UNIVERSIDADE CATÓLICA PORTUGUESA

Work in the European Union in 2030

Policy Recommendations for an Automated Future

por

Felisberto Sequeira Pereira

Católica Porto Business School

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Policy Recommendations for an Automated Future

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Resumo

O trabalho é uma atividade humana fundamental cuja distribuição está constantemente a mudar. Foi sempre assim no passado, e de forma mais intensa desde as primeiras revoluções industriais. Hoje, com a quarta revolução industrial e o ritmo da inovação tecnológica, testemunhamos uma reformulação radical da forma como o trabalho será distribuído. Neste contexto, o objetivo principal desta tese é investigar qual vai ser a estrutura do emprego na União Europeia em 2030 e, quais as medidas que devem ser implementadas para preparar esta transição. A tese mostra que nos próximos 10 anos, 15% a 25% dos empregos que hoje existem vão ser perdidos para a automação, sendo que, apenas num cenário otimista existe a hipótese de que os novos empregos consigam na totalidade compensar esta perda. Fica também demonstrado que em 2030 a União Europeia terá uma população mais envelhecida e mais dependente da classe trabalhadora do que aquilo que tem hoje. Por outro lado, o nível de educação na União Europeia é um dos melhores do mundo, o que pode ser crucial, uma vez que todos os indicadores apontam os empregos com mais qualificações como os mais necessários no futuro, sendo este um fator importante para entender quão preparados estamos para enfrentar as mudanças que terão lugar até 2030. Tendo em conta todos estes aspetos, esta tese propõe um conjunto de políticas públicas e de políticas de gestão. São necessárias políticas públicas de modo a garantir que as condições de vida da população melhorem em vez de se degradar. Em termos de políticas publicas, são abordadas medidas que dizem respeito à educação, proteção social, criação de emprego e impostos, tais como a aprendizagem ao longo da vida, o Rendimento Básico Incondicional ou um imposto negativo sobre o rendimento. No que toca às políticas de gestão, a tese argumenta que são precisas medidas que visem a gestão de talento, outsourcing e investimento, para que as empresas possam ser competitivas neste novo contexto. Flexibilização do trabalho, ligação a universidades e estratégias para investimento em automação são algumas das medidas abordadas.

Palavras Chave: Automação; Emprego; Políticas Públicas e Políticas de Gestão; População; Redistribuição do Trabalho.

Abstract

Work is a fundamental human activity which constantly undergoes change in terms of how it is distributed. This was always the case in the past, and with a growing intensity ever since the first industrial revolutions. Today, with the fourth industrial revolution and the pace of technological breakthroughs, we are witnessing a radical reshaping of the way in which work will be distributed. In this context, this thesis' main aim is to investigate what will be the employment structure in the European Union by 2030, and what measures need to be adopted to prepare this transition. This study shows that in the next 10 years automation will replace between 15% to 25% of existing jobs, and even though some new jobs may appear, only in an optimistic scenario will the number of new be equivalent to the number of jobs lost. It also shows that EU's population is going to be older and the number of people dependent on the labor force is going to increase. On the other hand, the education level in the European Union is one of the best in the world, which can help in the context of an employment structure that will privilege highly qualified jobs. This is important to understand how prepared we are to face the changes that will be in place by 2030. Bearing in mind all this information, this thesis proposes public and managerial policies. Public policies are needed to ensure that changes leave people better off, not worse. These measures cover education, social protection, job creation and taxation. Lifelong learning, Universal Basic Income and Negative Income Tax are some examples of measures that the thesis assesses. On the side of managerial policies, the thesis contends that measures in the areas of talent management, outsourcing and investment are needed, so that companies can stay competitive in this new landscape. More specifically, we address proposals in the domains of work flexibilization, connection to tertiary schools and strategies to invest in automation.

Keywords: Automation; Employment; Population; Public and managerial policies; Work redistribution.

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AI	Artificial Intelligence
EMU	Economic and Monetary Union
EU	European Union
EUBS	European Unemployment Benefit Scheme
Eurostat	European Statistical Office
GDP	Gross Domestic Product
ICT	Information and Communication Technologies
IoT	Internet of Things
IT	Information Technology
NIT	Negative Income Tax
UBI	Universal Basic Income

Introduction

This thesis revolves around the topic of the future of work. More specifically, it tries to anticipate how work will be distributed in 2030 and how this distribution can impact society not only in terms of the job structure but also concerning other social consequences. In the last decades, technological development has brought many innovations that have been changing the way we work, and also the kind of work that we do. However, the next wave of innovation, also known as the fourth industrial revolution, is bringing ideas and technologies even more disruptive, and the pace of this change has been accelerating.

The impact of the fourth industrial revolution is one of the topics that is now being studied by multiple academics (Ford, 2015) and consulting companies (McKinsey Global Institute, 2017a). Many of them share the idea that we are at the starting point of a turning point in the way work is done, and that will consequently influence the kind of jobs we will have in the near future. Therefore, the topic of this thesis could hardly be more timely, and this is one of the main motivations that led us to conduct our research on it. As will be seen throughout the thesis, to anticipate these coming changes is of the utmost importance in order to prepare companies and governments to adopt the right measures.

Moreover, besides the relevance and timeliness of this complex phenomenon, another reason why I decided to address this topic lies in my academic and professional background. I am an electronic engineer pursuing my PhD degree, in the context of which I am researching for new ways to deploy sensors in the most varied environments. In this way, I am working directly with many things that can have a big impact in the way we live today and in the near future. This thesis allowed me to a understand in a broader way how technology can impact society and what can be done to ensure that technology is a tool to improve living conditions and not a threat to the peaceful development of humankind. It provided me with a clearer vision of

the big picture in terms of the future of work for the coming decade and gave me some insights of its consequences.

The topic is thus of the utmost importance for the future of management. But, insofar as this process is so wide-ranging, it also raises several ethical, social, and even philosophical issues, pertaining to the nature of work itself and to the way in which we want to collectively organize ourselves in order to live better. This plurality of different ways of looking at this topic is a constitutive part of this thesis.

These predictions are based in the potential of technologies already in use, but also in technologies that are expected to emerge in the future. Internet of Things (IoT), 3D printing, mobile internet, artificial intelligence (AI) are some examples that are enabling this new wave of innovation that aims to take automation to the next level. In this context, automation should be seen not only as autonomous machinery. Rather, through machine learning and other developments of AI, it might alter the tasks traditionally attributed to humans so as to free us. For instance, if AI software is able to free oneself from answering e-mails, this can also be considered automation.

Automation can be responsible for a significant loss of existing jobs, and some new jobs may also appear. This process of work transformation is not something completely new for humankind, given that structural changes in jobs are an intrinsic part of human history, especially since the first industrial revolution. The way in which societies adapted to past modifications in jobs is explored in higher detail below, in Chapter 2 Literature Review.

However, the fourth industrial revolution has some intrinsic characteristics that are unprecedented. Not only do both information flows and goods travel faster; also, the unprecedented pace of innovations that we have been experiencing in the last years and the increasing pervasiveness of AI and machine learning show us the extent to which these changes might be much more profound than ever before. At the same time, this transition will happen fast. Times of transition have been always difficult for some people, and this time we are having less time to adapt than we had before.

The urgency of this subject is clear when some authors estimate that up to 30% of the jobs existent today can be eradicated within 10 years.

This overarching topic led us, in this thesis, to look at several different aspects. One obvious example is demographics. To understand future changes in the employment structure, one has to start looking at the characteristics of a given population: to assess whether the population is growing, getting older, or more or less literate are all factors that are going to impact its degree of adaptability to the new paradigm. Besides that, it is also important to try to understand who are the individuals with higher potential of risk in this transition.

However, in order to tackle this important topic in a way that could be manageable, we had, like one has to do in every research, make some options. It would be impossible to look into this topic without delimiting a certain geographic space and a specific timeline (2030). That space would have to be large enough to be a reference but also contain a certain degree of homogeneity in order to establish meaningful parallelisms when adopting a comparative perspective. Also, enough data about its population should be available. Taking that into account, we decided to tackle this question within the specific framework of the European Union (EU). Due to the fact of being the country from which this thesis originates, the case of Portugal was also explored, even though to a lesser detail. More information about these choices can be found in Chapter 1 Methodology. Given these options, the main research question which this thesis addresses is the following: What will be the employment structure in the European Union by 2030, and what measures need to be adopted to prepare this transition?

Moreover, in order to further specify the main objectives of this thesis, the main research question is broken down in several sub-questions: Sub-Q1: How will the fourth industrial revolution impact the EU employment structure? Sub-Q2: What public policies should the EU adopt to foster job creation and social protection? Sub-Q3: How can companies adapt to become more competitive within this framework? Sub-Q4: How can the workforce be retrained to acquire the new skills needed within

this framework? Sub-Q5: What are the specific findings and recommendations for Portugal when compared with the EU?

Our thesis is structured according to three main chapters. The first, the methodology, clarifies the methods used to assess data in order to answer the research question. Besides having an extensive data base in its literature review, this work follows a qualitative approach. The data is used as a way to describe characteristics and patterns than can lead to a better understanding of the research topic.

The following chapter, the literature review, which is divided in several subchapters, provides a thorough contextualization of the subjects under scrutiny by analyzing the literature available. In that chapter we go through the differences between labor and work in order to introduce the concepts of work and work distribution (including the employment structure), the historical context of changes in work structures, the demographics and the future of jobs for EU and for Portugal. In this chapter it is possible to find an extensive research of data important to support the findings and conclusions to which we arrived with this work.

The third chapter, the results, is divided in tree distinct parts. In the first part we present the findings stemming from the literature review regarding the EU population demographics and the reality of jobs by 2030. In this section we explore EU's aging population, its impact in the possible increase in the labor force dependency ratio and how the current state of education and employment can evolve within a 10 years range. This information was compared with the findings on the future of jobs that were based in the multiple reports analyzed in the literature review. The final output of this part is an employment structure scenario that systematizes the previous findings. In the second part of this chapter, we propose policies for private and public sectors to adopt. These measurements attempt to be solutions that ensure a smoother transition between the current and future employment structure. Regarding the private sector, the results try to propose management measurements in order to make sure that companies remain competitive in the new paradigm. For the public sector, the policy recommendations intend to be a critical reflection about which kind of measurements

can be implemented by governments in order to ensure stability to the population. Some policies try to guarantee job stability for population, but as we are going to see further, this may be impossible to accomplish. In this way, other policies that would, as it were, redefine the actual work paradigm are also put forward, such as Universal Basic Income (UBI) or a Negative Income Tax (NIT). Still within the chapter on results, there is a final subchapter analyzing the specific case of Portugal. Here we explore the main differences between Portugal and the EU taken as a whole and some particular recommendations regarding the country are also made.

Even though our means are the modest means of a masters' thesis, we believe that this work puts forward some valuable insights on this topic. Our recommendations can be seen as the basis to a deeper and critical discussion which future research can carry on.

Chapter 1

Methodology

This thesis adopts a qualitative approach to the topic it proposes to investigate. The topic is itself complex, as it touches on the nature and definition of a fundamental human activity such as work, on the implications of the growing impact of technology on it, and on the fundamental policy and managerial decisions that need to be done in order to prepare the transition for the coming decade.

Given the complexity of the topic at hand, and also the strict time constraints of this research, it would prove impossible to devise a specific quantitative model to collect and analyze primary data. Any such endeavor would always be very limited and exploratory, and it would be impossible, from such data, to generalize our conclusions to try to answer our specific research question and the several dimensions of the sub-questions in which the main research question is divided.

Consequently, the only manageable option was to adopt a qualitative approach. In this approach, what is at stake is grasping the very complexity of the phenomena at hand to make sense of them in a broader picture. Therefore, the research question itself was born from the literature review, and the main objectives of the research, which are pursued in the results, are based in the inferences we draw from the data collected and analyzed in the literature review, and which originates from the several reports, books, scientific articles and databases that we consulted.

In this approach, we were influenced by the hermeneutical approach to social reality, which is used by our supervisor (Marcelo, 2012) . This approach, which is proposed, among others, by Michael Walzer (1987) is understood to be a method of interpretation, in which social reality is not "discovered" or "invented" but rather interpreted, also taking into account the fundamental values that should guide our decisions. One of the specificities of the way we are using it comes from the fact that this interpretation is used in a prospective exercise, given that we are trying to draw

scenarios for the future in the medium term, for 2030. But the fact that we are assessing the definition of work and work distribution, and arguing for the implementation of some measures guided by ethical values, is grounded in this hermeneutical and ethical approach to social reality.

Also, using this specific method for this topic also draws on the importance of the discussion of the redistribution of work, which is argued by Gorz (1999) and was also explored in earlier theses around the same topic, such as Gomes (2017). Here, however, our main focus is on the EU, and paying very close attention to data such as demographics, automation potential of different jobs, and education. The choice of the EU for our analysis was not neutral. Even though employment strategies differ from country to country, the EU is a single market and it might be argued that in the future a closer integration between these policies is possible, also taking into account the EU's positioning as a global player. And even though many reports, such as the ones produced by the World Economic Forum (2016) or the MckInsey Global Institute (2017) focus on the impact of automation and the fourth industrial revolution for the future of jobs, we felt the need to bring that discussion specifically for the EU and Portugal's levels.

It should be noted that when we mention the EU, we refer to it in its current scenario: 28 member states, including the UK. This can, of course, still change from here to 2030, given the possibility of Brexit and also of an enlargement of membership to other countries. However, at the time this thesis was being finalized, Brexit is still not certain to happen and, as such, we maintained our predictions at the level of EU28. This can, of course, change at any given point in time but we adopted a conservative approach to the current status quo. If Brexit does happen or other countries join the EU, the figures for population, job market and education will of course change, but this would probably not change the main points we emphasize in the results.

Furthermore, the fact that we did not adopt a quantitative model does not mean that there is no use of quantitative data in the thesis. In fact, almost all the literature review and also a part of the results are filled with quantitative data on all the

dimensions we chose to analyze, in order to be as accurate as possible in our assessments and predictions. So that we would have a large enough time span to analyze the evolution, most of the data we use starts in 1990. When this is impossible, due to the absence of data, we use any available data that we can find. For most cases we could also only find data up until 2017, sometimes until 2018, but this does not change fundamentally the estimations being made. As for projections for the future, some of the data we use go as far as 2040 or 2050, in order to provide a sense of the evolution, even though in the results we concentrate on the timescale of roughly a decade, from the present moment to 2030. Whenever deemed useful, we chose to illustrate these data with different figures so that they would be more comprehensible. As a result, the literature review has a very descriptive nature, whereas the interpretive part is more present in the results.

The thesis uses figures from different sources. Some were taken, with due acknowledgement, from public reports, others were produced with data from different sources and a few are of our own making. This information is provided below each figure in its caption: figures referenced just with "source" originate from other documents; the ones referenced with "data source" were made by us with data from that source; those completely originally are tagged "self-elaboration".

Chapter 2

Literature Review

2.1 Work and Labor

In a thesis dedicated to analyzing the distribution of work in the near future, it makes sense that we start by trying to understand what it is exactly that is understood by this concept, and how it can be seen from different perspectives.

Traditionally work is seen as an activity that involves the use of time and energy on a task for some future social, financial, or psychological reward. Gorz (1999, p. 3) emphasizes that work performs a "socially identified and normalized function in the production and reproduction of the social whole". This means that the concept of work is determined by the social organization which usually means to have a job or a profession, thus reducing work to paid labor. This definition has some weaknesses especially when what is at stake is distinguishing between different activities – the line between what can, or can not, be considered "work" is sometimes blurred. The most common example is when a professional athlete is compared with an individual doing exercise, both are doing the same activity but one is working (and probably being paid) while the other is playing. Certain activities are financially rewarded and these, as well as practices taking place within a given organization structure are what is usually considered work; however, restricting work to these activities presents a problem to activities that are typical of certain social groups. Students or housewives, for instance, do not get paid or are connected to a structure, however their activities can be seen as work (Andersson, 1992).

In order to clarify the concept of work, some authors have proposed to distinguish it from labor. In the Marxist tradition labor is seen as alienated and exploited work, as

against work that is an anthropological category to the human species (Frayssé, 2014). In this tradition, labor, at least such as it exists in capitalism, is a form of work that is necessarily alienated, because the workers are forced to work in order to survive and they do not own the means of productions, thus being forced to sell their own labor regardless of the dire conditions they might have to face. It goes without saying that other forms of work exist, in which humans own the means and results of production. But, in a nutshell, in this tradition labor is an activity done for someone else in a position of subordination and done for some form of remuneration. Work is a more general concept, it is a process to transform nature, culture and society creating goods and services that satisfy the human needs (Fuchs & Sevignani, 2013; Standing, 2014).

To simplify matters, we assume that labor is thus a form of work, one that assumes the nature of paid work (thus one often speaks of "waged labor" – and here we are not considering other forms of labor, such as forced labor or other forms bordering on slavery). Throughout this thesis, we will thus use "work" as the more encompassing concept and so sometimes we can use it as meaning paid work (even in the form of a wage, as in waged labor) which means that the distinction between work and labor is not always used in a strict manner in the following pages. We proceed so because work being such a broad concept, it encompasses not only traditional employment schemes where work is associated with a career and a stable wage, but also intermittent work schemes, independent work or even unpaid activities. However, we will come back to all these important distinctions in the discussion of the results.

2.2 Industrial Revolutions in work distribution

This thesis revolves around the topic of the employment structure in European Union by 2030, and what measures need to be adopted to prepare the transition. The employment structure or work distribution as it is commonly called, is a subject that has been strongly debated over the years, and that takes its root in the social nature of work itself, and in the division of labor. However, to understand the dynamic nature

of the division of labor, it is important to take a brief glimpse at its history. This history fastens its pace ever since the dawn of the industrial revolutions, which we will analyze in more detail below. Nevertheless, the specialization in given tasks of course preceded these revolutions. Let us see how.

Roles in society have been changing ever since humankind went from hunter and gatherer to food producer. It started as a natural process to satisfy the most basic human needs: food, childcare and shelter. The different proficiency that some individuals showed in particular tasks, such as hunting animals, care skills or gathering skills created the first distribution of work. Age and sex were the main features driving work divisions. The older and the younger in each community lacked strength and so performed more sedentary tasks. The sexual division of work was also based in physical differences, with men taking on tasks such as hunting while women specialized in food gathering, child caring, and cooking (Kranzberg & Hannan, 1999).

We find in Wittfogel (1957) a general theory of the development of ancient civilizations in which one of the first complex systems of work distribution unfolded. The development of irrigation projects in Mesopotamia and Egypt led to a hierarchical organization in order to control social roles. Irrigation increased food supply, fostering the creation of people agglomerates in towns and cities; this brought the emergence of weavers, metalworkers, scribes, lawyers, among other occupations. Another important aspect of social stratification in Mesopotamia was the constant strife, as it created the need for military and also, indirectly, for several other occupations, as was the case of horse breeding (Flannery, 1972). A very different example can be found in Maya civilizations, characterized by many as the classic example of a "peaceful" civilization. This aspect combined with a fertile agriculture territory resulted in a society where people developed knowledge in astronomy, medicine and engineering, which is a strong indicator of scientific roles in society (Sharer & Traxler, 2006). Besides all the influence of the surrounding environment in the first complex systems of work, the distribution of tasks was also based in age, sex and skills. However, due to the strong hierarchical organization of these societies, the social position was also a defining element in work distribution.

During many centuries work distribution was based on the same principles, the differences between societies were mainly based on the scarcity of food and on the fact that they were living times of war or peace. The abundance of food would contribute to move people from agriculture to construction, trading or cultural activities, and in times of war the numbers of militarism and metalworkers would increase. In spite of significant differences from culture to culture and throughout history, it seems possible to claim that this was the fundamental division of work in many societies and that the first major shift that really changed the framework of existence for the human species would come about with Modernity and, more specifically, with the industrial revolutions.

The first industrial revolution, which happened in the West from about 1760 to sometime between 1820 and 1840, brought fundamental changes in the way people worked, where they lived and how many people could make a living around the world (Stearns, 2018). The essence of the first industrial revolution were the applications of new sources of power to production processes, such as the motors powered by fossil fuels which replaced humans and animals as power sources.

To understand the social impact of the first industrial revolution it is important to have an overview about the period leading to it. According to Deane (1979) the pre-industrial period was characterized by four aspects: (i) poverty – as it is extremely difficult to measure poverty the author made a simple and quantitative comparison, the level of economic development reached by the countries that were the first to go through the industrial revolution was distinctly higher when compared with countries still in development. This assumption only gives useful information if we consider that in the pre-industrial ages the different countries could be considered at an equivalent economic level; (ii) stagnation – the levels of living and productivity were relatively stagnant; (iii) dependence on agriculture – even though it is impossible to estimate precisely how many people worked in agriculture, some predictions estimate that about 80% of population was working in agriculture; (iv) lack of occupational specialization – in the pre-industrial economy it was normal for a person to be engaged in a variety of occupations and even in a variety of industries.

The first industrial revolution came to drastically change the work distribution given that the manufacturing process replaced agriculture as the main activity, some estimations claiming that at its peak 60% of people were working in manufacturing. The exponential growth in raw cotton, coal and the appearance of railway lines also signaled an economy focused in production. The per capita productivity increased near 90% (Clark, 2001). Industrialization also led to the creation of new jobs, the need for new specialized work resulted in jobs as machine operator or train driver and the complexity of factoring processes resulted in management roles. Besides this work redistribution the first industrial revolution brought huge alterations in social standards, as it improved human health by dramatically reducing infant mortality; yet it worsened, in a significant proportion, the quality of the natural environment. The new tasks needed less strength from people which meant that people started working from early ages, typically at 10 years old (Stearns, 2018).

During the first industrial revolution appeared the first movement against technology, the luddites. The movement, born in England by the hands of textile workers, opposed technology because people were losing their jobs for machinery, and the protest thus involved the destruction of textile machinery. In spite of the growth in the economy, living standards only rose slowly during this period, as population grew at an accelerating rate (O'Rourke, Rahman, & Taylor, 2013). Even though there was an effort from the government authorities to suppress the movement using military force, the dispatch is usually said to have been without much efficacy. The end of luddites is mainly attributed to fast declining of popular support caused by the growing living standards at the late 19th century (Hozumi, 1956).

Since the first industrial revolution the world has experienced wars, political revolutions and rebellions that together with industrial revolutions have changed societies. The second industrial revolution also known as the technological revolution arose in the late 19th century and ended in the beginning of the 20th century. This new period of transformation extended the success of the first industrial revolution (which was somehow limited in scope and geographic impact) to a much broader range of activities and products (Mokyr, 1998). The new paradigm was only possible due the

large number of new technologies and inventions: electricity, the internal combustion engine, new chemicals, telephones and radios are some examples of it. From all the new inventions, electricity was possibly the most important in the work organization. In the United States of America (US) before 1899, more than 95% of the mechanical power was derived from water and steam, 30 years later 75% of mechanical power was electric. This technical aspect resulted in an increase from 1.6% to 3.3% in the growth rate of output per hour in industry. The developments in chemistry allowed for the emergence of fertilizers which had a big impact in agriculture (Atkeson & Kehoe, 2001).

At the end of the second industrial revolution, in the US, 25% of the working population were operatives or laborers (except miners and farmers) and near 35% were working in agriculture. This shows a big difference when compared with periods of pre-industrial revolution, in which 80% worked in agriculture, and first industrial revolution, when 60% worked in manufacturing (Wyatt, 2006). These transformations also led to a valorization of knowledge and technical expertise, given that for the first-time employees were not selected due to their physical abilities. From a social point of view, the new roles in society and the value they created allowed for an increase in living standards and a bigger purchasing power in the middle and working classes. The status of the elderly also changed, as jobs became more associated with energy and ability to learn new techniques which consign elderly to care activities (Stearns, 2018).

Finkelstein (1989) describes with a present and futuristic perspective what is / would be the third industrial revolution. He points six major high technology change agents, and explores the ideas of engineered materials, life and drugs claiming that "engineers and entrepreneurs will have the imaginative range of expression that only poets and artists held". The third industrial revolution, also known as the digital revolution started somewhere around the 1980s and is directly related to Information and Communication Technologies (ICT) (Greenwood, 1997). The computer and Internet were the bases of what would be a deep transformation in the way work was distributed.

