

## **THE END OF EMPLOYMENT**

How is automation to change the future labor  
market?

Master's thesis for obtaining the academic degree

MSc

in the study programme TISE Transition Innovation and Sustainability  
Environments.

submitted by

Mr Miguel Lucea Jimeno

Department for Knowledge and Communication Management at University for  
Continuing Education Krems

Advisor: Dr Crystal Fulton

Advisor: Prof Marcin Szymkowiak

Krems an der Donau, 20<sup>th</sup> of June of 2023.

## STATUTORY DECLARATION

I, Mr Miguel Lucea Jimeno hereby declare,

1. that I have written my master's thesis myself, have not used other sources than the ones stated and moreover have not used any illegal tools or unfair means,
2. that I have not used my master's thesis or parts thereof as an exam paper in my domestic or any foreign country in any form to this date,
3. that, in case my master's thesis concerns my employer or any other external cooperation partner, I have fully informed them about title, form and content of the Master's thesis and have his/her permission to include the data and information in my written work.

## RESTRICTION OF ACCESS

### ATTENTION:

The exclusion of utilization of the master's thesis may be applied for to the Director of Studies (the officer responsible for the administration and enforcement of study law). A maximum of 5 years can be applied for, based on substantiated grounds that the student's legal or economic interests are endangered if it would be published immediately.

The approval document of the accepted exclusion of utilization must be included in the bound and electronic versions of the final master's thesis instead of this page.

The application should be made with enough time to allow processing and return of the official document from the Director of Studies (minimum 2 months).

## ACKNOWLEDGEMENTS / DEDICATIONS

I want to sincerely thank Dr Crystal Fulton and Prof Marcin Szymkowiak for helping me with this endeavour and being my supervisors giving me the opportunity of carrying on this project.

I wish to place on record, my sincere gratitude to all my beloved classmates that had offered their selfless support with this challenge. Special thanks to Shuvro Sen, Steven Go, Ahmad Muhammad Qamar and Pouya Jangorban for their technical support. Additionally, I would like to show appreciation to all my master's degree colleagues that have made this journey such an unforgettable one: Chiara Miozzo, Franziska Schranz, Yasmine Jhabli, Yee Thu Aung, Diana Ruiz, Yudai Aoyagi, Roza Mahmood, Thandiwe Majama, Nowai Linn, Ngan Pham, Okta Milatina, Mobin Udin, Nia Makatsaria, Ilya Lavrov, Kamilya Issaliyeva, Anna Prutseva, Goldy Yancha, Felita Viegas, Larissa Gehlen, Allena Arnold, Yimeng E.

Finally, I want to thank my parents and my sister for their never-ending support, encouragement, and care.

## Abstract

An incipient literature about the future of employment and its vulnerability to become automatized has arisen in the last decade. Seeing the exponential increase of robotics, capable of replicating humans in assorted tasks, many have attempted to understand how the coming labor market may look like. Despite advancements in the discipline, today we confront a central polemic disjunctive with no consensual answer. Will automation create or destroy employment? To tackle this question and to bring clarity on the position that massive job automation will be soon a reality, this paper revisits and updates the blueprint designed by Frey and Osborne in 2013. Taking in consideration ten years of further technological innovation and notions from the transdisciplinarity approach, a comparable methodology is followed to defend that over a half of current jobs are technically automatable in the next decade. Given the size of this figure, this paper states that significant numbers of active workers may soon be unemployable as neither the human capacity to create new jobs will overcome this loss nor the artificial intelligence ability to perform them. Seeing this as a coming threat scenario, this research paper concludes with a series of recommendations that should be addressed to tackle this social transition. A tax on robots, a wealth tax and a universal basic income are proposed to properly redistribute the future wealth in a society where work is entitled to lose the central pillar hold today.

### **Keywords:**

4<sup>th</sup> industrial revolution, job automation, the future of employment.

## TABLE OF CONTENTS

### Contents

<b>1. Introduction.....</b>	<b>6</b>
1.1 What is work? .....	7
1.2 Historical approach. ....	9
1.2.1. Job offenders.....	9
1.2.2. Job defenders.....	11
<b>2. Literature review. ....</b>	<b>14</b>
2.1. Job market continuist. ....	16
2.2. Job market disruptors.....	19
2.3. Summary of the literature review. ....	22
<b>3. Methodology.....</b>	<b>24</b>
3.1. Updated bottle necks to computerization.....	28
3.2. Mathematical rationale. ....	33
<b>4. Results.....</b>	<b>39</b>
<b>5. Discussion. ....</b>	<b>43</b>
5.1. Why if a job can be automated, it will be? .....	43
5.2. Mechanisms to conduct automation transition while keeping a welfare state.....	51
5.2.1. Tax on robots. ....	52
5.2.2. Tax on wealth. ....	53
5.2.3. Universal Basic Income. ....	56
<b>6. Conclusion.....</b>	<b>60</b>

## **1. Introduction.**

It is said by the ancient scriptures, that there was a day when mankind could worriless live in paradise. In the garden of Eden, food, comfort, and beauty were found everywhere for the joy of its occupants. All the plants, the animals existing, every exquisiteness ever imagined, were there to serve them and to make their lives plentiful. Adam and Eve as the first humans, had the privilege of having God's kindness for the sake of its welfare. In exchange, there was only one condition, not to eat from one tree, the one of knowledge.

“From the tree of the knowledge of good and evil you shall not eat, for on the day that you eat from it you will surely die” (Wycliffe et al., 1982).

According to these very sacred scriptures, life occurred peacefully in the garden till one day this condition was broken. The day where curiosity won over the security of wellbeing, was the one this tree was tested on, and changed history forever. The tree of knowledge offered new thoughts, new answers, and many questions to Adam and Eve. However, the consequence of its acts provoked the anger of God. As a result of their treason, they were expelled from paradise and condemned to work.

“Because thou hast hearkened to the voice of thy wife, and hast eaten of the tree, whereof I commanded thee, that thou should not eat, cursed is the earth in thy work: with labor and toil shalt thou eat thereof all the days of thy life”. (Wycliffe et al., 1982)

Whether this worldwide known story is true or not, the fact is that it may well serve us to conduct the genesis of our research. As far as can be perceived, the history of humankind has always been one of working. The one of effortfully raising and building up our coexistence. The one-off waking up to put food on the table. This constant universal need has been accompanied by two additional elements. On the one hand, knowledge helps us to evolve and ease our duties.

On the other hand, a power dialectic where the exploitation of some humans has been the norm, in exchange for the opportunity for few to build their own Eden.

