

THE EVOLUTION OF THE ICT INDUSTRY AND IMPLICATIONS FOR THE GLOBAL ECONOMY

Mihai TIMUȘ, Aurel BURCIU

„Ștefan cel Mare” University of Suceava, Romania
timusmihai05@gmail.com; aurel.burciu@usm.ro

Abstract:

The evolution of the ICT sector in recent years has had a major impact on the way we run businesses, produce value and interact with other people. New technologies have opened new markets in which more and more global giants have emerged. The ICT sector has grown both as an independent market (as added value in the economy) but also as working tools that have considerably increased labor productivity globally. In addition, we see that new technologies not only provide us with the best tools to practice our skills at work, but also shape the lifestyle for most of the population.

Key words: ICT industry, global economy, Management.

JEL classification: M21; O10; O33; J24

Received 6 June 2024; Accepted 21 November 2024

INTRODUCTION

The emergence and evolution of information and communication technologies (ICTs) has been and is a cornerstone of the modern era, catalyzing profound transformations throughout the global economy. There are many implications of new technologies in the global economy, which we can bring as arguments to the research topic of this document. In general terms, the technologization of economic activities can have its debut in the discovery of raw materials (metals, fuels) that have led from the creation of basic inventions currently used (such as electricity, steam engine, telegraph, chips, internet, etc.), to the creation of inventions encountered in the recent economy (such as autonomous robots, digitization and automation of digital processes, Artificial Intelligence - AI, Cloud Computing, etc.) (Outman and Outman 2003; Phyllis 1979; Schwab 2016).

The aim of this paper is to provide an overview of the evolution and implications of ICT to clearly delineate the fact that from the advent of the internet to the proliferation of mobile devices, ICT innovations have reshaped industries, revolutionised markets and altered the very structure of economic, social and political interactions.

In addition, the paper explores the paradigm shift towards a knowledge-based economy, where information accessibility and data analysis have become critical drivers of economic competitiveness. The knock-on effects of ICT technologies on employment patterns, qualification requirements and labour markets are also examined, highlighting both the opportunities and challenges posed by automation and digitalisation. At the same time, in this study, we investigate the role of ICT in promoting global integration, with an impact on the operation of enterprises in an internationally competitive environment.

We also highlight the digital divide and its implications, both among people and in business organizations of different sizes, which can bring economic disparities, as how equitable access to ICT can influence socio-economic development. The paper concludes by analyzing future trends in the evolution of ICTs, such as Artificial Intelligence and IoT, but also their potential to further transform the global economic landscape. In essence, this research highlights the fundamental role of ICT in shaping the contours of the global economy, marking it as an era of digital revolution and economic interconnectivity.

1. BACKGROUND

The ICT sector encompasses both manufacturing and services. ICT solutions primarily facilitate information processing and communication by electronic means, including transmission and display of digital content (Bangladesh Association of Software & Information Services 2018). The ICT sector can be described in terms of at least 3 components as follows (OECD - Organization for Economic Co-Operation and Development 2017):

1. **Hardware:** This includes physical devices such as computers, servers, routers, and other tangible equipment. The hardware forms the backbone of the ICT infrastructure, enabling data processing, storage and communication.
2. **Software:** A software application refers to the set of instructions that *govern* hardware behavior. It includes operating systems, mobile applications, databases and programming languages. Software applications play a crucial role in managing data, automating processes and increasing productivity.
3. **Telecommunications:** Telecommunications services involve the transmission of data over networks. This includes wired (e.g. optical fibre, copper cables) and wireless (e.g. cellular, satellite) communications. Telecommunications infrastructure connects people, devices and systems globally.

The development of the hardware industry, as an essential part of the ICT industry, began with the sale of transistor production rights by AT&T to other interested business organizations. This move paved the way for the first business organizations to enter into similar agreements and soon became manufacturers of computers or components for them. Initially, most of the business organizations that received a license were American business organizations, but later Siemens and Philips also entered the scene (Chandler and Cortada 2000:177–78). The transistor, which in turn was an important component in hardware development and played an important role in the birth of telecommunications, was invented at *Bell Labs's*, a research laboratory owned by AT&T. Thus, business organizations in the United States of America (USA) have had a major impact on technologies and services belonging to the ICT sector.

