the country must strengthen its economic factors, such as investment volume, innovation, production facilities, and government policies that are aligned with the country's political and social factors. (Kharlamova & Vertelieva, 2013, pp.39-41)

The competitiveness term is taken into account as an advanced term in economic thought. As a result, the authors have delineated it as a multidimensional and relative construct related to the market mechanism. It is explained and measured using variables for meso (national and regional sectors), and macro (national and supranational sectors). (Siudek & Zawojnska, 2014, p.94)

Kurgman (1990, 1994) presented national competitiveness as a meaningless concept and gave it a new description as "a dangerous obsession." He described it as another definition of productivity in order to raise living standards if it has any significance. (Siudek & Zawojka, 2014, p.93)

Michael E. Porter et al. (2000) argued that competitiveness is concerned with the state's policies and institutions that promote long-term growth. "National competitiveness" corresponds to the economic structures and institutions of the state for economic growth within the global economy. (Kharlamova & Vertelieva, 2013, p.40).

National competitiveness is defined as the set of institutions in addition to other contributors to the productivity level, according to the World Economic Forum (2019). (Schwab, 2019, p. xiii)

Putting the digital economy's numerous opportunities to use as a critical driver of improving the economy's productivity and effectiveness. The information and communication technology (ICT) sector is an important part of the digital economy's expansion and has the potential to dramatically boost a country's competitiveness. As a result, the goal of this research is to emphasize information and communication technology (ICT) as a factor in the digital economy's competitiveness and development. (Domazet & Lazić, 2017, p.11)

One of the most essential topics today in our digital era is information and communication technology (ICT) (Deloitte Touche Tohmatsu, 2019, p.9). Technology shaped the evolution of information, with technology serving as the primary driving

force behind human achievements. (Mehaboobullah, 2012, p.32)

Based on this understanding, the "ICT ecosystem" conceptualizes the various players involving telecom firms, government, incubators, start-ups, multinational technology companies, banks and their interactions involved as an "ecosystem"³ in the use of ICT. This is a useful metaphor for highlighting that ICTs are rooted as a social system not just a technological system. Many theorists always recognize the value of the process of innovation in ensuring that the ICT sector is important to greater social society's progress. (United Nations, 2013, p.3)

2. Research Problem:

There is a debate in empirical studies regarding the competitiveness of the ICT sector as it suffers from many obstacles that adhere the presence of ICT determinants, which result in some negative impacts on its competitiveness. The current research discusses and crystallizes the gap that emerged between the competitiveness of ICT sector in countries.

³ The system that concludes and manage both the biological and physical ingredients of an environment was named "eco-system". As well, "ICT ecosystem" is the system that acquire both information and communications' hardware and software platforms and application in addition to all regulators, developers, investors, entrepreneurs, users.

3. Research Hypothesis:

The competitiveness of ICT sector can be enhanced by influencing the most important determinants of this capacity which are infrastructure, human capital, the quality of institutions, and the role of innovation.

4. Objectives:

The research objectives are:

1-defining the meaning of competitiveness, ICT competitiveness, and the historical economic thought of ICT Competitiveness.

2-Identifying the determinants of competitiveness in ICT sector.

3-Determining macro and regional ICT measures.

5. Research Methodology:

This research paper is based on a systematic literature review as it has contributed significantly to the social sciences field. (Ao & Huang, 2019) The research uses a deductive approach to review theories concerning competitiveness, innovation, and technology in order to define the different concepts and determine the ICT sector's competitiveness determinants and solutions.

6. Research Importance:

Many countries suffer from a lack of ICT determinants, which has a negative impact on their ICT sector's competitiveness. The current research presents the ICT determinants that should be available.

7. Literature Review:

The study by Razvan Voinescu and Cristian Moisoiu (2015), "Competitiveness, Theoretical and Policy Approaches." Different Paths to a More Competitive EU. "theories around competitiveness, different approaches by policymakers and various targets are projected, both at micro and macro levels.