The new technologies impacted all economic sectors. In 2000 agriculture represented 7.3% of employment in the European Union (EU), in 2010 it was 4.4%. Additionally, services represented 65.2% in 2000 increasing to 69.9% in 2010 (European Commission & Directorate-General for Employment, 2018). The numbers are clear, there was a wide change in the work distribution during the third industrial revolution. Regarding the skills required, in 2010 the EU pointed that 27.6% of jobs required at least a bachelor degree, which shows the high level of specialization required if compared with previous years (Luxembourg: Publications Office of the European Union, 2013). The third industrial revolution brought important advances, the purchasing power adjusted Gross Domestic Product (GDP) per capita in EU grew 28.8% in the period from 2000 to 2010 (Eurostat, 2018b) and the risk of poverty rate was at 16.5% in 2010 (Eurostat, 2018a). The digital revolution also resulted in less desirable consequences, such as inequality: in Europe at the beginning of the industrial revolution the top 1% national income represented 9.3% of the total income, whereas in 2008 it was 13.2%, which actually shows an increase in inequality. In the same period, the same share grew 41.6% if analyzed in a world perspective (Alvaredo, Chancel, Piketty, Saez, & Zucman, 2018).

Even though there is not a clear end of the third industrial revolution, it seems as if a new industrial revolution is already underway, as the fourth industrial revolution is already defined by many authors. The pace of the developments in the last years can not only change the way how the world is organized, but also challenge the idea of what it means to be human (Marr, 2018). In Hawken, Lovins, & Lovins (2013) a utopian scenario as the result of the fourth industrial revolution is presented. The work explores the possibilities that will arise from the birth of a new type of industrialism, one that according to the authors, differs in its philosophy, goals and fundamental processes from the actual industrial system. The fourth industrial revolution or industry 4.0 as it is also known, represents entirely new ways in which technology becomes embedded within societies (Davis, 2016). However, the pace at which innovations have been made is unprecedented and the visions about the key factors at stake also constantly change with this pace. One example of it is the report

"The Future of Jobs Report 2018" produced by the World Economic Forum only two years after the "The Future of Jobs" that was launched in 2016. The Forum explains the need of a new report due to the further acceleration in the pace of change (World Economic Forum, 2018).

At the risk of being outdated by a new innovation presented tomorrow, some authors point to a set of technologies that are shaping the new industrial transformation. "The Future of Jobs" (World Economic Forum, 2018), pinpoints four specific technological advances that are presented as drivers of change: ubiquitous high-speed mobile internet; artificial intelligence; widespread adoption of big data analytics; and cloud technology. Other studies explain that industry 4.0 combines relevant physical and digital technologies, whose drivers are related with: analytics, additive manufacturing, robotics, high-performance computing, natural language processing, artificial intelligence and cognitive technologies, advanced materials, and augmented reality (Deloitte, 2018). From the point of view presented by McKinsey & Company, (2016) , the fourth industrial revolution is set in four pillars: data, computational power and connectivity; analytics and intelligence; human-machine interaction; and conversion to the physical world.

Even though technology is at the base of all industrial revolutions, in the fourth industrial revolution there are other elements that need to be considered. Environmental causes (such as the goal to eliminate waste), maximum product efficiency, green energies and sustainable growth will have a major influence on the paths chosen (Hawken et al., 2013). Other aspects that can have influence in the developments is the appearance of neo-luddites, movements that advocate anti-liberal instincts and reindustrialization to prevent unemployment and degradation of the community (Kryszcuk & Wenzel, 2017). The new luddites are particular active in the last years in subjects regarding automation and replacement of people by machines.

However, none of this needs to happen. The positive or negative impacts of technology will to a great extent depend on the policies adopted. And technology is

not, of course, the only driver of change for the job market. Other key factors are, for instance, population and education, which we will analyze next.

2.3 Demographics

After presenting some of the past events that reshaped the way in which work was organized, it is time to start analyzing the present situation. In this sub-chapter we present in a detailed and quantitative manner the population demographics. This data helps us to understand both the current situation and the likely future scenario for the EU, always in a comparative perspective, in which data for the EU is compared with the global scenario.

In the following pages we address the population numbers and its growing rates, the age groups in which population is distributed, as well as the labor force. Moreover, we also go through the numbers of education and employment numbers so as to grasp their current situation and how they can influence the future and shape our projections for 2030.

2.3.1 Population

According to the available data, the world population has been constantly growing, reaching a peak in 2017 (the last year of the available data), which by now has certainly been topped. The estimations point to a continued growth, expecting 7.76 billion people in 2020, and 8.52 billion by 2030 (World Bank Group, 2018d). According to the best available estimates, the first take off in growth began in the 18th century, involving relatively modest annual growth rates. Before that, the demographic rates were below 0.1% (Piketty, 2014). The highest population growth was registered during the 1960s with a growing rate above 2.0%. This rate has been decreasing and at the present moment the World population is increasing by 1.16% per year (World Bank Group, 2018d). At first glance, numbers around 1.16% and 2.0% can suggest low growth rates;

however, it is important to understand that these numbers are under what might be called the "law of cumulative growth". This law holds that a low annual growth rate over a long period of time gives rise to progress. In other words, a growing rate of 2.0% doubles the population each 35 years.

Figure 1 shows the data regarding past years and the estimates for the following years.

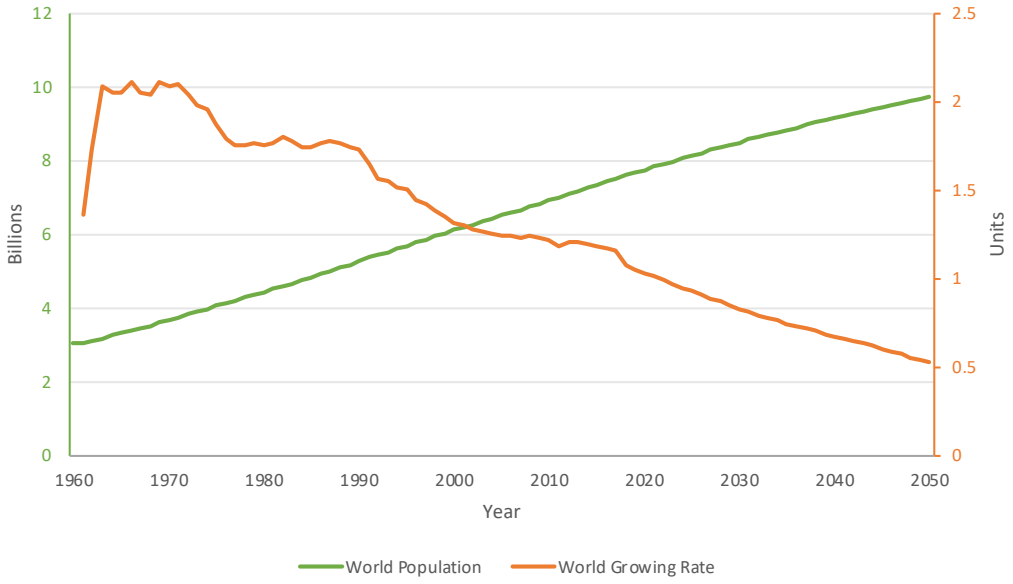

Figure 1 – World population and growing rate.

Data source: World Bank Group (2018b).

From the total population, 46.8% is accumulated in the 5 most populated countries: China 18.4%, India 17.8%, United States of America 4.3%, Indonesia 3.5% and Brazil 2.8%. By 2030, the concentration in the 5 most populated countries is estimated to have a small decrease by 2030, to 45.1%, distributed by: India 17.8%, China 16.6%, United States of America 4.2%, Indonesia 3.5% and Nigeria 3.1%. This information is also presented in Figure 2.

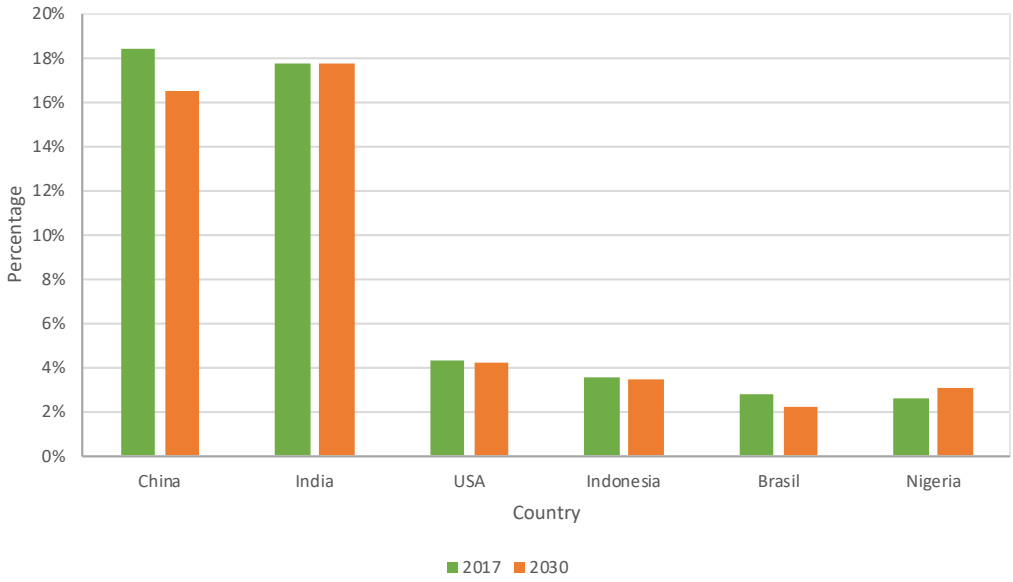

Figure 2 – World's most populated countries in 2017 and 2030

Data source: World Bank Group (2018b).

With 512.5 million people in 2017, the EU represented 6.8% of the world's population. However, this percentage is expected to decrease to approximately 6.0% by 2030, as the EU is not following the growth rates taking place in the rest of the world and specialists believe that its population can start declining by 2028. From Figure 3, it is possible to see the evolution of EU population and its growing rate. It is important to note that the data referred to the EU presents data from 28 countries (the 28 that belong to EU since 2013 until the time we collected this data, in January 2019) (World Bank Group, 2018d).

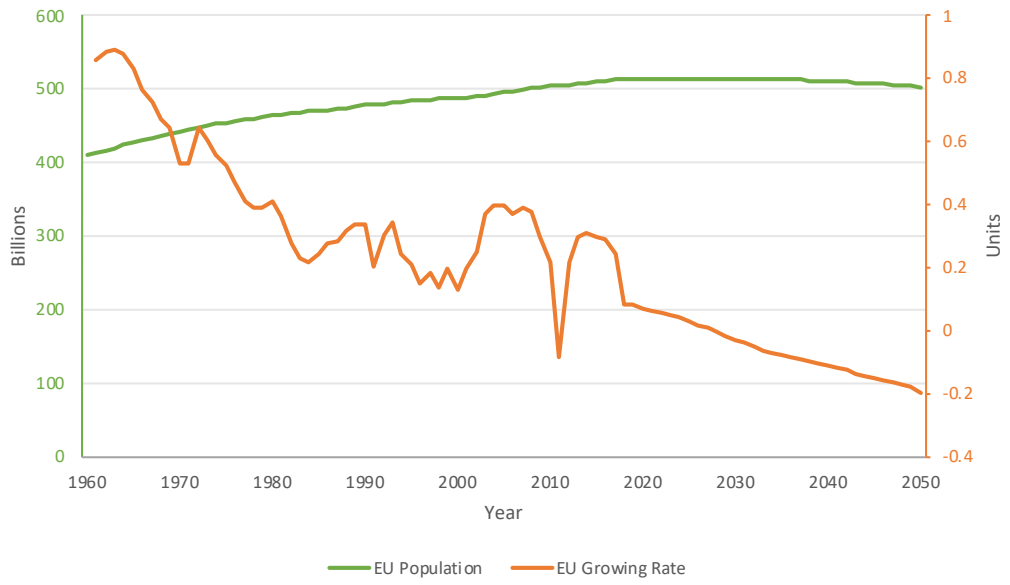

Figure 3 – EU's Population and its Growing Rate.

Data source: World Bank Group (2018b).

The 5 most populated countries represent 63.0% of the European Union population: Germany 16.1%, France 13.1%, United Kingdom 12.9%, Italy 11.8% and Spain 9.1%. By 2030 the same 5 countries (assuming all of them are staying in the EU) would have 63.6% of the total EU population by 2030: Germany 15.8%, United Kingdom 13.6%, France 13.6% Italy 11.6% and Spain 9.0%. Figure 4 shows this information.

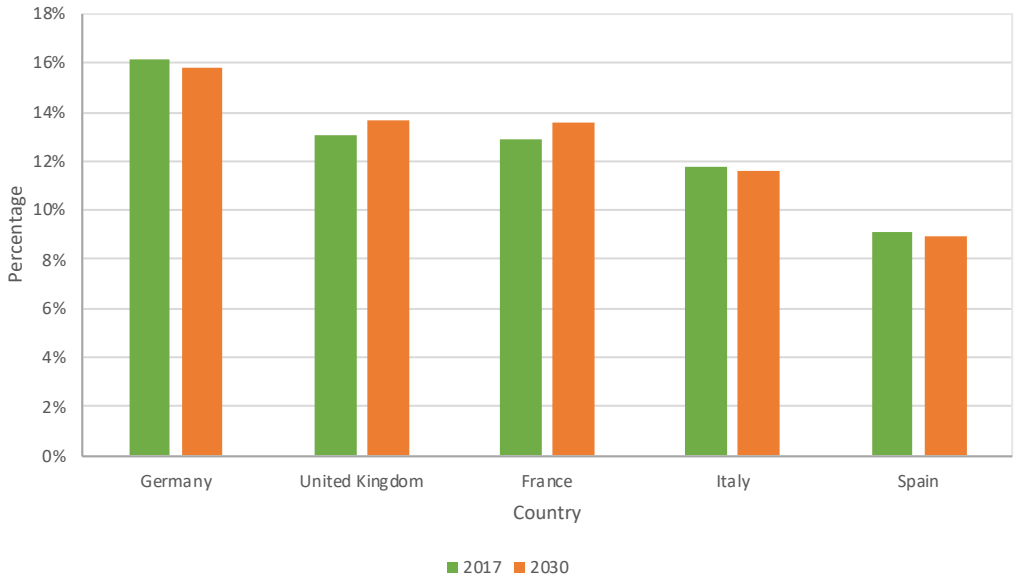

Figure 4 – EU's most populated countries in 2017 and 2030

Data source: World Bank Group (2018b).

2.3.2 Age Groups

When the subject is the population distribution by age group, there are three main segments: the first includes people from 0 to 14 years old, that do not have enough to work and are completely dependent; the second composed by people with ages between 15 and 64 years old that are in their majority capable of production, commonly named as active age; lastly, the third group consist in the population with more than 64 years old, this group is mainly constituted by retired people.

As we have already seen, in the global picture, the population is increasing, however, the distinct age groups have been performing differently.

The age group that encompasses people from 0 to 14 years old, has been increasing since 1960 (with the exception of the years 2000, 2002, 2003, 2004 and 2005) and it is expected to keep increasing until 2050. In 2017, this age group accounted for 25.9% of the total population, however, this value has been decreasing since 1967 and it is estimated to be 23.7% by 2030.

The segment that includes people aged from 15 to 64 years old has been increasing since there is available data and it is expected to continue growing. Its share in the global population grew until 2012 and started decreasing in the following years. In 2017, this age group represented 65.4% of the total population, number that is expected to decrease to 65.6% by 2030.

In the case of the group of the "elderly" (people more than 64 years old) the numbers have been growing sharply in total population but also in the share that they represent. In 2017 it accounted for 8.7% of the total population value and is expected to increase to 11.6% by 2030 (World Bank Group, 2018d).

Figure 5 and Figure 6 show the data about the age group distribution.

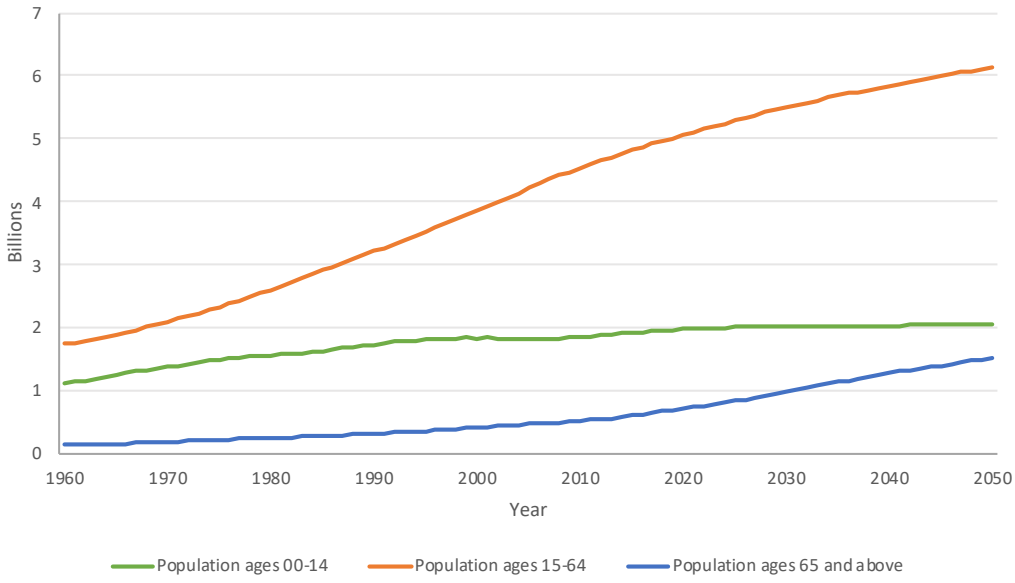

Figure 5 – World Age group distribution – total population.

Data source: World Bank Group (2018b).

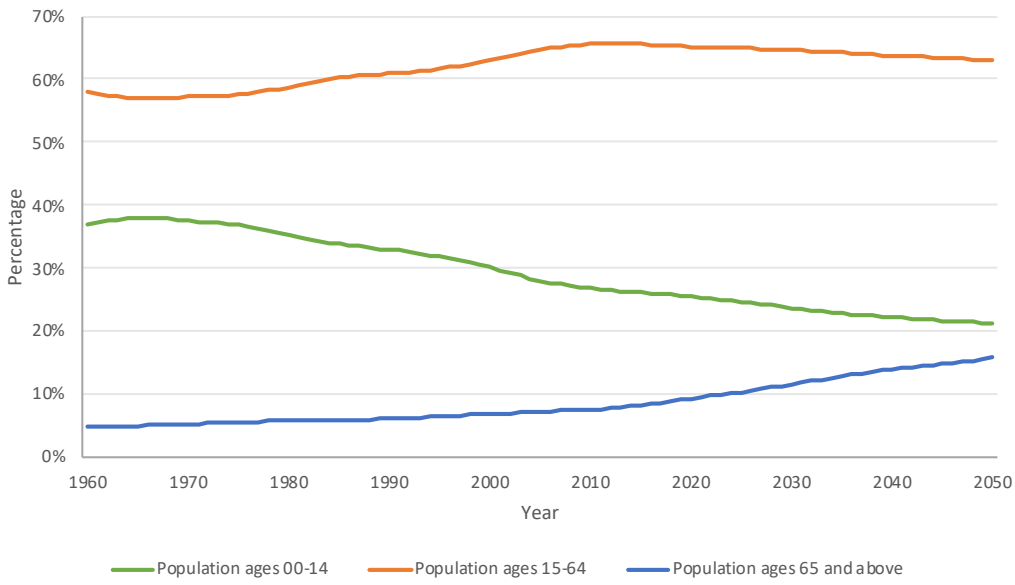

Figure 6 – World Age group distribution – percentage of total population.

Data source: World Bank Group (2018b).

Closing the scope to the EU reality, the younger age group has been constantly decreasing since the year 1970 (with a 7 years exception in such period). Estimates point that its share in the total population will decrease until 2040. In 2017, 15.4% of the population had 0 to 14 years old, share that is estimated to be 14.5% by 2030.

The age group of the people between 15 and 64 years old stopped growing in 2010, and the percentage of people belonging to this age group started decreasing a bit sooner in 2006. Consisting in a majority of the population, in 2017 the group accounted for 64.8% of the total EU population, value that is expected to decrease to 60.9% by 2030.

Contrary to the other age groups, the group that includes people more than 64 years old has been growing in its numbers and also in its share of the total population. This growth is expected to be maintained. The group represented 19.8% of the total population by 2017 and specialists expect it to represent 24.5% by 2030 (World Bank Group, 2018d).

Figure 7 and Figure 8 show the data about the age group distribution in the European Union.

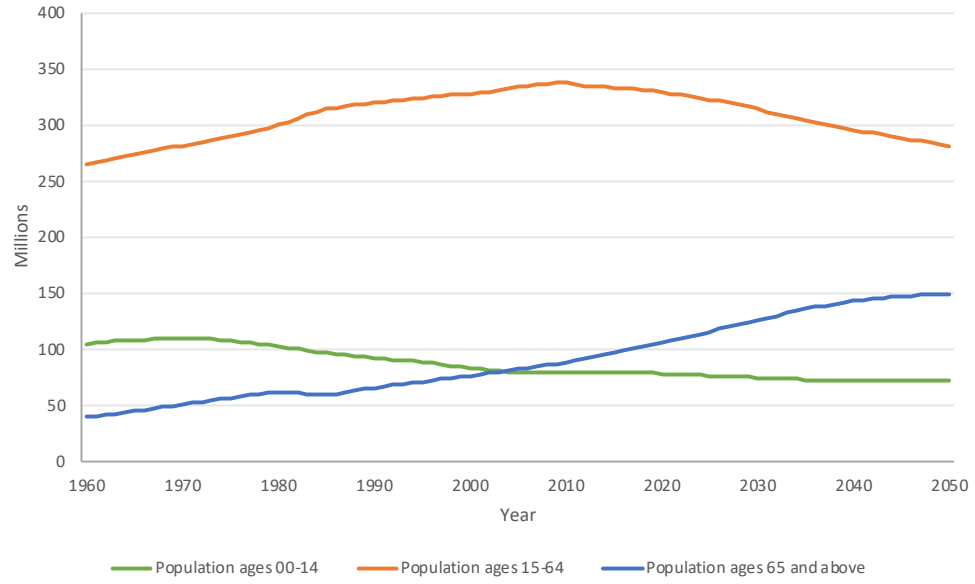

Figure 7 – EU's Age group distribution – total population.

Data source: World Bank Group (2018b).

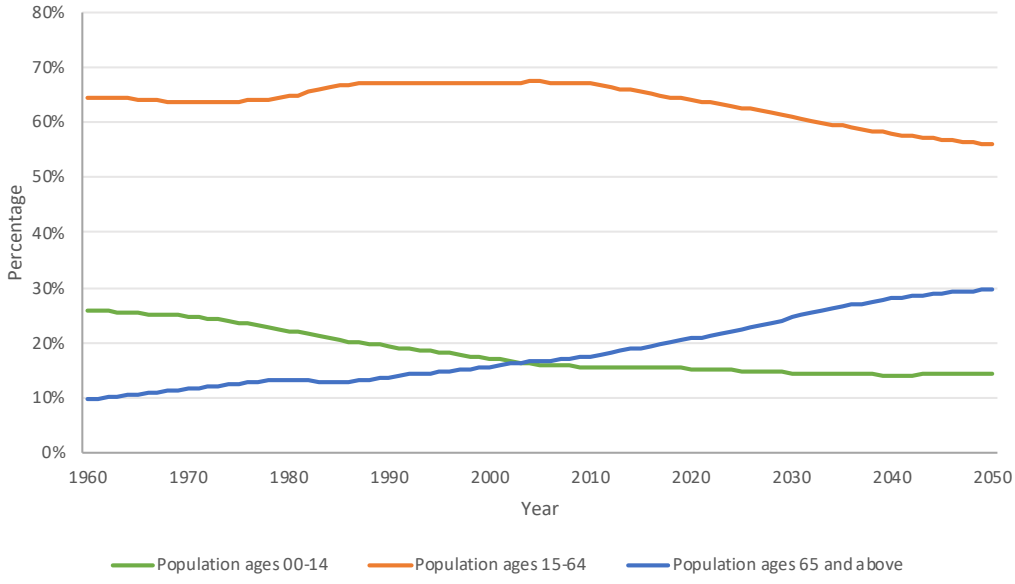

Figure 8 – EU's Age group distribution – percentage of total population.

Data source: World Bank Group (2018b).