Chandler mentions that the computer industry in the US had 3 stages (Chandler 2005:262–65):

1. *The Early Years* : the period from 1940 to 1960;
2. *The Data-Processing Era* : 1960–1970;
3. *The Microcomputer Era* (the era of mini-computers, those intended for the general public, of personal and professional utility): the period between 1980–1990.

The hardware industry cannot be separated from the software industry, i.e. we can treat it as a subcomponent of the ICT sector. A hardware component is a set of chips combined for certain functionalities, electronic equipment that can be programmed or that can run a software application (Suh and Lee 2017:9).

Analyzing the business environment from the perspective of using and implementing ICT solutions, we notice certain common elements that apply both in multinational business organizations and at the level of a country. The process of intensive implementation and use of ICT solutions in the public sector resembles models of implementing ICT solutions and transforming organizational processes within a business organization. In both cases, account must be taken of: (Mezgar 2006:160):

1. Virtual collaborations via the internet globally;
2. Process management and rapid adaptation to changes imposed by the implementation of ICT solutions;
3. Intensive use of human capital to optimize performance.

New technologies influence how we produce value, run a business organization, interact with people and gain knowledge. Through technology, the two universes *of doing* and *knowing* have become more accessible to humans. (Drucker 2011:161–62)

The impact of new technologies in the management of business organizations, in training employees and in stimulating innovations is increasingly visible and generates increasingly dynamic environments with increasing challenges for the actors involved.

2. METHODOLOGY AND RESEARCH QUESTIONS

In order to carry out this research, official databases were consulted that carry out systematic evidence at global level. Such data sources are: World Bank, OECD, UNCTAD and EUROSTAT. In the first phase, data sources were prospected and the most relevant indicators were selected to show the evolution and intensification of technology over the years. To show how much the ICT sector has evolved in recent years, the following indicators have been selected:

1. Export and import of ICT goods: This includes any electronic equipment traded between countries and continents.
2. Export of ICT services: this is where software applications primarily come in. They were included in this category because they involve digital solutions development and implementation services.
3. The evolution of workforce productivity: this indicator shows us how much human resources have evolved as productivity at work both through equipment and automation and by optimizing organizational processes.
4. The evolution of the added value of the information and communication sector at European Union level: to see the contribution of the ICT sector to economic development.

After consulting the listed indicators, we will comment the implications of the ICT sector in the management of business organizations. The research questions formulated to answer the overall purpose of the research are:

1. How do Products (Hardware) and Services (Software) relate as an essential component of the ICT industry?
2. What is the evolution of exports and imports of ICT products globally and which macroeconomic region holds the leading position in terms of exports/imports of ICT products?
3. What is the evolution of ICT services and the position of major economies in this respect?
4. How has the evolution of the ICT sector influenced labour productivity at European level?
5. How does the ICT sector evolve in the added value to the European economy?

In the following lines, we will bring some arguments and analyses on which to base our answers to research questions.

3. RESULTS

According to reports, the ICT sector is a vast one encompassing various industries and services, all of which are essential in the era of digitalization. Each of the ICT components (hardware, software and telecommunications) plays a critical role in the functioning of modern societies and economies. In this sense, we can draw an analogy between the global economic system and the human body, where:

- Hardware provides the tangible backbone of the sector, with continued advances in computing power and storage capabilities driving innovation.
- Software is the brain of operations, providing the tools and applications that enable users to perform a multitude of tasks in different industries.
- Telecommunications act like the nervous system, connecting different parts of the world in real time, facilitating global trade and information exchange.