Abdelhadi Boussas and Mohammed Saber Hassainate (2018), aimed to study "Competitiveness between Meaningfulness and Meaninglessness." The study explored competitiveness across economic history. Adam Smith and David Ricardo spoke about cross-national competitiveness. They did not, however, use the word "competitiveness" at all in their works. They created their own concepts. During the last century, expressions appeared as synonyms for competitiveness, such as "national power" and "productive power." All these expressions have been used with the aim of designating competitiveness. Other works have preferred to assimilate competitiveness through concepts and notions that they have created as a result of their reflections, as it is the case of absolute advantage, comparative advantage, and competitive advantage.

The study by Nikolaos Alexandros and Metaxas Theodore (2015), "Porter vs. Krugman: History, Analysis, and Critique of Regional Competitiveness". The goal of this research is to determine competitiveness using an interdisciplinary approach based on theories of new economic geography and regional economy. The new economic geography is mainly related to the Nobel prize winner, Paul Krugman, whose theories often conflict with those of Porter. This study initially sets out the views of both authors in terms of competitiveness and then attempts to make a comparative analysis between the theories they developed.

The study by Carlota Perez (2009), "Technological revolutions and techno-economic paradigms". This study locates the notion of technological revolutions in the Neo-Schumpeterian effort to understand innovation and to identify the regularities, continuities and discontinuities in the process of innovation. It looks at the micro- and meso-foundations of the patterns observed in the evolution of technical change and the interrelations with the context that shape the rhythm and direction of innovation.

The study by Sangwon Lee, Yoonjae Nam, Seonmi Lee, and Hyunjung Son (2015), " Determinants of ICT innovations: A cross-country empirical study". This study investigated key drivers of technological innovation in the ICT industry, attempting to evaluate whether the broadband network infrastructure, diversity of R&D funding, R&D performance, number of researchers, education, openness to international trade, and socio-economic factors have influenced ICT innovations in 40 countries from 1999 through 2013. the study found that high levels of broadband infrastructure and the R&D

factors were associated with high levels of ICT innovation. The findings also suggested that innovation infrastructure factors (education and openness to international trade) and the socio-economic factors of nations could be significant determinants of ICT innovation.

The study by Jens Krüger and Mathias Rhiel (2016), "Determinants of ICT Infrastructure: A Cross-Country Statistical Analysis". The results explain the ICT infrastructure very well. Major determinants identified are the availability of electricity, and indicators for the quality of the institutional environment, which are among the essential ICT adoption determinants.

The study by Paolo M. G. Quibria, Shamsun N. Ahmed, Ted Tschang, and Mari-Len Reyes-Macasaquit (2002), "Digital Divide: Determinants and Policies with Special Reference to Asia" The study examined the determinants of ICT Diffusion at the macro level in Selected Asian Economies. By undertaking a set of cross-country regressions, the study finds that income, education, and infrastructure are the significant actors in shaping the digital divide.

The study by Ni Made Krisna Marsela and Kusmawati Limbongan, (2021), "Indonesian ICT workers: Determinants and strategy to support national digital transformation". The development of digital technology provides opportunities for every country to increase its economic growth. Digital technologies are changing the workplace, providing a significant opportunity for nations and companies to boost

productivity, efficiency, and growth. The speed of digital transformation will depend on a number of factors, including This paper focuses on the availability of ICT workers in Indonesia. The paper aims to confirm the determinants that affect the availability of ICT workers in Indonesia. According to this research, the availability of ICT workers in Indonesia is influenced by optimising the utilisation of ICT infrastructure, demographic conditions, economic structures, worker education levels in Indonesia, and the development of entrepreneurship in 33 provinces in Indonesia.

