LUISS Guido Carli
LIBERA UNIVERSITÀ INTERNAZIONALE DEGLI STUDI SOCIALI

Department of Economics and Finance

Chair of International Economics

"Global Trade Flows in the Digital Age"

SUPERVISOR

Prof. Cecilia Susanna Jona-Lasinio

CANDIDATE

Claudia Piselli 210861

ACADEMIC YEAR 2018/2019

INDEX

ABSTRACT **3**

INTRODUCTION **4**

CHAPTER 1 BACKGROUND **6**

1.1 The two globalizations 6

CHAPTER 2 DIGITAL REVOLUTION **12**

2.1 Definition of Digital Revolution. 12

2.2 How Digital revolution is Changing the Global Economy: Competitiveness, Productivity and Integration. 15

2.2.1 Competitiveness 15

2.2.2 Productivity 18

2.2.3 Integration 21

2.3 Challenges 22

CHAPTER 3 TRADE PATTERNS IN THE DIGITAL AGE **25**

3.1 Trade Costs 25

3.2 Trade Composition 31

3.3 Trade Direction 34

CHAPTER 4 GVCs (Global Value Chains) AND DIGITALIZATION **38**

4.1 GVCs 38

4.2 Value added in Gross Exports and Digitalization 41

CONCLUSIONS **47**

BIBLIOGRAPHY **48**

ABSTRACT

Since the 19th Century, General Purpose Technologies (GPTs) have reshaped the way of living and the wealth of countries. In the past, thanks to the steam engine, inhabitants of London could easily order by telephone and have better services. Now, we live in a world where robots are replacing human beings and machines are increasingly substituting human intelligence. However, the effects of the higher availability and improvements on technologies do not involve the daily activities only, but they have a big role in the global economy. The paper investigates the role of digital tools in both the international trade and economic patterns, in terms of their effects on costs, direction patterns and competitiveness levels. Moreover, a closer look at the creation of Global Value chains (GVCs) and their relationship with the digitalization will be supported by a correlation analysis for the European countries.

INTRODUCTION

The 'hyperglobalization' we live in is only the last series of developments that our world has witnessed: great amounts and varieties of digital tools, such as machine learning, 3D printing and blockchain, are streamlining the overall business efficiency for both importing countries and exporting ones, allowing for lower trade costs and a higher efficiency in the production process. The purpose of the thesis is to assess the impact of the increasing diffusion and availability of digital technologies on international economics patterns, from the first globalization with the invention of the steam engine to the current digital revolution characterized by the birth of Big Data and Artificial Intelligence and the creation of global value chains (GVCs). In particular, the main focus is on the impact of those technologies on international trade patterns, in terms of both trade costs and direction, which have been significantly impacted by the changes brought in by the digital revolution in the last decades. Moreover, the world's economic center of gravity is shifting towards Asian countries with new manufacturing hubs and a great importance is given to the creation of global value chains (GVCs), as they can be considered at the delta of the majority of changing behaviours of trade costs, investments and technologies advances.

The dissertation is divided into four chapters, starting with an excursus on the world economy characteristics since the first globalization: an analysis of the differences between the first and the second globalization is conducted, in terms of both the participating countries and the technologies involved, in order to provide a solid basis on which to assess and better understand the main analysis. As the first globalization was based on the extensive application of the steam engine to a variety of situations and activities, nowadays Big Data and Artificial Intelligence are at the core of both business and daily activities. The second chapter aims at describing what the digital revolution really is about and it focuses on giving a definition of the phenomenon itself and its components as well (Big Data, Artificial Intelligence, Internet of Things, 3D printing). Moreover, the main object of the second chapter is the description of the correlation between the technological advances and the economic framework in general, as it analyses their impacts on the competitiveness levels, on the productivity levels and on the integration patterns.

The third chapter addresses the main topic of the essay: how trade patterns are impacted by the continuous changes in technology. The topic is addressed by three main points of view: costs, composition and direction of trade: on the one hand, costs have been significantly lowered thanks to the increasing availability of advanced and digital tools, on the other, goods based flows are leaving space for increasing service and digital flows and this shift is allowing for a wider participation in the international economy by more and more countries. In the fourth and last chapter of the essay correlation analysis and linear regressions with respect to the European Union countries are conducted to address the correlation among Global Value Chains, whose value is measured with value added variables, and the advances in digital intensity and availability. The results show that the substantial increase in the usage of the internet is allowing for a greater participation by more individuals and more countries in both the production processes and consumption behaviours. However, the increase in ICT usage and internet expansion are proved to be eroding domestic value added for gross exports and augmenting the foreign one. Finally, a conclusion, in which future insights on both the economic and policy patterns are addressed, is drawn.

CHAPTER 1

BACKGROUND

1.1 The two globalizations

An initial comprehension of the previous technologies' impact on the global economy over the past decades is crucial, if we want to understand not only how digitalization is going to influence future trade and growth patterns, but also the benefits and the opportunities that this integration may bring henceforward. Indeed, the main topic of the study is the interplay between technologies and the world economy, starting by the evidences of the past few centuries and thereby reaching the implications of future patterns.

1.1 The two globalizations

The globalization we live in is only the second big wave of economic and technological changes that has hit our planet. Indeed, throughout the past two centuries, at least two big episodes of economic growth have taken place, each one characterized by the systematic application of science to the processes of production, social organization and transportation, which, in turn, led to a consistent reduction in transportation and information costs and to significant levels of integration among the national economies (World Trade Report, 2018).[1]

The 'first age of globalization' could be placed in the years from 1815 to 1914, period in which both the commercial and transportation costs have been significantly lowered, with the advent of new general purposes technologies (GPTs). At the same time, these developments, together with favourable institutions and social advances, allowed for open trades across national economies and much easier completions of investment transactions. This period is the one Keynes wrote about, noting that an inhabitant of London "could order by telephone, sipping his morning tea in bed, the various products of the whole earth, in such quantity as he might see fit, and reasonably expect their early delivery upon his doorstep" (Keynes, 1920)[2]. At the time, this period was seen as an unprecedented

[1] *World Trade Report: The future of world trade: How digital technologies are transforming global commerce*, (2019) World Trade Organization

[2] John Maynard Keynes (1920), *The Economic Consequences of the Peace*

phenomenon, since it was mainly driven by technology, a big novelty with respect to the previous eras of expansion, which were driven by violence and need for conquest. The invention of the steam, the breakthrough of railways and the creation of canals had a great impact on the first wave of globalization: before their developments, trade routes were reliant on wind patterns and railways were inefficient and unsafe. Then, since the steam engine was used as a power source for both spinning and weaving, the steamships reduced shipping time and shipping costs. On the other hand, railways became safe, comfortable and crucial for the transportation industry, allowing for bigger volumes of trade and migration, in particular in the United States: in underpopulated areas, where people produced raw materials and agricultural food, it was impossible to reach industrialised centres. After the civil war, the American government started the construction of a big railroad system in order to assure high levels of connectivity in the country and to create a national market. However, transportation over land remained much more expensive than water transportation, and big progresses in the overseas connections took place: in Europe, navigable canals quadrupled between 1775 and 1820 allowing for much cheaper options for travelling. Moreover, the Congress of Vienna, in 1815, assured the passage through the Rhine to all. In the United States, the construction of the Eire Canal reduced transport costs from New York to Buffalo by 85%, and cut the journey time from twenty-one to eight days (Findlay & O'Rourke, 2007).[3]

Other than steam and roadways, which allowed for reduced distances among the markets and among the industrial centres respectively, other technologies have been crucial in the integration of international economy in mid-19th century, allowing for even lower communication costs: the optical telegraph, long distance telegraphs, laying transaction cables and early telephones. These inventions constituted a great novelty, especially for financial centres, since they allowed cities other than London to be involved in financial transactions. Moreover, ''*the telephone has linked up markets so closely that the investor, no matter what broker he employs, can never be certain in what market his deal has been concluded*'' as the Financial News noted in 1933. As a result, by 1851, over fifty separate telegraph companies were operating in the United States and in 1860, the Pacific Telegraph Act has passed, allowing for the construction of a transcontinental line. (Findlay & O'Rourke,

[3] Findlay & O'Rourke (2007), *Power and Plenty,* Princeton University Press

2007)[4]. These technological changes, together with growing trade agreements and the expansion of open markets, created a semi-unified market and made this period 'the most impressive episode of international economic integration' (O'Rourke, 2002)[5]. Indeed, as technologies led to higher volume of trade, which expanded by 486 per cent between 1870 and 1913 (Jacks et al. 2011)[6], comparative advantage and relative resource endowments allowed for higher profitability from this high volume. Standard economic theory holds that advanced trade patterns, together with enhanced market integration, enforce economic growth. Indeed, the so called first globalization, as previously described, coexisted with a period of unprecedented economic growth in both Western and European countries. Even eastern countries got benefits from exports of primary products but those benefits were so little that the growth potential was damaged as a result.

However, technological advances are not enough to grant permanent trade growth, since they need to be managed properly: this is one of the reasons why this economic integration came to a cessation during the interwar period, during which trade barriers emerged, trade volumes decreased by substantial amounts, the gold standard formally ended and the rigidity of labour and product markets left many economies devastated. World trade reached a low 5.5 percent of world GDP just before World War II began.

Afterwards, the global economy underwent a period of re-integration by the end of 20th century, defined as 'the second globalization'. The latter has been driven by radical information and technological innovations, that modified productivity patterns, while leaving behind the affirmed Ford system (Moroni, 2017)[7]. The analogies between what has happened in the first wave and in the second one, are clear: they both led to trade openings, lowered costs, international integration, important technological innovations and big migration flows. Moreover, the means by which the countries reached the previously cited results are similar: institutions and general-purpose technologies (GPT), the latter described as innovations that can be applied to a large number of production usages, such as the steam

[4] ibidem
[5] O'Rourke (2002), *Europe and the Causes of Globalization*
[6] Jacks et al. (2011), *Trade Booms, Trade Busts, and Trade Costs*
[7] Marco Moroni (2017), *Prima e seconda globalizzazione: effetti, reazioni, prospettive*

engine, railroad, electricity, microchips and electronics. Technology and institutions, being the main drivers of both the globalizations, they constitute a big fraction of trade integration and dematerialization: services are becoming increasingly more important than goods. Moreover, they're allowing for a big boost of global democracy.

Richard Baldwin, a professor of international economics at the Graduate Institute of International and Development Studies in Geneva, distinguished two types of unbundling as common grounds for both the globalizations: sector-by-sector separation of production and consumption, and offshoring of services. First, in the years between 1870 and 1914, thanks to steam ships and railroads, trade costs for goods and people declined, as they further declined during the latest days since the 1960s, thanks to containerisation, air cargo and advanced supply chain management. (R. Baldwin, 2006)[8]. As a result, the learning-innovation cycle, that has never been triggered before, is introduced in all the industries. Second, technologies allow successive stages of manufacturing production not to be in the same physical place, as it was in the previous years. The increase in trade reflects the fragmentation of manufacturing and of value-added chains among different economies, since single production stages are located where the costs of production are lower (Subramanian & Kessler, 2013)[9].

The differences with respect to the past globalization are the followings. First, the geographical context: while the 19th century's main characters were the United States and Western Europe, now this phenomenon is involving Eastern countries such as China and other emerging countries. Second, global commerce has changed its essence: during the 19th century, it mainly happened between different national economies on the basis of their technological level and resource endowment and it was composed by trades of manufactures and raw materials. Today, commerce involves changes of broadly similar goods and services (intra-industry trade), mainly among rich countries with similar resources endowments (Sachs, 2000)[10]. In essence, trade flows are different and there are no clear

[8] Richard Baldwin (2006), *Globalisation: The Great Unbundling(s)*, Economic Council of Finland
[9] Arvind Subramanian & Martin Kessler (2013) *The Hyperglobalization of Trade and Its Future*
[10] Jeffrey D. Sachs (2000), *Globalization and Patterns of Economic Development*

patterns as there were before. Capital flows are changing as well: before, capital mobility was characterized by intense foreign investments, it involved few capitalists and it was oriented towards long term investments rather than short ones. However, from the 1930s, with the beginning of the Bretton Woods Systems, capital markets began to be poorly integrated and afterwards, with the advent of new technological means, more people started to be involved in short term investments.