Despite the difference in magnitude, there are there are two factors that help to explain the current paradigm regarding the population age distribution. The first is the life expectancy at birth, it estimates lifetime in years for someone born in a given year. For example, someone who was born in 2016 can expect to live 72.0 years on average, but if this same person was born in the EU, he or she can expect to live 80.6 years. The difference between the two geographical areas (the EU vs. the entire world) has been on average 9.3 years, the time reference goes from 1990 to 2016. In the following years the value is expected to stabilize at 8.8 years (World Bank Group, 2018d). More detailed information can be found in Table 1.

Table 1 – Life Expectancy at Birth.

Life Expectancy at Birth (years)			
	EU	World	Difference
1990	74.9	65.4	9.4
1995	75.8	66.3	9.5
2000	77.2	67.7	9.5
2005	78.4	69.1	9.2
2010	79.7	70.7	9.0
2015	80.6	71.9	8.8
2020	81.6	72.8	8.8
2025	82.4	73.6	8.8
2030	83.2	74.3	8.8
2035	83.9	75.1	8.9
2040	84.6	75.7	8.9
2045	85.3	76.4	8.9
2050	85.9	77.0	8.9

Data source: World Bank Group (2018d).

The second factor is the fertility rate. This barometer can be translated in the average number of children that a woman would give birth to over her lifetime. In a simple exercise, we can say that with a constant life expectancy, and considering 50% women and 50% men, a fertility rate of 2 would maintain the population in its current numbers.

Figure 10 provides data about fertility rate. By 2016, each woman in the world could expect to have 2.4 children in her lifetime, but if that same woman were an EU citizen, she could expect to give birth to 1.6 children. On average, each EU woman contributes with less 0.8 children when compared with the World average (World Bank Group, 2018d).

Considering the most recent available data without future predictions (2016), the 5 countries with lower fertility rates are: Republic of Korea, Singapore, Hong Kong, Moldova and Porto Rico with an average of 1.2 births per women; the 5 countries with higher fertility rate are: Chad, Mali, Democratic Republic of the Congo, Somalia and Niger with an average of 6.3 children per women. In this matter, the EU has numbers close to the bottom. With an average birth rate of 1.3 are the 5 countries with lower births per women: Portugal, Poland, Greece, Spain and Cyprus; on the opposite top we find: Denmark, United Kingdom, Sweden, Ireland and France with a fertility rate of 1.8 (World Bank Group, 2018d). Figure 9 shows an alternative to visualize the numeric data.

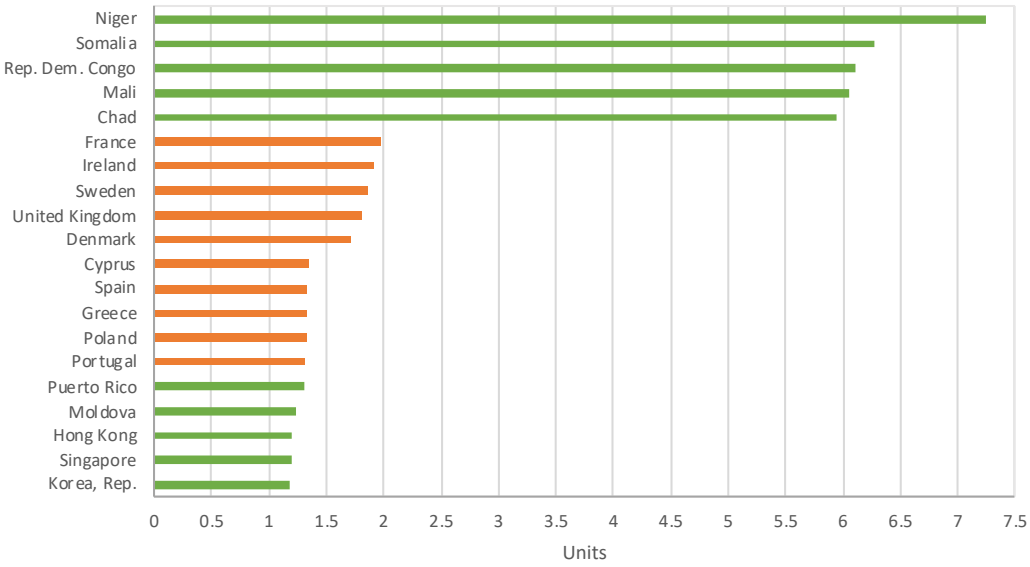

Figure 9 – Highest/Lowest fertility rates, global and EU perspective

Data source: World Bank Group (2018d)

The gap between the world and the EU rates is expected to decrease in the upcoming years. By 2030, an average woman is estimated to give birth 2.4 births, less 0.11 than in 2016. Conversely, a woman with EU nationality would have 1.7 children, an increment of 0.16 compared to the 2016 numbers.

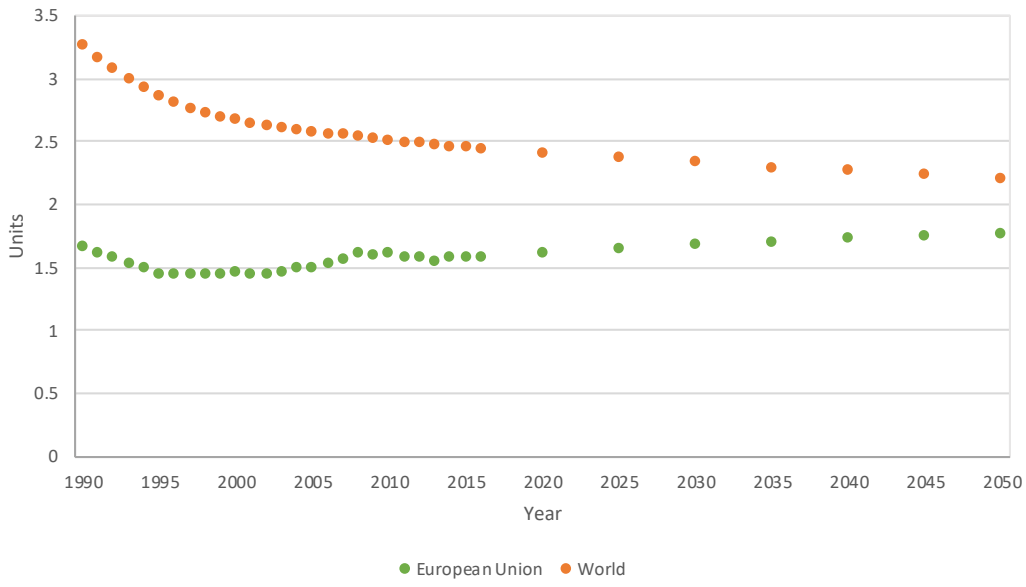

Figure 10 – Fertility rate, number of births per woman.

Data source: World Bank Group (2017).

2.3.3 Labor force

One of the key metrics to answer the research questions that we set out to investigate in this thesis is the number of people available to work or, put more precisely, the labor force. The labor force is defined by the World Bank Group (2018a) as "people aged 15 and older who supply labor for the production of goods and services during a specified period. It includes people who are currently employed and people who are unemployed but seeking work as well as first-time job-seekers.".

This indicator grew slightly until 2005 and was relatively stable until 2017 (last year of available data) with an average of 46.0%. Within the EU, the labor force had its main growth between 1996 and 2008 and after that it stabilized with an average of 48.4% (World Bank Group, 2018a). Due to its volatility, the labor force is not an indicator easily calculated. Given that fact, and for reasons of reliability, in this this thesis we also use, in what concerns the EU, data from the Organization for Economic Co-operation and Development, OECD (2019). Even though there is a discrepancy between these values and those previously presented, the correlation between both sources amounts to 98.6%, which shows that both are moving in the same direction. The data presented can be visualized in Figure 11.

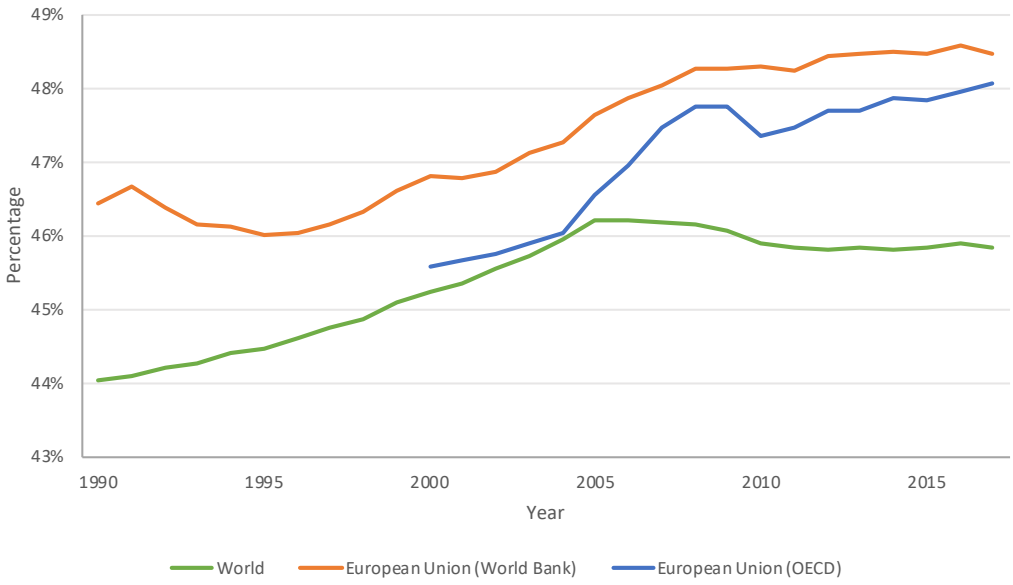

Figure 11 – Percentage of population in labor force.

Data source: World Bank Group (2018d) and (OECD, 2019).

At first glance, one way to predict the labor force is to look at the age group that encompasses people between 15 to 64 years old. However, there are also indicators, such as the percentage of female/male population older than 14 years old, that can have a big impact.

From 1990 to 2017, the World labor force grew 1.8%. As it is presented in Figure 12, in the same period, the population aged 15 to 64 years old grew 4.4%. The percentage of male population (more than 14 years old) in the labor force decreased 4.9% and the percentage of female population (more than 14 years old) in the labor force decreased 2.7% (World Bank Group 2018a; 2018b; 2018c; 2018d). These data allow us to understand that, in the perspective of the world taken as a whole, the labor force growth was sustained by the increase in the share of people aged 15 to 64 years old. On the opposite direction, the percentage of male/female population (older than 14 years old) in the labor force decreased, which can be possibly explained by the increase in the life expectancy at birth and a higher retirement rate (increasing the number of people with more than 14 years old that do not work).

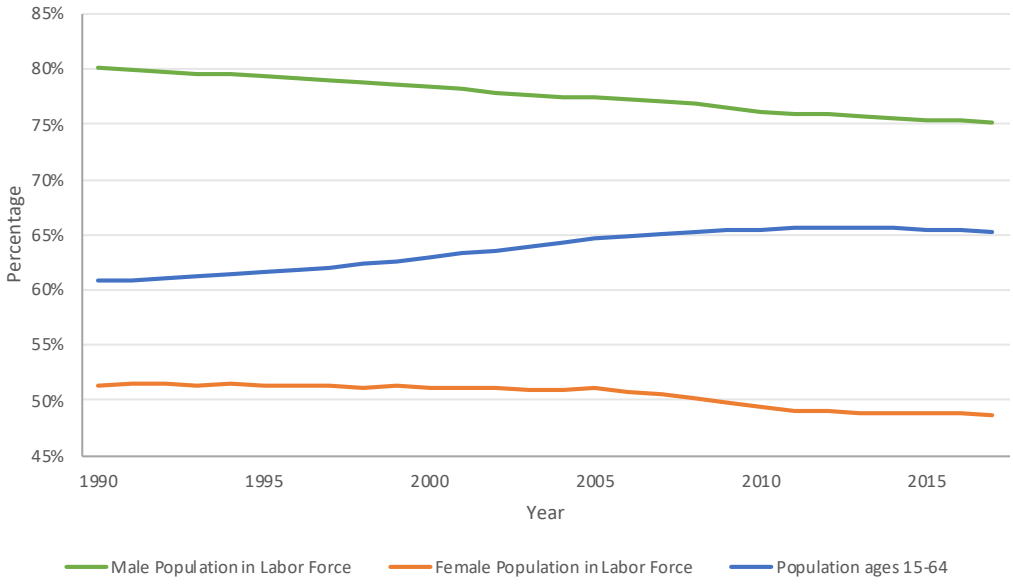

Figure 12 – Indicators with impact in the labor force.

Data source: World Bank Group (2018b), (2018c) and (2018d).

As for the EU, its labor force grew 2.1% between 1990 and 2017. This growth is backed by the female population (more than 14 years old) in the labor force that increased from 46.3% in 1990 to 51.1% in 2017, a surge of 4.8%. On the other side, the male population (more than 14 years old) in the labor force decreased 5.8% in the period, and the population share attributed to the age group 15 to 64 years old decreased by 2.1%. Once again, since the labor force consists of the people older than 14 years old, if the life expectancy rate increases and the people after a certain age stop working (retirement) the percentage of population in the labor force decreases. As it is possible to observe in Figure 13, the gap between male and female population (more than 14 years old) in labor force is shrinking, which shows that the EU is evolving towards gender equality in the percentage of the labor force. The increment of the female population (more than 14 years old) in the labor force is, by itself, not enough to sustain the labor force, and as it was seen before, the population aged between 15 to 64 years old is expected to decrease, which can lead to a future decrease in the percentage of labor force inside EU.

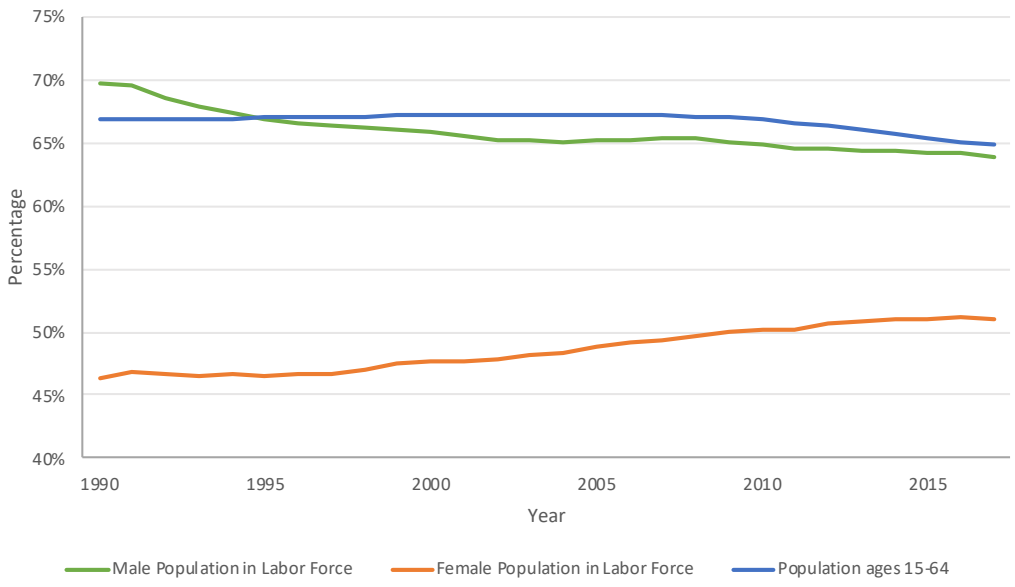

Figure 13 – Indicators with impact in EU's labor force

Data source: World Bank Group (2018b), (2018c), (2018d).

The labor force dependency ratio is an indicator used to measure the pressure on productive population, as it divides the population that is not in the labor force by the population in the labor force. If the result is equal to 1 then each individual in the labor force has one dependent; if the ratio is higher than 1 then one person has more than one dependent; if it is lower than 1 then there are more people in the labor force than in the dependent population. Figure 14 presents the ratios in a World and EU perspectives.

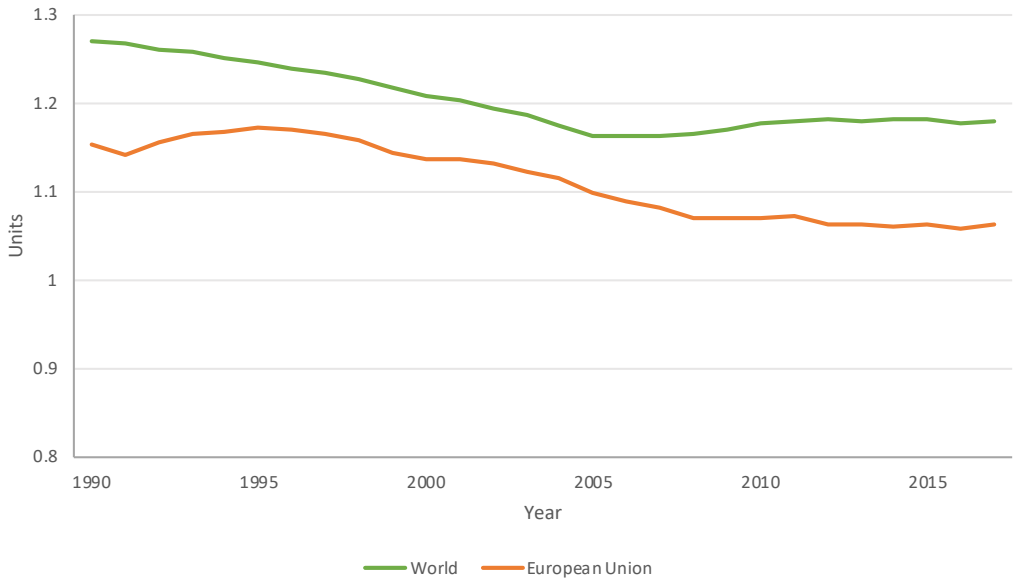

Figure 14 – Labor force dependency ratio

Data source: World Bank Group (2018b)

2.3.4 Education

To understand how the future of the labor force is going to be, it is also crucial to understand the current state of education both around the world and the EU, and to indicate some of the predictions for the future. Indeed, there is a strong correlation between high levels of education and a high level of labor productivity and greater ability to absorb advanced technology (Barro & Lee, 2013).

School systems are not uniform around the world. In this thesis, we adopt the following terminology: primary school, also known as elementary school, provides basic literacy as well as numeracy; secondary school, provides levels 2 and 3 of the International Standard Classification of Education (ISCED, 2011), that aim to lay the foundation for lifelong learning and a more specialized education; tertiary schools, correspond to the level 5 and 6 of the ISCED 2011 and may be academically based or practically oriented / occupationally specific.

When the subject is education, the enrollment rate is undoubtedly one of the ratios to consider. However, to better understand the following data, the difference between

net and gross ratio should be clarified. According to the World Bank Group (2018f), the net enrollment rate is the "ratio of children of official school age who are enrolled in school to the population of the corresponding official school age", on the other side, the gross enrollment rate is the "ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown" (World Bank Group, 2018e).

The primary school net enrollment ratio had been increasing worldwide since 1990 (with exceptions for 1992, 1995, 1996, 1997 and 2013), reaching 89.5 % in 2016 (the last year of available data). In the same period, the EU also did some progess increasing its ratio from 95.3% to 97.2%. Looking at the primary school gross enrollment ratio, since 2002 the gap between the world average and the EU disappeared and the difference between them is, on average, 0.6%. The difference between the net and gross ratios is, on average, 15.7% in the case of the whole world and 5.7% for the EU. In the available period the gap decreased by 2.4% worldwide and 0.3 for the EU (UNESCO Institute for Statistics (UIS), 2018). All the data about the primary school net and gross ratios, from the standpoints of both the world and the EU, can be seen in Figure 15.

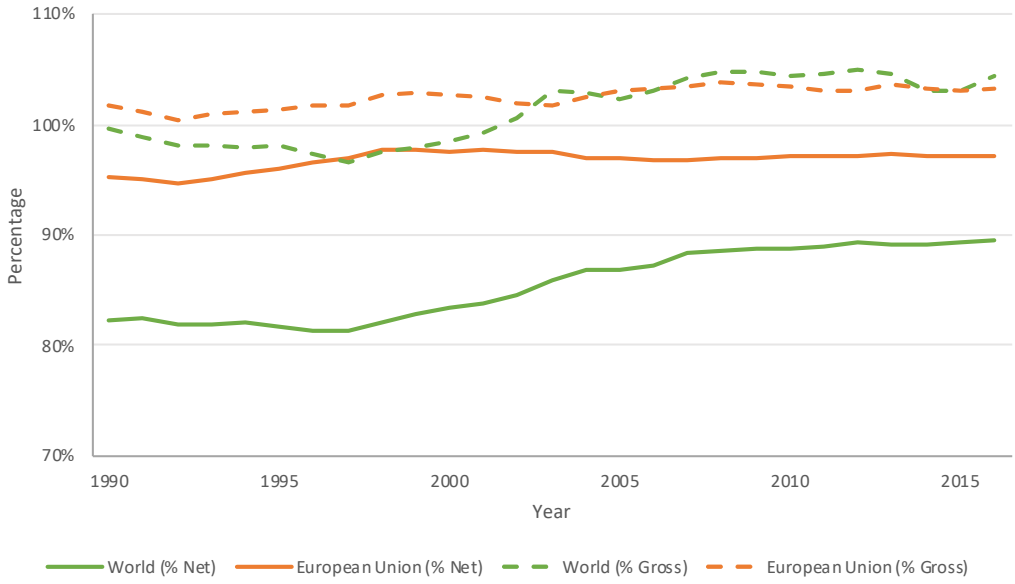

Figure 15 – Primary school enrollment ratio

Data source: UNESCO Institute for Statistics (2018)

Worldwide, secondary school was not perceived to be as essential as primary school, and the first indicator of this reality is the lack of data regarding the net enrollment rate from 1990 until 1998. The second indicator is the low enrollment percentage, despite its growth with an average rate of 0.6% (remember the "law of cumulative growth"), only 65.6% of the children with the official school age are enrolled in school. In this matter, the EU did a good progress especially in the years preceding 2005, where it increased its secondary school net enrollment by 9.9%; in 2016 its ratio was 92.2%. The gross enrollment rates have been following the net rates tendency, with the exception of, as presented in Figure 16, the EU abrupt rise in 2014 which was not followed by the net enrollment rate (UNESCO Institute for Statistics (UIS), 2018).

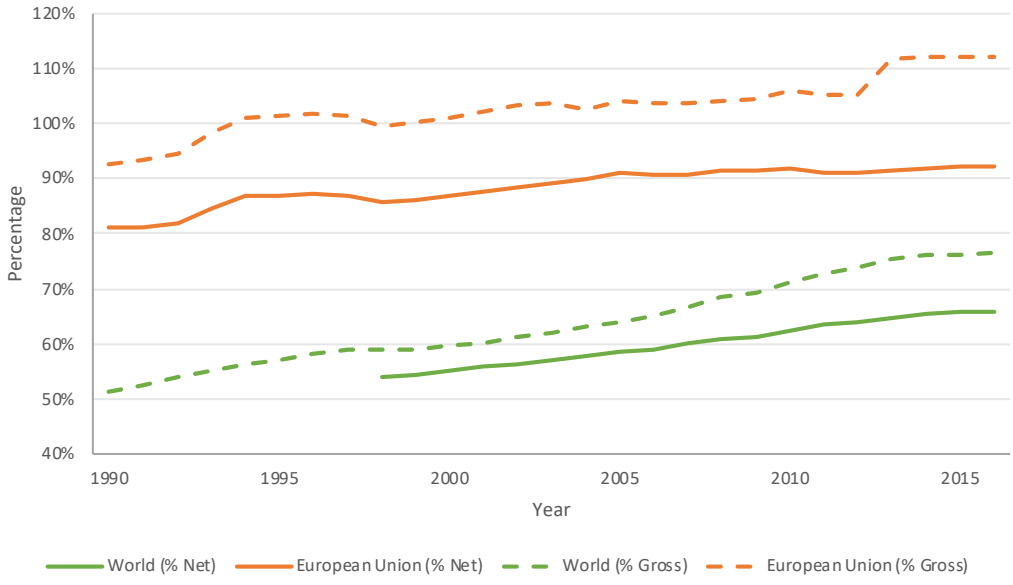

Figure 16 – Secondary school enrollment ratio

Data source: UNESCO Institute for Statistics (2018)

The higher level of education analyzed in this work is the tertiary school and, due to its students age diversity, the net enrollment ratio is not calculated. From Figure 17 it is possible to see that in both areas (World and EU) it is growing. In the period for which data is availale, it grew 23.1% worldwide and 38.8% in the EU. These different

growth rates resulted in an increment in the gap between the two areas, in 1990 it was 15.2% and by 2016 it was 30.9% (UNESCO Institute for Statistics (UIS), 2018).