A Study on "Mobile Subscription, Penetration, and Coverage Trends in the Indian Mobile Sector", by Rajeev Kumar Saxena and Neelu Tiwari (2016). The study explains that the mobile sector in India has experienced extraordinary growth in the past few years. In this regard, the mobile sector is one which is an integrated part of the economy of our country. A perfect and strong infrastructure in the telecommunication sector is very, very important for the economic growth of a country at a uniform pitch. Due to competition, the challenges imposed on the mobile market are increasing every day because of the evolving technologies and the advance of the knowledge base in India. The aim of the present study is to make an analysis of the competitiveness of mobile industries in India.

8. Concepts of ICT Sector Competitiveness:

One of the most essential topics today in our digital era is Information and communication Technology. Information and communication technology were abbreviated as ICT via the world bank and by other international organizations. (Deloitte, 2019, p.9)

Information and communication technology (ICT) represent an extension synonym for information technology (IT) in appreciation of the increasing role of communications technology as much broader and general term for IT. Where the information has a great impact on all fields and every progress's aspect of life, as it has supportive role in research and development, and education were built on. Information is acting as a dynamic and unending resource. (Mehaboobullah, 2012, p.32)

Digitization of information reduced a huge cost due to the unification of both telephone networks & computer networks using a single system for cabling, distribution & management as well as reducing the error among a massive amount of information during the high speed of transfer in a matter of seconds. Also, the development of world wide web (WWW) system acting as a base for web pages that permit to collect all kind of information at the same time as they exist on the internet. ICT has a decisive role as a source of competitiveness resulting from fundamental difference it performed. (David, 2011, p.11; Mehaboobullah, 2012, p.39)

According to Marcelle in 2000, ICTs including TV and radio broadcast, telecoms, hardware and software, computer services and electronic media. ICTs are a diverse and varied range of items, applications and services used for the creation, delivery, processing and transformation of information. (United Nations Conference on Trade and Development, 2003, P.3)

9. ICT's competitiveness in economic thought:

Competitiveness has crystalized as a central objective in economic thought since Ibn-Khaldun, 1332 AD. He was the first one to highlight the importance of technology, specialization, the role of international trade in achieving economic growth, and the government's role in setting policies for increasing output and employment. (Jose & Rajan, 2011, pp.17-18)

Therefore, in order for a nation to increase its domestic production by protecting its monopolists' and cartels' benefits against internal and external competition, as well as increasing exports through subsidies and imposing tariffs, Mercantilist's advocate government interference in order to attract trade advantages in their interests. By introducing the concept of competitive trade between European nation-states, mercantilists planted the theoretical seed for future theories of a nation's competitiveness. (Voinescu & Moisoiu, 2015, p.514) as the competitiveness concept extends to classical schools. Adam Smith' thoughts were the beginning of economic classicism in 1776. (Travkina & Tvaronavičienė, 2010, p.506) With specialization, more production can be produced with the same amount of input "labour". As international trade enhances specialization through technical and organizational innovations, it causes a rise in productivity. (Schumacher, 2012, p.60) Smith was the first economist who introduced the term "absolute advantage," advocating the free market and how it could help nations be wealthier via specialization. In the 19th century, Ricardo's theory became the most prevalent school of thought.

(Jose and Rajan, 2011, p.53) David Ricardo agreed with Adam Smith's view about the importance of international trade and how it provides benefits for nations. In his book "Principles of Political Economy and Taxation" in 1817, Ricardo introduced the "Comparative Advantage" as the principle that trade was based on, rather than the absolute advantage as Smith predicted. (Gupta, 2014, p.11) In 1844, Mill introduced his theory of "reciprocal demand" in his book "Essays on some Unsettled Questions of Political Economy." He agreed with Ricardo's theory that the terms of trade are based on comparative cost, not the absolute cost advantage. John Mill completed the Ricardian theory. Through Marshall's theory of perfectly competitive equilibrium, the amount of production can't decrease or increase, thus calling it equilibrium quantity. In that situation, the price of selling is called equilibrium price. (Nikoloski, 2016, p.89) A modern international trade theory known as the Heckscher-Ohlin model in 1920 tries to express the causes of comparative advantage differences between nations. These differences appeared due to their factor consistency, which means labour and capital used in output production. (The European Commission Directorate, (n.d), pp.7-8)