Another important difference is related to the efforts that national economies put in order to restore a lasting international economic integration: while, during the 19th century, those efforts were limited to rough agreements and weak trade unions, the 20th century saw the birth of solid international institutions and agreements. The Bretton Woods System, as well as the International Monetary Fund (IMF) and the International Trade Organization (ITO), would respectively put the basis for reinforced multilateral institutions, prevent from the return of a financial crisis while restoring exchange rate stability, and allow for stable commerce agreements. (World Trade Report, 2018)[11]. Moreover, technological diffusion is the most significant characteristic of the new wave of changes with respect to the past one, since, with the high-tech innovations and fruitful application of advanced knowledge, it allowed for the creation of global value chains (GVC). Information plays a big role in the new context, since it is much cheaper and it may be used to explain the rising in trades: information is needed in order to 'arbitrage'.

To conclude, technologies and economic patterns have always been interlinked. As the World Trade Organization points out, as the 19th century was marked by lower costs of raw materials' trading and the 20th century by falling cost of trading commodities, the 21st century will be characterized by significant falls in information costs. Nowadays, the cost of communication and information between countries has radically declined, thanks to satellites, digital technologies, fibre optic cables and important innovations in telecommunications. In its report, the World Trade Organization follows the Moore's Law, by which the number of transistors and power of circuits almost doubles every two year, to

[11] World Trade Organization (2019), *World Trade Report: The future of world trade: How digital technologies are transforming global commerce*

address the dramatic fall in computing power prices with the increase in power of computer chips. At the same time, the 21st century hosted the era of the internet, seen as the personification of the 'global information superhighway' by which global communication is achieved and people can search for information, start group discussion and be involved in global groups (Hura, 1998)[12].

Overall, the global economy has always been adapted to new waves of technological improvements and economic patterns, trade costs and technologies have always gone hand by hand: that's why both the first and the second wave of globalization reminiscences are of extreme importance in the understanding of what are the threats and the opportunities of this current digital globalization.

[12] Gurdeep Singh Hura (1998), *The Internet: global information superhighway for the future*

CHAPTER 2

DIGITAL REVOLUTION

2.1 Definition of Digital revolution

2.2 How Digital Revolution is Changing the Global economy: Competitiveness, Productivity and Integration

2.3 Challenges: Control, Inequality, Concentration

The following section is aimed at giving a definition to Digital Revolution, as the process by which the rise of digital technologies has impacted not only our daily life, but the majority of the industries. Moreover, it examines how the forces driving this revolution had impacted the global economy and given birth to new markets, advanced production processes and wider range of products and services offered.

2.1 Definition of Digital Revolution.

''Ubiquitous, mobile supercomputing. Artificially-intelligent robots. Self-driving cars. Neuro-technological brain enhancements. Genetic editing. The evidence of dramatic change is all around us and it's happening at exponential speed'' (World Economic Forum, 2016)[13].

According to a study conducted by Cisco, by 2020 more people will own mobile phones than electricity or running water in their houses. If Facebook were a country, today it would be substantially larger than China or India. It has been predicted that by 2020 people will have more conversations with robots than with their husband or wife. As time went by, digital innovations started playing a fundamental role in reshaping our world, stretching from changes in the daily sphere to switches in the composition of transitional flows. Our lives are becoming increasingly guided by data: 94% of all information is digital. The second wave of globalization put a solid foundation for the beginning of a new era - reasonably defined as 'Hyperglobalization' by Arvind Subramanian and Martin Kessler [9] - led by digitalization (or digitization) and characterized by continuous births of innovations, data flows and technological changes. In particular, the increasing and wide applications of Blockchain, 3D

[13] World Economic Forum (2016), *Mastering the Fourth Industrial Revolution*

Painting, Big Data, Artificial Intelligence and the Internet of Things (IoT), led to radical modifications in both the economic and social activities and they will eventually continue to affect those patterns in the years to come.

In the book 'The Second Machine Age' (McAfee e Bryonjolfsson, 2014)[14], the authors write about a new era in which the world economy is on the edge of an important economic growth triggered by intelligent machines, the ones characterized by high levels of technology, communication and artificial intelligence. According to McAfee and Bryonjolfsson, this digital convergence will bring to a world in which conceptual works will not exist anymore, as they will be carried out by machines. Furthermore, digitalization is changing the way people learn and communicate, accelerating the movement of goods, services, and capital, as well as of knowledge, ideas, and human and social capital. It has created not only a huge range of new products and services, but also new and transformed industries and infrastructures (Kahin, 2016)[15].

Other than 'Hyperglobalization' and 'The Second Machine Age', experts talk about 'Industry 4.0' or 'the Fourth Industrial Revolution' when referring to the current digital revolution, since there have been three industrial revolutions before and this is intended to be the fourth one. Previous industrial revolutions, as underlined by professor Klaus Schwab, Founder of the World Economic Forum, allowed for animal power to be substituted with humankind ones. The Fourth Industrial Revolution is radically different from the previous ones: it is bringing together physical and digital systems and a wide range of technologies is impacting all disciplines, economies, industries and outcomes.

Digitalization is at the basis of this revolutionary period and it is defined by Katz and Callorda as the set of social transformations of the techno-economic environment together with socio-institutional operations, stimulated by the technological communications' adoptions and applications. It involves access technologies such as mobiles, semiconductor technologies as computers, tablets and wireless devices, software engineering and complementary technologies such as Big data and Blockchain. Moreover, the results obtained through their applications, such as common platforms for application

[14] Andrew McAfee & Erik Bryonjolfsson (2014), *The Second Machine Age*

[15] Brian Kahin (2016), *Digitization and the Digital Economy*

development, e-commerce, social networks, sharing economies, blogs, portals and all kinds of online marketplaces, are at the basis of the phenomenon as well (Katz & Callorda, 2018)[16].

Construction, manufacturing, services, public health and education will still exist but they will go through radical developments and changes in their content, on the basis of six powerful tools: Artificial Intelligence (AI), Big Data, Blockchain, the Internet of Things (IoT) 3D Printing, and Robotics.

1. Artificial Intelligence (AI): discipline whereby computers can be trained to accomplish tasks and learn from experiences. AI adds intelligence to existing products and it can achieve important results through the right selection of data. It may be used for observing patterns, making predictions or simply improving models.
2. Big Data: the set of data characterised by high volume, velocity, veracity and variety. It is of extreme importance both at business and policy levels, since it allows to exploit a great amount of useful information.
3. Blockchain: a record of fast and secure transactions whose validation is driven by consensual mechanisms. It is possible to take advantages of the decentralized structure of Blockchain in order to best support the processes of production and distribution, implementing the logic of Industry 4.0. Moreover, it Is important in digital payments, since it guarantees security and stability.
4. Internet of Things (IoT): the ability to control and manage physical things through digital instruments. Its main goal is to monitor and transfer information that will allow for subsequent actions.
5. 3D Printing: a process that allows to create three dimensional objects starting by a digital representation or design. It facilitates the creation of peculiar pieces whereby traditional manufacturing fails to achieve concrete results.
6. Robotics: interdisciplinary branch of science and engineering dedicated to the development and production of automated systems, vehicles or humans. Robotics projects and applications can be found across a large number of industries.

[16] Raul Katz & Ferdinando Callorda (2018), *The economic contribution of broadband, digitization and ICT regulation,* ITU Publication

2.2 How Digital revolution is Changing the Global Economy: Competitiveness, Productivity and Integration.

Throughout ages, technological advances have reshaped how business is operating, from the first industrial revolution to the creation of new global value chains. Today, digital revolution is reshaping the way business and manufacturers operate and provide services and products to customers. As already mentioned, this 'Revolution 4.0' is transforming every sphere of our daily life and it is not just a field of technological improvements, perhaps it is making the global economy converge towards a totally automated industrial production and new systems under a variety of factors. The wide adoption of digital technologies' changes and the possibility of connecting through simple clicks allow wide untouched sectors of the economy to get benefits through investment and productivity. In particular, as the European Commission underlines in its 'Unlocking the ICT growth potential in Europe: Enabling people and businesses'[17] service sectors, which count for a big portion of GDP in developed economies, have gained several advantages. As digital technology increases in capacity, capabilities and adaptabilities, it continues to transform the economy, giving birth to a 'second economy' composed by data and technologies, in which computers play an ever-increasing role and trade composition, about which we will discuss in depth in the following chapter, is shifting from goods and services to financial and digital elements. The internet is playing a fundamental role in this shift, becoming the so called 21st century general purpose technology enabler, a once-in-a-generation technological development that radically changes the way economic activities are conducted and allows for a raise in productivity: according to the Organization for Economic Cooperation and Development, the Internet's impact on productivity may exceed the effect of any other technology enabler up to date, including electricity and the combustion engine.

2.2.1 Competitiveness

Digital global platforms have created much more transparent and flexible markets than the ones existing before and they are increasingly allowing for the participation of individuals in the overall globalization, as well as for lower costs of cross-border communications and

[17] European Commission (2013), *Unlocking the ICT growth potential in Europe: Enabling people and businesses*

transactions, with which businesses could easily connect with customers and suppliers among different national economies (McKinsey Global Institute, 2016)[12]. With this digital transformation, the single companies are intended to remould their business models in a digital framework and they are forced to implement new strategies that will allow for a consistent success in this new highly competitive environment. As a result, competition is intensifying and the world economy is leaving space for small and medium businesses, emerging countries and tech companies, which now cannot be cut out for the increasing connectedness. The biggest corporations, which were the dominant participant and main beneficiaries of the 20th century, are likely to face a more competitive environment. Businesses that fail to get digitally connected, instead, risk the exclusion from the global market (EU-Japan Centre for Industrial Cooperation, 2015)[18].

First, competitiveness is boosted thanks to technological changes. Companies need to redirect their investments towards new digital technologies that would add value to their business: it is necessary, in order to allow for a stronger interaction across the internal departments, that even small businesses knew the importance of the concept of 'digital disruption', a change that takes place whenever new technologies impact the existing business models and transform the value proposition of a business. Most of the new enterprises are located in a technological environment, in which both the daily strategic decisions and growing processes are characterized by a deep relation between innovation, entrepreneurship and internationalization. Hence, according to Laura Zanotti, all major executives shall have knowledge and experience in at least one of the following trends: IT as a Service, Hyperconvergence, Customer Relationship Management or Customer Experience, Business Intelligence or Big Data Management and Internet of Things.[19]

Thanks to technologies, small and medium size enterprises (SMEs), with factors affecting their development being international since the beginning, can identify specific markets and reach international levels, overseas markets as well as skilled potential members and a massive customer base. As a consequence, little enterprises can and obtain the benefits that big companies used to monopolize. We can easily identify two main passages in the implementation of the internet at corporate level: the first turning point could be placed in

[18] EU- Japan centre for industrial cooperation (2015), *Digital Economy in Japan and the EU*
[19] Laura Zanotti (2015), Digital Transformation: i 5 trend dell'innovazione digitale

the period in which electronic postal services began to be utilized at commercial and operational levels throughout the firms, allowing for efficiency and better organizational processes. Then, websites and corporate software began to play a fundamental role in this shift, enabling both companies and consumers to acquire even more information on the products and on the business itself, to keep track of their commercial operations and efficacy of their departments and to ameliorate their value chain structure, by communicating more information to the various components in a more efficient and rapid way.

In the last two decades the notion 'global society' itself has highlighted an evolution. First, big traditional multinationals master raw materials and commodities sector. On the other hand, the growth of digital capabilities has allowed new giants to exploit new and existing industries, such as retail with Amazon and hospitality with Airbnb. As Susan Lund and James Manyika pointed out in their report[20], these new companies achieved massive results thanks to their different marginal cost economics and their usage of data and new algorithms, with which they have been able to go over traditional value chains and create even better ones. Another strength of those tech firms is the fact that they have been successful in raising consumers advantages, offering wide choices of products and services at low costs, as the costs beard by companies have been substantially lowered. For example, with the birth of Ebay, small companies can now export through online platforms and substantially cut the fixed costs that they were facing with no marginal basis inputs purchasing. Exhibit 1 shows what kind of industries have been disrupted with the advent of new digital platforms, as well as who are the disruptors.