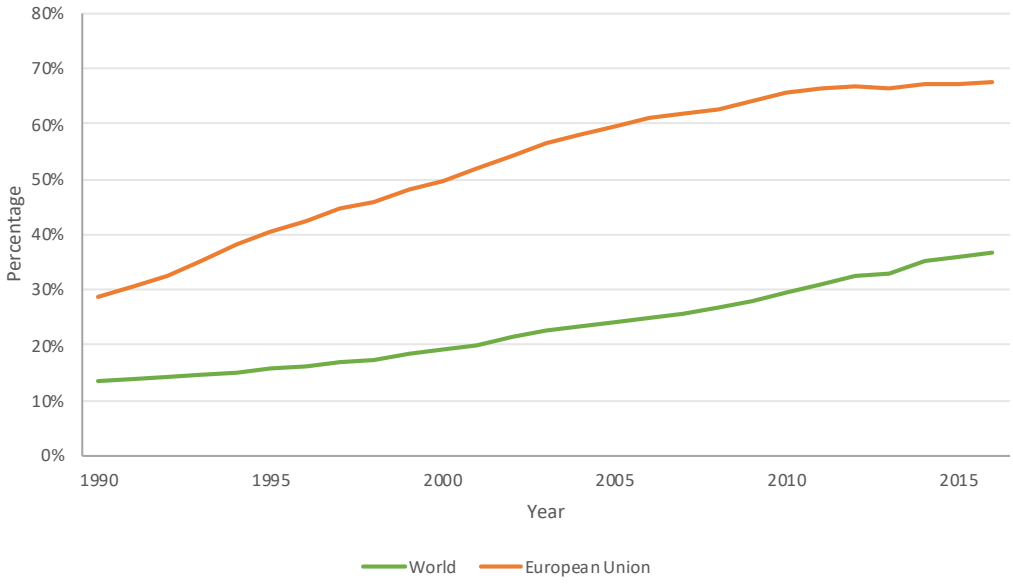

Figure 17 – Tertiary school enrollment ratio

Data source: UNESCO Institute for Statistics (2018)

The International Institute for Applied Systems Analysis (IIASA) / Vienna Institute of Demography (VID) (2015) projected the mean years of schooling for 2020 and 2030. This indicator shows the average number of years of education received by people aged 15 and older. Figure 18 and Figure 19 show the world map where colors represent different average values, the evolution is notorious in the scales, in 2020 the clear blue (lowest scale) represents approximatly 3.0 years of schooling in average, by 2030 it is expected to increase 33.8% to 4.0 years. The highest scale is estimated to increse by 2.5%.

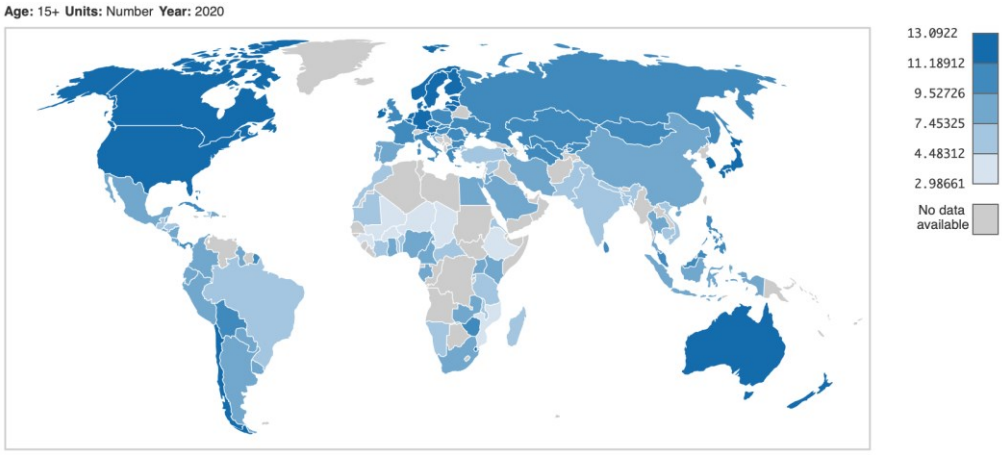

Figure 18 – World mean years of schooling 2020

Source: International Institute for Applied Systems Analysis (IIASA)/Vienna Institute of Demography (VID) (2015)

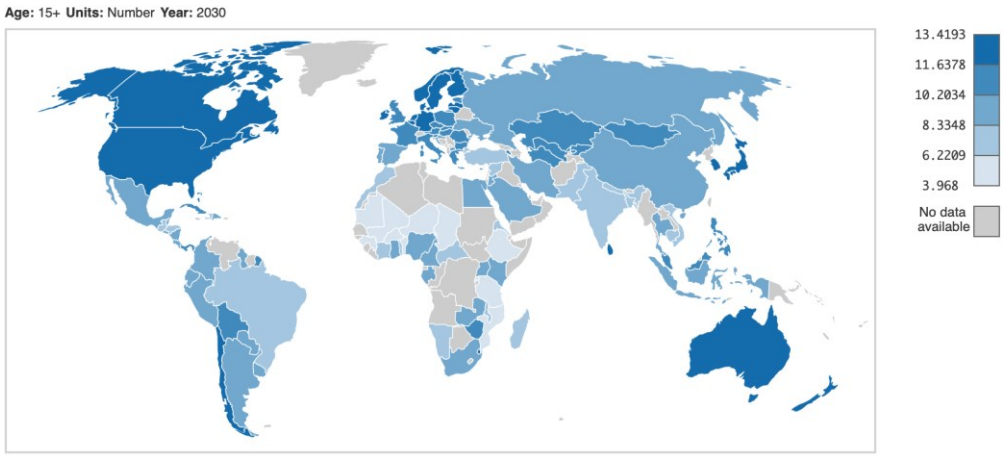

Figure 19 – World mean years of schooling 2030

Source: International Institute for Applied Systems Analysis (IIASA)/Vienna Institute of Demography (VID) (2015)

The maps available in Figure 20 and Figure 21 show the data for the whole of Europe. Some of the countries that belong to the EU are expected to increase its scale in the analyzed period, however, more important than that is the increse in the average values of all scales, meaning that, in a general way, all the EU countries would have people with more schooling years.

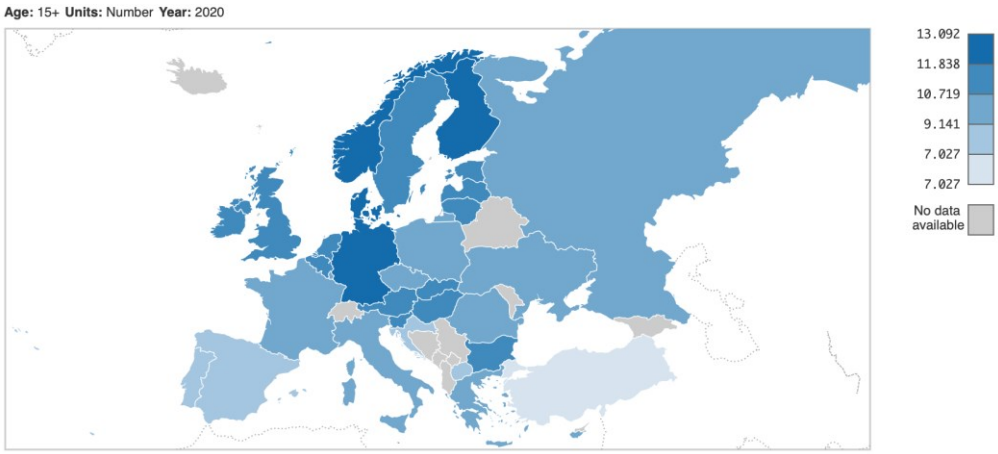

Figure 20 – EU's mean years of schooling in 2020

Source: International Institute for Applied Systems Analysis (IIASA)/Vienna Institute of Demography (VID) (2015)

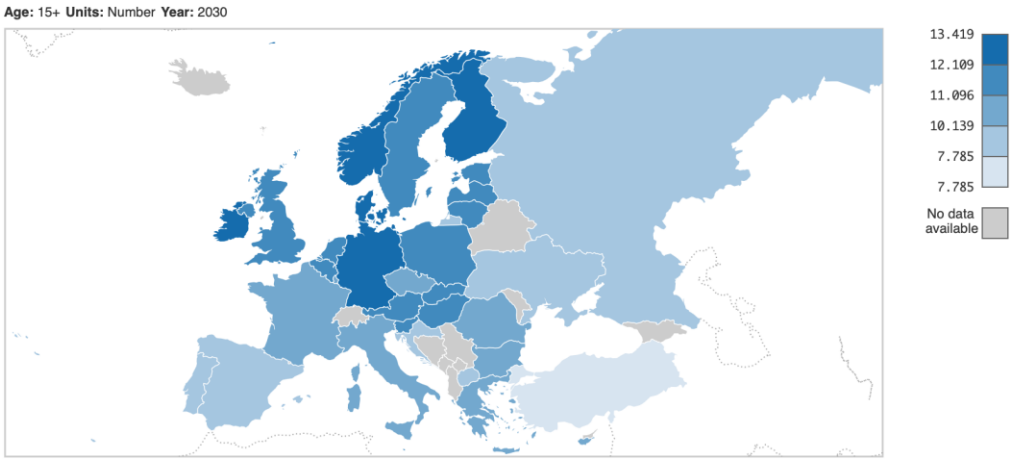

Figure 21 – EU's mean years of schooling in 2030

Source: International Institute for Applied Systems Analysis (IIASA)/Vienna Institute of Demography (VID) (2015)

After taking a glimpse at the expected education levels by 2020 and 2030, it is time to look to education in different subject areas. Due to its specification, this kind of information was not collected during many years and there is no information concerning this data for the whole world. As such, the data presented in Figure 22 represents the EU in the year of 2016. The limited range of the data does not allow to have a broader picture about what happened in the past but can give some information about the precedent and following years (assuming some uniformization).

The EU divides its areas of knowledge in twelve blocks, the most significant one is composed by business, administration and law with a share of 22.1%; it is followed by engineering, manufacturing and construction with 15.9% and the podium ends with health and welfare with a share of 13.2%. In 2016 there were 19.6 million people enrolled in the EU tertiary education (Eurostat, 2019).

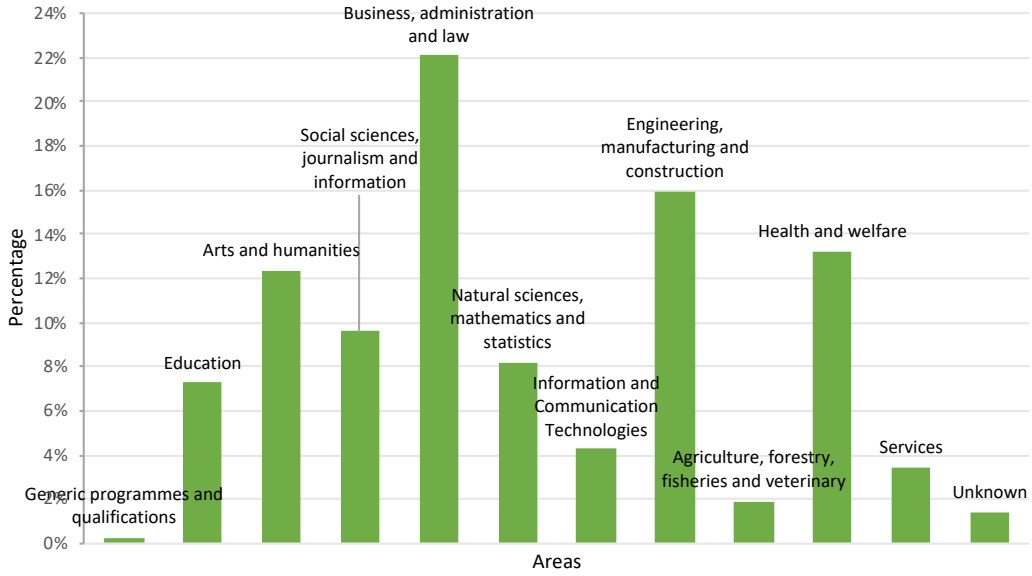

Figure 22 – EU Students enrolled in tertiary education by field of education in 2016

Source: Eurostat (2019)

2.3.5 Employment

After having finished their education levels, the natural transition for people is to find a job. Along the lines of the same transition, we are now going to scrutinize employment numbers. It is crucial to have a clear picture about the amount of jobs existing today in order to tackle future challenges. Jobs have been changing at an unprecedented rate and, if we look back, it is easy to perceive that many of the most common work activities today did not exist ten years ago. Consequently, it is essential to analyze some data regarding employment rates and employment distribution.

The employment rate divides the employed population by the total population under a certain age group. Since 2000, considering the age group more than 15 years

old, the employment rate has been decreasing and it is expected to keep decreasing globally. The same indicator has been more stable in the EU. Comparing the EU and worldwide employment rates, the global values have been higher with an average gap of 7.7% until 2018. If the analysis is done considering the age group more than 25 years old, the gap increases to 10.4% (International Labour Organization, 2018b). It is important to understand that the gap between both realities is not due to the longer studying period in EU and can rather be possibly explained due to higher retirement rates. The presented employment rate is defined as the proportion of a country's working-age population that is employed, Figure 23 presents the global and EU employment rates.

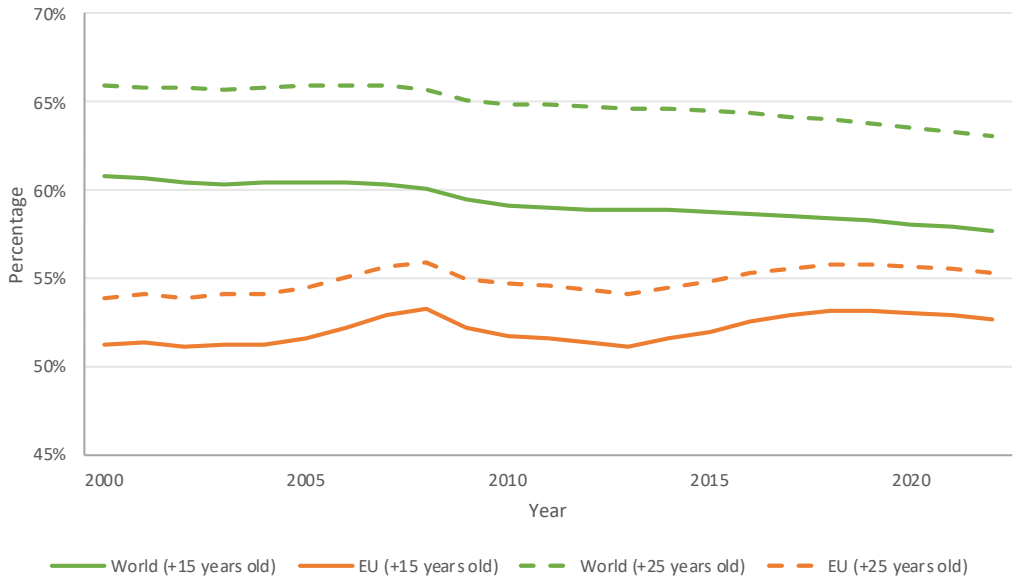

Figure 23 – Employment rate

Source: International Labour Organization (2018b)

Another important data regarding this subject is the employment distribution by sector, and it divides the total employment in three work sectors: agriculture, industry and services. Once again, there are some considerable differences between the global and EU percentages. Services are the bigger employment share in both cases, however the second sector with more employees is industry in the EU and it is agriculture in the global perspective. Services represented 72.1% of EU employment in 2018, a value

20.4% higher when compared with worldwide levels. The opposite happens in agriculture, globally it represents 21.8% more than in EU.

Inside the EU the share of agriculture has been decreasing since 2000 and the International Labour Organization expects that it continues decreasing until 2022 (last year of data). A similar situation is predicted for the industry sector, where estimates point to a share of 23.0% by 2022. The decrease in both sectors has been, and probably will continue to be, supported by an increase in the services sector, from 2000 to 2018 it grew 9.4% and it can grow more 1.0% until 2022. All this data is provided by ILO modelled estimates (International Labour Organization, 2018a) and can be visualized in Figure 24 and Figure 25.

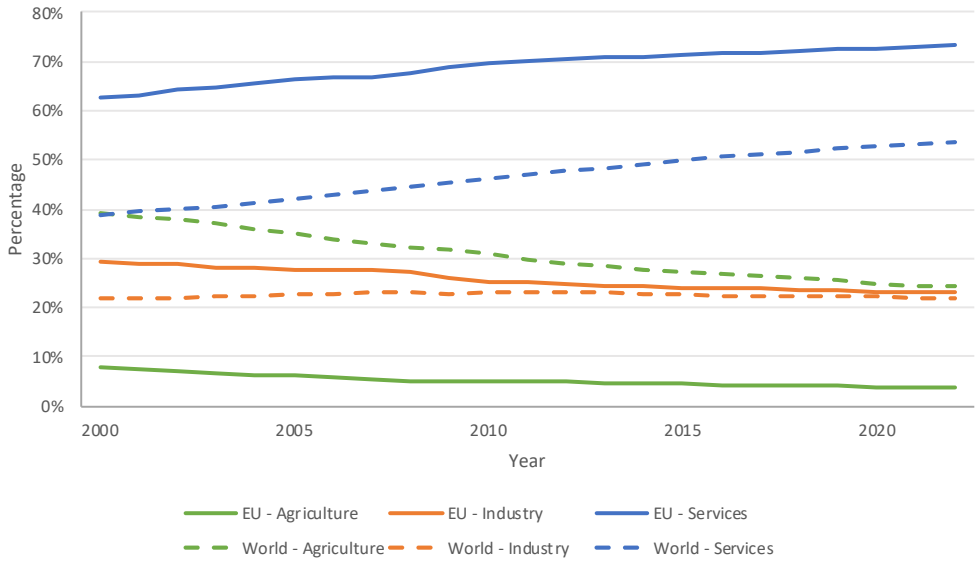

Figure 24 – Employment distribution by sector

Source: International Labour Organization (2018)

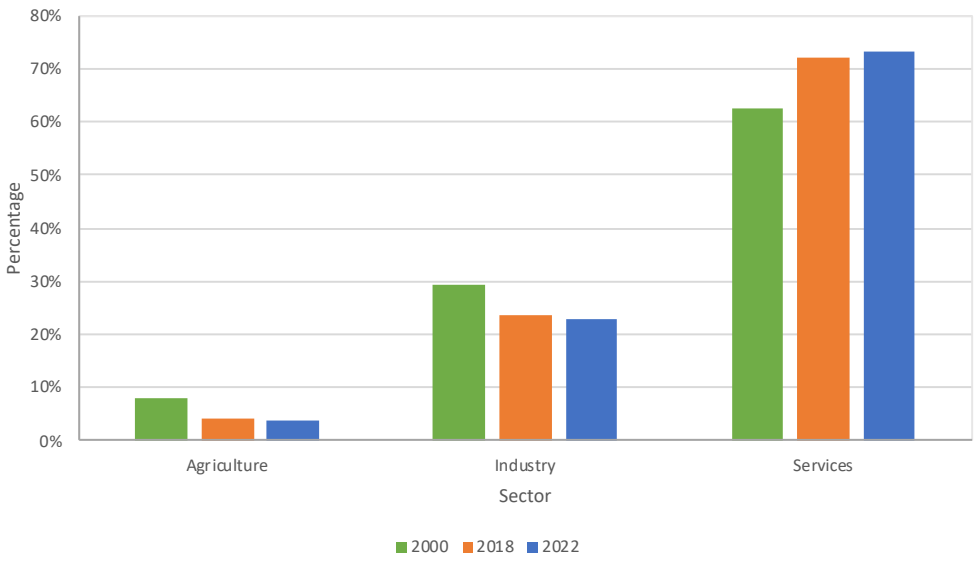

Figure 25 – EU employment distribution by sector

Source: International Labour Organization (2018)

Dividing the work structure in agriculture, industry and services allows us to have a general picture about the numbers of employment by sector. However, in order to have a better understanding of what is happening in the EU, a more detailed work distribution was analyzed.

Figure 26 presents the EU employment distribution in non-financial business, which includes the sectors of industry, construction and distributive trades, and services, in 2015. Manufacturing and distributive trade, which is mainly composed by retail and wholesale sub-sectors, represent the biggest employment share with 45.8% and 45.7% of value added in non-financial business. Administrative and support, and transportation and storage services, are the third and fourth in the employment list, they represent 10.7% and 9.2% of the total share, respectively. Together the sectors amount to 17.7% of the value added to the EU economy. In this way, the four biggest employment sectors employ 65.7% and add 63.4% of value to the EU economy (Eurostat, 2017).

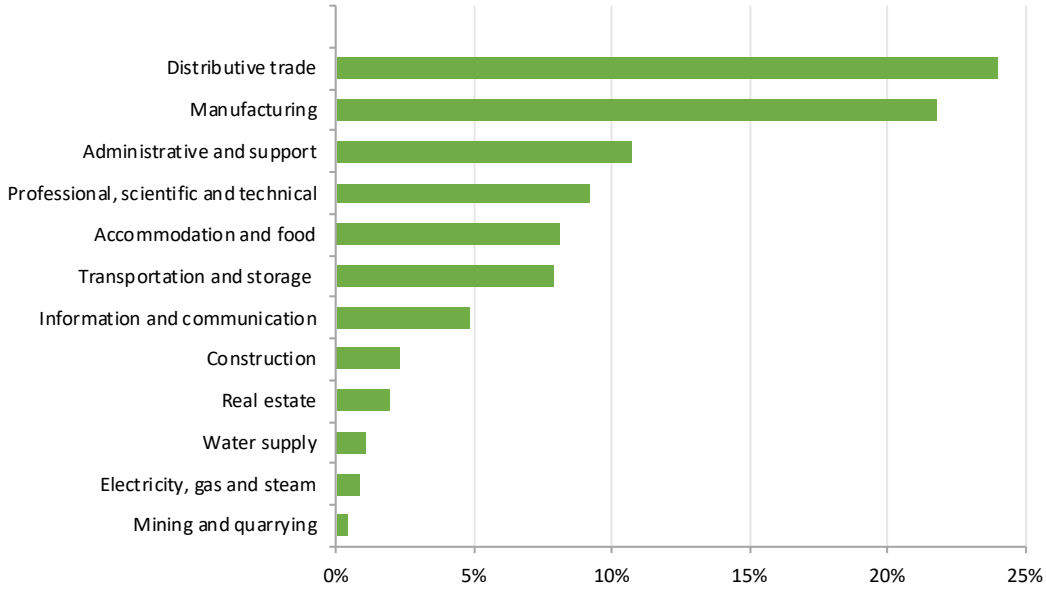

Figure 26 – Percentage of all people employed in the non-financial business in EU by 2015

Source: Eurostat (2017)

2.4 The future of jobs

As we have seen in the subchapter above, the employment structure has been changing along the years. The changing nature of work is directly connected with events and technological developments, changing the way in which humans work and live. The current subchapter provides more detail about the fourth industrial revolution and in how it can impact the future of jobs.

There is no doubt that we are at the starting point of a period that will reshape jobs. Technological breakthroughs are rapidly shifting the frontier between the work tasks performed by humans and those performed by machines and algorithms (World Economic Forum, 2018). This new paradigm has caught the attention of public and private organizations that have been trying to predict the dimension and timeline of the changes that will bring about this new world.

The inclusion of robotics and cognitive technologies in the workspace is creating a world where many employees will work and collaborate with robots and learning machines. The specificity of this technological revolution is that today's advances in digital technologies are remaking not just manufacturing and low-skilled labor, but every sector of economies and societies. Past industrial revolutions transformed the work form in highly specialized and standardized tasks that became tightly integrated. This is true not only of jobs related with manufacturing and construction but also of a broad range of white-collar jobs (Deloitte, 2017).