Technological change induces per capita growth, motivates savings and investment, and, as a consequence, causes real GDP to increase. Both technology and growth are linked together. (ÇalŖukan, 2015, p.651) So, if the transition in technology stops, growth will also end. The clearly growing significance of entrepreneurship, innovation, and the rapid rise of the Information Revolution has led to a significant revival of interest in the principles of Schumpeter as a social scientist of

the twentieth century (Perez, 2009, p.3). The reputation of Schumpeter as a "prophet of innovation" as a specialist in the field of economic research his original approach was to the role of innovation and entrepreneurs in economic life in 1934. (Tuncel, 2015, p.60; Bazhal, 2016, p.3; Thanawala, 1994, p.353)

Indeed, Schumpeter is among the earliest economists to indicate that both entrepreneurship and technical progress are at the root of economic growth. Nevertheless, he saw technology as exogenous and outside the realm of economic theory, along with institutions and social organizations. The entrepreneur was his subject, and his aim was to clarify the role of innovation in economic growth and the system's cyclicity. (Perez, 2009, p.3) The presentation of new amalgamations for the current resources is known as innovation for Schumpeter, 1934. (Tuncel, 2015, p.61) Innovation represents the soul of Schumpeterian entrepreneurship, which is the introduction of a new idea, method, or device. Innovation is the process of bringing and putting into practise a new concept. (Mehmood, Alzoubi, Alshurideh and Al-Gasaymeh, 2019, p.5)

The idea of competitiveness, extended via the theories and principles of the British economist John Keynes (1883–1966), is the basis of Keynesian economics. He was the first to introduce modern macroeconomics. (Jahan, Mahmud & Papageorgiou, 2014, p.53) as well as some concepts that are related to regional competitiveness, whose origin dates back to the economic development fields' concepts. So, the development theories including, Rostow in 1960 put five stages for any economic development for societies to go through based

on the assumptions of modernization. (Jose & Rajan, 2011, p.135)

In the 1950s, neoclassical growth models took a different path. They didn't offer an innovation or technological transformation theory. Instead, they realised that technical progress plays a significant role in growth. (Daniele, 2017, p.1) "A Contribution to the Theory of Economic Growth," by American economist Robert Solow, was published in 1956. The Solow Growth Model was born. (Zhao,2019, p.62) In order to maintain continual growth, Solow included technological improvement as an exogenous factor in his model. (Zhao,2019, pp.62-64)

Endogenous growth theory, known as the "new" growth theory, technology has always played a key and forward-thinking role. The limit of a society's production capabilities was set by abundant resources and existing technology. Changes in technology, especially in the long run, are primarily responsible for the extension of this border. Despite its importance, economics regards technology as a black box because it is assumed to be exogenous in most models. (Zhao, 2019, p.62)

On October 8, 2018, Paul Romer was given the "Sveriges Riksbank" Prize in Economic Sciences by the Royal Swedish Academy of Sciences for integrating technology innovations into long-run macroeconomic research (Zhao, 2019, p.62).

Romer (1986) highlighted how new technology-based ideas for new commodities and services can be applied in the market economy. also demonstrated how endogenous technology

development can shape growth and which policies are required for this process to be successful. (Zhao, 2019, p.64)

The diffusion of innovations (DOI) is one of the most important sociological theories of the twentieth and twenty-first century. Despite the fact that it was first introduced more than half a century ago, the DOI is still regarded as a chronology- and discipline-transcendent theory that is widely used today. The adoption of an innovation by individuals and groups is referred to as "diffusion" (as new technology, idea, or another innovation). The diffusion of innovations is defined by Rogers as the obtaining and processing of information in which people use knowledge about an innovation to decide whether or not to employ it. Roger's Diffusion Theory, in instance, features two key aspects that have been extensively researched and applied in social science. The first is concerned with the rate and scope of diffusion. (Lund, Omame, Tijani and Agbaji, 2020, pp.867-868)