During the following pages, it is intended to open a historical revision of what has been the meaning of working. How terminologies have changed and how realities have been kept. For this reason, first, it is important to understand the definition of employment and only then we may proceed to understand how its printed values have historically evolved. This way, we will be able to properly introduce the scope of this research and study if it is knowledge, or in other words, the current technological development, the way we might transform the way of working to get paradise back or not.

### 1.1 What is work?

Even though work is a mundane topic, defining its essence can be more demanding than it might first seem. Today, it is clear to everybody how essential work is in defining our lives, and yet it is still ambiguous what is and what is not work with a capital 'W' (Thompson, 1967). From one perspective, work is the backbone of our lives, it orders society, makes it function and directs it from the moment we are born to decide "what we want to be". It appears so influential that sometimes it is even felt as an intrinsic component of the human being. However, as the social construction that it is, it is neither indispensable nor has it always been permanent.

Throughout this essay, work and employment will be considered synonymous. In examining either of these concepts reference is made to **the assignment carried out by a person that allows him or her to obtain the resources needed for survival**. Whatever its quality, paid or not, independent, or subordinated. The common element that makes any task WORK is that its performance is key for the preservation of the individual's life. (Sahlins, 2013).

Anybody does a job, if explicitly or not, their effort delivers them with the material conditions they need to keep going. An intern, a housewife or a slave

performs a job if they eat and live thanks to it. In case of non-compliance, their survival would be seriously threatened unless they quickly reinvented themselves in another occupation. On the other hand, if these same people were to carry out the same task but were not dependent on it for their livelihood, this could not be categorized as work. It must be stressed that it is the relationship of economic dependence that converts a task into a job (Greenstein, 2000).

Nonetheless, the concept of employment enriches its capacity once we move from the individual scope. Only socially, it is when the institution of work builds up at its most expression. (Thompson, 1967). Work shapes societies, their culture, and their way of living to become the very fabric of its soul. Societies that accept this ideology, organize their lives according to it. The formative periods, the resting ones, holidays, and special events are those, just because they make sense for productive reasons. The identity of the people becomes directly related to the way they make money and how much they do (Greenstein, 2000). The purpose of life connects, without any question, on the technical capacity of human beings to become productive and generate welfare. Finally, according to the normative centrality, social political benefits occur depending on the level of this performance, the level of respect, health, or inclusion follows simultaneously.

Waking up to grow your vegetables as a hermit is one job, but having a whole nation structured according to a working paradigm is another way more intense. Those communities that do not put the employment in such a central way as we do, cannot understand the whole meaning of the concept. (Sahlins, 2013). While for those like us, immersing in one, may again look strange that there are other ways of living, it is fundamental to bring some historical perspective. Only this way, the concept of working gains the needed relativism required to address current defies.

## 1.2 Historical approach.

The concept of working has evolved from positions where it has been loathed to ones where it has been venerated. From empowering perspectives to diminishing ones. Working and its connected aura have shaped the way humanity has perceived the world and itself. To reflect on these changing perspectives, this paper focuses on archetypical historical eras that following their economic factors culturally shaped its civilizations. Reflecting on the phenomenology of social feeling, a thorough analysis of the evolution of the working perspectives can be done.

### 1.2.1. Job offenders.

There have been several historical periods where the concept of work has been strictly devalued. Despised in every sense it has been recognized and pictured as a sully, unhonourable, dehumanizer function to condemn and avoid (Noguera, 2011) With nothing to offer or nothing good, those having to work have been always compared to animals from a minority over them. This perception, born in the classical Greece philosophy, would continue with every alike following historical situation.

Work as *poiesis*, as the action of creating things from nothing, be it a pair of shoes or a sculpture, covering from art to artisanry, any moving action. (Balme, 1984). The movement from not being to being.

Greek citizens scorned every kind of work, being on top of it the manual physical one. Mundane, unrewarding physical taxing duties such as agriculture, farming, and artisanry, building in total around 80% of the jobs of the era, could offer nothing of worth for a citizen back in time. The nature of employment in Greece helps to explain some of this derogatory attitude toward labor. Hard tasks under horrible quasi non-human conditions will develop a reactive ethic model. With a heavy reliance on slavery and a tiny minority of citizens above them, it seems

understandable how to clearly differentiate people, narratives and duties followed accordingly (Balme, 1984).

According to Aristotle, working would be neither necessary nor virtuous, as the end of every human being would be to aim for happiness (Balme, 1984). The “arete”, the citizen excellence, would be found through the way of leisure, contemplation of nature, learning new knowledge and politics. This way, with the celebration of talent and philosophy exclusively available to the wealthy, a condemnation of work seemed logical. Against workers, the answer was not to find idle citizens. However, the nature of the activities would be centered on those that were exploring the world of the ideas, the differential features of the human soul.

Money will be the bane of Greek philosophers in all its manifestations, whether explicit or not. Money will be despised by the Greek elite due to its soul-corrupting, perennial materialism, or, more mundanely because it was the means of equating the non-noble with the noble in terms of wealth (Seitz, 2017). It will be viewed as a dirty item connected equally negatively with those working for it. Contrary to this vision, land ownership exaltation and natural privileges, always fixed in the hands of few, in contraposition to money, always moving from hand to hand, would be incentivized by this vision.

As we can see, the social narrative that was created in ancient Greece because of the dominant economic system is rather like following slavery/vassals models. The medieval conception of feudalism or the pre-revolutionary aristocracy of Russia would imitate these conceptions later. A self-serving ideology is used by an elite to defend the status quo and the privilege of birth. These mentalities can be seen in the pieces of art created by and for these very powerful social groups. The defense of lineage and historical inequalities over a culture of effort will defend that nothing good could be obtained from working. As a result, an enormous apologia of the leisure of the rich, against the working of the poor.

### 1.2.2. Job defenders.

On the other hand, it is imperative to highlight those theories and periods on which working has been seen as a value creator. Job defenders do it as an extrinsic source of value in terms of productivity, but also sometimes as an intrinsic resource building up solidarity or personal growth to be considered in this part (Noguera, 2011). Rather reduced perspectives of the working function are compared with open and wider notions on which personal values are to take in consideration. To mention some, it is relevant to focus on the liberal ethics, the postulates of Karl Marx and the current American effort culture.

In front of centuries of job despising by premodern feudal societies, the first liberal trends, the origins of mercantilism, and finally the first industrial revolution moved drastically the vilified perceptions of working.

For all those in need of working for subsistence, considering its job as something to be avoided as it was perceived by the ruling class, was simply a luxury they could not have. For this reason, even if they were socially misperceived, the progressive empowerment process results of its work and effort led to a historical change (McCloskey, 2016). Under the possibility of making up a future and becoming a self-made person thanks to effort and intention, the previous paradigm could not work any longer. The economic semiotics, little by little, changed when thanks to the working conditions, innovation, and prosperity were attained by a new social class, the bourgeoisie.