In the report "A Future that Works: Automation, Employment, and Productivity", McKinsey Global Institute (2017) explores the potential of automation and its impact in the world productivity. To predict the percentage of work automation the company based the analyzes in two scenarios, one that represents an early scenario and the other that represents a late scenario. By 2030, 50% to 85% of the time spent on current work activities could be automated, however the adoption rates in the same time period should be between 0% and 30%. This study involved 46 countries, representing 80% of the global labor force. With a higher degree of uncertainty due to the longevity of the prediction, by 2040 the technical automation potential is estimated to be between 55% and 95% with an adoption rate that can go from to 5% to 65%. The illustration produced by the company can be seen in Figure 27.

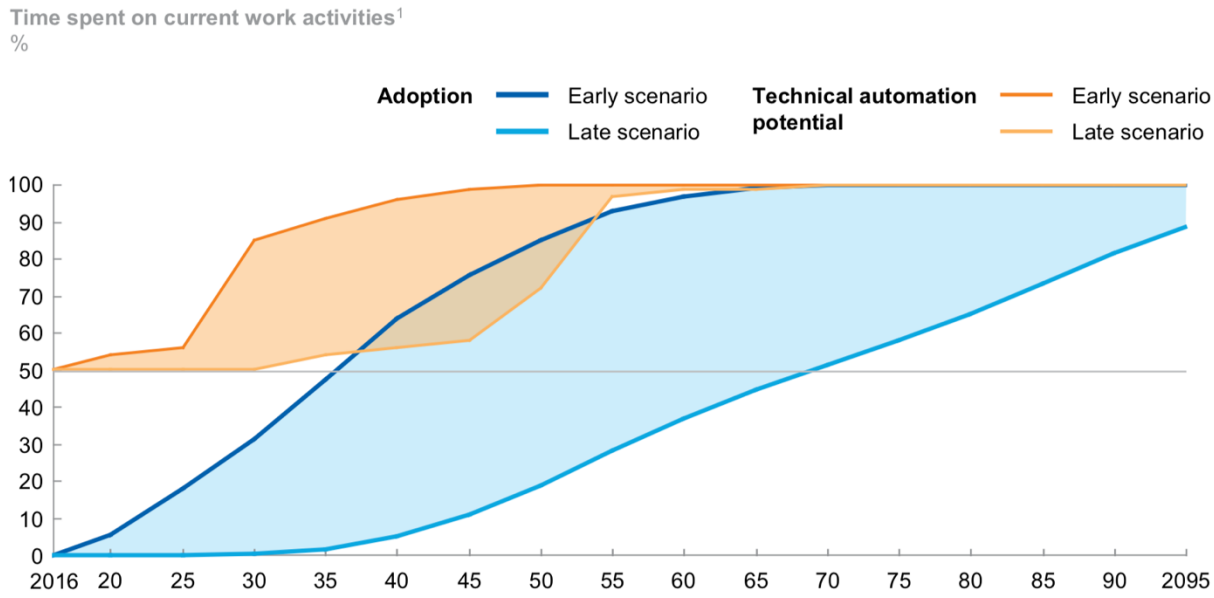

Figure 27 – Potential and adoption of automation

Source: McKinsey Global Institute (2017)

The same analysis was made by Bain & Company (2018) in its report "Labor 2030: The collision of demographics, automation and inequality" where the company estimates that by 2030, 20% to 25% of current jobs may be eliminated. This study was based on secondary market research, analysis of financial information available or provided, and a range of interviews with industry participants. This report only considers the US market, and, as such, its conclusions should only be seen as guidelines for the EU market.

Besides the individual data about automation's technical potential and its expected adoption, Figure 27 also shows the significant discrepancy between both realities. In McKinsey Global Institute's (2017) perspective this can be explained by a set of factors:

Technical feasibility – It explores the technical capacity of automation to perform tasks, if technology is already developed at a level that can deliver the required level of performance. At this moment, there is total technical feasibility in tasks such as information retrieval or gross motor skills but others like natural language understanding are not at the desired level.

Cost of developing and deploying solutions – After being developed some technologies need a maturation process not only to stabilize the technology but also to reduce its development and deploying costs.

Labor market dynamics – Even though a certain activity can be automated it is only automated if it proves to be a better option than other market alternatives. One example of it is the labor cost, if it declines (which is not expected) automation will take more time to happen.

Economic benefits – Besides labor costs, there is also the performance gains and the increased profit. The potential to increase throughput, improved safety, reduce waste, and higher equality are some examples of aspects to take into consideration.

Regulatory and social acceptance – one of the aspects that can contribute to the rapid or slow adoption is the regulatory approval and the reaction of the user. This aspect is extremely relevant to the process and some of the conclusions provided by this thesis try to provide some insights about what should be done.

Coming back to the technical feasibility aspect, it is important to understand that the technical potential for automation across sectors varies depending on the activities involved. With technology already available, activities related with managing and developing people have 9% of automation potential, applying expertise to decision making, planning, and creative tasks can be 18% automated and 20% of the activities related with stakeholders' interface no longer require human action. Physical activities and operating machinery in unpredictable environments can be 26% automated, human time required to collect data and process data can be 64% and 69% reduced respectively, as well as 81% of the physical activities and operating machinery in predictable environments. This information can be visualized in Figure 28.

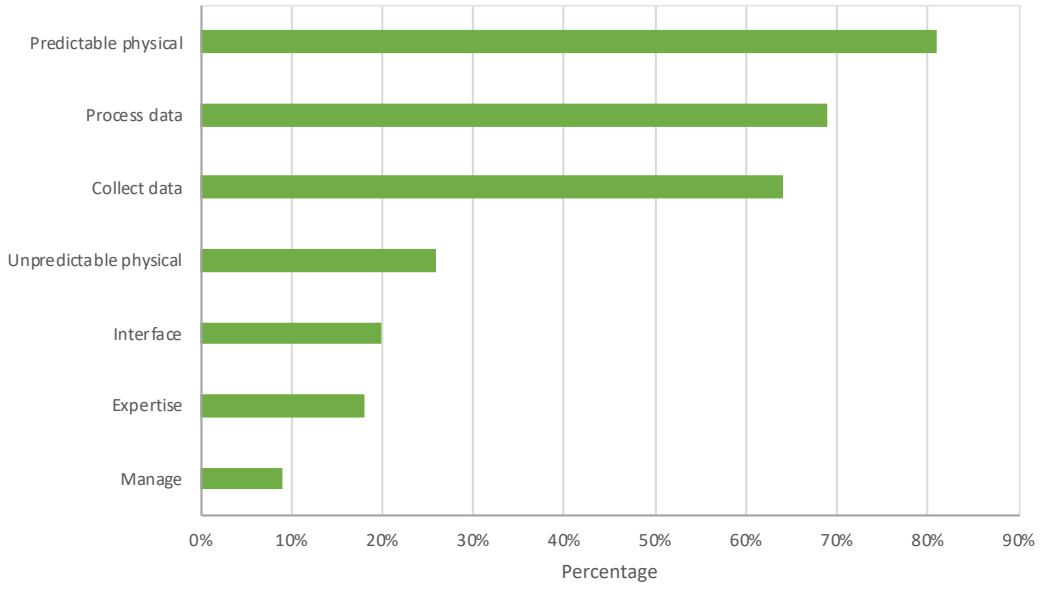

Figure 28 – Potential of automation, currently demonstrated technology

Data source: McKinsey Global Institute (2017)

In a more detailed description of activities, Eurofound (2018) devised Figure 29 where it is possible to understand which activities are going to be more and less needed by 2030. Concurring with the other studies we already mentioned, this figure shows that physical activities are expected to be reduced in the future as well as repetitive and standardized methods. The more puzzling finding may be the reduction in working with machines; however, this can be easily understood considering that machines are going to work with lower human intervention. On the other side, the activities expected to grow are related with intellectual and social aspects. However, it is interesting to note that the activity with higher estimated growth is ICT – basic IT, which is considered a tool.

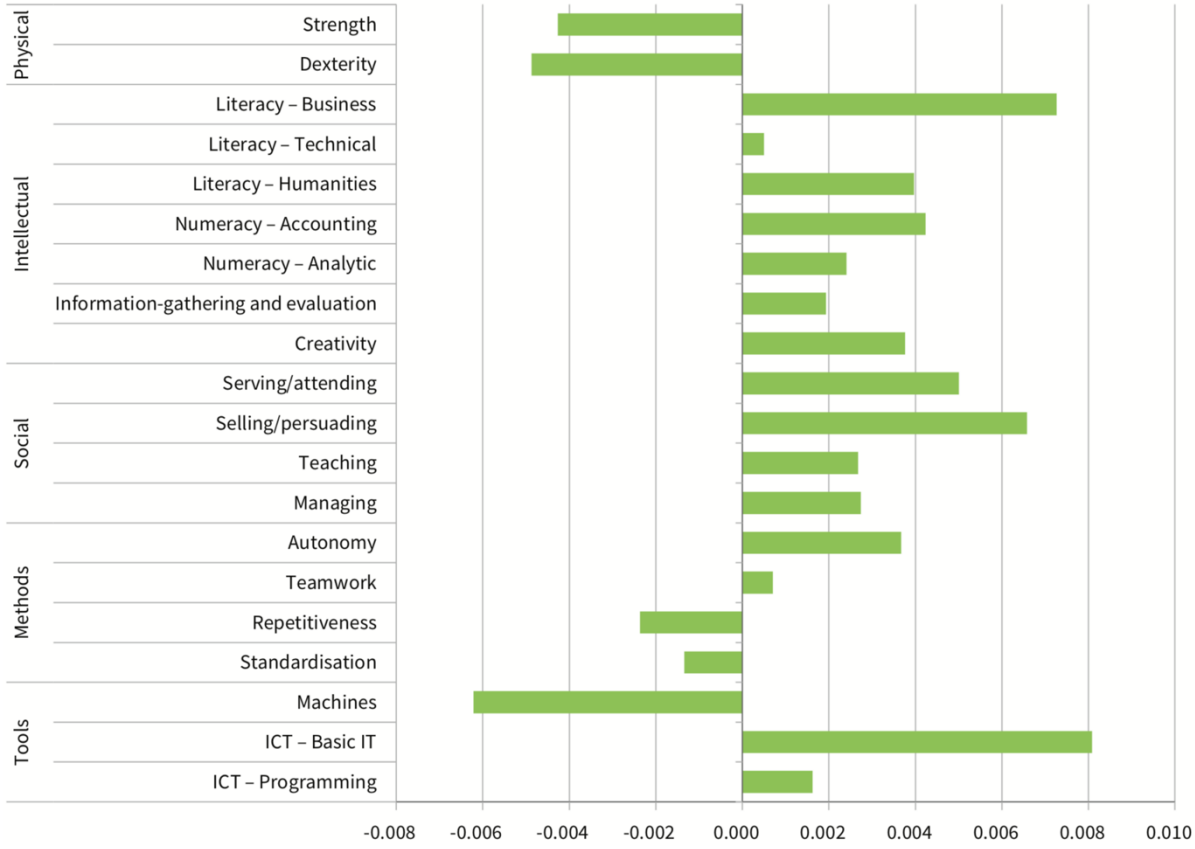

Figure 29 – Change in the task indices in the EU, 2015 to 2030

Source: Eurofound (2018)

Picking the seven activities defined in Figure 28 and estimating their impact in different business sectors can provide some insight on the impact of automation. Businesses that have a higher percentage of physical activities and operating machinery in predictable environments have a much larger automation potential than businesses with a core business in managing and developing people. McKinsey Global Institute (2017) depicts this information in Figure 30 (note that this information is relative to the US market).

Accommodation and food services, manufacturing, and transportation and warehousing are the top of sectors regarding automation potential, 73%, 60% and 60% respectively. These sectors are at the top because their core processes involve activities more susceptible to be automated, as is the case of accommodations and food services where a big part of activities are considered physically predictable. On the opposite

direction are the sectors that encompass professionals, management and educational services, given that their core does not involve a lot of time in highly automated activities, they rank 35%, 35% and 27% of automation potential respectively. These sectors have activities like manage and expertise that as presented in Figure 28 are more difficult to automate.

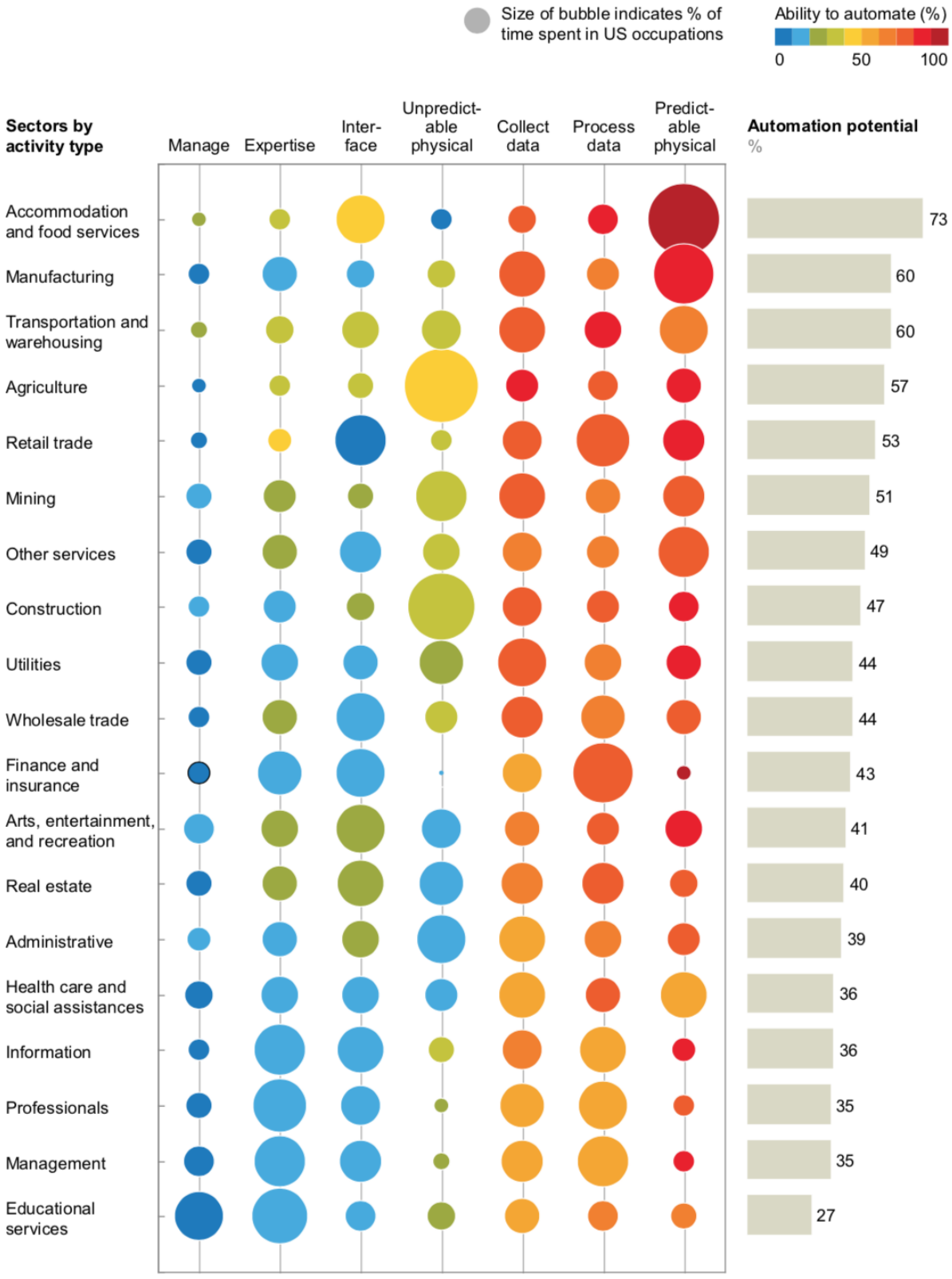

Figure 30 – Technical potential for automation across sectors varies depending on mix of activity types.

Source: McKinsey Global Institute (2017)

The process of automation is expected to boost labor productivity, which can lead to a drop in the need for workers in a given sector. Second, the relative cost of goods produced by automation can fall, increasing the overall material standards of living. And third, by reducing the amount of resources used needed for producing of set of goods, it allows resources to migrate elsewhere, increasing the production of other goods. However, the impact in labor productivity is not the same in all sectors (Bain & Company, 2018).

Compared with 2018 standards, productivity can increase 30% by 2030, however there is a big variance across the industries. Top gains due to automation are expected to occur in manufacturing 55%, accommodations and labor services 51% and retail 49%. On the opposite side are healthcare and social assistance 18%, retail estate 16% and education services 10%. Figure 31 presents the complete data set about this topic and it also shows a strong correlation with Figure 30 in the activities where automation will have a bigger impact by 2030 (Bain & Company, 2018).

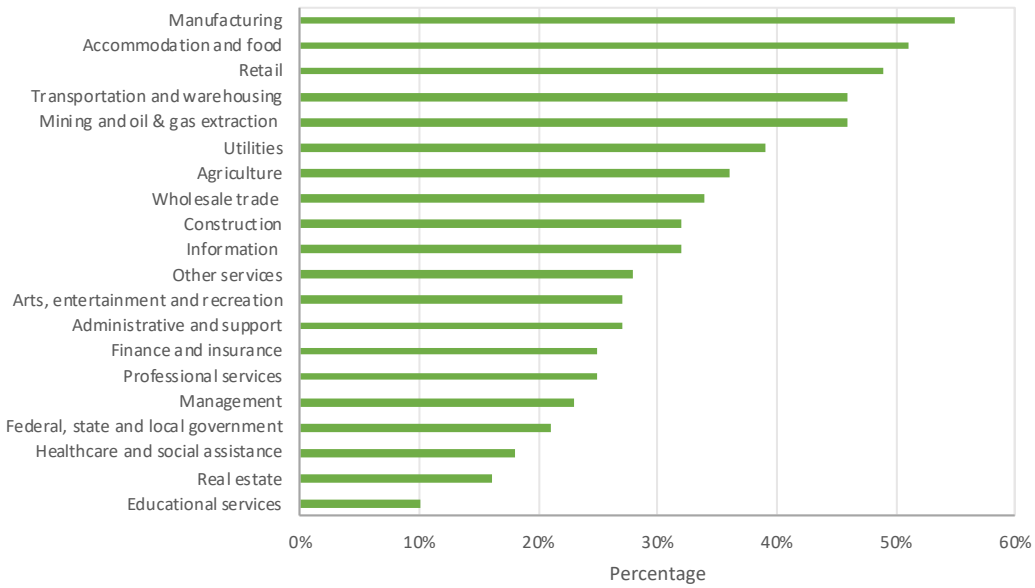

Figure 31 – Automation-driven labor productivity growth, 2015 vs. 2030

Source: Bain & Company (2018)

Even though the data provided by the McKinsey Global Institute (2017) and the data provided by Bain & Company (2018) contain different information, the two can

be directly correlated. Four from the top five sectors identified in the McKinsey Global Institute (2017) are also present in the Bain & Company (2018) report. On the other hand, regarding the sectors where automation is expected to have a lower impact the correlation is three out of five.

This reconfiguration of jobs can leverage unique human skills. Three out of four executives believe automation will require new skills such as empathy, social and emotional intelligence, the ability to set context, and define business problems (Deloitte, 2016). The required skills are going to change and activities involving interacting, applying expertise and managing will become more common than they are today. Global teams will increase the demand for virtual-collaboration skills and the additional complexity will boost the need for adaptive thinking. This set of skills will also emphasize the importance of leadership and transdisciplinary skills. Among technical skills, expertise in cloud technology, statistics, system integration, big data, and the Internet of Things will be valued (McKinsey & Company, 2017).

All these transformations will require companies, government and people to adapt, and some factors, such as wages, will also suffer significant changes. Based on Bain & Company's (2018) information, workers should expect a depressed wage growth, which can benefit owners of capital and the 20% highly paid workers.

The general assumption is that people with high qualifications have jobs with higher income and people with low qualifications have jobs with lower incomes. However, the predictions for 2030 show that people with low qualifications may not have a job. Figure 32 presents the employment change by job-wage quintile for different qualifications. The job-wage quintile divides jobs in five groups of wages, where the low and high wages represent 20% of the employment each. As it is possible to see, by 2030 estimates point that all sectors in EU will have more people with high qualifications and that people with low qualifications will have more difficulty to find a job (Eurofound, 2018).

This change of paradigm shows one of the main threats to work distribution caused by technological evolution, space for people with low qualifications will be drastically reduced.

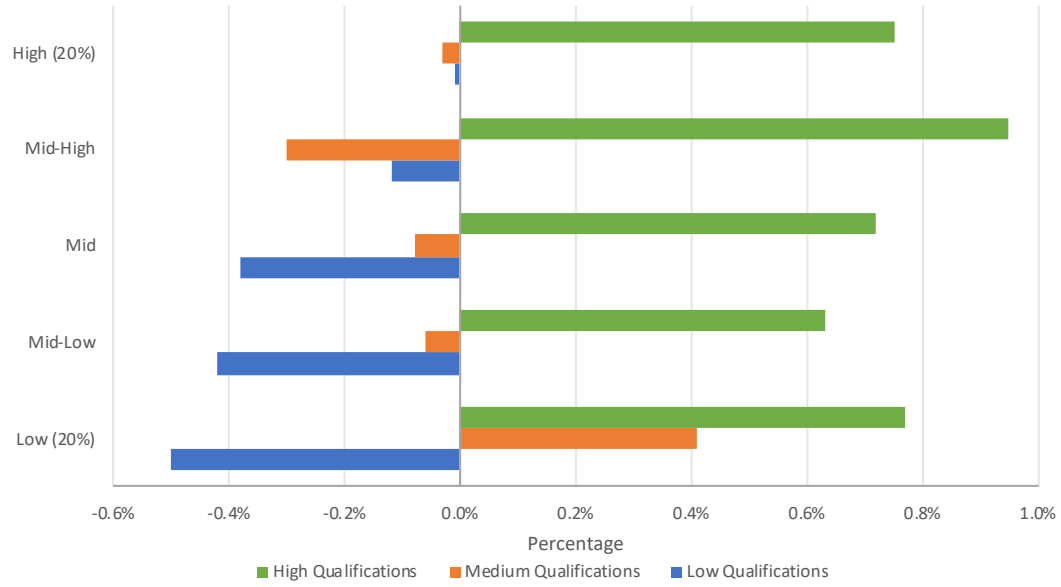

Figure 32 – Employment change (% per year) by job-wage quintile, 2015-2030 EU by qualification.

Data source: Eurofound (2018)

The predictions are clear: future jobs need people with high qualifications. However, even people with high qualifications will be differentiated according to salaries. A certain kind of occupations will be more valuable than others and this will result in a stratification of wages.

Work distribution considering the job-wage quintile tries to understand the impact of wages in work demand. Projections show that all EU job-wage quintiles will experience a growth in employment by 2030 compared with 2015 levels. However, if the 28 EU countries are analyzed one by one, only two of them (Bulgaria and Greece) expect a negative change in the high-paid quintile, whereas the number of countries that expect a decrease in the low-paid quintile is twelve (Bulgaria, Croatia, Denmark,

Estonia, Finland, Greece, Hungary, Italy, Latvia, Lithuania, Poland and Slovenia) Eurofound (2018). Figure 33 illustrates the numbers regarding the EU.

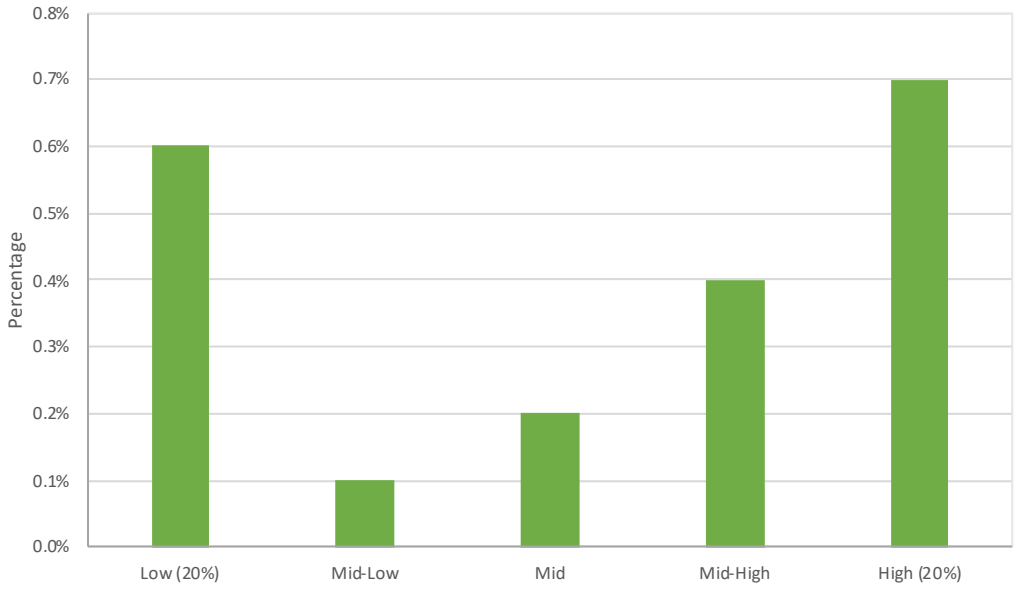

Figure 33 – Employment change (% per year) by job-wage quintile, 2015-2030

Data source: Eurofound (2018)

Even though there is a clear indication that unique human skills are going to be the most significant in the future, it is very difficult, in the present, to anticipate new jobs and trends that, first, need to be invented. One thing seems certain, though: the trend of lifelong learning becomes permanent, as individuals have to continually learn new skills to remain employable (Deloitte, 2017).