The creation of a dynamic and rapidly evolving sector is due to the symbiosis between ICT components. Thus, this sector contributes directly to economic production and employment. Moreover, it also indirectly influences other industries by stimulating technological change and innovation. It is a sector characterized by a high rate of investment in research and development, leading to constant innovation and improvement of products and services. In addition, it contributes significantly to gross domestic product (GDP) in many countries, reflecting its importance in the global economy. It is an industry that not only supports the digital economy, but also serves as a reliable indicator of a country's economic health and growth potential. As such, the ICT sector is often seen as a strategic sector for investment and development by both governments and private businesses.

Next, we identify the evolution of the hardware industry in terms of sales of goods in this category globally. Therefore, we present a series of data representing the import and export of hardware products at the level of the highlighted economies. In this category we included: computers and peripheral equipment, communication equipment, consumer electronic equipment, electronic components and other information and technology goods. To make a clear distinction, we will call them "ICT products" and elements of the software industry "ICT services".

In Figure 1 we present the export of ICT products as a share of total product exports for the four major players on the global market: North America, South Asia, Europe and Central Asia and, East Asia and the Pacific.

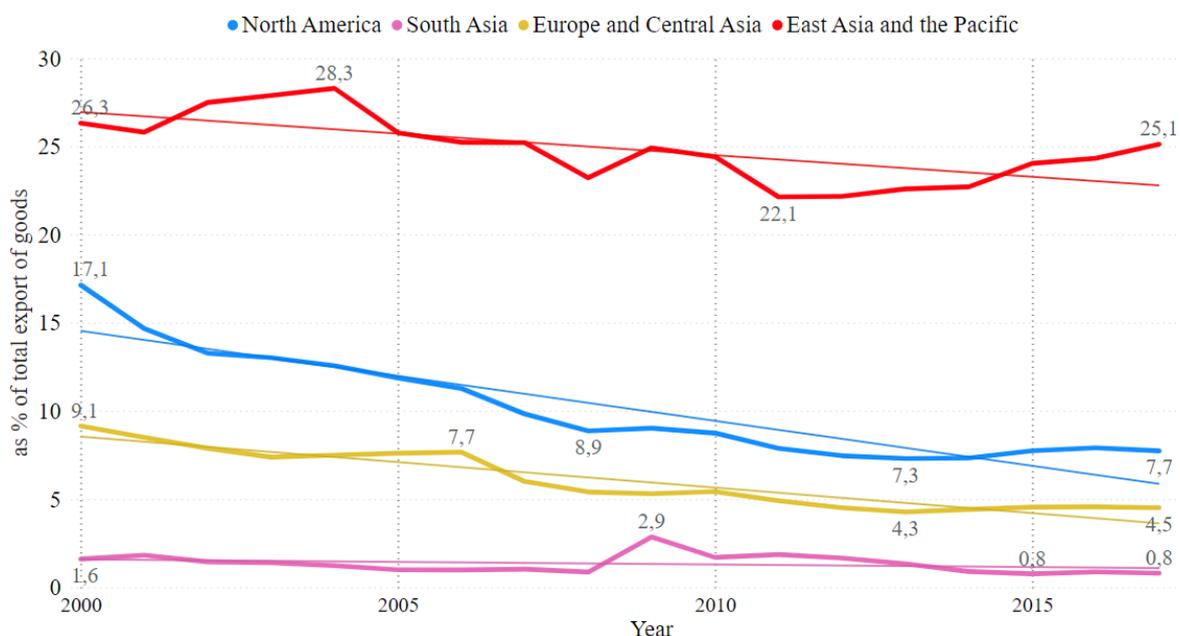


Figure 1. Overview of ICT goods exports globally (as % of total export of goods)

Source: Elaborated by the author based on (The World Bank 2022)

We note in Figure 1 that East Asia and the Pacific hold the leading position (including countries such as China, South Korea, Japan, which probably make the largest contribution) with an average of 24.87% of total goods exported between 2000 and 2017; followed by North America. If we look at the trend of evolution, represented by the continuous straight lines accompanying the graph of each category, we notice a sharp decrease for each of the four actors. For proper conclusion, we also present the import flow for this product category.