Rogers (2003) frequently used the terms "technology" and "innovation" interchangeably in diffusion studies due to the predominance of technological advancements. (Sahin, 2006, p.1)

10.The major Determinants for the establishment of a competitive ICT environment:

Over the past few years, economists have widely discussed the potential factors that determine the competitiveness of national ICT sectors. The underlying rationale is that, since ICT is found to be a major driver of productivity and growth, understanding the factors that boost ICT competitiveness can automatically

translate into key policy measures that would lead to competitiveness and growth. The most widely acknowledged determinants of a competitive ICT environment include infrastructure, education, institutional quality, innovation and investment. (United Nations, 2013, p.18)

A. Infrastructure:

“Telecommunications infrastructure is the foundation for a new digital economy. Investments in this sector generate intensive potential in economic activity, digital inclusion, and social welfare.” André Müller Borges - Telecommunication Secretary of Brazil. (Deloitte Touche Tohmatsu, 2019, p.8)

While ICT provides an infrastructure for applications and services, the ICT ecosystem requires the presence of a solid, resilient and affordable high-speed broadband infrastructure. This in turn requires a resilient electricity network and/or the allocation of a spectrum for emerging, high-speed mobile broadband. (United Nations, 2013, pp.18-19)

Investing in Broadband, the rise of mobile broadband, higher Internet speed, Prices for connectivity, Infrastructure for the Internet of Things, Secure servers’ infrastructure, Household access to computers, and Household access to the Internet all are showed different sides needed to develop for ICT infrastructure. (Group of Twenty, 2018, pp.11-22)

B. Education, skills and digital literacy:

Another fundamental driver of ICT competitiveness is education. The three most essential prerequisites of this driver are;

- A high-quality secondary and tertiary education constitutes a fundamental angle of the so-called “knowledge triangle” that brings together industry, education and research. (United Nations, 2013, p.20)

- A qualified workforce will include skilled employees, skilled researchers and skilled entrepreneurs. Quality ICT education leads to the creation of a qualified labors that has the e-skills in demand in developed and developing countries. As a result, multinational ICT corporations might decide not to invest in data storage centers in a certain country due to shortage of skilled workers. (United Nations, 2013, p.20)

- Digital literacy among youth is an essential precondition for creating a population of “Yollies”, the young and dynamic entrepreneurs who, through startup ventures, often contribute to a dynamic ICT environment. (United Nations, 2013, p.20)

In this modern economy, though technological and interpersonal skills, which are currently being addressed by educational institutions, are still needed, a new collection of critical skills has emerged. The willingness to learn on one's own, seek lifelong learning, and cope with risk and transition are all examples of “methodological skills”. These methodological skills cannot be learned in the conventional educational framework, in which the teacher is the sole source of information, imparting facts to students who imbibe them in order to pass classes and achieve degrees. To encourage students to “learn how to learn”, new teaching methods involving the teacher as a facilitator of learning must be created. (Asian Development Bank, 2007, p.12)

C. Institutional quality:

International economic trends in recent decades have shown a positive relation between economic performance at the national level and the quality of institutions. This is connected also by the ICT sector, especially when it comes to creating a legal environment that is correlated to innovation, property rights, and encouraging investment in ICT infrastructure, applications and services. The presence of weak legal environment, bureaucratic system, corruption, and rigidity all are examples that can hinder the implementation and flourish of ICT sector. (United Nations, 2013, pp.20-21)