[20] Susan Lund and James Manyika (2016), *How digital trade is tranforming Globalisation*

Exhibit 1: Business Dynamism during the Digital Revolution,
Source: OECD

However, the rapidity with which this technological revolution is spreading across countries opens up to new practical challenges that enterprises need to face, as several aspects of digital economy cannot be easily regulated by traditional trade agreements. With digital platforms becoming so spread, trade agreements have shifted their focus to digital trade and intellectual property, in order to have much more stability in both security and privacy concerns.

We can easily affirm that today a small enterprise can develop a bigger global visibility with respect to the past, invested resources being at the same level. Other than small and medium companies, also individuals can gain from Internet expansion: entrepreneurs can now take a larger piece of the pie of the market, reaching a significant higher number of people. As a result, competition is strengthened and consumers obtain a higher surplus from their interaction with companies.

2.2.2 Productivity

Shushanik Papanyan attempts to define productivity in terms of digitization in its economic analysis 'Digitization and Productivity: Where is the Growth?'[21]. First, the main takeaways from the report include the fact that technology is in a low growth state, while information technology is in a high growth state and it is boosting the growth rate of productivity. Indeed, the World Bank Group confirms that better information availability is helping both

[21] Shushanik Papanyan (2015), Digitization and Productivity: Where is the Growth?

companies and institution in optimizing their operation management, supply chain management and time management as well as in developing existing capacities and inventories (World Bank Group)[22]. Here, Big Data plays a big role: in every industry, a significant amount of data is being analysed every single hour to make sure that their models adapt to the current changes. For example, in the airline industry, several improved algorithms are applied to prices and reservations and make it possible to substantially increase fuel and other load factors' efficiency. Moreover, retail companies and delivery businesses take advantage of intelligent algorithms to save time and fuel (almost 4,5 million litres of petrol per year).

The ICT (Information and Communications Technology) sector contributes to a consistent part of the world GDP: considering the OECD (Organisation for Economic Co-operation and Development) countries, the ICT sector accounts for an average of 6% of GDP (Exhibit 2 A), which has been fairly constant since 1990s.

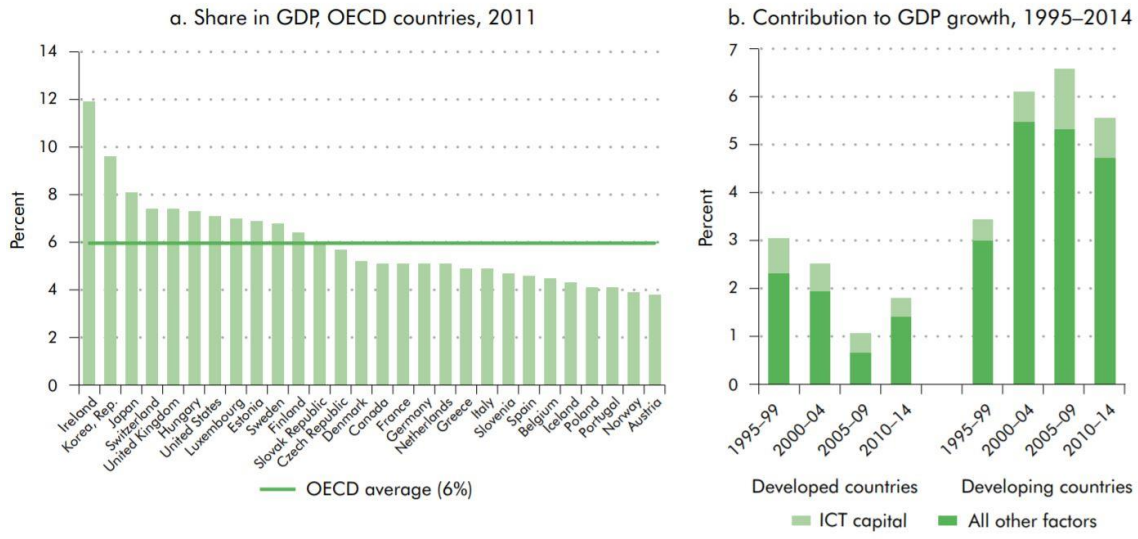


Exhibit 2: ICT size (A), ICT size growth (B)

Source: World Development Report (2016)

As it can be observed from the graph, in Ireland, a large number of tech firms, established in the country thanks to a sustainable environment and favourable regulations, make the value added of ICT sector to GDP reach the 12%. However, in the United States, although they host a great number of important technological firms and institutions, the contribution

[22] World Bank Group (2016), *World Development Report: Digital Dividend*

of the ICT sector to GDP is just 7%. A distinction between richer and poorer countries for ICT contribution to GDP throughout the years, can be drawn by looking at Exhibit 2(B): while developed countries experienced little changes, low-income countries saw a modest growth of roughly 15%, thanks to the increasing adoption of new technologies. The reasons why productivity growth is rising include the fact that internet is lowering the costs of inputs, thereby raising labour productivity and efficiency: through improvements in total factor productivity, the internet and information and communication technologies are consistently affecting the overall economic growth. On the one hand, digitalization increased the mobility of labour since more and more units are needed to work on a global scale, however, technologies are a serious threat to human labour, since they are slowly substituting medium wage jobs and set of skills priories detained by humans. At the same time, the cost of capital has lowered, making it a fair substitute of labour and thereby making the labour share decline.

Moreover, the incremental usage of technologies in the everyday businesses allowed for an increasing segmentation of production across borders and the rise of new global value chains made it impossible to conduct a comparative advantage analysis based on exports as policy guide and have posed new challenges to analysis of trade and competitiveness. Indeed, in the past decades, the main analysis was based on the fact that all the stages of the development of a product were conducted in a limited area, by using domestic input only. However, with the increasing fragmentation of production across borders and the increasing usage of foreign inputs, this assumption can no longer be maintained: supply chains are now located all over the world and this enables the companies to exploit advantages and specialization. For example, Apple has reinvented its value chain by looking for foreign suppliers that would have assembled the components in the cheapest way (Timmer et al., 2013)[23]. When framing policies and evaluating performances, sector-specific analysis is not the principal tool anymore: the examination of the kinds of activities that each country carries out along the value chain can be intended as a powerful tool to exploit the potential benefits of this last globalization.

[23] Marcel Timmer, Bart Los, Robert Stehrer, Gaaitzen De Vries (2013*), Rethinking competitiveness: The global value chain revolution*

2.2.3 Integration

Other than changing competition and productivity levels, this digital economy leads to a process of economic integration. While after the World War II emerging countries were entering the world economy thanks to liberalization from their motherlands and thanks to their manufacturing ability, today, thanks to the increasing adoption of technologies and to the wider availability of communication and information technologies, developing countries, such as India and China, other than officially entering the international economy, are expected to gain a significant share (45%) of the global Fortune 500 (McKinsey Global Institute, 2018). The growth of information technology within emerging markets has to be taken into account: there have been significant changes in the importance that IT sector has gained in developing countries since 2012. According to MGI (Margin Growth Indicator) Index, in 2000, only twenty of the global Fortune 500 companies were located in emerging markets. Today, that figure is more than quintupled. Furthermore, MGI predicts that roughly half will be from emerging markets by 2025, as Exhibit 2 shows. Trade patterns are changing as well and they will be addressed in the third Chapter of this dissertation.

Exhibit 3: by 2025 emerging countries will host 230 companies of the Fortune Global 500

Source: McKinsey Global Institute

2.3 Challenges

Together with benefits and opportunities, digital technologies are bringing to the table a variety of challenges for both policymakers and governments. The World Bank Group, in its World Development Report[24] examines how the internet is capable of creating opportunities as well as of transforming these opportunities into risks. The group has distinguished three main threats: control, inequality and concentration (Exhibit 4).

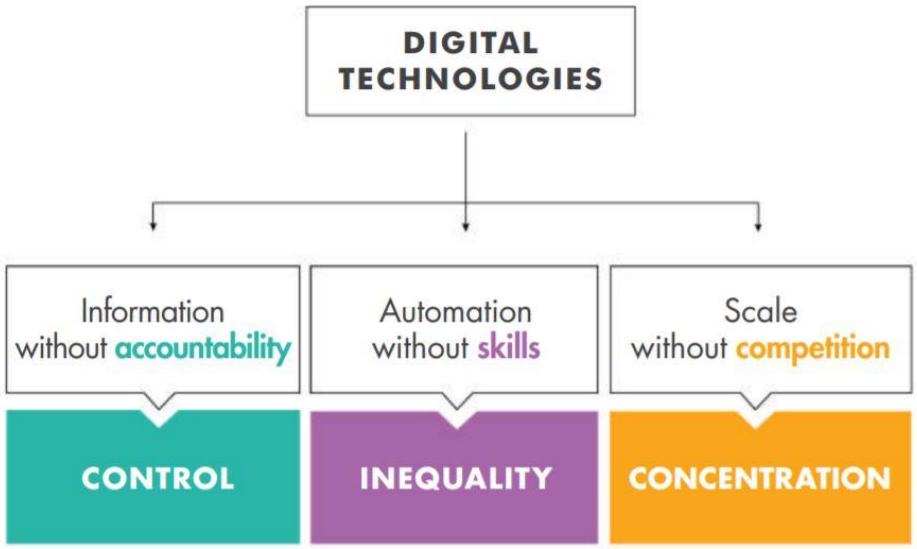


Exhibit 4 : Opportunities may turn into risks
Source: World Development Report (2016)

First, whenever information technologies help in lowering the barriers and making productivity increase, there is the possibility that the overall improvement is not sustained by good governance. Whereas certain actions and functions served by institutions are made more efficient themselves with the help of digitalization, most of the times, digital improvements do not lead to reinforcements of accountability relationships between citizens and governments, as the latter are not responsive and adaptable. Overall, the gap between improvements in technology sector and stubborn institutions is not closed yet, as

[24] World Bank Group (2016), *World Development Report: Digital Dividends*

it needs radical changes in the culture of the nation: governments are needed to exploit opportunities for domestic firms in foreign countries, allow for major transparency and identify the right regulations on the basis of the needs of the domestic market.

Second, the fourth industrial revolution has the potential to make inequalities bigger and more visible: at a national level, advances in technology sector don't guarantee a successful integration of those technologies to daily activities. Today, the majority of developing countries lack good education, meaningful regulations and sustainable environments and these failings lead to fewer foreign investments and to difficulties in managing digital technologies and transforming them into high productivity levels. As it happened during the Great Divergence, technologies themselves are not enough to guarantee stability and efficiency, as they need good governance to be exploited in a meaningful way. As a result, the equality once hoped for low-income countries is not achieved and inequalities are spreading around. Indeed, while global welfare is enhanced, labor market disruptions resulted in higher inequalities: the benefits of this new era are concentrated in the hands of a few countries characterized by fruitful environments and solid legal frameworks, characteristics that are at the basis of meaningful innovations. However, as technologies widen up the gaps, they allow to make those inequalities more visible than they were before and therefore more addressable. Recently, several governments (India, Mexico, New Zealand, Singapore, the United States and United Kingdom) have provided big data sets that would create comparative advantages and value added.

Finally, whenever a technology enters the market, three main potential problems rise: first, it is widely acknowledged that mainly large and fast-growing firms are more open to implement new technologies, while other countries still remain slow in the adoption. Then, disruption has been enlarged with the advent of digital businesses: those firms have such scalable and adaptable business models that regulators often have difficulties in addressing and enforcing established sector regulations. Finally, many digital platforms have assumed dominant positions in the market and they have gained such high profits that they became a serious threat to incumbent companies.