In Figure 1 we present the import of ICT products on the global market as a share of total product imports for the actors mentioned above. As we can see, the hierarchy remained the same as Figure 1. Regarding the averages for 2000-2017, we mention that only East Asia and the Pacific recorded a surplus in this chapter. They imported on average 21.02% of total imports of goods, i.e. they exported 3.85% more than they imported. For the other regions, we see a higher average

volume of ICT imports than exports of ICT goods. However, South Asia also holds the largest difference between average exports and average imports for the years 2000-2017, with a deficit of 5.34%. This explains why the trend is increasing compared to other regions.

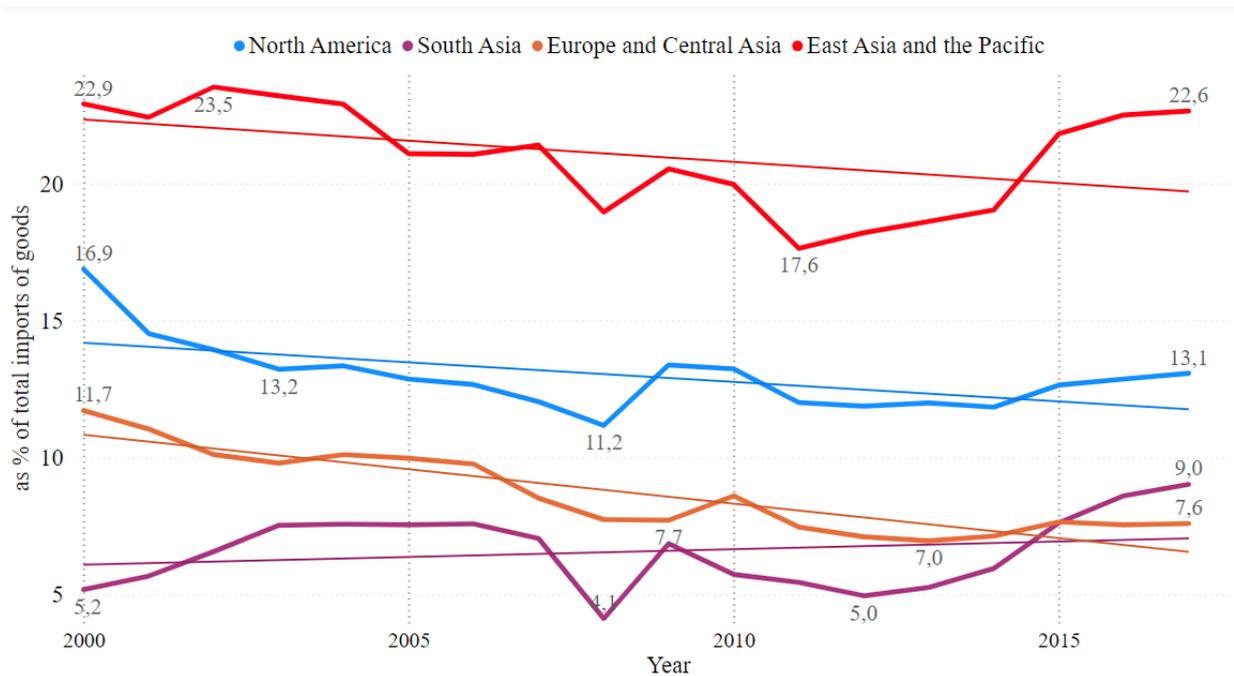


Figure 2. Overview of ICT imports (as % of total imports of goods)
 Source: Elaborated by the author based on (The World Bank 2022)

All changes that an application supports can be limited by creators (developers reach professional and creative limits to make improvements) or if it is related to hardware, they reach an incompatibility. However, developers often increase the range of ICT services in order to remain competitive on the market, given the speed with which new technologies are emerging.

To have a clear picture of the ICT sector, but also to know the occupants of top positions, with the help of Figure 3 we present the evolution of ICT services export globally as a percentage of total service exports.