D. Innovation in the ICT sector:

With many actors are playing different roles an innovation ecosystem was exist. The national innovation system, as described in academic literature, emerged in the 1980s and is defined as the exploitation and commercialization of new information originating from the science and technology base, as well as their interactions by both private and public sectors. Main actors of innovation are entrepreneurs, large firms, SMEs, and Diaspora. (United Nations, 2013, pp.22-25; Asian Development Bank, 2007, p. 13)

11. Measures comprised of aspects for measuring sector competitiveness:

A. On Miso Level:

Global competitiveness index (GCI) one of the best-known competitiveness indices was developed by the world economic forum (WEF). The forum defines national competitiveness in

2007 as a collection of policies, institutions and factors that evaluate a country's level of productivity. The WEF concept ties the competitiveness of micro (firm level) to macro (country level). (Dijkstra, Annoni & Kozovska, 2011, p.3)

The description of regional competitiveness stands between the micro and macro stages. A region is neither a simple community of companies nor a minimum version of nations. In recent years, attempts have been made to expand the study to the regional level. (Dijkstra, Annoni & Kozovska, 2011, p.3)

According to Meyer-Stamer in 2008 territorial competitiveness is described as a locality's or region's ability to generate high and rising incomes and boost the livelihoods of the people who live there. (Dijkstra, Annoni & Kozovska, 2011, p.3)

1. The EU Regional Competitiveness Index (RCI):

Is the first composite indicator which provides a synthetic picture of territorial competitiveness for each of the NUTS 2⁴ regions of the 27 EU Member States. (Dijkstra, Annoni & Kozovska, 2011, p.5)

The RCI follows the framework adopted by the World Economic Forum for its Global Competitiveness Index (GCI) up to their 2017-2018 edition. It builds on and modifies the approach of the Global Competitiveness Index of the World Economic Forum (WEF). (Dijkstra, Annoni & Kozovska, 2011, p.3; Annoni & Dijkstra, 2019, p.17)

⁴ Includes Belgium, Germany, Spain, Cyprus, Hungary, Poland, Slovakia, Bulgaria, Estonia, France, Latvia, Malta, Portugal, Finland, Czech Republic, Croatia, Lithuania, Netherlands, Romania, Sweden, Denmark, Greece, Italy, Luxembourg, Austria, Slovenia, and United Kingdom.

The RCI is composed of eleven pillars that describe the different aspects of competitiveness and are classified into three major groups: (I) Basic, (II) Efficiency and (III) Innovation. (Dijkstra, Annoni & Kozovska, 2011, p.5; Annoni & Dijkstra, 2019, p.17)

Basic includes five pillars: Institutions, Macroeconomic Stability, Infrastructures, Health, and Basic Education representing the Quality of Primary and Secondary Education. (Dijkstra, Annoni & Kozovska, 2011, p.5; Annoni & Dijkstra, 2019, p.17)

Efficiency includes three pillars: Higher Education, Training and Lifelong Learning, Efficiency of the labor market, and Market Size. (Dijkstra, Annoni & Kozovska, 2011, p.12)

Innovation includes three pillars: Technological Readiness, Business Sophistication, and Innovation. (Dijkstra, Annoni & Kozovska, 2011, p.12)

In total, 84 indicators have been statistically tested for inclusion in RCI 2019, 10 of which are new to this edition. 74 indicators were eventually included in the index. (Annoni & Dijkstra, 2019, p.17)

2. European Competitiveness Index (ECI):

The second edition of the European Competitiveness Index 2006, which follows the success of the first edition released in 2004. The ECI tracks, compares, and analyses the competitiveness of the regions and nations of Europe. As region's competitiveness rely on its ability to predict and

respond effectively to internal and external economic and social challenges by offering new economic opportunities, including higher-quality works. (Huggins and Davis, 2006, p.1)
competitiveness is increasingly calculated in terms of the economy's knowledge base and the degree of investment in innovation, as well as its propensity to gain a competitive advantage in the leading and rising sectors of technology. This is because every region or nation's long-term economic success will rely on its capacity to adjust to change and provide employees and businesses with new opportunities. (Huggins and Davis, 2006, p.1)