Recently, more companies can enter new markets and incumbents could easily be disrupted by aggressive global competitors with new digital business models. Moreover, the impact on productivity is difficult to be properly defined. As Susan Lund and James Manyika[17]

describe, governments are enacting a variety of regulatory requirements, including limitations on foreign ownerships and investments and other administrative barriers, as well as pursuing several bilateral and multilateral agreements. For example, The Association of South East Asian Nations (ASEAN), has put a lot of efforts in the construction of a solid trading bloc, by eliminating import tariffs across its ten member states. Second, cybercrime has become a real threat, since losses of privacy and security are not taken as serious problems by many companies. The security of data storage needs to be addressed by both the government and the single entities. Governments need to invest in cybersecurity initiatives and in incentives for improving security: in 2014, McAfee has estimated that roughly $400 billion have been lost as a result of market manipulation and financial crimes.[25] Being this globalization so complex and fast-paced, connectedness and integration are certainly needed and can lead to substantial and stable growth, hence, governments need to work closely with their counterparts, taking into account differences in interests and priorities, to reach agreements and to avoid threats. (Insurance Governance Leadership Network, 2015)[26]. At an institutional level, governments are trying to drive their own industrial systems, since 'the Second Machine Age' represents a challenge for the established productivity models. For example, Germany has enacted its own 'Industrie 4.0' in 2011, a strategic initiative for pushing forward digital transformation that addresses the new challenges on a variety of levels. (European Commission, 2017)[27]. A similar initiative has been enacted in Italy, the 'Industria 4.0', a political action plan, presented in 2016 by the the Ministry of Economic Development, that strived for reinforcing the financial instruments for new start-ups and spin-offs and fostering the development of new digital competences. Overall, the latter has significant impacts on economic growth, quality of life, competition and regulation patterns, although these impacts vary according to a country's level of technological endowments. Indeed, in general, whenever a country has reached significant level of digitization, it has achieved significant social and economic benefits.

[25] McAfee (2014), *Net Losses: Estimating the Global Cost of Cybercrime*.
[26]Insurance Governance Leadership Network (2015), *Risk and opportunity in an increasingly digital world*
[27] European Commission (2017), *Germany: Industrie 4.0*

CHAPTER 3

TRADE PATTERNS IN THE DIGITAL AGE

3.1 Trade Costs

3.2 Trade Composition

3.3 Trade Direction

In the previous section the relation between technological improvements and economic activities has been assessed. The following section will explain in depth how digitalization is influencing patterns of trade in the global economy. It is widely acknowledged that technologies have transformed the economy, creating a new sphere of opportunities, modern business environments and means for expanding international trade. With internet being at the edge of this new era, economists and authors regularly refer to 'the Internet economy' while addressing the vital role of the internet in this new economy. The internet economy has consistently impacted international trade, allowing for a more integrated world economy from both geographical and regulatory points of view and for new opportunities as well as new challenges. The section opens with an analysis of the impact of technologies on the intrinsic factors affecting transportation costs, thereby assessing the changes in the composition and in the direction patterns of international trade.

3.1 Trade Costs

International trade is not only about economies' size and resource endowments of countries, but also about the issue of reducing the costs associated to the transportation of goods as well as to communication and information, since they constitute important determinants of productivity levels and trade patterns. As pointed out in the column 'Trade costs in the developing world: 1995-2010'[28], when examining late trade patterns, the importance of taking into account trade costs, intended as the group of factors affecting import and export prices, is driven by the fact that in this globalized world they count as the main determinants of bilateral trades, investments and geographical distribution of

[28] Jean-François Arvis, Yann Duval, Ben Shepherd, Chorthip Utoktham (2013), *Trade costs in the developing world: 1995-2010*

production. As already mentioned in the previous chapters, trade costs have been falling by significant amounts throughout the ages and they will fall even more with the help of digital technologies.

In order to examine how trade costs have been behaving throughout the years and changing their patterns with internet ease, it is necessary to understand what trade costs are about. A narrower view of the factors affecting trade costs would only include the outlays of goods between the ports of departure and arrival or the wedge between export and import prices. However, the reality is that trade costs are affected by a wide range of concerns, across the entire trade chain, that must be taken into account to realize a complete analysis of their patterns. Trade costs encompass two principal sources: the first ones are about those exogenous factors that are independent from any kind of decision and that, in general, capture the degree of separation across countries and they can be geographical distances, languages and borders. The second types of sources involve endogenous characteristics of trade patterns such as tariffs, barriers, logistic performances and connectivity levels.

1. Exogenous factors: geographical distances, languages, borders, common history.
2. Endogenous factors: bottlenecks, costs, delay, reliability, air/marine services, tariffs.

Jean-François Arvis, in its report, has analysed the relative impact of the previous factors on trade patterns and synthetized it in Exhibit 5: physical distance turned out to be the factor with the major impact on the amount of bilateral trade costs, followed by transport connectivity and logistic performance. In general, tariffs, restrictions and regulations play a fundamental role in moulding the costs patterns.

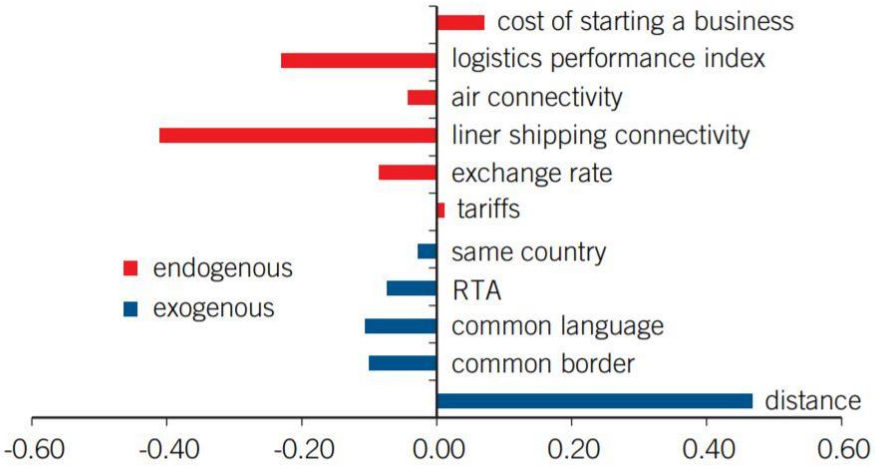


Exhibit 5: Impact of different sources on trade costs
Source: Arvis et al. (2013)

Other studies conducted in Eastern Countries by ESCAP found that endogenous factors between countries account for 21% of total trade costs, while tariffs are accountable for 2-3% of trade costs across countries. The remaining 76-78% of these costs included policy-related non-tariff barriers, such as maritime/air/land connectivity levels and services, national environment of both domestic and foreign partners, ICT services availability and direct costs of information across countries.

By utilizing data collection from both UNESCAP and the World Bank, encompassing trade flows data 178 countries between 1995 and 2010, , adapting the inverse form of the gravity model developed by Novy (2013)[29] to the analysis and thereby assessing the trade costs behaviours from the observed patterns of trade, Jean Francois Arvis averaged the results by income groups. Lower income countries exhibited the highest costs of trade with respect to the richest countries, as shown in Exhibit 6. Once this classification is given, it is easy to understand that developing countries face higher trade costs with respect to the developed world, since tariffs and other types of barriers are still substantially high and the dysfunctionality of logistic, infrastructural and transportation services doesn't allow for the exchange of big volumes of exports and imports.

[29] Dennis Novy (2013), *Gravity redux: measuring international trade costs with panel data*

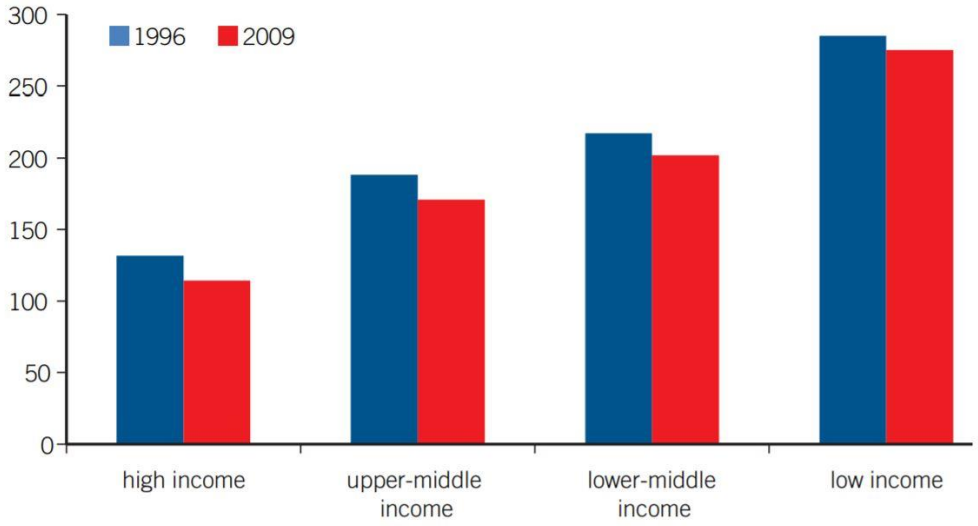


Exhibit 6: Trade costs by Income levels
Source: Arvis et Al (2013)

Moreover, converting the results to index numbers throughout the period 1996-2009, it is possible to get an overview on the dynamics of trade costs, making a distinction between income groups, shown by Exhibit 7. Trade costs have fallen quickly in higher income countries, while poorer countries did not experience such a decline. Exhibit 8, instead, shows how trade costs have been declining in the years between 1996 and 2014, distinguishing three directions of trade flows: trade among developed countries (North-North), which experienced a static reduction of costs of about 15%, trade among developing and developed countries (North-South), which followed a similar trend with respect to the patterns among developed countries and, finally, trade flows among developing countries (South-South) which have been the slowest to adapt to the reduction trends.

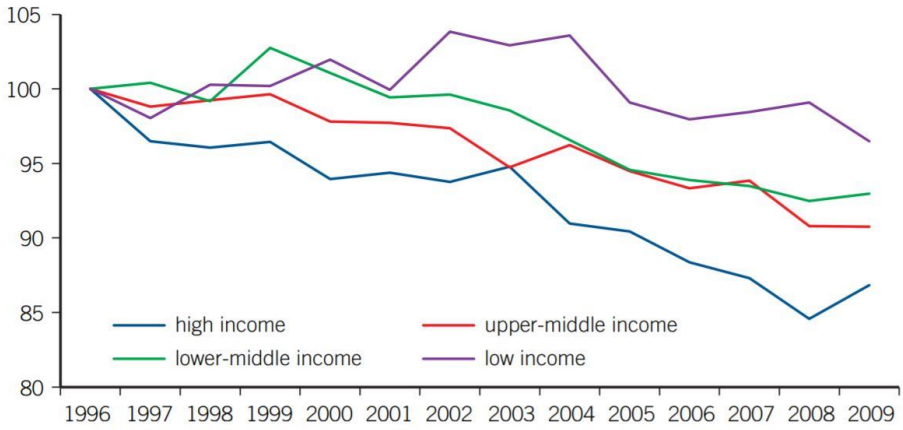


Exhibit 7: Trade costs dynamics by income groups 1996-2009
Source: Arvis et al. (2013)

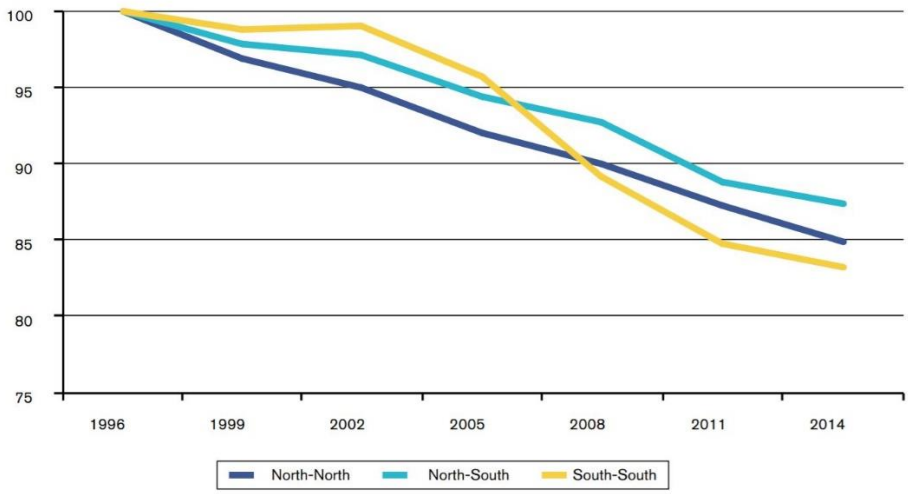


Exhibit 8: Overall Trade costs dynamics by directions 1996-2014
Source: WTO Report 2018

Whenever international trade costs are lower with respect to domestic ones, national economies tend to sell products on the international market, mainly to foreign consumers than to domestic ones. In the same way, if a country sells most of the products to domestic consumers than to foreign ones, it means that international trade costs are higher relative to domestic costs, keeping other factors constant. Hence, a deep understanding of trade costs' behaviour is necessary to design adequate policies to reduce those costs and facilitate trade. One of the main points brought to discussion during the Fifth Global Review on Aid for trade, held in 2015, is that it is necessary that countries and governments understand how much comprehensive trade costs are important to get to a sustainable development of the international economy and to measure the contribution of tariffs and other barriers to costs. In particular, developing economies shall take into account the results of the analysis in order to be able to reconstruct their regulation system and to have better chances of being integrated in the world economy. Thanks to the analysis conducted by Jean-François Arvis, Yann Duval, Ben Shepherd, and Chorthip Utoktham, policymakers are able to derive insights on trade costs that they will need to better address policy matters, especially since it has been the first time in which the inverse gravity approach has been conducted considering a great number of emerging countries. It is believed that reduction in cost of trade is significantly affected by non-tariffs barriers other than tariffs since the costs related to other types of barriers are significantly higher than the ones related to tariffs, as

highlighted in a study by Anderson and Van Wincoop[30]. Taking into account those intrinsic factors affecting trade costs, we can now establish their relation with digitalization together with their improvements throughout this era.