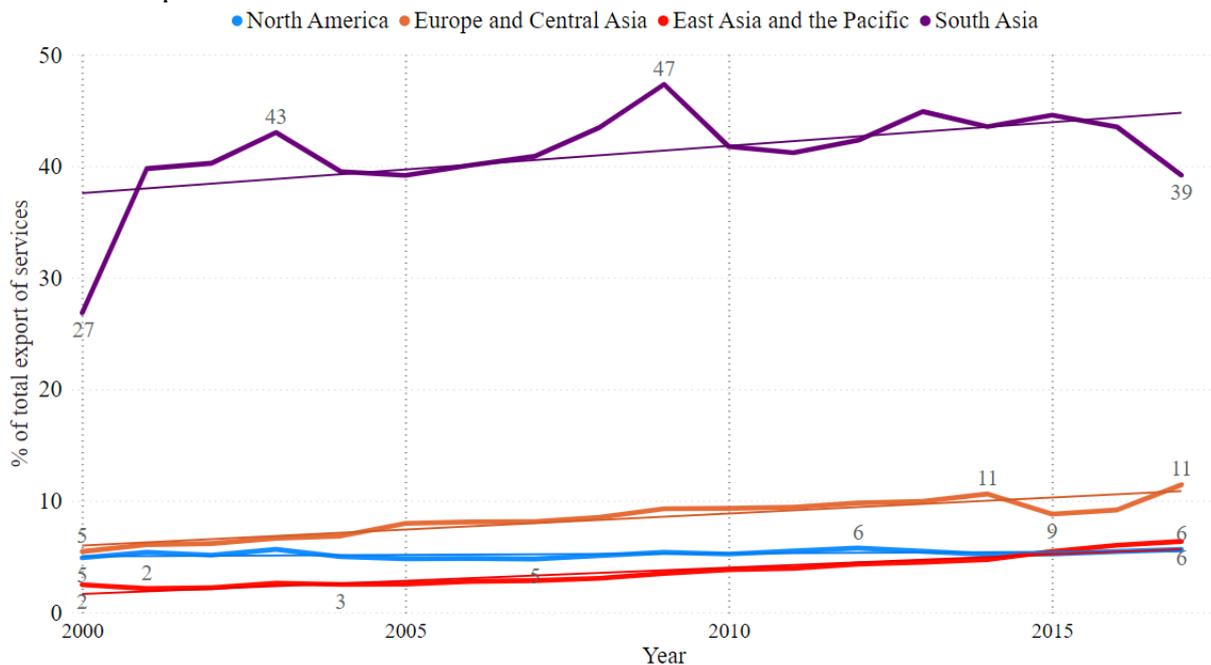


Figure 3. Global ICT exports overview (as % of total services exports)
 Source: Elaborated by the author based on (The World Bank 2022)

From Figure 3, we notice a change in ranking, compared to the export of ICT products. South Asia, from the last position, came out on top, with an average value of 41.18% representing ICT exports of total services exports between 2000-2007. Looking at North America, East Asia and the Pacific or Europe and Central Asia, we see that only Europe and Central Asia reached the 11% threshold, while the others recorded exports below 10% during this period. Following comparisons between the two industries, we noticed that between 2007 and 2008, when the ICT products sector declined in all markets, the ICT services sector, except for the South Asian market (which we can say had a boom for exporting these categories between 2007-2009), had modest growth. According to trends represented by continuous straight lines, the ICT services sector is growing in all four markets mentioned in the chart.

Therefore, we can say that the ICT services sector is constantly developing, and the leader in this regard is the South Asian market. In the following sections we will present the level of markets described above from the perspective of telecommunications, an integral component of the ICT sector.

In Figure 4, we have seen a steady increase in productivity over the past 10 years across European countries. This graph suggests that people have begun to use resources of any kind more rationally, in order to achieve maximum benefit from the activity they perform.