This ability is affected by a variety of factors including market access, public and private human capital investments, social capital, the quality of physical infrastructure, institutional capability, labor efficiency, innovation and research facilities, and so. (Huggins and Davis, 2006, p.1)

B. On Macro Level:

1.Global Competitiveness Index (GCI):

The GCI 4.0 highlights the deep deficit in competitiveness that needs to be tackled urgently in order to restore productivity and to boost living standards through growth. (Schwab, 2019, p.viii)

The global competitiveness report series was First introduced in 1979, the 2019 edition of the Global Competitiveness Report series includes the Global Competitiveness Index 4.0. From a mix of data from international organizations as well as from the Executive Opinion Survey of the World Economic Forum. The report evaluates 141 economies' competitiveness environment, offering unprecedented insight

into the drivers in the Fourth Industrial Revolution era.

(Schwab, 2019, p.viii)

GCI 4.0 is the product of 103 individual indicators being aggregated. Institutions, infrastructure, ICT adoption, macroeconomic stability, health, skills, product market, labor market, financial system, market size, business dynamism, and potential for innovation are grouped into 12 'pillars'. (Schwab, 2019, p.viii)

The performance of a country on the overall GCI outcomes as well as each of its components is recorded as a 'progress score' on a scale of 0 to 100, where 100 represents the 'frontier' which is an ideal and hypothetical situation in which a country on each component of the index achieves the perfect score. Each country on each part of the index should seek to move closer to the frontier. The GCI 4.0 helps economies, over time, to track development. (Schwab, 2019, p.viii)

The GCI 4.0 findings for 2019 show the scale of the global competitiveness deficit. In the 141 economies surveyed, the average GCI score is 60.7, which means that the 'distance to frontier' stands at almost 40 points. The average distance globally stands at more than 30 points on nine of the 12 pillars. Developed countries are steadily doing better than the rest of the globe, but still fall 30 points short of the frontier overall. (Schwab, 2019, p.viii)

But, the star performer overall, Singapore, nevertheless falls 15 points short of the ideal. Singapore is the country nearest to the frontier of competitiveness, with a 2019 GCI ranking of 84.8 out of 100. The nation ranks first in terms of health, infrastructure, the functioning of the labor market and the progress of the financial system. (Schwab, 2019, pp.41-609)

2.The Global Sustainable Competitiveness Index (GSCI):

The ability to create and maintain inclusive wealth without reducing the potential ability to sustain or raise current levels of wealth is refers to sustainable competitiveness. (SolAbility, 2020, p.4)

The competitiveness of nations is calculated by the Global Sustainable Competitiveness Index (GSCI). The much more accurate reflection of a country is the integration of all relevant dimensions that together form the basis of competitiveness than, for instance, the widely used GDP now. GDP and other economic indicator-based measurements do not assess true competitiveness. (SolAbility, 2020, p.4)

The GSCI is focused on 127 quantitative indicators, integrated in five main factors representing natural resources, social capital, intellectual capital, governance, and resource efficiency originating from major global institutions such as the World Bank and UN organizations. (SolAbility, 2020, p.4)

Rankings, ratings and traditional Comparisons between countries are based on financial and/or economic indicators. Economic and financial metrics represent current economic success, without looking at or describing what makes such economic success possible. They often fail to consider both financial and non-financial factors for recent developments that form future opportunities or drop.