For this novel social class, venerating the job that was providing them with everything was a must. Their only source of power, in front of those with titles and properties, was their talent and effort to make it through. They considered that those making valuable things, even if doing it because they need it, should not suffer any shame, as they have had before. A musician, an artisan, or a merchant could and should be respected for the welfare they were creating not only for themselves but for the whole society. It is for this reason that working

as a means to the existence will start to be differently seen as before, and the puritan set of ethics will be slowly created.

Discipline, hard work, and diligence will start to arise as value concepts of a man when in previous centuries it was privilege, eloquence, or presence (Weber, 2005). This change will affect all extracts of society till reaching a point of replacing the ruling power. People will develop a hunger for risk, for building up career and work when before even begging could have been seen as a preference before getting hands to work (Ricapito, 2013). The ambition to scale in the social pyramid, to build wealth and status when previously forbidden, will initiate the work ethics and the culture of effort we well know today.

First, the value of working will be directly addressed to the capacity of making a materialistic life improve. Better conditions were coming to those pursuing them and for this reason, it was venerated. This strictly liberal thinking will suppose the initial reevaluation perspective on the issue of working. Nonetheless, soon further virtues were added to the previous premise. Comradery, personal development, a sense of belonging, and self-realization were obtainable thanks to the focus on a professional career. These wider notions of the concept of work will be considered by thinkers such as Karl Marx (Hill, 2007). For a communist like him, work would and should have, under the right conditions, away from the concept of alienation, the capacity of leading to the maximum, and the personal aspirations of the workers. In the personal and even spiritual sense, a job would be a passion on which a person could see his/her reason in life.

If we move forward till today, it might be possible for the readers, to recognize in some of their personal contacts some of these different beliefs to work. Nowadays, it is easy to find people in love with their profession, haters that do it because they must, entrepreneurs aiming to become big and even rich dad kids that do not intend to find anything this way. To be fair, this variety of mentalities has always existed, but the mainstream, as it is today the questioned culture of effort, has been historically modified as explained. For this reason, while in ancient times work was belittled and in the industrial revolution

venerated, it should be noticed that majorities under these conceptions could think differently, as these were always the ruling class perspective.

Our current times live with a final factor that is to change all the historical premises before. While for centuries few have been using many to free themselves from working or at least from hard work, automation is starting to do that universally and without discrimination. A revolution that started with the first machines substituting manpower into other missions faces today a key turning point. Under the fastest and farthest-reaching technology ever, a question that many desire and panic at the same time arises, will there be a moment when working will disappear? Will there be a moment when working may not be more necessary?

Aiming to focus on the future trends of employment thanks to the present dynamics found, this paper proceeds to determine what the literature of this discipline has said before. Despite job automation being a dynamic topic during the last centuries, it is only in the last decade that it has found a salient interest to address all the technical novelties disrupting the market.

## **2. Literature review.**

Academic literature focusing on the future of employment suffered a clear uprising fifteen years ago, exactly after the 2008 economic crisis. Since then, this subject has gradually become a social and academic concern without reaching yet substantially the political arena. Within the bibliography, we count economists, analyzing the current situation of the European job market, mathematicians applying statistical models to foresee the future, historians to bring comparisons from past revolutions and sociologists to better understand what the meaning of employment in our society is. Many fields have brought their point of view but not many offer satisfactory approaches to estimate the future. While it is important to recognize the complexity of foreseeing what is to happen, building upon those with replicable systems and consistency, allows us to construct with warranties thanks to the new pools of data recently unleashed.

The beginning of this literature review needs to focus on the consensus that establishes the foundations of this paper. The common ground and the axioms that will allow for the following theoretical construction. In broad terms, all literature shares the opinion that the fourth industrial revolution will strongly affect the job market (Crowley et al., 2021). Every scholar agrees that most employees will have to adapt or change, and these are to take special attention, but not only, to mundane repetitive tasks. (Frey and Osborne, 2013; COTEC, 2019; Decanio, 2016; Manyika et al., 2017). The speed of this socio-economic revolution and its dimension are highlighted on every occasion as a differential factor to always consider (Agrawal et al., 2019).

The second consensual data, a consequence of the previous, highlights polarization as the evident outcome. With job creation happening only on the very sides of the salary scales and job destruction insisting on traditional middle-class employment, social fragmentation seems the destiny of these changes (Abeliansky and Prettner, 2017; Wike and Stokes, 2018; Brand, 2015). This increase in further inequalities and the end of the middle class as risk dynamics can be perceived in several EU countries today (Crowley et al., 2021). The nature of tasks on which automation outweighs tackle directly those related to the vast majority, routine-based middle-class paid jobs (Johannessen, 2019).

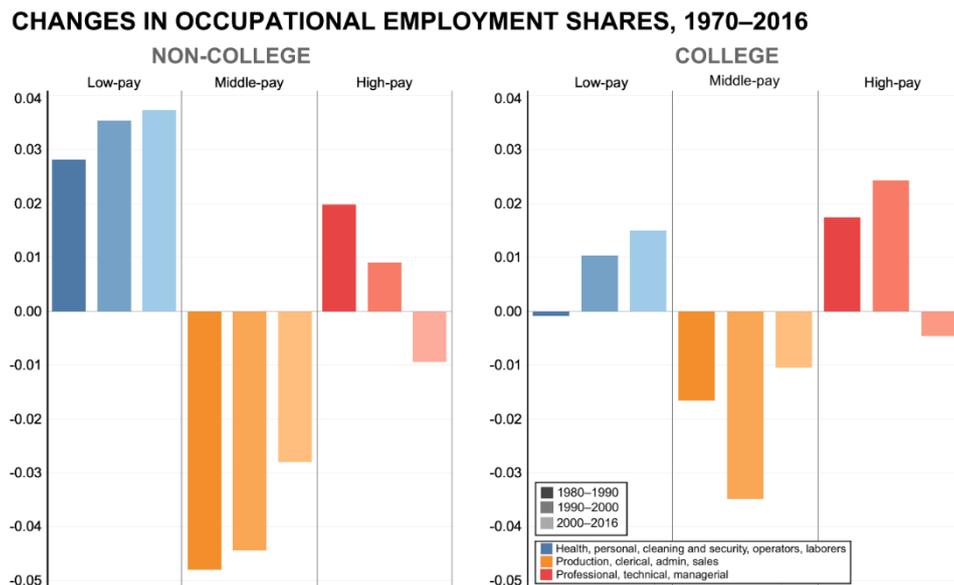


Figure 1 (Autor, 2022)

With this perspective in the future, education arises as a key actor on this equation. Job tasks adaptations require workers one, which needs educational programs too (Finn, 1957; Leonor, 2018; Peters et al., 2019). Under a socio-economic change of this caliber, skills and competences attempt to be constantly remodeled. The flexibility of the working mass, never seen at this scale, is intended to be fundamental in assessing the effectiveness of the automation revolution (Cedefop, 2013). Under increasing scenarios of job market mismatches and knowledge disparities, no nation seems yet ready enough for this convulsion (Wikes and Stoke, 2018). After three industrial revolutions and

only one educational one, it is the moment to have structural transformation in both.