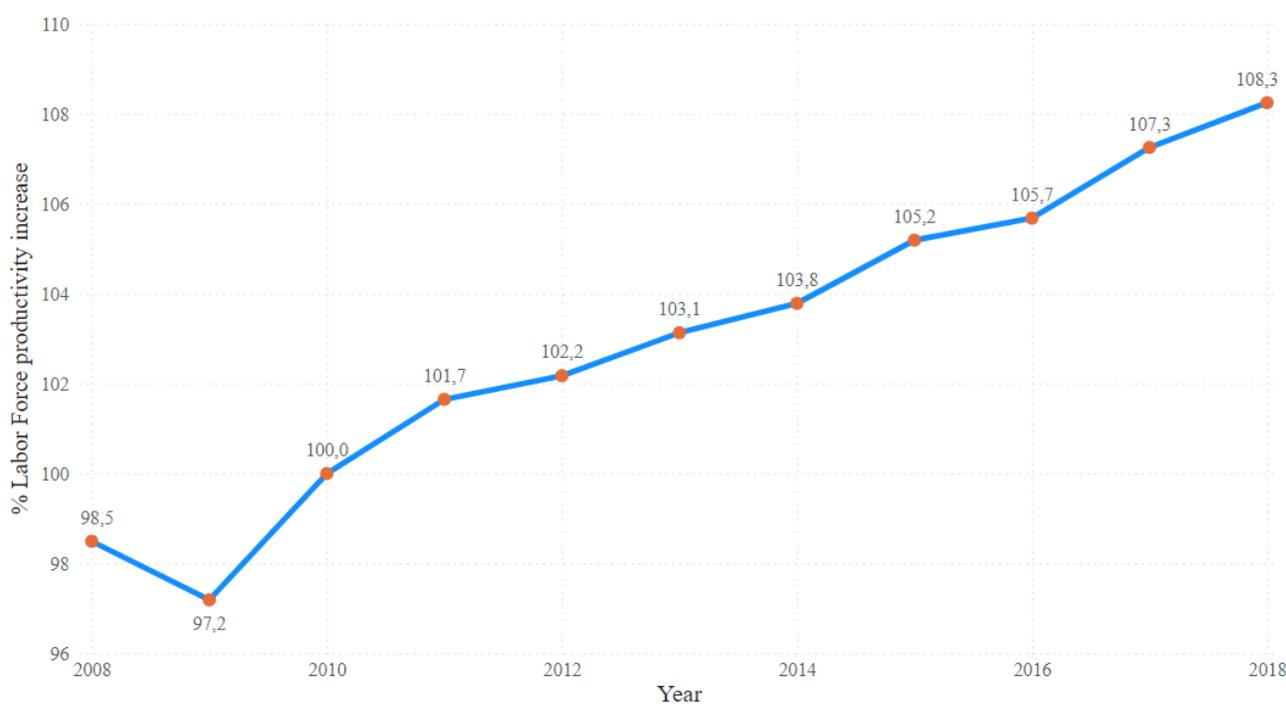


Figure 4. Evolution of labour productivity in the European Union (2008-2018)

Source: Elaborated by the author based on (OECD - Organization for Economic Co-Operation and Development 2022)

In Figure 4 is represented the percentage increase in labour force productivity at European Union level, having as reference the year 2010. Therefore, we notice a productivity increase of about 8.3% in the European Union from 2010 to 2018. This change proves an economic growth at the level of European countries where it has been possible to ensure the welfare and sustainable development of society.

Correlating the increase in labour productivity in the European Union with the increase in the added value of the ICT sector to the economy of these countries, from Figure 5 we can see steady growth between 2014-2018. The values represented refer to the share by which the ICT sector contributes to the economy of EU countries. We see an increase from 4.87% in 2010 to 5.29% in 2018. The dotted line represents the rapid growth trend recorded during the analyzed period.