1. Information costs: the birth and expansion of internet significantly improved information and communication schemes, thereby allowing for a reduction in information costs: internet gives better and wider access to information for both potential buyers and sellers, making them gain substantial advantages. Moreover, the aggregation of useful data and the practicability of new models of 'open data' put in place by several industries, bring to consistent reductions in information costs. For example, in the healthcare industry, the 'digital sanity' makes up the frame of a new architecture in which both quality of the services and management of costs are improved (Accenture, 2014)[31].

2. Fixed costs: internet enables markets to reduce fixed costs of production: thanks to new tools such as Big Data and the Internet of Things, together with adequate software, computers and IT management, firms are now capable of improving their routine processes by automotive systems and data-intensive production processes. The advanced usage of capital and labor is now adapted to the additional information provided by technologies and it has certainly helped the entire company in becoming more productive. If we simply focus on 'smart working', a new managerial philosophy based on the concept of flexibility and autonomy for the entire workforce, we can notice that it brings benefits for both workers, since they can easily increase the quality of their lifestyle and decrease transportation costs, as well as for companies, since the costs of work places are reduced and there is more commitment and motivation across the departments. Cloud Computing and the Internet of Things have deeply impacted the so called 'Operation Management': they both help in recognizing where there are errors of the systems and other fallacies in a company, thereby allowing for a prompt intervention and for better forecasts in general. IoT is

[30] James E. Anderson; Eric van Wincoop (2004), *Trade Costs*
[31] Accenture (2014), *Looking Forward: La Trasformazione Digitale*

a powerful tool to face the most recent needs for rapidity, efficiency and mobility, characteristics that must be taken into account for whatever productive process.

3. Variable costs: variable costs connected to online transactions must be considered as well (e-commerce costs). In this new context, digital firms need to be carefully considered as they help reducing the cost of trade by allowing big companies in integrating value chains, avoiding intermediaries when establishing trade connections, increasing the efficiency of their managerial activities, decreasing inventory costs, connecting buyers and sellers directly, thereby lowering the costs of coordination (McAfee and Brynjolfsson 2017)[32]. Many online platforms are also involved in delivery services and payment services that further decrease the costs that incumbent firms need to bear if they want to continue their business. Perhaps, traditional companies are increasingly investing in new technologies as they need to improve their productivity levels and adapt their existing business models to new environments.

A significant decline in trade costs, together with regional and bilateral trade agreements, allowed for a massive growth of trade and subsequent high productivity: global trade flows have been growing by significant amounts since 1970, reaching more than twice the economic growth in the same period and improving wealth and lifestyle in the majority of the countries. Overall, all the new digital technologies, like platforms, Big Data, Blockchain, and the Internet of Things, will continue to reduce transaction and logistics costs, thereby improving and boosting trade (World Trade Organization, 2018)[33].

3.2 Trade Composition

''Flows of physical goods and finance were the hallmarks of the 20th-century global economy, but today those flows have flattened or declined. Twenty-first-century globalization is increasingly defined by flows of data and information'' (McKinsey Institute, 2016)[34].

[32] Andrew McAfee & Erik Bryonjolfsson (2017), *Machine, Platform, Crowd: Harnessing our Digital Future*.
[33] World Trade Organization (2018), *World Trade Report*
[34] McKinsey Global Institute (2016), *Digital Globalization, The New Era of Global Flows,* McKinsey & Company

Other than size, international flows have been changing their composition over the past five decades.

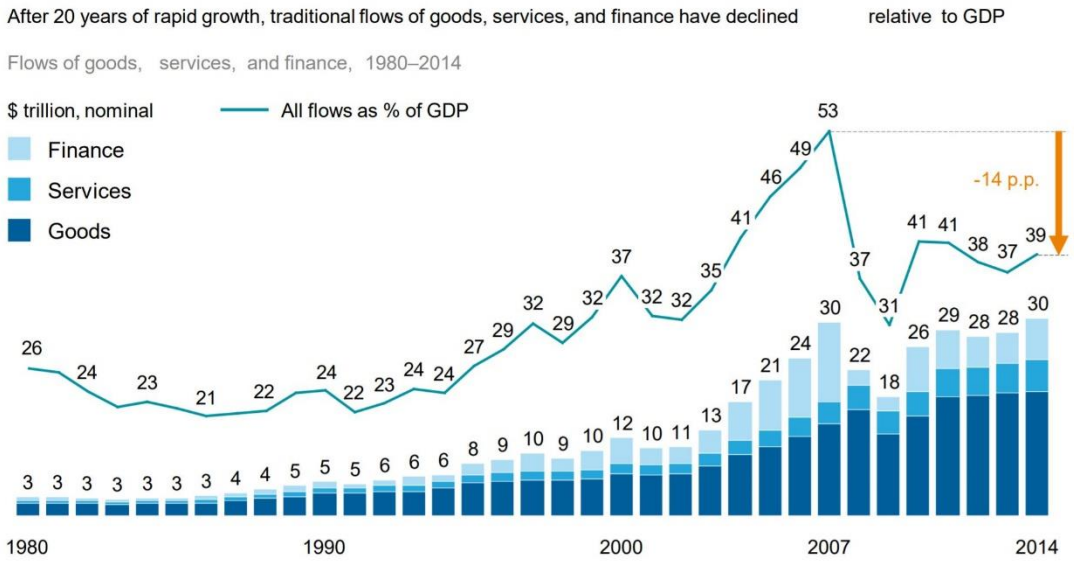


Exhibit 9: Trade in goods, services and finance patterns 1985-2014
Source: McKinsey Global Institute

The Digital Revolution is changing every type of global flows, from goods and services to money and people, changing the overall patterns of trade: once trade was dominated mainly by physical flows (raw materials, agricultural products, steel) and it was mainly between big national economies and big companies. Now, trade flows are composed by large amounts of data and services and more participants are involved in the transactions. As it can be observed in Exhibit 9, from 1985 to 2005, countries have experienced a steady growth in trade and good flows (considering finished goods, inputs and commodities) hit the 26.6% of the overall GDP in 2007. At the same time, also services and financial flows accounted, together with goods, for a high portion of GDP (53%). However, after decades of significant growth, goods flows have taken a sharp tumble, financial trade has fallen and services have underexperienced modest declines.

The decline in traded goods is what mostly determines the jump from the second globalization to the digital revolution: in the decades before the Great Recession, big multinationals used to invest in new basis for production and expansion of their value chain: this allowed goods trade to substantially increase from 13,8% of the GDP in 1986 to 26,6% in 2007. Then, after a short decline, goods flows began to increase again, more slowly. Structural changes, new factor costs and the advent of new technologies such as 3D painting

are the main causes of this decline. Moreover, almost 12% of goods flows is now taking place online, as more and more people are involved in cross-border delivery of digital goods. The increasing usage of AI and other additive manufacturing could collectively reduce global goods trade by up to 10% by 2030 or $4 trillion in annual trade flows (McKinsey Global Institute, 2019). Roughly the same path was followed by financial flows (foreign direct investments, purchases of bonds, equity) which, after a notable growth from 4.1% of total GDP in 1980 to 20.7% in 2007, declined by about four thirds of their previous size, mainly because of falls in foreign lending.

Trade in services account for a much smaller part of global flows, but it is obtaining a powerful role in the composition of flows: in the past, it accounted for the journeys of expert people to reach the needs, while now all services such as technical support, financial services, advertising and many more can be exchanged via the internet, through simple clicks. Companies such as Netflix and Spotify are gaining so much power with their subscription and online business models that the shift from goods trade to flows of services is considered to be only at its ease. It is sufficient to see that more than 40% of the revenues from recorded music comes from streaming. (McKinsey Global Institute, 2019)[35].

Even if traditional flows still account for a considerable part of global trade, the 21st century is characterized by a great amount of data flows and digital trade, which consists of communications, videos, transactions and any kind of information and which increases day by day by enormous volumes. Digital trade is not just about the continuous exchange of ideas and information, but it also sustains those traditional flows that have been declined throughout the past years, such as goods, services, finance and people. As McKinsey cites, ''*virtually every type of cross-border transaction now has a digital component*''. As digitalization expands, both companies and users become more international: more and more people are signing up to social media to keep connections with international friends and online platforms allow businesses to have connections with customers all around the world. Moreover, cross border bandwidth is growing at an annual rate of 53% and this is encouraged by the increasing creation of extensive global cables. Emerging countries are

[35] McKinsey Global Institute (2019), *Next generation technologies and the future of trade*

integrated more than ever: in 2005, only 75 countries used to exchange more than one gigabyte per second, in 2014 that figure is increased to 164 (Exhibit 10).

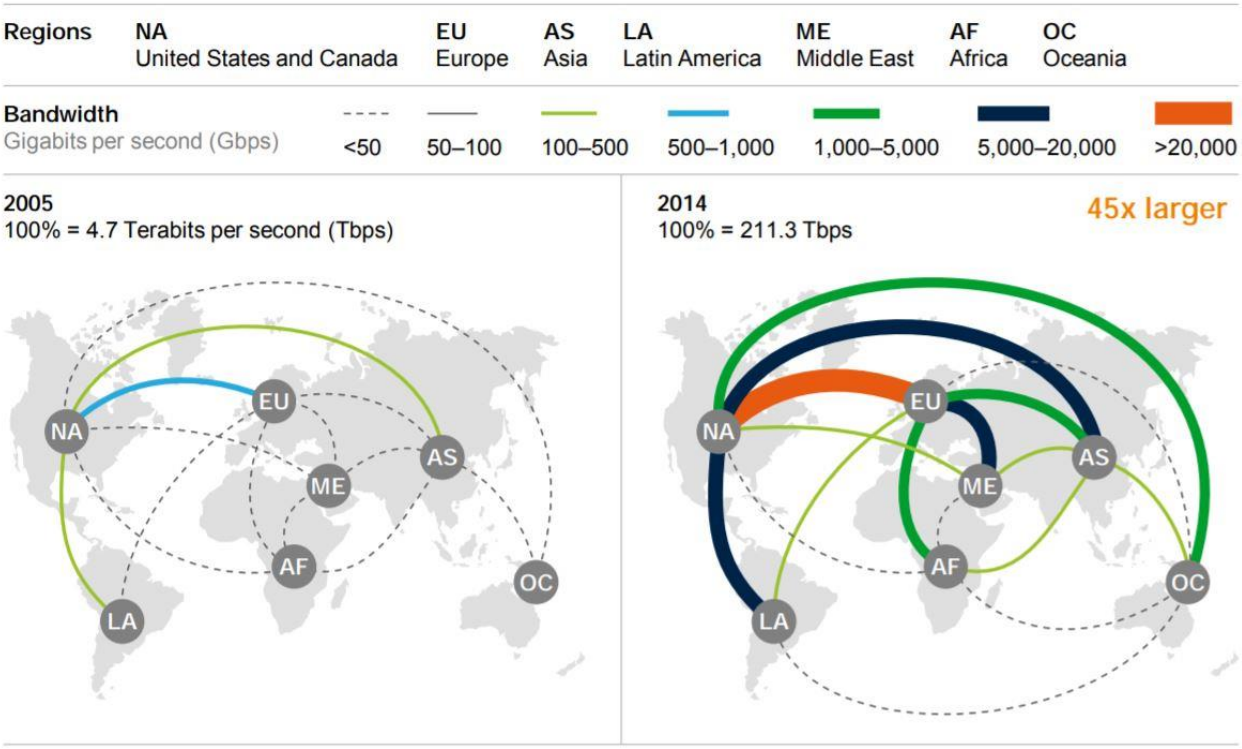


Exhibit 10: cross-border Data Flows across countries

Source: McKinsey Global Institute (2016)

Data flows are expected to increase furthermore at a high speed, not only because of the big volume of videos, social media and emails traffic, but mainly because of the wide range of firms that are understanding the advantages that internet may bring.