Presented the consensus on which this paper is to build on. It is necessary to address the disputes occurring under this discipline. The ongoing debates and discussions which are to explain the ideal perspective for this paper, to align first in content and then in method, with the needs of the topic. The cornerstone of the debate about the future of employment is that its net result is yet incognita. No agreement is found, if this fourth industrial revolution is to provoke jobs to disappear or just to change. Instead, two schools of thought appear in the scene defending their antagonistic results. Jobs net construction or continuist about the future of employment and jobs net destruction or modifiers are to be contrasted next.

## 2.1. Job market continuist.

Traditional economics theorists stand out in this chapter. Their main arguments are found in history and the free market institution. They defend how adapted services and goods appear when technological disruptions occur and relate to the always changing consumption patterns leading growth and employment (Atkinson, 2017). In a nutshell, they refer to this fourth industrial revolution as another one, as one of many transitions' societies are constantly living without any differential factor to consider (Vermeulen et al., 2018).

The gale of destructive creativity coined by Schumpeter is the main line of thinking on which we can address this school of thought. (Schumpeter, 2020). The economic kinetic on which innovation appears to replace what existed before, under a constant cycle of change sets the standpoint of this theory. (Acemoglu & Restrepo, 2016). This philosophy perceives transformation as the natural shake of events and defends this approach for the healthy development of human systems. Under this rationale, while employment might be destroyed by disruptive techniques, it should also regenerate thanks to them. (Vivarelli, 2015). History and former industrial revolutions strongly prove this argument

vanishing apocalyptic beliefs from tech developments. (Mokyr et al., 2015). Despite some resistance, all previous revolutions have brought collective prosperity after short frictional unemployment periods.

Luddism appears today as a naive failed reaction leaving a lesson for history. 150 years after its origins, machines have been continuously growing without stopping jobs from evolving. (Author, 2015). The economic reasoning behind it is that a drop in labor cuts the cost of production, which lowers the price and expands the supply point, tentatively involving intensified labor inputs. (Jerome, 1934). The logic behind this is that higher demand for cheaper goods will always require additional labor on those tasks humans need to assist automation. Being the demand limitless and the number of jobs as well, this reasoning has worked fine during the whole industrial era.

On top of that, the power of compensation effects of technology has traditionally outweighed the losses. For every job destroyed by innovative tools, four new service-oriented occupations have the opportunity to appear (Demerouti, 2020). As people moved from agriculture to the factories, today we see an abundance of services yet to expand such as in the fields of caring, education, or entertainment. The fear of long-term technological unemployment has historically been proved as a Luddite fallacy, creating the biggest diversification of the economy ever. Luddism believed in one key pillar that neoliberals have been refuting for decades. Their defense of the thesis that there is a finite global amount of work, was coined as the lump of labor fallacy and was contrasted by the plethora of new employment occurring after the second industrial revolution (Jones, 2013). If human creativity and needs appear as limitless as they have always been, a world with limited possibilities seems rather unlikely to occur. For this reason, destructive creativity is defended as the main tool to keep this constant state of inspiration.

The nature of this argument, while obvious, brings paradoxes that are important to consider. Academics from this school of thought defend that destruction is many times the only way to construction. (Schumpeter, 2020). However, some

of them advise that ignoring the dimensions of destruction may make us lose perspective on the issue. Economic crises and wars, larger every time, are the main tools to carry on the mentioned metamorphosis that capitalism has always inherently led into this process (McKraw, 2006). Being aware of this feature of the economic system and its potential casualties is important to understand the cyclical description of it. As a counterargument, these scholars are criticized for not considering the limitations of the system when addressing it (Harvey, 2010). With climate change and pandemics as current external tools to enforce transitions, questions arise about the survival rate of these reinvention traumatic methods (Harvey, 2010). While for some, changing means growing others suggest, under a finite template of resources, this might not be possible.

Scholars from this line of thinking see current automation trends as an opportunity to increase stalled productivity by allocating human and technical resources where they perform best. (Demerouti, 2020; Coupe, 2019; McQuay, 2018). They believe in infinite vision and want to create unimaginable jobs that new training is to unleash. They perceived automation as a cooperation tool with humans that does not necessarily need to bring about unemployment. (Acemoglu and Restrepo, 2016). They argue that developed countries' main worry is still the lack of manpower in key sectors, rather than unemployment (Coupe, 2019). For this reason, they defend that educating experts to work hand to hand with the new trends is the solution to cover all vacancies existing (Peters et al., 2019).

Finally, market continuist discredit automation as a mass unemployed for two reasons. On the one hand, they differentiate between full automatable jobs and just tasks. This way allows for partial liberation and further specialization of humans instead of unemployment as the only solution. (Wolters, 2020; Arntz et al., 2017). When considering only separate tasks, forecast estimates appear way moderate as when considering full jobs. Taking in consideration most jobs will have at least one task automated, leaves a door open for better human performance, being liberated where we offset (Downey, 2016). On the other

hand, the fact that even automatable jobs may not reach this point due to social and economic reasons suggests deeper reasons for automatization rather than its mere technical possibility. (Wallace et al., 2017; Wolters, 2020). This opens already ethical debates that will be addressed during the discussion part.

As a summary, under this group of academics, we perceive a clear defense of the status quo. Automation and technological development are considered as what they are, natural drivers of the system. While considerable changes are expected no modifications are foreseen in the system. Employees will be replaced and means of production will be swift, but the broad framework will be kept. Employment and the market will be constant as the nature of this change does not differ from the previous. Existing tensions in the system both internal such as social and political or external such as extreme weather events or health risks do not seem to be threats to an economic system that has overcome many transfigurations before. In a few words, human jobs will remain, different from now, but limitless.