Besides the concept of lifelong learning there is also other key aspect that can shape the future of work, which is the freelancer job. In a survey conducted by Deloitte (2016), 42% of the executives surveyed expect a significant increase in the use of freelancer work, against 16% that are expecting a decrease. This lack of stability of jobs can also have important consequences, as will be see in the results.

2.5 The case of Portugal

Due to the complexity in finding a certain kind of data at a national level, and for reasons of simplicity of analysis, all the data respecting to Portugal will be presented in this sub-chapter. Although at a lower level of detail than the previous research conducted from global and EU perspectives, the following pages explore demographics and future work scenarios for the Portuguese reality.

The Portuguese population reached 10 million in the year of 1985 and continued to grow until 2010 when it reached its maximum. Since them the population has been decreasing and by 2030 Portugal is expected to have 9.9 million of people. Figure 34 presents data regarding Portugal' population and its growing rates.

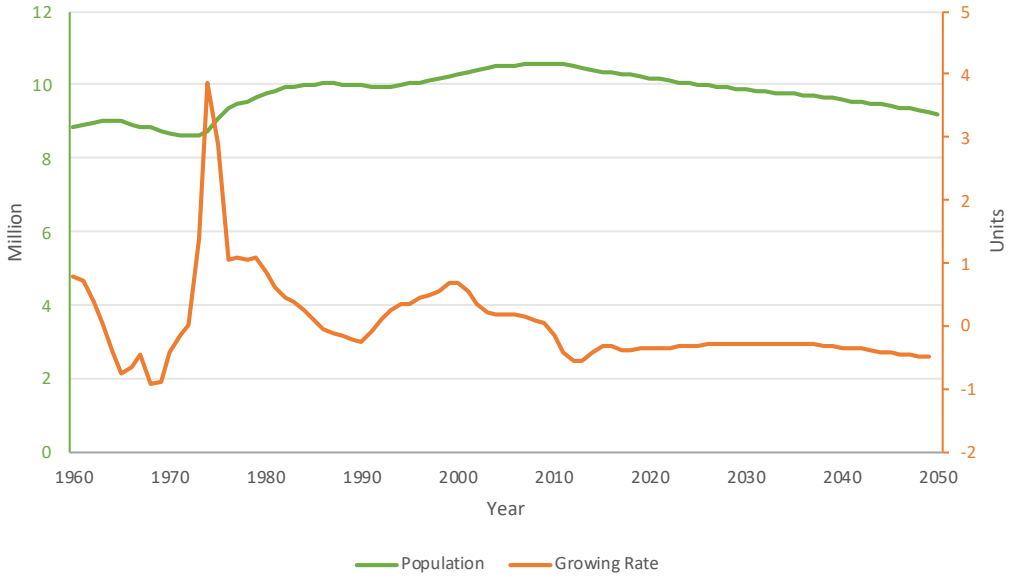

Figure 34 – Portugal's population and its growing rate

Data source: World Bank Group (2018b).

Besides the negative growing rate, Portugal has also declined in the percentage of population under 14 years old as well as in the population that belongs to the age group 15 to 64 years old. Since 2000 the number of people more than 64 years old has

exceeded the number of people under the age of 14. The Portuguese age group distribution is illustrated in Figure 35.

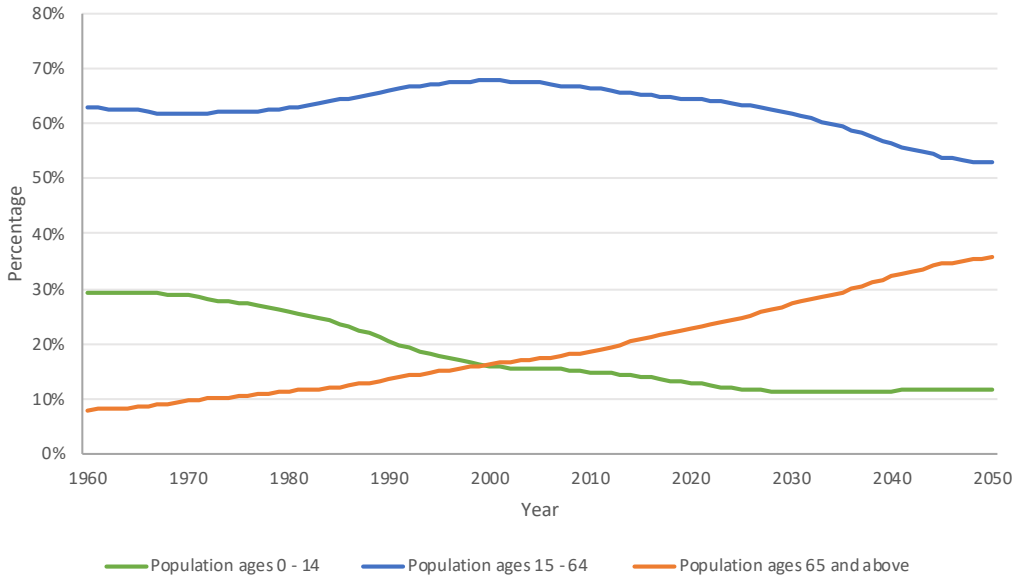

Figure 35 – Portugal's age group distribution.

Data source: World Bank Group (2018b).

One aspect that can justify the growth in the population more than 64 years old is the life expectancy at birth. When compared with EU levels Portuguese people have a lower life expectancy at birth; however, by 2030 people in Portugal are expected to live to be 83.4 years old, an increment of 7.5 years when compared with 2000 values. A more detailed analysis is shown in Table 2.

Table 2 – Portugal and EU life expectancy at birth

Life Expectancy at Birth (years)			
	EU	Portugal	Difference
1990	74.9	74.0	0.9
1995	75.8	75.3	0.5
2000	77.2	76.3	0.9
2005	78.4	78.1	0.3
2010	79.7	79.0	0.7
2015	80.6	81.1	-0.5
2020	81.6	82.0	-0.4
2025	82.4	83.0	-0.6
2030	83.2	83.8	-0.6
2035	83.9	84.5	-0.6
2040	84.6	85.1	-0.5
2045	85.3	85.8	-0.5
2050	85.9	86.4	-0.5

Data source: World Bank Group (2018d).

The main problem in the aging of population is the reduction in labor force and consequently the increase in the labor force dependency ratio. In the Portuguese case, the labor force dependency in 2018 almost reached 1, twenty years after the last time that this value was above 1, 1998. More concerning than that is the current tendency which, if maintained, will increase even more the pressure on the labor force to support the population that is not active. The only reason why this future is not certain is due to some unpredictability both regarding the political will of the Portuguese people in the present and in the future. Be that as it may, one thing is certain. As it is possible to grasp from the population data displayed below the Portuguese population will be older by 2030 than it is today. Figure 36 presents this data.

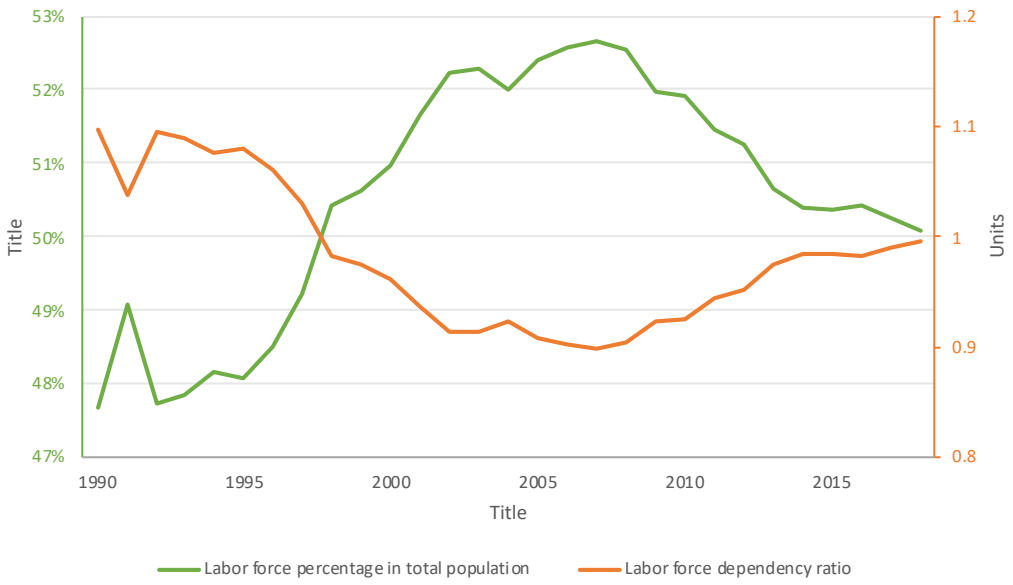

Figure 36 – Portugal's labor force.

Data source: World Bank Group (2018b) and (2018d)

In order to better understand who is driving the labor force, data about female, male and people in the age group 15 to 64 years old was collected. It illustrates the reality for the defined parameters. From Figure 37 is possible to see that the percentage of female population in the labor force has been decreasing in the last years, following a long-standing trend in the percentage of male population in the labor force. On the opposite side is the percentage of people with age between 15 and 64 years old in the labor force, that has been slightly growing (World Bank Group, 2018d).

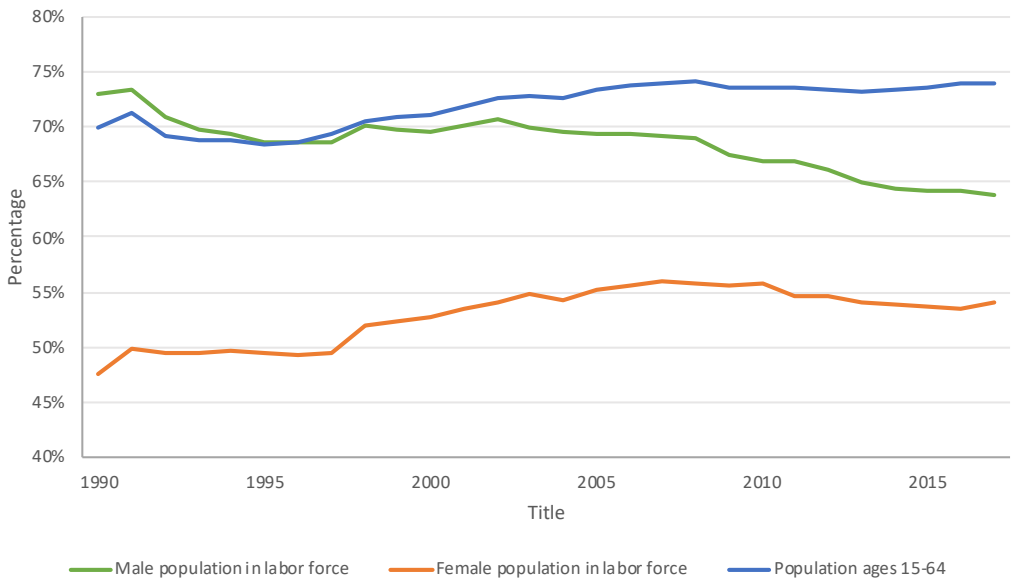

Figure 37 – Portugal's indicators with impact in the labor force.

Data source: World Bank Group (2018d)

One aspect that highly contributes to the success of the labor force is the level of education. Portugal has been reporting a primary school enrollment ratio of 100% over the years however in the last years this level lowered slightly. This can be probably attributed to new accounting methods that ensure more precise results. Regarding the secondary school enrollment Portugal did great progress from 2005 to 2010 increasing its rate 8.7%. The current level of enrollment is 84.2% (PORDATA, 2018b). The values that pertain to the tertiary schools are presented in a different dimension. The tertiary school is presented in the total number of students. Only for one time did Portugal have more than 400 thousand students in the tertiary school and this happened in 2003, the current number of students is 362 thousand less 9.5% than in 2003 (PORDATA, 2018a).

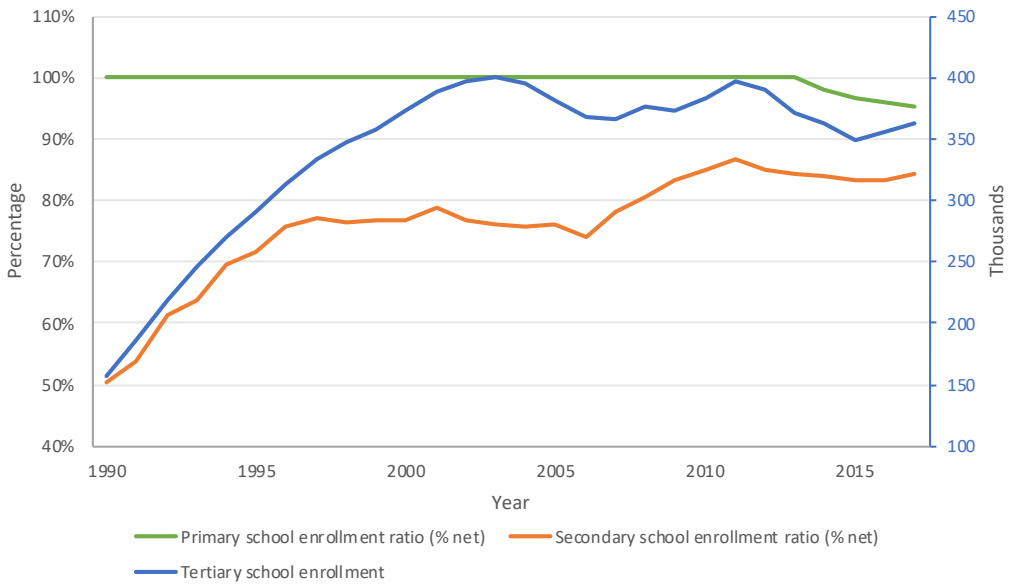

Figure 38 – Portugal's school enrollment.

Data source: PORDATA, (2018a) and (2018b)

The distribution of tertiary school students in Portugal is very similar to the one presented before in Figure 22 regarding all EU countries. Social sciences, business and law is the area with the biggest percentage of students, 32.4%. It is followed by engineering, manufacturing and construction with 21.1%, with health and welfare placed third, with 15.4%. Compared with 2010 levels, engineering, manufacturing and construction decreased 2.0% followed by health and welfare that decreased 1.9%. The biggest percentage increases occurred in arts and humanities 1.5% and sciences, mathematics and informatics 1.2% (PORDATA, 2018a).

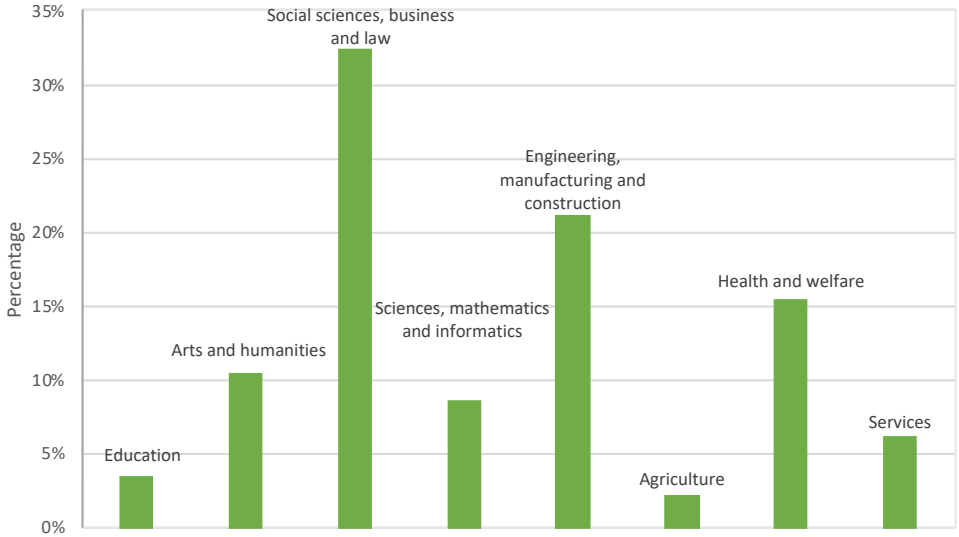

Figure 39 – Portugal students enrolled in tertiary education by field of education in 2018

Data source: PORDATA (2018a)

Concerning the employment rate, Portugal experienced a recession during the last financial crisis. The employment rate reached its lowest percentage in 2013 with 49.6% considering people older than 15 years old and 53.6% if only people more than 25 years old are considered. After reaching this minimum in 2013, Portugal has been recovering and its growing curve can be compared with the EU curve presented in Figure 23. However, as Figure 40 suggests, the International Labour Organization (2018b) expects a decrease in the employment rate after 2019.

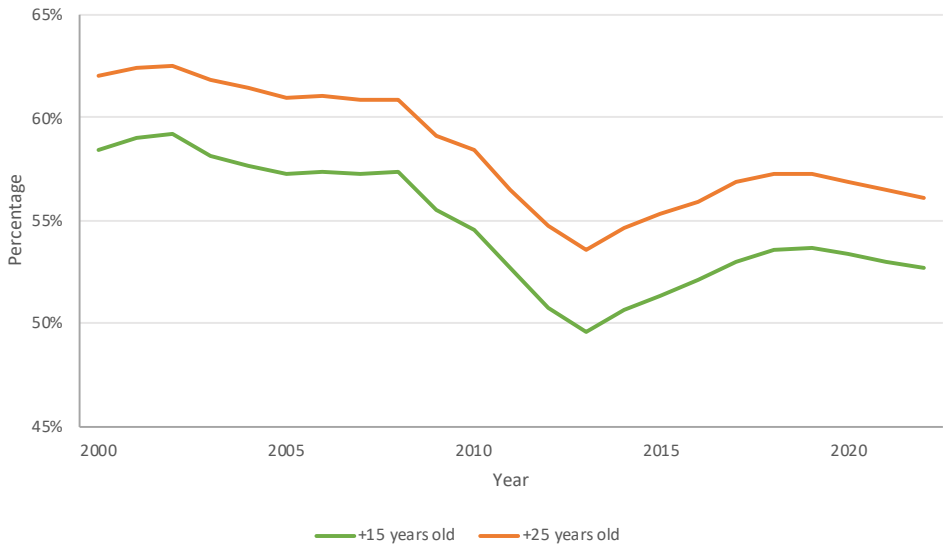

Figure 40 – Portugal's employment rate

Source: International Labour Organization (2018b)

Figure 41 presents the Portuguese employment distribution. From distribution depicted here, we can see that the sectors that employ more are distributive trade, administrative activities and education, with 15.7%, 7.2% and 6.7 respectively. However, if the multiple manufacturing activities were grouped together that would be the most represented group.

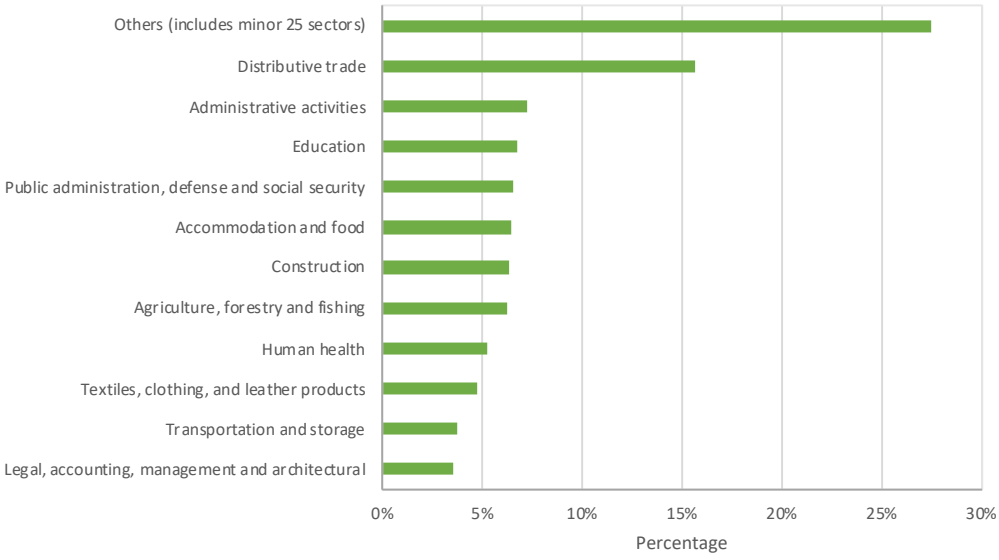

Figure 41 – Portugal's employment by area in 2016

Data source: (PORDATA, 2018c)

Regarding the future of jobs, the case of Portugal is not much different from the general predictions presented before, however there are some particularities which are interesting to understand in this particular case.

In the current situation, 50% of the time spent in work activities can be automated recurring to technologies that already exist. These figures can be expected to grow, considering an average technology development, up to 67% by 2030. From these 67% of automation capability it is expected that 26% are going to be effectively implemented resulting in 1.1 million redundant jobs. The kind of activities that are more susceptible to automation (see Figure 28) represent 52% of the work time in Portugal (McKinsey Global Institute, 2019). Figure 42 presents the expected job loss by 2030 across different activity sectors.

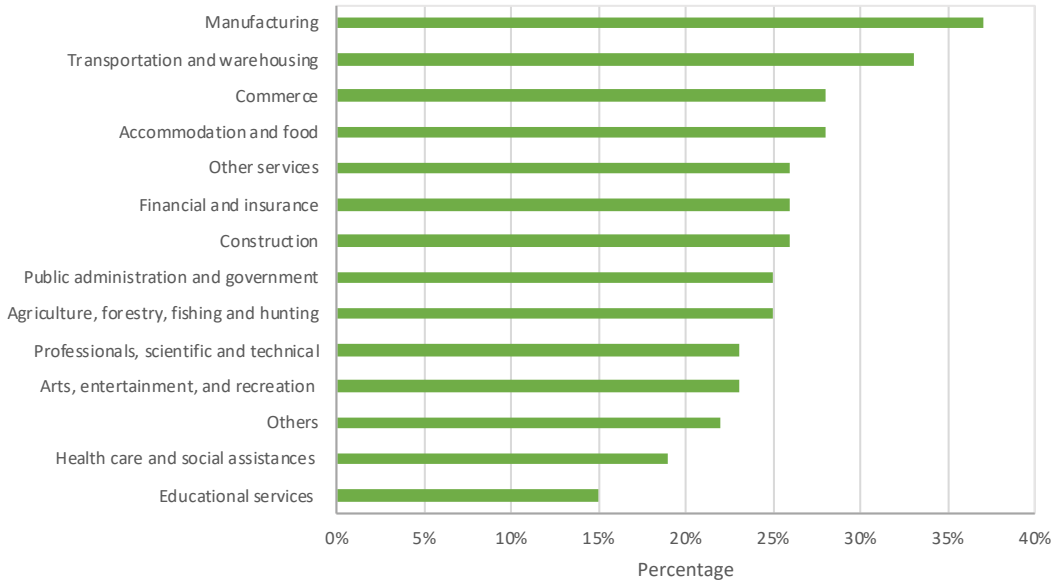

Figure 42 – Portugal's job losses due to automation adoption, intermediate scenario by 2030

Data source: McKinsey Global Institute (2019)

Even though the fourth industrial revolution can turn many of the jobs that we know today obsolete, the creation of some new jobs is also expected. In its report, the McKinsey Global Institute (2019) estimates that this wave of automation can generate

in Portugal between 0.6 and 1.1 millions of new jobs. Comparing the expected work distribution for 2030 with 2016 scenarios the sectors with higher job losses will be commerce, public administration and government, and manufacturing. On the opposite side are health care and social assistance, professionals, scientific and technical services, and construction. A better depiction of this scenario can be found in Figure 43.