3.3 Trade Direction

If we consider the predominant patterns of trade before digitization began, we can observe that the United States were the largest and most powerful economy and, together with Western Europe, they accounted for most of the world production of manufactured products such as vehicles as well as of more technology intensive products such as electronics. In particular, both Western Europe and USA used to export manufactured materials to less developed countries (North-South direction) and the latter used to export

back mainly raw materials and agricultural products (Globalization101, 2015)[36]. After the war, Europe and Japan sent conspicuous recoveries to the most devastated countries and this allowed for both the revitalization of those countries and for large opportunities for the United States, that could export greater amounts and invest in more projects: American prosperity rose as a result from new commercial and financial opportunities. As already mentioned in the previous chapter, technological developments, together with recoveries, enabled developing countries to become important industrial powers and to be involved in the international economy, in particular in international trade patterns, making trade agreements with the most developed countries change as well. In 1990, only 72 countries had the majority of the GDP composition accountable for goods, services and financial flows, while in 2014, 121 countries reached that position (McKinsey Global Institute, 2016). Nowadays, thanks to digital wrappers, developing countries may develop trade patterns more rapidly than before, even though they still have primitive groundworks.

As it can be observed in the last paragraph, the rising flows of data and commerce are varying the level of connectedness across countries, regions and cities. The connectedness index provided by McKinsey Global Institute in their most recent topic-related report[12] shows that ''*for the first time in history, emerging economies are counterparts on more than half of global trade flows, and South-South trade among these countries is the fastest-growing type of connection*''. Exhibit 11 shows that emerging countries are gaining a significant share of total goods trade and how fast South-South trade flows are growing with respect to the other directions. According to the Global Development Institute[37], trade amongst emerging economies more than doubled reaching a fair 25,3% of world trade in 2015, from a mere 11,4% in 1995. However, even if Singapore, China and Korea are among the first twenty countries by participation by flows, advanced economies remain more connected than developing countries.

[36] Globalization101 (2015), *The Changing Composition of Trade*
[37] Global Development Institute (2017), The rise of South-South Trade: Polycentric Patterns

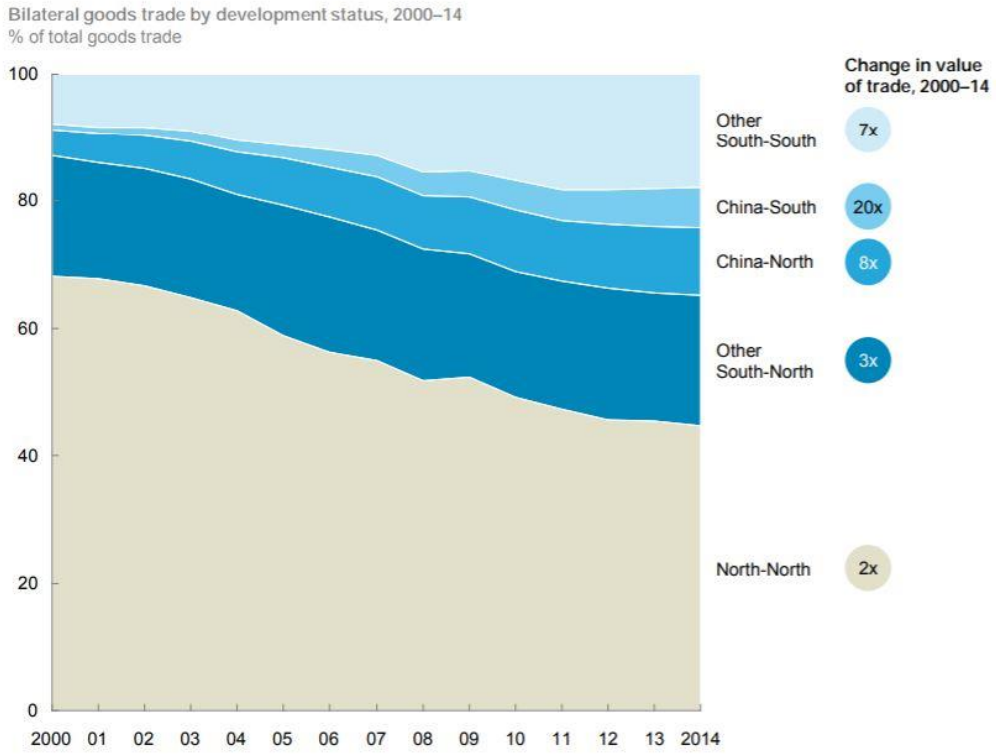


Exhibit 11: Trade directions 2000-2014
Source: McKinsey Global Institute

Global connectedness can also be addressed from the point of view of cities, regions and trading blocs. Again, according to McKinsey Global Institute, emerging economies can exploit several opportunities by increasing interregional trade, thereby capturing the benefits of competition, scales and specialization.

While North-South oriented trade flows characterized the 20th century, the new patterns involve different endpoints: intra-regional trade has risen and it stands for the existence of multiple production network at both domestic and regional level. New corridors, linking emerging and fast-growing economies, are at the delta of the creation and expansion of global value chains: value chains are not only global, national economies are becoming more and more interdependent, as companies of big and small sizes try to boost the quality and variety of intermediate inputs and of primary commodities (McKinsey 2014)[38]. For example, Apple manufacturing processes involve high degrees of intermediate and commodities exchange within emerging countries in Asia, where there is a great concentration of final

[38] McKinsey Global Institute (2014), *Insights into the dynamics of new trade flows*

demand for those products. In general, as production moves closer to consumers, developing countries are better off. Overall, these new technologies are leading to nearshoring and regionalization, creating a more 'polycentric' trade pattern as shown in Exhibit 12, rather than continuing with the reshoring in advancing economies. Policymakers and governments are taking into account this shift towards regional corridors and they're helping industries in redirecting their supply chain consistently with regulation frameworks.

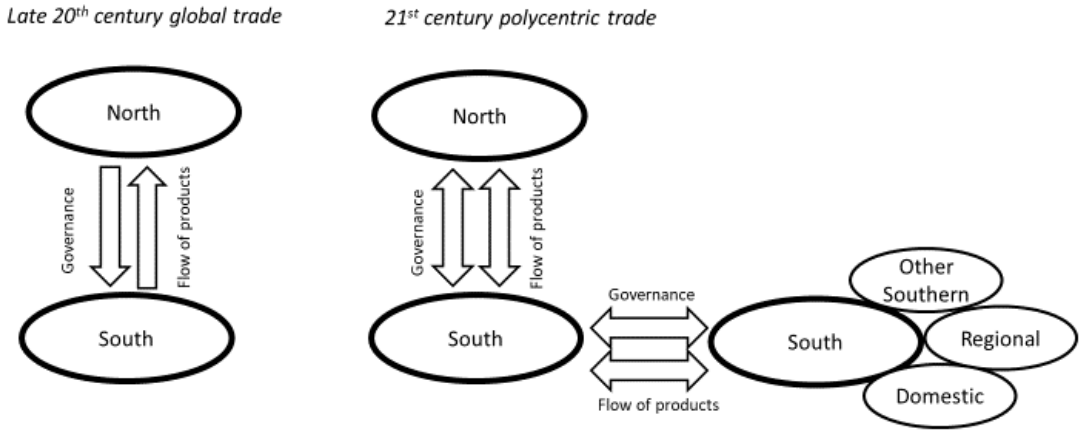


Exhibit 12: 21st century Polycentric Trade patterns

Source: Global Development Institute (2017)

Overall, technologies have meaningful impact on trade patterns, in terms of the costs involved in the transactions, the substance of trade flows and the countries involved in the corridors. Understanding the specific changes and compliances that may rise from this influence is of crucial importance in a forward-looking analysis.

CHAPTER 4

GVCs (Global Value Chains) AND DIGITALIZATION

4.1 GVCs

4.2 Value Added in Gross Exports and Digitalization

As explained in the last chapter, the increasing availability of digital technologies is consistently affecting the way trade patterns are evolving and, in particular, it is creating the so-called Global Value Chains (GVCs), in which different countries from different regions add value to the production processes until the stage of final consumption. In the following section, together with a brief introduction regarding the increasing strategic importance of global value chains, a regression analysis will be conducted in order to get deeper insights on the concrete effects of potential drivers on both domestic value-added and foreign value-added of gross exports. Other than traditional drivers, the digital intensity indexes will be added to the analysis to assess to what extent technologies are relevant to define those constraints.

4.1 GVCs

Global Value Chains are now expanding everywhere. As mentioned in the first chapter, the second great unbundling drawn by Baldwin[39] is of extreme importance in the understanding of the latest patterns and corridors of trade, as it involves the explication of the fragmentation of the linear production processes that characterized the previous revolution. Even though primitive Global Value Chains existed before the advent of the internet, the latter allowed for further disaggregation and outsourcing to foreign suppliers and for a wider participation from countries all around the world. In the last two decades, the birth of Global Value Chains has been one of the most important changes in the framework of international trade: by themselves, Global Value Chains, being the set of activities, people, countries and transactions involved in the production process of a good, represent the clue of the impact

[39] Richard Baldwin (2006), *Globalisation: The Great Unbundling(s)*, Economic Council of Finland

of digital technologies on international economy, that we have analysed in the previous chapters of this report.

The increasing presence of Global Value Chains, involving more complex production patterns, requires a different approach when assessing the analysis in international trade: exports-based measures are not enough to guarantee a full compliance with what the real transactions involve, as they do not explicitly tell about the different stages that they come across and they do not take into account foreign intermediates. As the OECD points out in its report 'Interconnected economies: Benefitting from Global Value Chains'[40], Global Value Chains are becoming so composite that sometimes the value originated in a country is returned to the same country through later imports. That's why, when we talk about Global Value Chains, we need to focus on the measures of the value added involved in these new global transactions, that allow to better describe the final result of all the complex linkages among firms and countries. For example, the Domestic Value Added (**DVAiX**) of a country's gross export, being the extent of Foreign Value-Added embodied in domestic goods that are exported, is a fundamental measure of both the gains from trade and the level of competitiveness of a country. Moreover, according to Josè Caraballo and Xiao Jiang, Domestic Value Added for exports levels is fundamental to assess the development policies to be implemented (Caraballo & Jiang, 2016)[41]. In particular, the WTO, in the 'WTO "Trade in Value-Added and Global Value Chains" explanatory notes, has distinguished the components of Domestic Value Added of Exports (WTO,2018)[42].

1. 'Domestic value added sent to consumer economy' represents the domestic value added of final products or intermediates (goods and services) that is consumed in the importing economy.

2. 'Domestic value added sent to third economies' corresponds to a part of the domestic value added of exported intermediate goods and services, that are sent to partner economies. The latter tend to re-export those products to third parties in the form of other products. As the WTO underlines, this second component is a perfect example for the increasing complexness of the Global Value Chains.