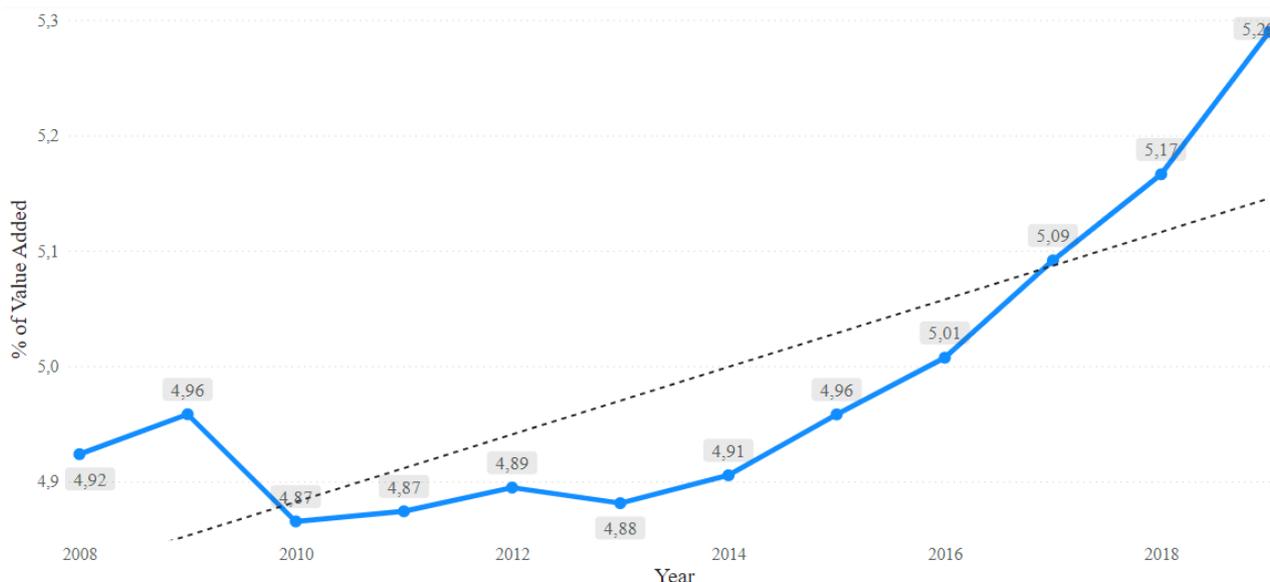


Figure 5. The evolution of the added value of the information and communication sector at the EU level

Source: Elaborated by the author based on (OECD - Organization for Economic Co-Operation and Development 2022)

Through a visual comparison between Figure 4 on labor productivity and Figure 5 on the value added by the ICT sector, we see that in 2009, when the effects of the economic crisis began to be felt on labor productivity, the contribution of ICT to the economy of countries was higher than in 2008 or 2010. The decrease in value added by the ICT sector in 2010 can be explained by the return to normality of the other sectors that suffered more during the economic crisis. Next we try to identify which are the top countries in digitalization at European Union level.

In 2020, the value added by the EU ICT sector was equivalent to 5.2% of GDP. "Between 2015 and 2020, the added value of ICT services in the EU increased every year and increased overall by 28.9%, while the value added of ICT production increased by 20.4%. Thus, we confirm the faster growth of ICT services (software development and implementation and IT consulting). At the same time, in 2020, the largest sub-sector of ICT services in the EU, computer programming, consulting and related activities, employed 10 times more people than the largest ICT manufacturing sub-sector, "making electronic components and boards (Eurostat 2022).

Researchers from different fields are concerned with exploring the relationship between ICT infrastructure and economic growth. Advances in digital technologies have an impact on productivity and economic prosperity. Some key points include (Sarangi and Pradhan 2020):

- Digital transformation: A critical assessment of the direct or indirect effects of ICT infrastructure on economic growth is essential. Support policies, adequate funding, stable governance and an innovation-friendly environment contribute to ICT-induced prosperity.
- Economic benefits: Policymakers, managers and entrepreneurs evaluate ICT solutions for economic benefits. Understanding the interaction between hardware, software, and telecommunications helps to make optimal use and growth of resources.

The ICT sector plays a strategic role in the growth of new industries, the competitiveness of business organizations and general technological progress in all economies.