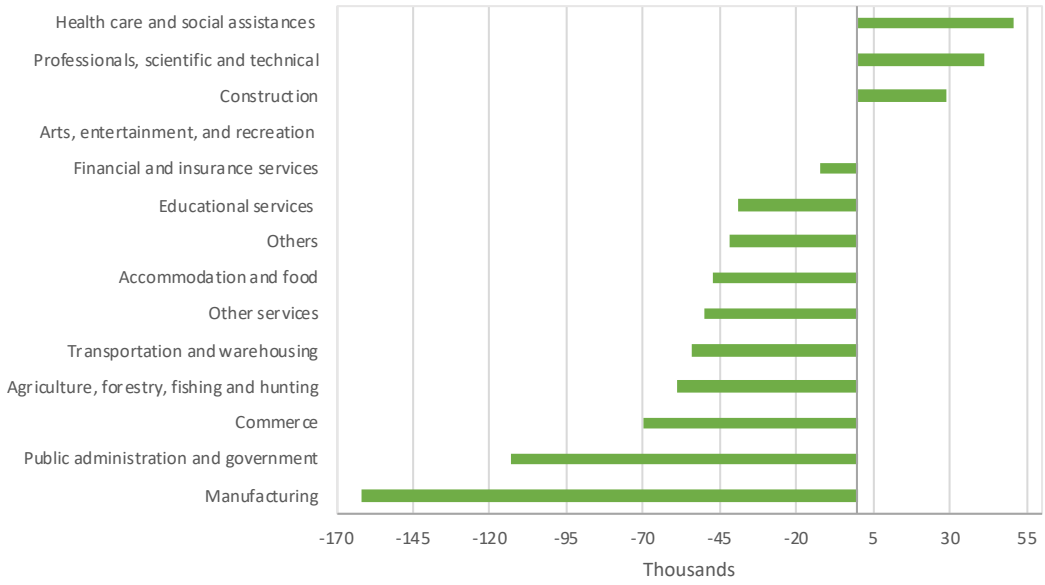

Figure 43 – Portugal employment change (2016 - 2030)

Data source: McKinsey Global Institute (2019)

All the data presented here, for Portugal and the EU, respectively compared with the wider global situation, are perhaps sufficient to draw a portrait that is sufficiently accurate to draw the scenarios and policies that the next chapter, our results, will thus elaborate.

Chapter 3

Results and discussion

In the literature review, the most meaningful data concerning forecasts for 2030 was collected. Now, in this chapter, it is time to draw the most significant conclusions from this data, in order to prepare the answer to our main research question and sub-questions.

3.1 The future of jobs by 2030

As we already stated above, changes in work distribution have been part of history almost since its dawn. Due to the uncertainty they bring, these changes have always alarmed people. In multiple moments in history, people saw their role in society threatened by some new process or technology. However, looking back to the evolution of humankind, with more or less ease, we always found a way to adapt and to reinvent ourselves, eventually creating a brighter future than the one we might have had, if the conditions had not changed the way they did. The world today is a better place than it was before: child mortality has more than halved, the percentage of extreme poverty in the world has fallen, and the tasks that we perform involve much less physical hardship.

If history can teach us something about the future, and if we take the historic reminder of the previous paragraph as a valid indication for that future, we should not be too worried about what is going to happen next. After all, our concerns today might not seem too distant from those that luddites had in the beginning of the 19th century. Nonetheless, to formulate this hypothesis and believe in its likelihood, we would need to be completely sure about the similarities between the past and present/future times. But this never actually happens because technology tends to

accelerate and so does its impact on societies. In other words, technological change sometimes tends to grow exponentially. This is what Raymond Kurzweil (2004, 2005) called "The Law of Accelerating Returns". On it, he explains that contrary to commonly held perceptions about the pace with which technology grows, technological change is actually exponential and not linear, meaning that in the 21st century we are experiencing a lot more than 100 years of progress. In this way, if we are standing in a completely different point than humankind was during the first industrial revolutions, then we need to grasp what is happening and what should be done. This new timing can be as important as the innovation itself.

The European Union is one of the fastest environments in the world. In order to understand the future of jobs and employment, the first aspect that is important to explore are the consequences of the demographic data presented in "Demographics". There, the dissimilarities between the current situations for the EU and worldwide start in the population. The EU population is stabilized and if we look to the growing rate predictions it even may start decreasing in some years. People in the age group from 15 to 64 years old, or active population as it is also known, started decreasing considerably in the last years; so did the group of people under 15 years old even though the latter with a slower rate. On the opposite side is the age group of people more than 64 years, which is undergoing a sharp increase in its share of total population. This phenomenon can be explained mainly due to the increase in the life expectancy at birth, which has been increasing strongly in the last decades, and to this we have to add the low fertility rate.

With this data alone we can see the degree to which this new situation is unprecedented. There is no other time in history in which people lived for so long and the EU population was so elderly. This aging has a strong impact in the labor force. However, in the last years this impact has been smoothed due to the increase of female population in the labor force. Nonetheless, the recent tendency shows that the percentage of female population in the labor force has stabilized, so if these tendencies are maintained we can expect a decrease in the EU labor force by 2030.

All this data brings us to the conclusion that within the EU the labor force dependency ratio is expected to increase in the following years, which means a more important role for each of the individuals in the labor force. However, due to automation the productivity per individual is expected to increase. Theoretically, each individual accounts for more producing even though the actual production might not depend so much on him but rather on machines. And this has a very practical consequence: we might need less human labor and still be more productive.

If we put this into perspective within the global context, the EU population is going to represent a smaller percentage of the world population and also a more aged population than the world average. However, regarding the labor force and despite this expected decrease, the EU can have a considerable higher percentage of labor population compared with the global scenario. The EU also presents better values regarding the labor force dependency ratio but this time with a lower margin. In these topics there is not enough data to support future worldwide predictions, it highly depends on what is going to occur in developing countries in the following years.

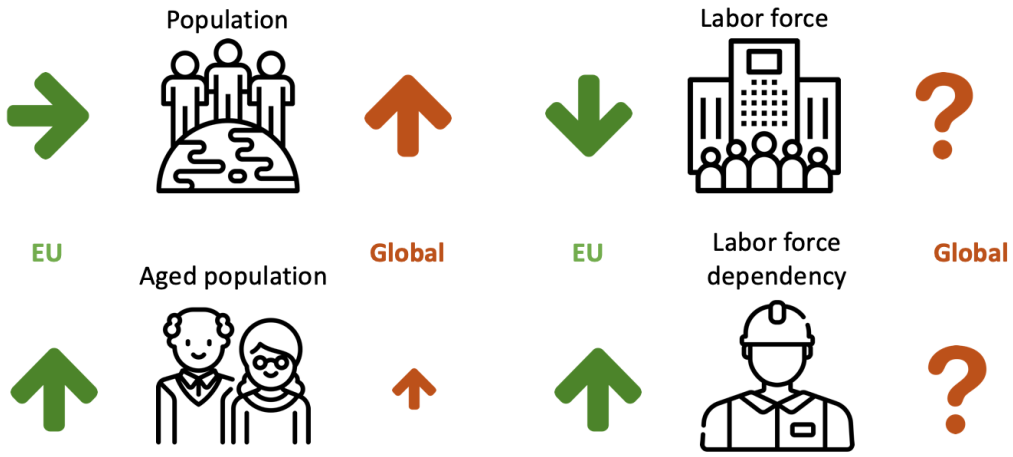

Figure 44 – Population and labor force, comparing between actual and 2030.

Source: Self-elaboration

When the subject is education the EU appears has a global reference. Its primary and secondary school enrollments rates are relatively better than the world standards, and regarding tertiary school, the gap is even bigger. People in the EU study more

than the global average, and the tendency will be to study even more in the following years. This higher level of education can provide EU citizens with a competitive advantage in a market that is increasingly looking for people with higher degrees of specialization.

Concerning employment, we already know that it is expected to decrease by 2030 when compared with current levels. However, the tendency regarding the sector is expected to be maintained: more jobs in services, and less in industry and agriculture. In this aspect the only difference between EU and the global average is that, in a worldwide perspective, the industry is expected to remain at the same levels. Therefore, the EU is somehow distancing itself from the traditional sectors and is betting in the kind of jobs that have a lesser degree of automation potential.

Regarding automation and technical automation potential, the world has already developed the technologies to automate half of the jobs that are being done today by humans. However, there is a big difference between being able to and actually doing it. If in some cases the reason not to automate is related with costs, in others the reasons are more related with regulations and social acceptance. Even in the present moment, we see many technologies that are effectively implemented but not completely regulated. This kind of situation is a clear warning sign to our regulatory systems; the pace of innovation is very fast and if the systems are not prepared to deal with the disruptive changes that are now taking place then society can suffer dire consequences. The social acceptance of automation is highly dependent on how it is going to impact living conditions. However, it is very unlikely that those highly affected by automation would be able to stop it. Not that everything that can be done should necessarily be done; but when the subject is technical innovation that might lead to productivity, we might assume that, at least if proper ethical standards are respected, most innovations that are technically feasible and efficient will eventually be implemented. And from that moment on, the question becomes how to prepare for that implementation in a way that makes more people better off, and not worse. We will come back to this topic when discussing the social consequences of these changes in the employment structure.

Besides all these factors, we also have to consider future innovations that can be so disruptive that they might change all the predictions that we may have nowadays, i.e., the highly improbable, that is sometimes also referred to as the possibility of the "black swan" (Taleb, 2007). Probably the best example of it is the possibilities surrounding Artificial Intelligence (AI). This disruptive technology has the potential to change many of the jobs that all predictions indicated as jobs in which there will be growth in the next years – if some breakthrough development is achieved in AI, all current projections can be significantly underestimated.

However, we can not wait for the next breakthrough innovation to think and prepare our future. Rather, it is crucial to use all information that we have available to do future projections as accurately as possible. Herewith, and bearing in mind that it is very difficult to predict how many existing jobs are going to be lost to automation in the next 10 years, we can still venture to say that a reasonable expectation is a job loss of between 15% - 25%.

Jobs that are expected to be more affected by automation are the ones which are predictable, physical, or dealing with processing and/or collecting data. However, all the existing jobs will be somehow transformed by automation. The best example is related with the functions that are nowadays attributed to a CEO: 25% of them can be done by automated mechanisms.

Sectors like manufacturing, accommodation and food services, and retail are some examples of sectors that involve many activities with high automation potential. In these sectors, more than 60% of the activities that are nowadays performed by humans have the potential to be automated by 2030. These sectors represent a big share of EU employment in non-financial business (more than 50%). And this means that in the next 10 years many of the EU workers are going to change their functions, and much likely change to another sector.

In this kind of sectors, performing these activities are usually workers with low qualifications. One of the biggest problems with this new wave of technology starts at this point: automation, at least in its first years, is going to target mainly the work of

people with lower qualifications, and the new jobs that may be created are mainly for people with high qualifications. Simultaneously, this might lead to a further pressure to attain qualifications: for many jobs an increasing level of qualification will be demanded; and given that less jobs will likely be available, and that many people who already have high levels of education might eventually move to occupy job positions that are now available to people with lower qualifications, those with lower qualifications, unable to compete, could be thrown out of the job market. And this might therefore create the risk of leaving those who are already worse off even in a worse situation, unless other policies are adopted.

The time has now come to answer the research question we stated at the outset: What will be the employment structure in the European Union by 2030, and what measures need to be adopted to prepare this transition?

It is of course impossible to answer this question in a definitive way, given that all exercises in prospective are fallible. However, given the time that is needed to prepare well in advance public and managerial policies, and also all the empirical evidence we presented in the literature review and summed up in the first paragraphs of the current chapter, we feel confident that two alternative scenarios present themselves: scenario 1, which we called "market mismatch" presupposes roughly an equivalence between the number of jobs created and lost by 2030 if compared with the current situation; in scenario 2, the number of jobs destroyed surpasses those created. Given the data presented above, we estimate that a scenario in which the employment rate would actually increase significantly would be a scenario too optimistic to be credible and so there is no third scenario.

In the rest of this chapter, then, we endeavor to answer each of the sub-questions that together constitute our main research question. As there is a significant overlap in the policies that might apply both to scenario 1 and scenario 2, the work follows the thread of the research sub-question. Firstly, the public policies that should be taken by governments and other institutions at a national or EU level; and secondly the managerial policies adopted by the private sector. Certainly, given the complexity of

these future changes, no society will be able to adapt and thrive without strong collaboration between the private and the public sectors, between governments, companies and even the civil society. And perhaps a higher level of coordination of these policies at a EU level shall be needed. However, for analytical purposes, we keep these axes separate in each of the given scenarios.

Why are there these two scenarios, rather than just a description of what seems more likely to happen in a single scenario? Because, if there is uncertainty about how many jobs are going to be lost to automation, an even bigger doubt exists about how many of them can be created (McKinsey Global Institute, 2017b). In the best scenario (which is also more unlikely) the fourth industrial revolution is going to create the same amount of jobs that it is going to replace and, as we saw earlier, those jobs require high qualifications. The information regarding education shows that the EU is moving in that direction, given that the numbers of people enrolled in higher degrees of education have been evolving considerably. However, we are looking at a horizon of just 10 years, which means that the big majority of the working population by 2030 is already in the labor force. The other scenario presents itself has a bigger challenge for humankind because it addresses the hypothesis of a job shortage due to automation.

Based in all the information that we have been exploring until here, the proposed scenarios present our answer to the first research sub-question, Sub-Q1: How will the fourth industrial revolution impact the EU employment structure?

3.1.1 Scenario 1 – Market mismatch

In a positive scenario, we can assume that the number of jobs lost to automation is going to be equivalent to the number of new jobs. However, even in that optimistic scenario we still have a problem, as we just argued: if the new jobs require high qualifications and if people that lost their jobs have low qualifications there is a mismatch between what the market is looking for and what market has available. By the year 2000 the tertiary school enrollment in the EU was somewhere near 50%.

Considering that people work 40 years after finishing their studies all of these workers are supposed to still be working in 2030. The other 50%, that were not enrolled in tertiary school in 2000 are also going to be part of the labor force. It is clear that tertiary school enrollment is not the only way to have the qualifications that are going to be required by 2030. There are people that were enrolled that would not fit the market and others that were not that are not going to have any problem within the new paradigm. The point here is to understand that there is a considerable part of EU populations that does not have the qualifications that are going to be needed by 2030.

This problem is mainly due to the accelerated pace of evolution. In the past industrial revolutions innovations were gradually implemented, the diffusion of information was very slow compared with present standards and people had time to adapt. This time we are facing a job loss from 15% to 25% in the next 10 years. Besides that, going from agriculture to manufacturing did not require any special change in qualifications, the need for qualified people only arrived with the third industrial revolution, while it is not entirely clear whether the third industrial revolution already ended or is now happening concurrently with the fourth industrial revolution. Other aspect is that by 2030 the EU population is going to be aged which is going to result in a higher pressure for the labor force.

Even though this work focuses in the future by 2030, the mismatch between individual competences and market needs can already be felt. This is particularly true in areas like engineering and informatics where the market needs outstand the actual labor offer. In 10 years, this reality is expected to be felt in more areas with higher impact and the EU needs to have a preventive approach to these situations.

3.1.2 Scenario 2 – Jobs shortage

In a not so positive scenario in which the jobs lost far surpass the jobs created, all the aspects that were analyzed before are still true. The difference lies in the worsening of the situation, more people would be without any job and without perspectives of

finding one. This scenario can not be disassociated from the market mismatch scenario given that both can happen at the same time.

Even though it is very difficult for many people to envision their lives without a job, this may happen due to the development of automation. The data shows that the introduction of automation is going to increase efficiency in production. Now, if we produce more we should not be concerned about the future (except perhaps for environment reasons). However, the real question here is how can we prepare to distribute the outcomes of this productivity in an equitable way.

This challenge does not have an easy answer and its discussion is crucial to try to find the proper solution. The idea that people need to work to earn a salary so they can have living conditions could perhaps be reaching its end. Yuval Noah Harari (2017), explored that idea introducing the concept of "the useless class", a class formed by people that are not just unemployed, but unemployable. And this brings us back to the discussion on the "wage-based" society (Gorz, 1999) and the likely need to go beyond it. From the standpoint of policy-makers, what should be done with the aforementioned "useless class", should it appear? Perhaps one will need to rethink the structuring of our social protection system.

At this point we can already understand that there are major differences between what happened before and what is happening already and can still happen in the future. Understanding what is going to happen is important but it is not enough: private and public measures need to be adopted so we can all deal with future transformations with more desirable outcomes.

Within this backdrop, the following sections provide answers to the second and third research sub-questions: sub-Q2: What public policies should the EU adopt to foster job creation and social protection? and sub-Q3: How can companies adapt to become more competitive in this framework? This organization does not clearly distinguish which measurements should be applied in the first and second scenarios. And this because, in our opinion, many policies apply to both scenarios. As we argued before the job shortage scenario is just a worsening, in terms of available jobs, of the

same conditions that are already present in scenario 1. However, given that some policies can be more relevant in one scenario than in the other, we will draw attention to these specificities when discussing the proposed policies.

3.2 Public Policies

How can societies combat markets mismatch, jobs' shortage and the several social problems these phenomena can lead to? Several options can be envisaged, not all of them necessarily compatible with one another and the decisions might hinge on the political or ethical options our societies will want to assume. Our goal here is not to favor any ideology whatsoever, rather just to discuss the possibilities at hand. Thus, these policies do not form a full-fledged set of recommendations, as each suggestion should be analyzed by itself.

In the following pages we propose policies related with education, social protection, job creation and taxation in order to answer the research sub-Q2: What public policies should the EU adopt to foster job creation and social protection? Also, research sub-Q4: How can the workforce be retrained to acquire the new skills needed within this framework? is answered in sections 3.2.1.1 lifelong learning and 3.2.1.2 mandatory training for employees.

3.2.1 Education

3.2.1.1 Lifelong learning

In terms of education, one the most claimed solutions is lifelong learning, a concept that has gained popularity in the last years. This concept opposes the belief according to which after having acquired some knowledge people are set for life and, as soon as they transition to the labor market, require no further training or knowledge. This

belief is obsolete, and lifelong learning assumes that people should be constantly learning in an ongoing and many times self-motivated mode to pursue new knowledge. In this model the learning is constant, from schools to jobs and even after retirement people should be engaged in of activities that allow them to create, acquire and apply knowledge.

This idea is not a strange topic to the EU. The report "Training leave – Policies and practice in Europe" CEDEFOP (2012, p. 1) starts its foreword acknowledging that "one of the fundamental changes in the dynamics of labour markets is the requirement for employees to update, often upgrade and sometimes acquire completely new knowledge, skills and competences to stay employed or find new employment". In this same report it is acknowledged that the 2010 target of 12% of adults participating in lifelong learning was missed and a new target of 15% was established to 2020.

To support the lifelong learning model, governments need to create choices, provide information and incentives. Market demand should be learner driven and mechanisms to control the learning quality need to be established. In this way, on the one hand, people have opportunities to acquire new knowledge that is in the line with market needs and, on the other hand, companies have the guarantees that quality is ensured. Besides these direct actions, policies aiming companies can also be helpful for both sides. One example is the creation of mandatory training for employees whereby companies are required by law to provide training to their human resources. This kind of training can many times be implemented using internal resources, however in this kind of situations it is more difficult for governments to control if the policy is effectively being implemented.

3.2.1.2 Mandatory training for employees

Public policies can also have an important role in helping people in their pursuit for a job. With the correct incentives policymakers can push companies to hire and train people to acquire the knowledge needed to perform a specific work. This kind of measures help the fast integration of people in the market given that it is an intense

and focused program to train people in a specific task. The evident drawback is that with these policies, people are acquiring very specific competences that can only fit a niche market or that can be obsolete after some time. Applying these actions requires some control as well as a commitment from the companies to ensure that these programs were not used as temporary and disposable work but as a solution integrated in a broader strategy.

3.2.1.3 Incentivize advanced education of the youth

The education of young generations is other crucial point. Public authorities should make an effort to ensure that as many students as possible are enrolled in the tertiary school. Data suggests that by 2030 a big part of the jobs available will require high qualifications, qualifications which many times are acquired during the tertiary school. If governments are fast to implement policies to incentivize young generations to pursue their studies, then we are reducing the problems that can arise from a mismatch between market needs and demand. These policies can be deployed in multiple ways: providing direct financial support, making more student residences and providing better mobility for students are some of them.

Still concerning the tertiary school, it is crucial that education institutions provide their offer according to market needs. To do that, decision-makers should seek for market insights and specialists' opinions to understand what are going to be the market needs (such as the findings we alluded to above). At this point it is important to once again highlight the pace of evolution: the market is changing very fast and more than ever education systems need to be prepared not only to adapt but to adapt very fast.

3.2.2 Social Protection

The challenges presented by the scenarios presented above for 2030 are made more acute by the fact that at the level of social protection, taxation schemes and work policies, the overwhelming majority of policies fall to member states and are not fully coordinated at a European level. Tackling these challenges could perhaps entail new

solutions that involve a higher degree of collaboration or even proper EU mechanisms that would perhaps partially replace national competences. We explore some of these possibilities in the following sections.

3.2.2.1 Unified unemployment scheme

In current social protection schemes one common way to deal with joblessness is simply to provide financial assistance, for a limited amount of time and more often than not with other kinds of conditionality, to those that are left without a job. This can happen in the form of proper unemployment schemes, for those who were employed or, ultimately, in the form of minimum income schemes for those who are no longer (or never were) in the position to receive unemployment benefits. There, the conditionality resides in the fact that people are forced to be "active", that is, to be introduced in the labor market or at least to receive training. One of the downsides of these schemes is, on the one hand, that the amounts distributed are usually very low (except in the case of unemployment benefits of workers who had high salaries beforehand, but they are limited in time); the other is that, being conditional, some social protection schemes tend to turn away all those who, even though they might need the material assistance, do not want to be subjected to these conditions (e.g. means-tested benefits which involve a high degree of surveillance of the lives of those who receive them), thus leading to hidden poverty and to a whole group of people that is left out of official stats (Standing, 2017).

In the EU social protection systems are not unified; each country has its own policies, which are dealt with at national level. A different, albeit related problem is the incomplete nature of the Economic and Monetary Union (EMU), which leaves the Eurozone ill-prepared to deal with asymmetric shocks, such as those felt in an economic crisis. When this happens, some countries might have further unemployment problems, or brain drains, due to the migratory flows caused by the fact that the crisis usually hits countries differently.

However, in the last years the idea originally proposed in 1975 of a European Unemployment Benefit Scheme (EUBS) has been gaining strength. The idea behind this fiscal instrument is for the EU to provide financial support during a short period of time to unemployment situations. This financial support can be extended and top up by the national unemployment systems.

EUBS could provide added value contributing to macroeconomic stabilization and efforts to address unemployment at a European level, thus proving to be a powerful automatic stabilization mechanism that is currently lacking within the EMU. It would encourage labor mobility and stimulate convergence being a clear sign of union (Beblavy, Lenaerts, et al, 2017). Even though the findings in this thesis project a scenario where the whole EU can have a job shortage (which would probably also affect the whole of Europe), this kind of measure would strengthen the EU's response. However, it is important to understand that EUBS is mainly designed to short term unemployment. But in this scenario, and in all likelihood, the drop in the number of available jobs and in the employment rate might be somewhat permanent. And should that be the case, the EUBS could be helpful but would not, by itself, be a definitive solution. So this leads us to consider what could be deemed more ambitious solutions.

3.2.2.2 Universal Basic Income or Negative Income Tax

Another idea, which is in itself very old (going back at least to the 16th Century, if not before) is that of a Universal Basic Income (UBI). This idea has gained traction in recent years, due to a pilot project in Finland, a referendum in Switzerland, and the support of many business moguls and academics. With multiple variants regarding its implementation, form and even name, UBI consists in a periodic cash payment delivered to all on a regular and individual basis. To receive it people would not need to prove anything about their financial state or work condition (it is unconditional), everyone would receive it (universal) and it would be non-withdrawable. The goal of UBI is to ensure that every citizen has decent living conditions without any

dependency, i.e., that he or she is able to have the means to have "real freedom" (Parijs, 1995) without having to be subject to poorly paid or undignified jobs just to survive.