[40] OECD (2013), *Interconnected economies: Benefitting from Global Value*
[41] Josè Caraballo and Xiao Jiang (2016), *Value-Added Erosion in Global Value Chains: An Empirical Assessment*
[42] WTO (2018), *"Trade in Value-Added and Global Value Chains" profiles*

3. ‘Domestic value added re-imported in the economy’ is related to the domestic value added embodied in either final goods or intermediate inputs that is returned to the original economy in the form of other intermediates andthat are re-used to produce exports.

The dynamics in which the previous components are involved are shown in Exhibit 13.

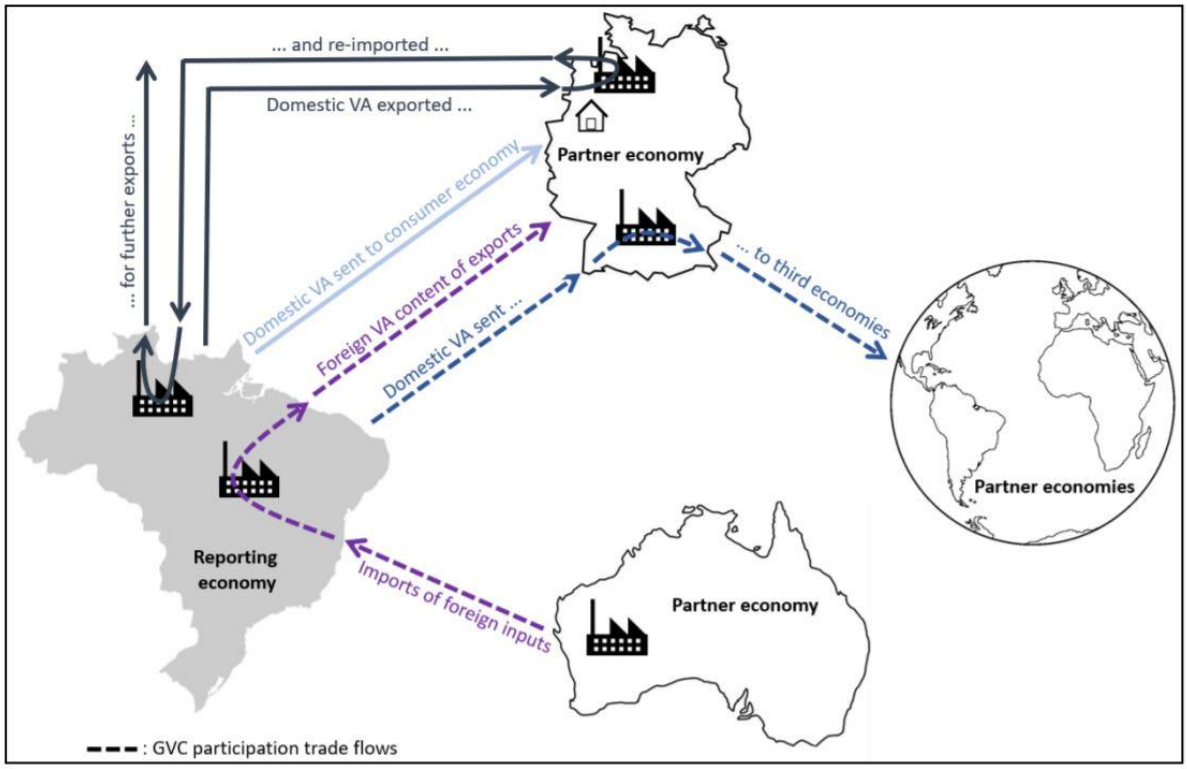


Exhibit 13: Value Components of Trade Flows

Source: WTO

Also, Foreign Value-Added for share of Gross Export (**FVAiX**), the value added of inputs that were imported from foreign countries and devoted to the production of final goods, is a meaningful variable to be included in the model and it is typically used as a simple indicator of participation in GVCs (Johnson and Noguera, 2013)[43].

However, even if Global Value Chains clearly promote investments and benefits from trade, their impact on the value added is less clear (Kummritz, 2015)[44]. Even if a positive and

[43] Robert C. Johnson and Guillermo Noguera (2014), *A Portrait of Trade in Value-Added over Four Decades*
[44] Victor Kummritz (2015), And yet it moves – Why GVCs benefit the domestic economy

consistent correlation between domestic value added and the increasing participation of countries in these new global corridors is already verified, making the studies conducted by Li and Liu in 2014 hold, the differences between richer and poorer countries need to be taken into account in order to have a complete overview. Some authors have attempted to conduct analysis on the basis of a new perspective: the OECD itself, together with WTO, has helped in defining the role of trade patterns in the birth and expansion of Global Value Chain as well as the degree of additional value that they may bring to the country. From this analysis, it emerged that the economies with very high levels of value added to gross exports tended to be very large economies or important exporters of natural resources, such as Australia and Norway. On the other hand, the ones with very low levels of value added were little economies such as Luxembourg or Iceland or nations characterized by deep involvement in global value chains (OECD, 2013)[45]. It was also verified that the share of foreign intermediates increased by a consistent amount throughout the years.

4.2 Value added in Gross Exports and Digitalization

Most of the papers addressing the topic use Foreign Direct Investments, skills and wage levels as independent variables for the determination of both Domestic and Foreign Value-Added trends, rather than the impact of digital advances. In order to be consistent with the reasoning behind the previous chapters, the following analysis, with an econometric model, will therefore be conducted with Domestic Value Added and Foreign Value Added embodied in Gross Exports, as the dependent variables, and the significance of digital indexes, such as ICT usage, ICT used by businesses and the amount of broadband subscriptions, will be tested on its basis.

In this subsection, we use the Organization for Economic Co-Operation and Development (OECD)[46] dataset as the main source from which to extract the data needed. The correlations and the linear regressions are derived on the basis of the following functions:

[45] OECD (2013), *Interconnected economies: Benefitting from Global Value*
[46] OECD LIBRARY

$$LnDVAiX_{ij} = c_i + +\theta_i LnICTB_j + \varepsilon_{ij}$$

$$LnDVAiX_{ij} = c_i + \vartheta_i LnBSub_j + \varepsilon_{ij}$$

$$LnDVAiX_{ij} = c_i + \varphi_i LnInternet_j + \varepsilon_{ij}$$

$$LnFVAiX_{ij} = c_i + \theta_i LnICTB_j + \varepsilon_{ij}$$

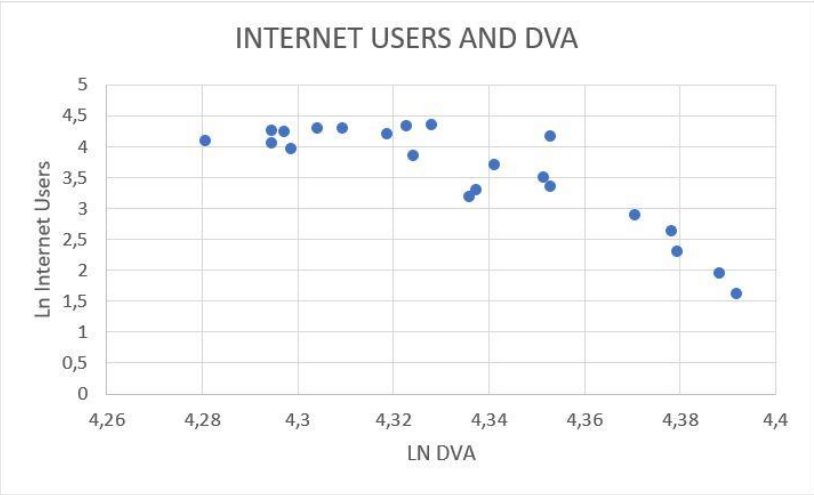
$$LnFVAiX_{ij} = c_i + \vartheta_i LnBSub_j + \varepsilon_{ij}$$

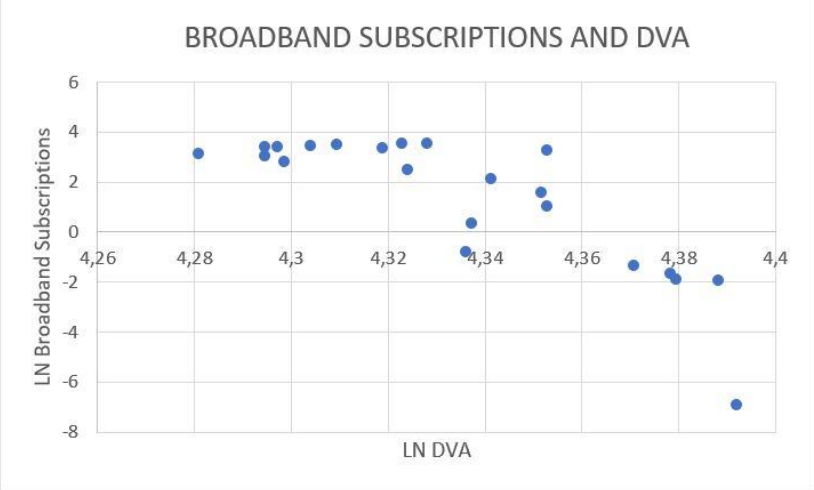
$$LnFVAiX_{ij} = c_i + \varphi_i LnInternet_j + \varepsilon_{ij}$$

The unit of measurement is $LnDVAiX_{ij}$, the Domestic Value-Added Share of Gross Exports, as a measurement of GVCs involvement. On the other hand, also $LnFVAiX_{ij}$ **,** the Foreign Value-Added Share of Gross Exports, is included in a second group of correlations as the dependent variable. Since relative values are needed, logarithm for the dependent variables was used to assess the analysis. To estimate the trends in the measure, the focus is given to the European Union countries and the data was collected for the period from 1995 to 2016. The two dependent variables are put in correlation with three digital-related ones.

The first variable measured is $\gamma_i LnICTB_J$, which measures the percentage of people that use ICT in Europe. A relative increase in ICT usage is likely to increase the possibility for both individuals and firms to be involved in the commercial activities on a global scale and this should affect the global value chain. The second independent variable included in the model is $\vartheta_i LnBSub_j$, which measures the percentage of broadband subscription throughout the period, a significant variable in the telecommunication sector and which is now a key economic indicator. Finally, the last variable tested is represented by the number of internet users throughout the identified period: $\varphi_i LnInternet_j$. Finally, we need to include ε_{ij} as an error term which is independent and identically distributed.

When the correlations among the dependent variable and the digital-related ones are tested one by one, we can notice that $LnDVAiX_{ij}$ is moderately negatively correlated with all the three variables $\theta_i LnICTB_j$, $\vartheta_i LnBSub_j$ and $\varphi_i LnInternet_j$, as shown by the dispersion diagrams in Exhibit 14**.**





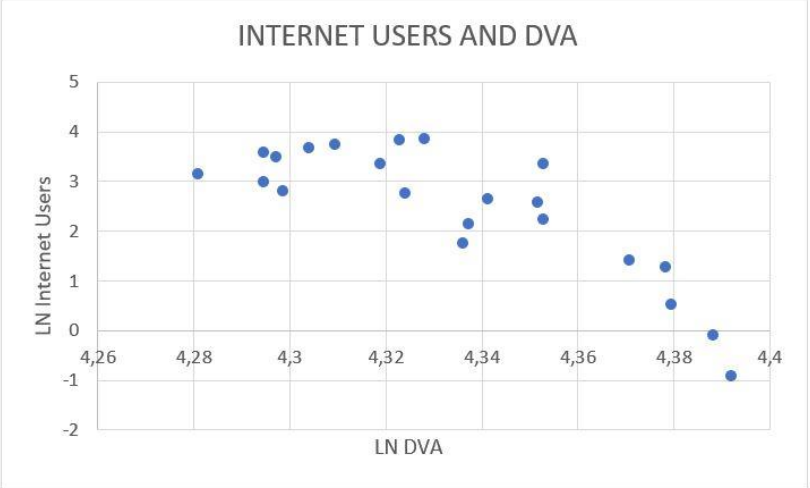


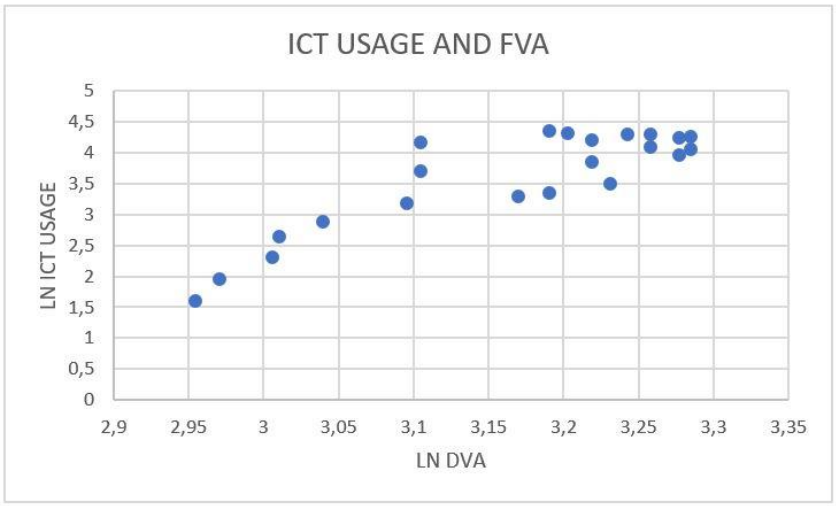
Exhibit 14 A, B, C: Correlation between ICT usage, Broadband Subscriptions, Internet Users and Domestic Value Added of Gross Exports, European Union, 1995-2016