CONCLUSIONS

The market for ICT (hardware) products slightly decreasing between 2000-2018. At the current level of research, we can argue this change by several possible influencing factors that led to this situation, including:

- The ICT industry, globally, is gradually being eclipsed in terms of its contribution to a region's economy by the production of other types of consumer goods. This change would

mean, on the one hand, changing the consumer trend on the market (replacing ICT products with other types of products) and, on the other hand, the decreasing contribution to GDP from this product group.

- The market for ICT products has reached a saturation level. This may be due to the fact that those, for whom the newly manufactured product is intended, give up the older version of it harder (as long as it is functional), that is, they are attracted more to its emotional value and not to new functionalities or increased performance.
- The purchasing power of a large category of consumers decreased due to unpredictable factors (war, cataclysms, conflicts and political and economic strategies).
- The manufacture of these types of products by business organizations has become more difficult due to environmental policies, tax policies, lack of certain categories of resources, etc. respectively, they move their manufacturing points to other countries, at the same time data reporting errors may occur.
- Other political, economic and social factors.

Certainly, the listed influencing factors can be found in each other or different combinations can be made in this regard. These are preliminary results of a vast research, which aims to adapt, combine or eliminate some of the factors in order to respond as effectively as possible to the purpose of the research.

In conclusion, the ICT sector, through its hardware, software and telecommunications industries, forms the cornerstone of the digital age. It is an integral part of the global economy, driving innovation, productivity and connectivity. As technology continues to advance, the ICT sector is expected to remain at the forefront of economic and social development, shaping the way we live, work and interact with the world around us.

LIMITS

We recognize that the data reported by each country or economy analyzed may have errors and inconsistencies that do not fully reflect reality. However, we believe that small deviations that may be due to differences in reporting interfaces, the period of data collection or other factors do not significantly change the analyses performed. We intentionally did not include post-pandemic reported data because the purpose of this study is to prove that naturally (without great economic/social disruption) technology will advance and reshape the business environment and the global economy.

BIBLIOGRAPHY

1. Bangladesh Association of Software & Information Services. 2018. "IT and ITES Industry Overview." *BASIS* 7.
2. Chandler, Alfred D. 2005. *Inventing the Electronic Century*. Harvard University Press.
3. Chandler, Alfred D., and James W. Cortada. 2000. *A Nation Transformed by Information: How Information Has Shaped the United States from Colonial Times to the Present*. New York: Oxford University Press.
4. Drucker, Peter F. 2011. *Technology, Management and Society*. Routledge (First published 1970).
5. Eurostat. 2022. "ICT Sector - Value Added, Employment and R&D - Statistics Explained." (February 2022):1–18.
6. Mezgar, Istvan. 2006. *Integration of TIC in Smart Organizations*. Idea Group Publishing.
7. OECD - Organization for Economic Co-Operation and Development. 2017. *OECD Digital Economy Outlook 2017*.
8. OECD - Organization for Economic Co-Operation and Development. 2022. "Productivity and Value Added by TIC - OECD Data." Retrieved November 12, 2022

- (<https://data.oecd.org/>).
9. Outman, James L., and Elisabeth M. Outman. 2003. *Industrial Revolution Almanac*. edited by M. May. Thomson Galr.
 10. Phyllis, Deane. 1979. *THE FIRST INDUSTRIAL REVOLUTION*. Cambridge University Press 1965.
 11. Sarangi, Ajoy Ketan, and Rudra Prakash Pradhan. 2020. "ICT Infrastructure and Economic Growth: A Critical Assessment and Some Policy Implications." *Decision* 47(4):363–83. doi: 10.1007/s40622-020-00263-5.
 12. Schwab, Klaus. 2016. *The Fourth Industrial Revolution*. World Economic Forum.
 13. Suh, Yongyoon, and Hakyeon Lee. 2017. "Developing Ecological Index for Identifying Roles of TIC Industries in Mobile Ecosystems: The Inter-Industry Analysis Approach." *Telematics and Informatics* 34(1):425–37.
 14. The World Bank. 2022. "ICT Import/Export World Bank Data Catalor." *Data Catalog*. Retrieved November 10, 2022
(https://datacatalog.worldbank.org/search?q=&sort=last_updated_date desc).