## 2.2. Job market disruptors.

Members of this group defend that job net destruction is to accelerate under current technical transformations (Frey and Osborne, 2013; COTEC, 2019; Decanio, 2016; Manyika et al., 2017). They perceive substantial differences in this technological revolution that differs from all previous seen and defend that structural systemic changes rather than stationary ones are expected, considering the level of extenuation of the current one. They emphasize that the expected speed of jobs destruction appears outstandingly higher than the one of construction as for this one to happen political measures and educational programs should adapt when they are yet not doing it (Agrawal et al., 2019)

Velocity and impact are the main adjectives used when describing the fourth industrial revolution as a differential one. Automation is not only machines,

algorithms, apps, and data computers that skyrocket all around the world. The fast pace is addressed when referring to the levels of popular adaptation of new technologies but also to the level of further transformation of the previous one. (Wallace et al., 2017). We are happily accepting technology and expecting what is to come. The speed at which the smartphone, 3D printers, Instagram, or the Internet of things have risen has no precedent (Brynjolfsson, 2014). In the last ten years, the consumption of the former multiplied without antecedent. The momentum on which these tools can reinvent and learn from each other thanks to big data, shapes a limitless exponential curve doubling its power every two years (Thackray et al., 2015).

The impact of this transition is such that little are the spaces of our society not being affected by digitization and automation. From agriculture to science, covering private to public spheres, computerization is everywhere. Regarding employment and activities, machine learning and AI are now able to cover not only manual dexterity tasks but also intellectual or even social for the first time in history. (Autor, 2015). Its reaching capacity and level of adaptation appears limitless under a scenario where "ChatGPT" or self-driven vehicles appear to do what seemed impossible ten years ago.

The main fear scholars have is that under a limitless expansion of technology doing easy jobs, it may be reached the point where all jobs can be considered easy (Jones, 2013). Even if occupations are infinite if so, is technology, most of the jobs will be able to be performed by cheaper and more efficient automation (Ford, 2015). There might always be "not easy" jobs, but how many available and which percentage of the population will be able to practice them, raises the possibility of systemic technological unemployment to happen.

While we see this outstanding job market penetration of new technologies, the degradation of the job market provokes an increase in inequality and the crisis of the welfare state as collateral risks (Kurz et al., 2022). These further tensions, perceived in current events, are for the scholars of this group another example of the expiring date of the system. Being their own labor force, the main source

of income for most of the population, the discrepancies between the dynamics of wealth and workforce have a big say on this (Wallace et al., 2017). As Thomas Piketty defends, being the rate of return of capital remarkably higher than the one of the workforces, the central contradiction of capitalism furthering inequalities risks its own existence (Piketty, 2017). Being the quality of employment a key factor for so many, it is understandable how any change provoked by the automation wave will be momentum socially (Crary, 2014).

The explanation of these events relies on the kind of jobs that are destroyed, and the ones created. Job market disruptors focus on the nature of the jobs we do. While they agree innovation creates new jobs impossible to foresee before they are implemented, they defend that the number of new jobs being born are distant in comparison to previous cutting-edge industries. Current leading industries such as Google, or Apple create 10 jobs whereas previous leading ones such as Ford or Boeing back in the third industrial revolution were creating 100 (Brynjolfsson, 2014). All of that while creating higher comparative levels of wealth.

Studying the nature of jobs we do; scholars defend that in broad numbers not much has changed in the last 100 years. Most of what occupies the working class has remained the same and it is not a product of new professions developed due to technological innovations (Pouliakas, 2018). For each influencer, programmer or AI analyst, our societies count with 5 drivers, ten accountants or 15 waiters whose chance of automation is remarkable (Crary, 2014). Yet nowadays, more than half of the employment is repetitive because of the constant labor division coined by Adam Smith (1996) 250 years ago. "Average jobs", the ones that sustained the system as we know it, are the ones at further risk and this might be enough to talk about the end of an era.

In conclusion, this revolution is exceptional. No one has seen such a thing before as this time machines will be both stronger, as they were already, and smarter. In a matter of time, what will be left for humans? The speed and impact of this

trend present nothing, but more challenges to cover the quaking future of employment.

### 2.3. Summary of the literature review.

The literature review about the future of employment has been quite fertile during the last 15 years. Many scholars from every discipline have been compelled to give their input into such a relevant socio-political hot topic. Nonetheless, if we assess the number of studies with concrete numeric predictions the final figure of studies to consider decreases into a tenth. These studies, the ones that cover more than the mere abstract reflection on the issue, the ones with scientific admissible methods are the ones relevant for this paper. (Brandes and Wattenhofer, 2016; Schwabe and Castellacci, F, 2020; Wike and Stokes, 2018; Pouliakas, 2018; OCDE, 2017; Frey and Osborne, 2013) Despite being speculative, they allow for consistency and clarity, structuring the content under categories that bring more rigor.

Regarding this kind of documents, two are the blueprints that construct the framework of predictions. On the low side of the scale, the OCDE (2017) study forecasting that 9% of the employment of the United States might be automated. On the high side of the range, the widely cited, Frey and Osborne (2013) work, estimating that 47% of the jobs of the USA are at high risk of being automated in the following decades. In between, many more array diverse projections complicating any kind of reliable scenario making.

The vast number of expectations are distant from a common point of view. While some scholars see the future close to a status quo scenario; where in essence little is to change with regard to how societies access and perceive employment, others see this as a new trend, with high chances to change the rules of the game, even if little can be yet perceived. From the logical point of view, under limited human capacity but limitless AI one, it seems reasonable

that a future with no human jobs may occur. Under this same point of view as well, it seems naïve to expect a limitless future where working is always a constant having a limited planet. Despite this mere logical syllogism, which might offer an idea of how the situation may look, a lot of effort is required to understand and foresee what the future job market for the next generation may look like.

Uncertainty added to a diversity of opinions regarding the methodology to use, converting this area into one needed for further study. On the one hand, it is obvious that it is complex to understand how many jobs will be destroyed, how many will just transform, and how many will be created later, to calculate net employment levels. On the other hand, different competing approaches difficult possible comparisons and contrasts. While some people have focused on one concrete automation and then aimed to extrapolate results, others aim for wider perspectives focusing on whole countries. While some focused on individualized tasks others target current complete job positions. Whatever the orientation of the study, a lot diverges on the epistemological difference between the possibility and probability of automation to happen. As mentioned before, for automation to happen it does not only need to be available, but also acceptable and accepted.

Seeing that the only substantial takeaway is that we have no clue how many jobs will be gained or lost in the following years, this paper aims to cover two different points. First, to calculate one more time the technical possibility of jobs to be taken by technological tools. To revise the used methods and create a revisited approach on which current levels of development are assessed in confrontation to the current job market. Second, with the result of this methodology and taking the consensus we have of expecting a future of contrast where the middle class is to suffer a great change, this paper would like to discuss measures and orientations that should be addressed these days to prepare in time and form what is to come.