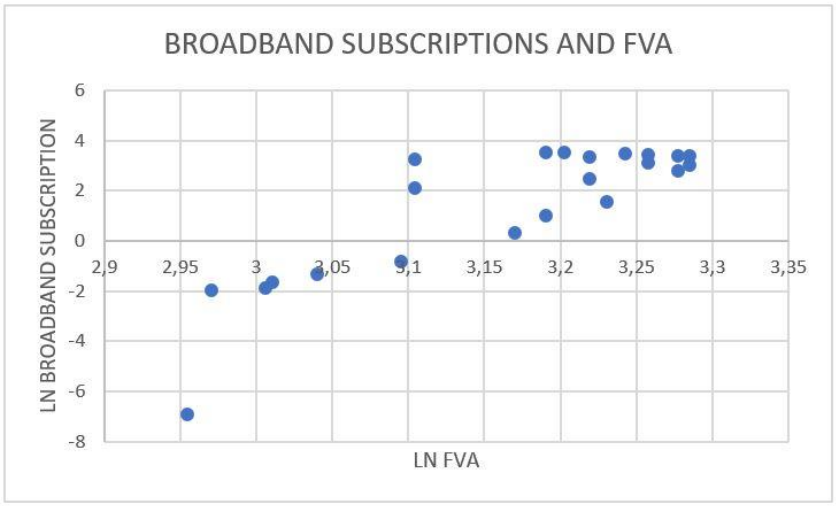
In all the three dispersion diagrams, strong correlations, even not being linear relationships, can be noticed: as the value of all the three independent variables in Europe increase, the share of the domestic value added of gross exports tend to decrease.

As Josè Caraballo and Xiao Jiang have pointed out through their analysis, the higher inclusion of foreign countries to the stages of production, together with increasing import of intermediates from abroad and the increasing global production fragmentation, is eroding the domestic value power in exports: more than 87% of the countries taken into consideration for the sample of their study showed decreasing domestic value added between 1995 and 2008 (Caraballo & Jiang, 2016)[47]. Other than the advances in digital technologies, also the availability of foreign high skilled labours and the possibility of asking for help abroad could be involved in this decreasing pattern, since the majority of the countries rely less on their own inputs and domestic intermediates for the production process.

However, these relations do not hold for all the countries: Hiau Looi Kee and Heiwai Tang, in their report 'Domestic Value Added in Exports: Theory and Firm Evidence from China', state that China is an 'intriguing exception': its domestic value added of exports has increased throughout the last decade, probably as a consequence of the increasing domestic production costs, which have lowered the overall competitiveness levels, or for the fact that China is shifting to industries with high domestic content needed (Looi Kee & Tang, 2015)[48]. However, if we test the correlation among the independent variable $\boldsymbol{LnFVAiX_{ij}}$ and the digital-related ones in European Union countries, we may notice strong positive correlations (Exhibit 15 A, B, C). With respect to the analysis conducted on the Domestic Value added, the correlations between Foreign Value Added of Gross Exports and the variables $\boldsymbol{\theta_i LnICTB_j}$, $\boldsymbol{\vartheta_i LnBSub_j}$ and $\boldsymbol{\varphi_i LnInternet_j}$, are positive ones, which means that with higher levels of ICT usage by companies and individuals, subscription to wide band connections and internet users, the foreign value added share of gross exports increases, as more and more countries tend to be involved in the production processes of external economies.

[47] Josè Caraballo and Xiao Jiang (2016), *Value-Added Erosion in Global Value Chains: An Empirical Assessment*
[48] Hiau Looi Kee and Heiwai (2015), *Domestic Value Added in Exports: Theory and Firm Evidence from China*





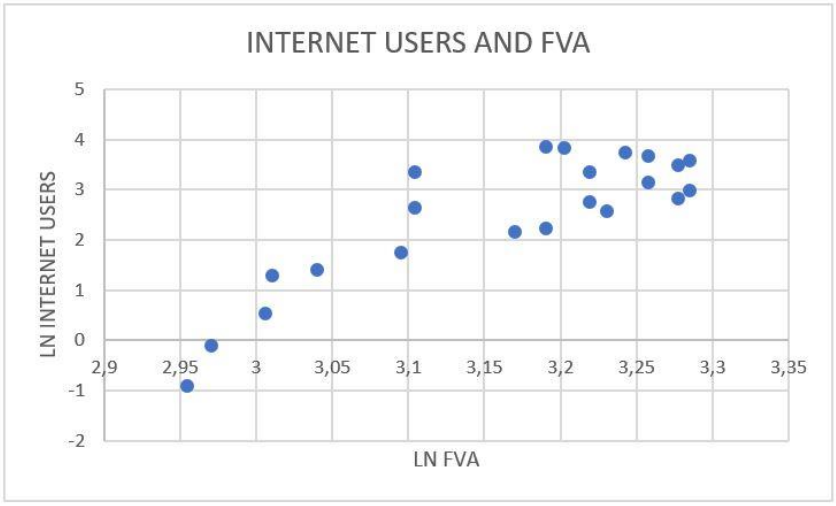


Exhibit 15: Correlations between ICT usage, Broadband Subscriptions, Internet Users and Foreign Value Added of Gross Exports, European Union, 1995-2016

The positive and consistent correlations among these variables are confirmed by the very low P-Values resulted by the linear regressions conducted between the dependent variables and the single digital-related ones. The rise of Global Value Chains has dramatically changed the way production processes are conducted, as well as investment, trade and labour markets. Relationships among countries have changed significantly, leading institutions to be more involved in monetary policy decisions. As a result, a correct understanding of the latest dynamics of Global Value Chains is fundamental to predict future changes and to address macroeconomic developments.

CONCLUSIONS

The world trading frame has been significantly reshaped by technologies: not only trading costs, such as logistics and information costs, have been significantly reduced throughout the last decades, but also patterns of competitive advantage and social frameworks have been affected by this revolution. The report has analysed these changes throughout the last decades. Indeed, the understanding of those past patterns is fundamental to catch the future opportunities and to address the following potential challenges driven by technological improvements. From enhancing business models to improving the way payments are conducted, governments and institutions are realising that data and digital tools are becoming valuable commodities in the overall economy and that more regulations are needed to keep in line with the continuous shifts. For example, the EU General Data Protection Regulation (GDPRA), designed to protect and empower citizens for their data privacy, is one of the most valuable steps in data privacy in the last twenty years. However, also geopolitical factors will continue to affect and challenge trade patterns: from the US-China trade war to the UK's Brexit, the main variables affecting trade will go through substantial changes in the years to come.

According to the World Trade Organization (WTO), digital technologies will have a much more consistent effect on the ways business and commercial exchanges are conducted in the years to come: by 2030, the increasing inclusion of digitalization in the international economy will add benefits to cross-border trade growth by 34 percentage points, it will increase the share of services trade from 21% to 25% and will be able to cut the current trade finance gap. In particular, it is believed that Blockchain will represent the key variable for developments in tracking of goods and financing transactions, thanks to its high security levels and big volume capacity. The most of these changes will open up to new opportunities and challenges for both companies and emerging countries: in particular, those benefits will reach Small-Medium Size companies, whereas they are able to conduct their business in line with the latest digital trends.

Overall, companies need to take advantages of the wide range of opportunities that technologies are bringing and institutions are needed for the construction of a better environment in which to make those opportunities flourish.

BIBLIOGRAPHY

- World Trade Organization (2019) *World Trade Report: The future of world trade: How digital technologies are transforming global commerce.*
- John Maynard Keynes (1920), *The Economic Consequences of the Peace.*
- Findlay & O'Rourke (2007), *Power and Plenty, Princeton University Press.*
- O'Rourke (2002), *Europe and the Causes of Globalization.*
- Jacks et al. (2011)*, Trade Booms, Trade Busts, and Trade Costs.*
- Marco Moroni (2017), *Prima e seconda globalizzazione: effetti, reazioni, prospettive.*
- Richard Baldwin (2006)*, Globalisation: The Great Unbundling(s), Economic Council of Finland.*
- Arvind Subramanian & Martin Kessler (2013), *The Hyperglobalization of Trade and Its Future.*
- Jeffrey D. Sachs (2000*), Globalization and Patterns of Economic Development.*
- Gurdeep Singh Hura (1998), *The Internet: global information superhighway for the future.*
- World Economic Forum (2016*), Mastering the Fourth Industrial Revolution.*
- Andrew McAfee & Erik Bryonjolfsson (2014)*, The Second Machine Age.*
- Brian Kahin (2016)*, Digitization and the Digital Economy.*
- Raul Katz & Ferdinando Callorda (2018), *The economic contribution of broadband, digitization and ICT regulation, ITU Publication.*
- European Commission (2013), *Unlocking the ICT growth potential in Europe: Enabling people and businesses.*
- Susan Lund and James Manyika (2016), *How digital trade is tranforming Globalisation.*

- Shushanik Papanyan (2015*), Digitization and Productivity: Where is the Growth?*
- World Bank Group (2016)*, World Development Report: Digital Dividend.*
- Marcel Timmer, Bart Los, Robert Stehrer, Gaaitzen De Vries (2013*), Rethinking competitiveness: The global value chain revolution.*
- McAfee (2014), *Net Losses: Estimating the Global Cost of Cybercrime.*
- Insurance Governance Leadership Network (2015), *Risk and opportunity in an increasingly digital world*
- European Commission (2017), *Germany: Industrie 4.0.*
- Jean-François Arvis, Yann Duval, Ben Shepherd, Chorthip Utoktham (2013)*, Trade costs in the developing world: 1995-2010.*
- Dennis Novy (2013), *Gravity redux: measuring international trade costs with panel data.*
- James E. Anderson; Eric van Wincoop (2004), *Trade Costs*
- Accenture (2014)*, Looking Forward: La Trasformazione Digitale*
- Andrew McAfee & Erik Bryonjolfsson (2017), *Machine, Platform, Crowd: Harnessing our Digital Future.*
- McKinsey Global Institute (2016), *Digital Globalization, The New Era of Global Flows, McKinsey & Company.*
- McKinsey Global Institute (2019)*, Next generation technologies and the future of trade.*
- Globalization101 (2015), *The Changing Composition of Trade.*
- Global Development Institute (2017), *The rise of South-South Trade: Polycentric Patterns.*
- McKinsey Global Institute (2014), *Insights into the dynamics of new trade flows.*
- *OECD (2013), Interconnected economies: Benefitting from Global Value*.
- Josè Caraballo and Xiao Jiang (2016), *Value-Added Erosion in Global Value Chains: An Empirical Assessment.*

- *WTO (2018),"Trade in Value-Added and Global Value Chains" profiles.*
- Robert C. Johnson and Guillermo Noguera (2014), *A Portrait of Trade in Value-Added over Four Decades.*
- Victor Kummritz (2015), *And yet it moves – Why GVCs benefit the domestic economy.*
- Hiau Looi Kee and Heiwai (2015*), Domestic Value Added in Exports: Theory and Firm Evidence from China.*