Moreover, emissions and loss of natural resources, climate change, impacts on health, inequality and impacts on a

country's socio-cultural structural all are the negative side-effects for economic activities in environment and societies. (SolAbility, 2020, p.5) The foundation of current economic performance can be diminished by lack of these variables. (SolAbility, 2020, p.5)

3. ICT Development Index (IDI):

Information and communication technology (ICT) is recognized as being a key enabler of economic expansion. The ICT Development Index (IDI) is a composite indicator as a collection of individual indicators introduced in 2009 by the International Telecommunication Union (ITU) to analyze and compare advances in information and communication technologies (ICTs) across countries and over time. Between 2009 and 2017, the first version of the IDI called the 'original IDI,' was released annually. (International Telecommunication Union, 2020, p.1)

The IDI is a composite index that combines 11 indicators into one benchmark measure that can be used to monitor and compare developments in ICTs between countries and over time. The IDI was developed by ITU in 2008 in response to ITU Member States' request to establish an overall ICT index, was first presented in Measuring the Information Society Report 2009, and has been published annually since then. The recognition that ICT can be development enabler, if applied and used appropriately, is critical to countries that are moving towards information or knowledge-based societies. (International Telecommunication Union, 2021, para. 1)

The ICT development process, and a country's transformation to becoming an information society, can be depicted using the three-stage model;

Stage 1: ICT readiness – reflecting the level of networked infrastructure and access to ICTs.

Stage 2: ICT use – reflecting the level of intensity of ICTs in the society.

Stage 3: ICT impact – reflecting the results/ outcomes of more efficient and effective ICT use. (International Telecommunication Union, 2021, para. 3)

Based on this conceptual framework, the IDI is divided into eleven indicators that categorized into three sub-indices, with their component indicators: (International Telecommunication Union, 2021, para. 4)

-Access sub-index: This sub-index captures ICT readiness, and includes five infrastructure and access indicators (fixed-telephone subscriptions, mobile-cellular telephone subscriptions, international Internet bandwidth per Internet user, households with a computer, and households with Internet access).

-Use sub-index: This sub-index captures ICT intensity, and includes three intensity and usage indicators (individuals using the Internet, fixed-broadband subscriptions and mobile-broadband subscriptions).

- Skills sub-index: This sub-index seeks to capture capabilities or skills that are important for ICTs. It includes three proxy indicators (mean years of schooling, gross secondary enrolment, and gross tertiary enrolment).

4. Global Knowledge Index:

The Global Knowledge Index (GKI), produced annually since 2017, is a summary measure for tracking the knowledge performance of countries at the level of seven areas; namely pre-university education, technical and vocational education and training, higher education, research, development and innovation, information and communications technology, economy and the general enabling environment. (UNDP-RBAS & MBRF, 2020, p.1)

The GKI aims to introduce a more systematic understanding of knowledge by breaking down the concept into its constituent components, thus recognizing the multidimensional nature of knowledge systems in all contexts and applications relating to economic and social structures. This allows a more meaningful and insightful exploration of knowledge policies in relation to different sectors. This index Covering 138 countries and 199 indicators, the GKI provides a systematic tool for guiding and informing policymakers, researchers, civil society and the private sector to collaborate on different aspects of policies to foster knowledge-based societies and bridge knowledge gaps. The country profiles provide an insight into each country's performance in terms of its knowledge infrastructure. (UNDP-RBAS & MBRF, 2020, p.1)

12. Conclusion and Recommendations

Competitiveness is a multidimensional term. It is a widely-used term that doesn't have a definite concept. The majority of researchers defined competitiveness as a strategy for increasing economic welfare by increasing productivity. ICT is used to

enhance productivity through the availability of intangible and plentiful resources and up-to-date technologies in order to foster the nation's development via the competitiveness of this sector. This research clarifies the major determinants that, without fulfillment, will slow the country's position on both micro and macro levels as well as the measures that determine the degree of implementation of these determinants. From the researcher's point of view, the enhancement of access and the intensity of the internet, fixed and mobile broadband subscriptions, intensive training, increased engagement in years of schooling enrolment to capture the necessary skills for ICT, avoiding bureaucratic systems, the presence of strong regulations, cybersecurity, and the presence of a strong intellectual property rights protection system are among the important features for a strong ICT-based economy determinants.

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