### **3. Methodology.**

As mentioned before, job automation is a disputed field even from the procedural aspect. The channels of measurement define the later results to the extent that choosing one or another may produce antagonistic rival results. Of all the quantitative methodologies available to imitate, there are two on which this paper had to decide. The current fight between task models and full job position models represents the main academic dispute today.

The full job position model, the one selected for this study, covers the abilities needed to perform an occupation completely today. It divides the population according to the different professions that build the total active population and considers the average level of education, knowledge and competence needed for each of them (Frey and Osborne, 2013). Comparing a comprehensive list of the current division of workers with the abilities they perform and contrasting it with the one's automation can bring the probabilities of these employments to be substituted by AI.

The task model instead focuses on the different duties each job performs. It calibrates how many individual activities and how often these are needed for every single occupation and thus concentrates on these assignments that are shared between different professions (Lautaro et al, 2020). With this list of tasks, this methodology follows a similar tactic comparing the abilities of machine learning and machine robotics to the nature of these tasks. The results express how many tasks can be done by automation and how many by human beings, leaving most current jobs safe from automation as some percentages if some of its current tasks are of human exclusivity.

To clarify the difference these two strategies provoke it is necessary to address the very two examples used by OCDE (Arntz et al, 2016). In this paper, they explain how the two jobs of bookkeeping clerk and retail sales show different results according to what strategy is being utilized. According to the occupation

approach on which Frey and Osborne (2013) make their calculations, both employments suffer a 98% and 92% of probability of being technically automatized. Considering the task approach on which Arntz et al (2016) work on, only 24% and 4% respectively, are considered to have automation potential. How is this possible?

The reason why the task model considers these occupations unlikely to be automated relies on the fact that both have today, some level of face-to-face interaction. Even if this interaction is not the main function of the job, it is enough to keep it safe. Being face-to-face relations a technological bottleneck today, they conclude these jobs are very unlikely to be displaced by technology. Therefore, even if these jobs might lose some of their current tasks if there are exclusivity areas performed by humans, this process does not perceive threats.

To contrast what numbers and estimations say, it is often important to come back to the original subjective assessment of the topic. If we think about the nature of the employment of clerk and retail person, we will quickly have in our mind activities where routine tasks, structured objectives and simple calculations and interactions make most of the duty. Indeed, we may catalog them as mundane and rather not desirable careers that could be quite easily automated. On top of that, if we look out on the streets, we might already see cases where robots, apps or programs are substituting these low paid, low skilled positions (Meyer, 2022).

The argument defending that face-to-face interaction jobs are safe from automation can be discarded when we have cashiers, drivers, or receptionists, with face-to-face interaction involved, being automatized by machines, apps, or robots today. In addition, the argument that a full job may not be automated as long as there is one task that can be humanly done loses weight when we identify the labor division scheme liberalism has been deploying in the last centuries. With activities always being specialized and further detailed to construct simpler tasks, automation can forget about some aspects required today and still fully complete the order.

This paper considers that a method that does not consider these employments as automatable translates a basic misconception that cannot be prolonged. Technical automation must relate to the capability or not, of machines to achieve the result workers would be doing instead. The means, or the task to reach that goal, can be different as simplification and the use of more than one kind of technology are recommended practices in this case. It is for this main reason that the full occupation strategy is taken into consideration.

The fact that this approach can be considered the pioneer of current probabilistic research on job automation offers an opportunity to run an updating process one decade later after its first execution. Studying the technological advancements of recent years and the possibility of revisiting some of the bottleneck's assumptions builds an opportunity, as already happened twenty years ago when Frey and Osborne revisited the model of Autor (2003). This approach brings the opportunity of keeping the simplicity of a peer-validated process that can be compared while bringing improvements to adapt to the new under-construction realities.

Done the rationale on why the method selected is found to be the optimal one, it is the moment to proceed with its detailed explanation. In it, a two steps process, summing the learnings of transdisciplinarity and the advancements of machine learning and R programming will be presented.

The first step of our methodology requires the input of expert opinion. To initiate a machine learning process with the totality of employment existing, first we need to come out with a reduced sample manually selected. While in the blueprint established by Frey and Osborne this task is carried out by themselves and ML researchers, in this paper it was decided to come out with a more diverse and inclusive approach. This step of our line of action was made following the learnings of Transdisciplinarity aiming for a holistic coverage of the labor situation (Scholz & Steiner, 2015). To do so, a multidisciplinary group of ten international students participated in a workshop to handpick 80 employments on which there was consensus about its automation or not.

The profile of the contributors relates to young scholars of the Erasmus Mundus master's degree TISE, representing all sides of the world and all disciplines from law to engineering moving to economics or anthropology. Thanks to the experience gained in complex science during their curriculum, added to their local view into global problems a better thorough understanding of the reaching capacity of technological automation to employment can be done. A significant sample of collaborators from this course was taken to perform the evaluation more efficiently and leave space for further reflection.

Inspired by the very list of handpicked jobs utilized by Frey and Osborne, this list was confronted to the group under the question "Can this job be technically automated by current AI, machinery and IT capabilities in the following 15 years?" Assigning 1 if automatable and 0 if not, a list of jobs was cataloged, deciding only those where a maximum agreement was obtained, over 90% of agreement. Those jobs where dissensus was the result were discarded and replaced by others of a similar nature till completing the list, aiming always for maximum levels of appreciation and certainty.

Thanks to this approach several advantages can be taken in comparison to previous methods. First, personal, or subconscious biases are reduced providing additional quality and confidence to the sample designed. Second, all opinions are considered equally before voting, opening different perspectives disregarded by others. Third, a variety of realities and scenarios is considered before making any assumption providing a more realistic picture of how automation is perceived by those that are to conform the labor market of the future. In conclusion a more democratic perspective brings theoretical and experiential knowledge to better address complexity.

Covered this first rather innovative phase, we continue our protocol following the next step as Frey and Osborne do. Benefiting from the exhaustive list of O-net variables, we cover the same categories they take, as the bottlenecks to computerization still occur in the same branches they defined. Taking into consideration the "levels" of in-depth this list provides, a structured pondering

of how much each of the abilities is required for any specific job can be done. The very nine variables they utilized are taken again to assess the main questions technology is today to answer, what level of manual ability, creative and social intelligence can perform.