This potential policy is not consensual. Some authors claim that it is not financially feasible while others point that it would lead us to low productivity levels (Annunziata, 2018). In its pure definition, this policy has never been implemented in a full scale, even though there are modest social dividends attributed on a regular basis in Alaska or Macau, and more than a few pilot projects with basic incomes being attributed to certain groups of people for a limited amount of time have been happening all around the world, from Finland to Kenya, India, Canada, the US and Barcelona, to name just a few.

Our goal here is not to determine whether or not UBI would be feasible. However, discussing UBI or other policies akin to it, reopens one of the debates with which we opened our literature review: that of the definition of work. When Gorz (1999) mentioned the project of going beyond a "wage-based society", he also had in mind the possibility of something such as a UBI. Some of the proponents of this idea, such as Van Parijs, Standing and others, contend that by providing unconditional assistance to everyone, a UBI would: free up time so that people could dedicate themselves to their true passions; facilitate the transitions in and out of the job market; value reproductive or creative work, or the dedication to political or social causes. In other words, UBI would value activities that are "work" in a broad sense, but are not "waged labor"; as such, "labor" would cease to be the value around which society revolves.

Furthermore, if implemented at the level of the EU, like Philippe van Parijs and Yannick Vanderborght (2017) contend, even if at a modest sum to start with (a euro-dividend of ca. 200 euros funded by TVA) it would not only contribute to harmonizing social protection at a EU level, but also act as an automatic stabilizer (Parijs, 2012). To reiterate, we are not implying that a euro-dividend or a UBI would easily be financed. But that, or any other harmonized social protection policy introduced at a EU level

could be justified at least in scenario 2, in order to prevent that a growing number of people fall below poverty levels.

A closely related, even though different option from UBI is the so-called Negative Income Tax (NIT). The NIT is a way to provide people below a certain income level with an extra income. In the currently used taxation systems, everyone pays taxes to the governments, with the negative income tax people with low incomes would receive an income from these taxes. The basis of this policy is that it tries to incentivize more people to work instead of receiving the unemployment benefits. However, by itself, this measure would prove insufficient to drastically reduce unemployment in a job shortage scenario. This policy can be deployed as a way to better distribute the automation dividends given that it reduces the gap between capital owners (the ones that would support financially this model) and the employees with lower salaries.

All in all, in terms of providing a strong safety net, a UBI would always be a better option than a NIT; however, in terms of financial feasibility, perhaps a NIT could be a first step that could later be transformed in a UBI.

Some of the policies we have been analyzed here would apply both to scenario 1 and scenario 2: that is evidently the case of the education measures we alluded to above. Others make, like UBI, would make more sense in scenario 2, because, without a UBI, many more people would probably fall below poverty levels. But even if a UBI would be implemented, many people will still work; which makes it necessary to also address policies of job creation.

3.2.3 Job Creation

3.2.3.1 Reduction of working hours

Another measure that can have a positive impact in society is the reduction of working hours (Gomes, 2017). This idea is not something new or untested, actually it was a long-term trend, starting in the social struggles of the early 20th century, and that came to a halt in the 90s probably due the economic and financial crisis

(Spiegelaere & Piasna, 2017). The reduction of working hours allows people to have more time to dedicate to other activities but, more than that, allows more people to have a job. This could be a solution to ensure that more people are receiving a salary even though it would be difficult for companies to maintain the same salary levels for a shorter amount of time. However, again, if automation is going to increase production, this might be a lesser problem.

3.2.3.2 Incentivize entrepreneurship

Yet another way that governments can explore to create new jobs is to incentivize entrepreneurship. Entrepreneurship involves personal risk and, due to that, many people avoid it. Policy-makers can have an important role in edging this risk in a way that facilitates people's decision – e.g., a UBI would also foster risk-taking, because one's survival would never be at stake.

Also, measures that aim to protect intellectual property rights are important to promote innovation by protecting ideas. Even though some people claim that, by themselves, these measures do not help innovations, these policies surely protect individuals that have disruptive ideas from major companies. This factor is an excellent incentive for someone to start his or her own job.

One of the major challenges that entrepreneurs face is the access to capital and investment. Governments can assist in this area by encouraging cooperation between banks and start-ups, providing access to public funds, or implementing tax laws favorable to small business. These measures can all be applied; however, governments should prioritize them: aiming at fostering business in areas that could have a positive impact in society, financial returns and, if possible, create new jobs.

3.2.3.3 Exportation

As the world does not develop all at the same time and as the EU is expected to be one of the most developed regions by 2030, policies aiming at fostering exportation can also be positive. These kinds of measures can also be an opportunity to diminish

the job shortage inside the EU, while perhaps also not ignoring the need for a fair trade in an increasingly connected world. To establish partnerships which also foster the prosperity of countries in development is a good way to export goods and knowledge. Governments need to be careful deploying such policies, they should be thought of as a balance between social responsibility and economic gains. Foregoing one of these elements would have undesirable results.

3.2.4 Taxation

And let us now see this problem from another angle. Job shortage is also a problem for state revenues. This problem arises because the vast majority of tax revenues are now derived from labor income, so firms avoid taxes by eliminating employees (Abbott & Bogenschneider, 2018). This means that in the current paradigm, automation is desirable not only due to its higher production efficiency but also due to tax incentives. Between having one person performing a certain job or automate it the company gets tax benefits if it opts by automation. But this needs to change. We need to think in different solutions, and tax automation should be seen as one possibility, even though never an isolated one.

The opinions about taxing automation are varied, some authors claim that taxing automation would stop innovation; others argue that we need to tax automation exactly to stop automation; while others say that we need to do it but in a balanced way in order not to compromise innovation.

3.2.4.1 Capital taxation

At this point, our proposal is to do not tax automation directly. However, we need to ensure that its outputs are properly taxed in a way that allow policies as the ones referred before to be implemented. Therefore, our proposal tries to change the current paradigm, instead of deploying policies that tax labor income (that is reduced in a job shortage), governments should focus on taxing capital. This would be a way to ensure the basic living conditions to, if not all the people (should we not choose to implement UBI) at least to those most in need, trough other redistributive measures.

One way to do that would be a unified corporate profit tax all over the EU. Implementing this policy would allow the EU to put an end to the schemes of fiscal dumping applied by some countries to have extra revenues. This would foster a common policy for the EU. Other option would be to tax personal wealth and assets with values above a certain level (Piketty, 2018) or a Tobin tax (Costa, 2005).

Besides, environmentally friendly taxes should also be applied. This would be applied based in a physical unit that has a proven specific negative impact on the environment. Current EU policies are privileging energy and transportation taxes instead of focusing in pollution and use of resources. By 2030 the amount of clean energy produced and used should have increased significantly, and by that time governments should be prepared to directly tax pollution and use of resources as it would be one of the key metrics to humankind. In this area, the idea of taxing carbon emission could be a hypothesis.

This idea of capital taxation only has a desirable effect if applied at an EU level, countries by itself will not implement these policies because capital owners would just move their location to another EU country. More than that, these measurements and their quantification should also be thought of considering that EU companies need to remain competitive in the global market. As we have already seen, automation can help companies to be more efficient and, in this way, to remain competitive in the global market.

Certainly, taxation is not an end in itself. But these new forms of taxes could foster new and better forms of redistribution that could, in turn, help strengthen the social protection systems in order to be up to the challenges of the 2030 scenarios, especially if scenario 2, which is more likely, becomes a reality.

3.3 Managerial Policies

Besides public policies, the private sector also needs to actively implement policies in order to remain competitive. Companies need to think in a strategic way and always bear in mind the changing environment that surrounds them. Previous findings show that the next 10 years will be particularly challenging to companies: constant innovation, talent management and structural changes will be necessary.

In the following pages we propose policies related with hiring, training and retaining talent, outsourcing and investment in order to answer research question sub-Q3: How can companies adapt to become more competitive in this framework?

3.3.1 Talent Management

If in the past job rotation was not very significant. This is not true anymore, because conditions have radically changed. The easiness with which people can travel and how they are able to adapt in different parts of the world brought a higher volatility to the market. Companies need to be proactive on their capacity building to attract and retain talent, focusing on employee's wellness and personal development. These aspects, that are addressed in the area of personnel management, are achieved by a combination of multiple factors, including remuneration in its diversified ways, work recognition, personal relations and working conditions.

3.3.1.1 Constant training

The concept of lifelong learning that was explored on the side of public policy is also extremely important inside corporations. Companies should implement a strategic thinking approach on this subject, understanding that future needs give companies time to prepare their workers to the new challenges, but that this time is finite. Doing it with some time distance is crucial in the private sector. Imagine an employee that needs a certain training for a future task; if this is detected with enough time it allows for the company to manage the training periods according to the amount

of work; if not, the employee needs to undergo intensive training which usually results in higher costs to the company.

However, there are situations that managers can not anticipate, and this is no reason not to provide training to the company's workers. Constant training should be one of the key goals in the policies adopted by companies, even though this training might not always be directly connected to current or new tasks. Providing knowledge to people ensures that companies have resources with higher qualifications and that are more prepared for the future. In addition to the traditional learning methods some alternative paradigms have been appearing: two examples are microlearning and free time to learn. Microlearning modules are based in short nuggets of 3 to 5 minutes that in an interactive way try to address a specific matter. These modules have to be seen as part of a bigger, full-fledged path with an exact goal: free time to learn. This is a learning method where companies allow employees to self-direct their learning during working-time. This approach is normally used with e-learning courses that companies make available to their workers.

These kinds of measures are increasingly valued by workers and they are an important factor in retaining talent. Besides that, these policies are very well seen by the general public, which can be translated in clients or easiness in hiring.

3.3.1.2 Work flexibilization

Other important measure organizations can implement in order to prepare the future is work flexibilization (Gomes, 2017). This method can already be seen in some jobs that do not require a fixed location or schedule and this is expected to be a more prevalent trend in 2030. This approach allows for employees to manage, whenever possible, the time and place of their work, without compromising production metrics, which is something highly valued by employees. Implementing this method is not suitable for every job, but the ones that can implement it can benefit from its advantages. Having an organized and controlled work flexibilization allows companies to transfer responsibilities to workers and, besides that, makes possible to

recruit outside the strict location of the corporation. By itself, this possibility is extremely important, especially in a market with talent shortage, which is expected to happen in the EU by 2030.

3.3.1.3 Location

The place where the company is situated is also another important aspect to consider for the following years. Low density areas have the attractiveness of lower costs of implementation, but this usually also means a shorter amount of available labor. Organizations should think in this situation based on their costs' strategy but also considering talent requirements.

3.3.1.4 Tertiary schools

One way for companies to ensure a source of talent is to maintain good relations with tertiary schools. These good relations can be fomented by supporting student activities and studies, creation of competitions or just participating in job fairs. All these methods ensure some visibility in the academic world which can be translated in an easier access to talented labor.

3.3.2 Outsourcing

Unlike our previous recommendations that focus in ways how to hire, retain and maintain talent, the last recommendation is to not hire for activities that are temporary for the company. Using outsourcing in tasks that are not key tasks for the organization allows them to have less concerns about recruitment and training which, as seen before, can involve a complex process. Besides that, outsourcing a task gives the company the flexibility to change or end it easily, it just focus on the outputs and not on the process.

3.3.3 Investment

It is undeniable that companies need to invest in automation in order to remain competitive. However, the private sector should be aware of the pace of evolution. As nowadays innovation happens very fast companies need to plan their investments very carefully.

3.3.3.1 Short periods of amortizations

Organizations can not wait for the perfect moment to invest in automation because such a moment may never appear and in the meantime the company is obsolete. However, companies also can not be always following state-of-the-art innovations, as this would result in constant investments and at the time that some technology would be implemented the next one would be ready to test. Investment should be made considering all these factors and resources should be planned to have short periods of amortizations. These policies are recommendations that are not easy to implement, however the only way to companies to remain competitive is to find a good trade-off between investment in innovation and monetization of assets.

3.3.3.2 Investments in higher production efficiency

When calculating this trade-off, the tax compensations in replacing labor by automation should be considered as a temporary effect. As we explain earlier in this chapter, in a scenario of job shortage one of the taxation methods would be to tax automation direct and indirectly. Thus, it is expected that the taxation of automation will be an even more predominant subject in the following years. Companies should be aware of it and should have it in mind when planning their investments. The best scenario possible for private sector is when the investment is good for the company due to its higher production efficiency.

3.3.3.3 Human resources

As we can conclude from our previous findings, companies should focus on the timing for investing and on how to profit from automation. However, they must keep in mind the needs of their human resources. The way in which EU companies manage their human resources is equally or even more important than the way they implement innovation in automation. As we alluded to above, findings show that by 2030 work will likely be very specialized, and essentially geared towards people with high qualifications.

Perhaps the job shortage scenario will restrict itself to a group of people that will become unemployable, whereas the market for highly qualified jobs is kept open, albeit competitive. Another scenario is that of a less competitive market in its whole. However, in both cases companies should adopt measures to value people and their contributions. As the work complexity increases people that perform a certain task with great value would be more difficult to replace than they are today. In this way, policies that address talent retaining and training should always be implemented, both in the cases of scenarios 1 or 2.

3.3.3.4 New opportunities

This new wave of innovations is also an opportunity for EU companies to expand their business in areas where cheap labor has become mandatory in the last decades. Technological advances suggest that by 2030, some of the processes involved in production are going to be cheaper if automated, even when compared with countries here the cheapest labor is available. This presents a new opportunity for EU companies to bring back businesses they have lost due to labor price. These examples are mainly related with the manufacturing of goods but the same can be true for agriculture or mining.

To reiterate, we believe all the policies we alluded to be could be useful, and some will be strictly necessary, but they probably will not be implemented all at the same time, and some will not be completely compatible with one another. For instance,

education measures such as training and efforts to attract and retain talent will always be necessary, as will be the strengthening of the social protection systems, investment in automation and job creation. This might happen at national or at a EU levels, even though we argued that a further level of development of EU policy would be better.

On the other hand, the specific way in which this happens is up for debate. We argued that measures such as further increasing taxation, for example by taxing capital more widely, could give way to stronger redistribution schemes. But if this happens by redefining work by attributing a UBI or, more traditionally, by reinforcing unemployment schemes and, for example, reducing working hours, is a matter for further debate. However, we do insist that at least some of these measures need to be taken, in order to prepare the transition to 2030.

3.4 The Case of Portugal

In this sub-chapter we explore the main differences between Portugal's specific case and what we have seen for the EU taken as a whole. The first part approaches the demographic aspects as well as the predictions for future jobs. The second presents some recommendations for the particular case of Portugal. It is important to reinforce that findings and recommendations suggested to he EU are also valid to Portugal, this section only tries to give some more insights about the Portuguese reality.

In this way, this sub-chapter presents the answer to the research sub-Q5: What are the specific findings and recommendations for Portugal when compared with the EU?

Concerning population, and contrary to the EU, Portugal is already declining in its population, something that EU should only experience after 2030. In the projected age

groups to 2030, Portugal is expected to have a lower percentage of people under 15 years old, and a higher percentage of active population compared with the EU. Even though the numbers are not drastically distant, this difference already shows that the Portuguese labor force would be in percentage higher than EU levels.

More concerning than the ageing population, is the fact that Portugal displays education levels below the EU average since the secondary school. Considering that all scenarios indicate that jobs by 2030 would be mainly filled by people with high qualifications, this data show that Portugal is falling behind the EU in this aspect.

From the current available jobs in Portugal 26% are expected to be automated by 2030, resulting in a loss of 1.1 million of jobs. The number of jobs created by automation are expected to be 0.6 million, in the worst scenario, and 1.1 million, in the best scenario. This fact, together with the data of highly specialized jobs, shows that Portugal's future seems to be somewhere between the two scenarios proposed before, market mismatch and jobs shortage, with the worst case being both happening at the same time.

The employment data also shows that Portugal has some tradition in manufacturing. This sector is expected to be the one with a higher job loss in Portugal due to automation. At this point it is important to suggest to manufacturing companies, especially the ones that are located in Portugal, due the country's relatively cheap labor cost of labor within the EU, that automation is going to change this competitive advantage. Besides the private sector, also the public sector should be concerned about this aspect. The Portuguese government should be favorable to policies that ensure that companies that are producing in Portugal due to the cheap labor, are still producing in Portugal after that labor is automated. One measure that can be used to prevent this to happen, while at the same time stimulating the economy, is to help companies in their automation process with the caveat that after receiving the help they are still operating in Portugal.

Moreover, Portugal has a huge opportunity to take advantage of its privileged location. If the place where goods are produced is indifferent due to automation, the

way goods are transported is always crucial. By further developing its ports and, maritime and air transport, Portugal can thrive in the global market due to its "proximity" to Europe, United States and Africa. To do that the public and private sector in Portugal should work together to develop a joint strategy regarding the transportation systems that could place the country as the center of distribution. Once again, with automation the center of distribution would also be the choice for production. All these topics should be explored with a higher detail to validate this strategy.

Even when looking for highly qualified workers, companies still base themselves in Portugal mostly due to cheap labor. However, companies that are looking for this kind of competitive advantage should be aware that today migration is easy and very feasible inside the EU. This means that companies should recognize the value of their human resources and diminish the gap between the level of salaries within the EU. If not, in Portugal's case, there is always the risk of having invested in the formation of talent that ultimately moves elsewhere. Besides the private sector, also the Portuguese policy makers should be concerned about this. Promoting policies that aim to keep talent in Portugal, and encouraging companies to do the same, are some of the guidelines that should be followed.

Other aspect that seems to be different between Portugal and the EU is the jobs lost to automation in the public administration and government. After manufacturing, public administration and government is the sector expected to experience the biggest change in employment. Portugal should anticipate this situation and start preparing people to move from the public to the private sector. One way to do that is to train a part of the public sector in the tasks that can expect a positive change in employment.

Conclusion

The research carried out in this thesis led us to assess the employment structure in the European Union by 2030, and what measures need to be adopted to prepare this transition. After presenting the results, we will now put forward a few concluding remarks. These will consist of a reflection on the future of work, and which policies we propose to allow a transition with economic and social concerns.

This conclusion is structured in three parts. The first part answers in a broad way the first half of the research question: what will be the employment structure in the European Union by 2030; the second part provides the final considerations about its second half: what measurements need to be adopted to prepare this transition.

And finally, after briefly recalling the main claims that we are making as a result of this investigation, we put forward a few notes on the constraints and limitations of the thesis itself as well as some recommendations both for the implementation of these measures and for future studies to be developed on this topic.

What will be the employment structure in the European Union by 2030?

This question has been answered during the Chapter 3 Results and discussion through the answers given to the sub-questions. The goal here is to recall the main findings of the more detailed work developed in this thesis.

By 2030, for the first time since data is available, the European Union population will be declining. The population will be older than it is today, mainly due to the life expectancy at birth but also due to the low fertility rates. Although there is no data on this, the indirect indicators show that we also may expect a decrease in the EU labor force. If these indicators may be of concern, on the other hand, in education the

European Union is a global reference, having results much better than the global average.

All these demographic data will have an impact in the way in which the EU shall prepare to the new wave of innovations. On the one hand the aged population can mean lower flexibility to adapt; on the other, the high levels of education show that people will be more qualified to specialized jobs.

The future of jobs is exactly about the specialization of expertise, jobs that are based in predictable, physical, or dealing with processing and/or collecting data are more likely to be automated. Manufacturing, accommodations and food services, and retail are the activities more likely to be automated. By 2030, if we consider all the sector of activity, automation will probably be responsible for a job loss of at least between 15% and 25%.

There are big doubts about how many jobs automation can create. The best scenarios point to similar numbers for jobs gained and lost, other scenarios expect less. Due to this, in this thesis two different scenarios were explored: the first is a scenario without loss of jobs, but with a mismatch between market needs and labor qualifications; the second points to a job shortage where some people are not only without unemployment but, are unemployable.

Having presented all the meaningful data, we cannot go further and decide between the scenario 1 and 2 – only the future will tell. As we stated, scenario 2 seems more likely than scenario 1, and in both scenarios similar measures need to be taken, even though scenario 2 would prove to be a more significant social and ethical challenge than scenario 1, perhaps calling for a more radical reformulation of social protection systems.

What measures need to be adopted to prepare this transition?

For both scenarios, some public and managerial policies were put forward. As stated, many of these overlap for both scenarios. In the case of scenario 1, of a market mismatch, some essential policies deal with acquiring new competences, and strategies to hire and retain talent, as well as investing in automation and assessing the possibility of work flexibilization and other investment measures in order to remain competitive, find new markets (perhaps exploring new locations) and adapt to this rapidly changing environment.

In terms of public policies, policies to enhance lifelong learning, create training opportunities, incentivize companies to provide training to their employees, and encouraging advanced education are proposed. In the companies' perspective, the recommended measures are in line with constant training, work flexibilization, good relations with tertiary schools and outsource the tasks that are not fundamental for companies.

Scenario 2, which explores a hypothesis of a job shortage, would necessarily entail all the managerial policies also recommended for scenario 1, but would involve a much more ambitious overhaul of social protection systems in order to prevent the undesirable social consequences of high unemployment. The degree of innovation this would require also depends on the severity of the job losses but, in any case, a further level of development of EU policies, strengthening taxation in order to foster redistribution and finance social aid, seems to be inevitable.

Indeed, in the case of a job shortage only public policies can provide a solution. This, on the one hand, would involve active policies of job creation, such as providing incentives to entrepreneurship, and likely a better work redistribution (for instance with reduction in working hours in order to create more jobs) but with many more of the tasks being performed by machines other measures seem necessary. Therefore, we addressed the possibilities of creating a European Unemployment Benefit Scheme, a Universal Basic Income (in the form of a euro-dividend) or a Negative Tax Income. These would be policies that would directly help those affected by joblessness.

To fund these policies, we propose not to tax automation directly, because it could hinder innovation. The alternative is to tax capital in compensation for the labor income that is not taxed, which could be combined with other taxes, for instance environmentally friendly taxes, such as carbon taxes. For companies, investment should be planned to amortize in the shortest time possible and should not be done just because of tax compensations. Human resources are vital for any company, and organizations should be aware that replacing specialized workers will not be easy. In this way, retaining talent and training are still crucial. From a strategic point of view, the impact of labor price in sectors like manufacturing, agriculture or mining will decrease considerably. With automation EU companies can once again compete in price with developing countries.

In sum, as we stated before, there is no need to fear the future. Automation, and all the other technological breakthroughs associated with the fourth industrial revolution, yield the potential to make economies grow and make more people better off. But in order to keep our societies balanced, the kinds of measures that we addressed should be put in place.

Limitations and Recommendations

Like in any study we have faced many constraints during the process of writing it, the greatest one being the lack of in-depth studies that correlated the future of jobs by 2030 and detailing which policies should be applied. As such, the answers that are provided in this thesis are exploratory and somewhat tentative.

For data on demographics we used different sources, as it was impossible to find them all together. There our option was to select one source and every time that this was possible, to follow that same source. The use of diversified sources can lead to mistakes: data can vary. To try to mitigate this problem, we tried to understand how data was acquired in order to select the most homogeneous data possible. However,

in the context of this thesis it was impossible to do in all detail, and that is one limitation.

Even though there are some predictions about the future of jobs by 2030, we could not find meaningful sources detailing the situation of the European Union in that specific date; at least not with the amount of data that we needed to make our forecasts. Some of the existing studies target EU in a different year, some target 2030. Due to that, the predictions that we present in the thesis are based in multiple studies and reports made by public institutions, academics and private organizations.

Besides that, we can not forget that given we are doing a prospective study, and the fast the pace of evolution that we are experiencing today, every prediction is uncertain. Some technological breakthrough in a few years could radically change what is going to happen and, as such, looking for what is going to happen within the next decade is always an endeavor prone to risk. But gathering all the available data that we could find, our interpretations led us to the conclusions we have shown.

For future researchers willing to work on this topic one of our recommendations is to better understand the impact of artificial intelligence and what specialists say about its timing. This new disruptive technology has the potential to perform highly specialized tasks, which are the ones whose jobs are expected to increase in the next 10 years.

Concerning the recommendations, our aim was to propose different possible solutions, rather than putting forward an in-depth study of all the possible consequences of one specific policy in one or both of the given scenarios. A different and future approach would be to study in detail one of these policies (e.g., UBI) within the EU for 2030, to see how it could be done and what would its consequences be.

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