### 3.1. Updated bottle necks to computerization.

Technology has historically evolved expanding the quality and quantity of tasks capable of successfully performing. From primitive techniques able to repeat simple physical movements in a factory line, the first leap occurred when cognitive repetitive calculations were included within the possibilities. The first computers are a good example of this accomplishment of the third industrial revolution. The second step forward refers to the advancement into non-routine physical actions as it is happening with surgical robots and the final one will imply the achievement of non-routine cognitive tasks as big data, ChatGPT and AI are starting to show off.

This constant introduction of machine robotics and machine learning into our quotidian lives can be explained due to two cooperative factors. The first relates to engineering advancements. Today, we live in a scenario where the processor's power duplicates every two years under an exponential growing trend, energy resources are more powerful than ever, and technology of communication becomes cheaper and more accessible. The race of innovation as well as the rate of investment in I+D+I reaches record figures in an industry recalled for many as the solution of most of the social current challenges we have.

The second reason why automation expands relies on the nature of the entrusted tasks to do. In other words, it is explained thanks to job reduction, specialization, and simplification. Imagining one machine doing the same job of an artisan seems quite challenging as it is in fact for a human being. Dividing as Adam Smith suggested the whole effort into smaller pieces made it doable first for humans and after some time ideal for tireless machines. By limiting the amount

of variability, automation can reach further as the limit of the process can be as divided as machines can take part in it.

### **Perception and manipulation tasks.**

While robots are still beaten by humans in this matter, several upgrades seem to shape the horizon way brighter than it was in 2013. The movement, adaptation, and recognition of objects in diverse scenarios such as forests, opens a lot of challenges for technology as the level of irregularities and surprise factor is too broad. The capacity of a human to freshly adapt to problems, accidents and unexpected events offers another additional layer of complexity that robotics has been struggling with in the past. Finally, the level of sensitivity required to comprehend textures, colors, or smells involves subjective factors which often produce polemic results often.

However, if we check the increased advancement in camera recognition of humans, the advancement in drones or the outstanding results of non-automated vehicle navigation, we may think manipulation tasks are getting closer to automation that we may consider at first. Examples of recent upgrades are the contact-less delivery system of amazon air, on which no human is required to fly a parcel till the property of the customer; the novel cooking robots that outweigh the famous Termomix both in autonomy and skills; or the popular Boston dynamics robots with dancing and equilibrium capacity parallel to professional athletes. All of them, still in prototype status or recently presented to the market, are likely to see their potential fully deployed in the following years.

### **Creative intelligence tasks.**

The creation of beauty, art and new content relates to a very emotional part of human beings. The invention process remains surrounded by a special aura that offers, for those who find it, a gift that translates into honor and prestige. We value the process of genius and the whole of humanity celebrates their masterpieces as an integral part of themselves. Their pieces of work become shared identity and patrimony of humankind. When we say that humans have sculpted *The Thinker*, painted the *Mona Lisa*, or composed the *Magic Flute*, we accept a social misconception, a white lie that needs to be understood. Gifted extraordinary individuals, most likely helped by other talented assistants, were the ones that carried on these masterworks. Only they, with their effort, passion and knowledge did it and it would not be fair to say otherwise.

For centuries we have always granted the honor to the rest of society as a matter of symbolic romanticism or patriotism against other nations. Nonetheless, from now on the battle against artificial intelligence builds another layer into this topic. If we are honest, to defend creativity as a differentiating factor of humanity against technology seems very risky when for the vast majority the artistic vein is almost extinct. For this reason, the same way it is understood today that AI cannot reach for now the levels of creativity of the big genius, it seems naïve to say that WE humans can compose music better than a PC when 90% of us would not know how to. As most of us do not understand how to paint a portrait it is quite tricky to what extent we defend creativity as a human skill.

Today, thanks to the vast array of data available and considering creativity as a process which often translates into mixing differently previous existing pieces, we have several cases where AI deploys a higher level of creativity than a human being. This fact, is demonstrated in the way essays, songs, or presentations can be done with average quality, from scratch, faster, and more efficiently than a person offers a challenging response to the issue of creativity and artificial intelligence. At this stage, with the initial steps of software such as Gamma, ChatGpt3.0, we may agree that while excellent creativity may be far from being

automated, that mediocre average creativity most of us are used to employ might be under a serious threat these days.

### **Social intelligence tasks.**

Movies like “Her” exhibit the extent to which social abilities are exclusively humans or not. Virtual reality videogames reflect on the friendship capacity people can have with other beings. E marketers may question how influential or persuasive software can be. All these deceptions share one psychological trick we all, from kids with their toys to grownups with their “Alexa”, are happy to enjoy. The magic of the Internet of things stands for the capacity humans must humanize things that are obviously not. The ability to forget about the way things work and just enjoy the process as “magical”.

Step by step, helped by improving aesthetics, the adjusted algorithm answer system, and our willingness to believe, robots and apps appear more like humans than ever. They can chat, they can answer what we like to hear, and they can even understand basic emotions if we offer them our biological constant analytics. Their progress appears directly connected with the level of social acceptance which varies on the situation. While no app has yet passed the Turing test it is impressive how depending on which occasions, people prefer to be addressed to a non-person to discuss socially oriented matters.

In a nutshell, technology has significantly advanced in this decade but not enough to overcome its previous bottlenecks. It is necessary to recognize that these are still areas where humans outweigh artificial intelligence options. Nonetheless, the progress of these years must be highlighted as activities previously unmanaged are now approximately doable. The size of this narrow pass, wider now allows for more functions to be replaced and for a future of expectations closer to come true. Analyzing these three categories and

understanding the limitations automation suffers with them, we may proceed to the probabilistic calculations as a function of these task features.

Computerization Bottleneck	O-NET variable	O-NET descriptor
<b>Perception and manipulation</b>	Finger dexterity	The ability to make precisely coordinated movements of the fingers of one or both hands to grasp, manipulate, or assemble very small objects.
	Manual dexterity	The ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects
	Cramped work space	How often does this job require working in cramped work spaces that requires getting into awkward positions?
<b>Creative Intelligence</b>	Originality	The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem.
	Fine Arts	Knowledge of theory and techniques required to compose, produce, and perform works of music, dance, visual arts, drama, and sculpture.

<b>Social Intelligence</b>	Social Perceptiveness	Being aware of others' reactions and understanding why they react as they do.
	Negotiation	Bringing others together and trying to reconcile differences
	Persuasion	Persuading others to change their minds or behaviour.
	Assisting and caring for Others	Providing personal assistance, medical attention, emotional support, or other personal care to others such as coworkers, customers, or patients.

Table 1(Frey and Osborne, 2013)

With these variables it is aimed to address to what extent ten years of technical development have affected what previously were the three challenging pillars for automation. While back in time, the leap from routine to non-routine tasks created a revolution, the dimension on which technology is now able to physically manipulate objects, develop innovation and behave socially well deserves an updated study. With this mindset and awareness of the impact current upgrades are having in our milieu, we aim to revisit, thanks to econometrics probabilities, how prone automation is in our labor market.

### 3.2. Mathematical rationale.

Once checked the reasoning regarding the content of this paper is, it is the moment to proceed with the presentation of the logical tools required to carry on the methodology presented. To do so it is required to start with the data selection. The data array taken for this paper is formed by the same sources

selected by Frey and Osborne in their methodology, but differently defined. O-Net catalog with its extensive detailed explanation of the different tasks relevant to each occupation and the Bureau of Labor Statistics to compare this with the active population and salary figures are considered updated with 2023 figures. These two sources offer the required exhaustive information to have a comprehensive representation of the labor market in the United States. However, as different sources offer different shapes, a new approach is taken to overcome the challenge that joining together means.

It is compelling to mention the necessary reductions made to follow up with the calculations. On the one hand, from the 873 occupations that O-Net considers, the final data sample of this investigation has been reduced to 723. On the other hand, out of the 147 million citizens working that are considered by BLS, only 131 million or an approximate 90% of the active population are covered here. These reductions, provoked by the lack of consistency between sources, i.e., occupations that O-Net mentions do not appear in BLS and vice versa, are carried out to allow the creation of a merge dataset without modifying the content of the entries.

With this reductionist approach, while we cut the size of our sample, we avoid having to merge similar jobs with a mean of their salaries and capabilities to create a third artificial one. This is an extremely risky exercise that must be highlighted i.e., With this process we save having to practice tricky combinations such as the one needed to join an aircraft repairer and a vending machine one that according to their code are almost similar and thus could be equalized. Despite their similarities, these positions offer significant differences in terms of education, salary, and number of workers, but also in variables such as manual dexterity or cramped workspace with gaps of 20 points. We consider making a mean calculation of both would modify in excess the reality and thus we believe reducing the sample is a fair price to pay to gain visibility. Our strategy differs in this step from previous methodologies, and we believe it is important to value the quality of the data preserved.

Explaining this important detail, it is the moment to fully explain the data we have worked with. Our table counts 723 occupations, addressing the level of importance of the 9 O-net descriptors, mentioning the number of workers, salary figures and job zone. This last one, covering a classification from 1 to 5, establishes a mark depending on the years of education and experience needed to access an employment. With these 3 key categories being added to the 9 variables that address the nature of each job, we consider a complete picture that allows us for further analysis and comparison needed to test the consensus found in the literature review and the open debates that are to be answered.

Added to this list that forms the final complete data, a sample of 73 occupations, 10% of the total, has been manually selected by the multidisciplinary team described in the previous chapter. This, which allows for the Machine learning calculations to take place with the R studio programming tool, presents us with the first insights into the data collection process. For instance, with a simple Chi-square equation, between job zone and automation, we obtain a minimum p-value, from which we can already conclude the existence of strong negative correlation between job zone level and automation, defending a priori, the always highlighted importance of education in preventing automation from happening.

Having this data selection cleaned from sample disparities, this paper can proceed to the explanation of the mathematical equations to be used to provide the reader with all the required information to follow up on this investigation. For this purpose, two are the equations that need to be presented. To offer consistency one previously utilized by the literature, a logistic regression, and then a random forest model to offer contrast.

Logistic regression:

The statistical process of fitting an s-curve logistic or logit function to a dataset to determine the likelihood of the occurrence of a certain category event based on the values of a number of independent variables is known as logistic regression. For the purpose of this investigation, we proceed with a binomial

logistic regression used to predict a binary decision such as a simple dichotomy between yes or no, alive or dead or in our concrete case automatable or not.

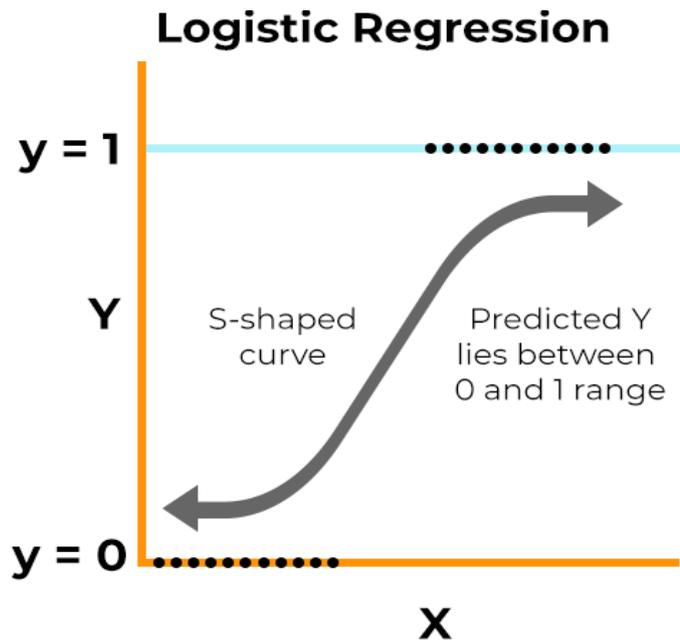


Figure 2 (Logistic Regression: Equation, Assumptions, Types, and Best Practices, 2022)

In this kind of function, we get as a result an estimation of the probability always bound between 1 and 0. Therefore, according to the different bottlenecks we have identified before, established in the x axis this model will give us the automation chance in the y axis (example  $0,6=60\%$ ) of an occupation to be (1 or 0) automated or not.

Logistic regression is one of the most common methods to predict future outcomes. Its simplicity for training machine learning processes make it a fundamental tool to start with probabilistic methods. It performs best when the data is linearly separable like in our case of employment automation. It allows us to quickly find the kind of correlation existing between variables at the expense of not informing us of causation reasons behind this situation. In comparison with linear regression, logistics help us to find binary outcomes providing a constant output where linear provides a continuous one. For these reasons, the first coding practiced calculating automation probabilities has been this which translates into the following formula:

$$y = \frac{e^{(b_0 + b_1X)}}{1 + e^{(b_0 + b_1X)}}$$

**Logistic Regression – Sigmoid Function**

here,

- x = input value
- y = predicted output
- b0 = bias or intercept term
- b1 = coefficient for input (x)

*Figure 3 (Logistic Regression: Equation, Assumptions, Types, and Best Practices, 2022)*

### Random Forest:

The popular second mathematical tool to be used implies the use of a vast number of single decision trees that operate together. In this model, each tree independently predicts one class. This way, every tree is made of different training data that is later tested. In our particular case, different trees are

randomly applied to control all the different variables that affect automation. Then, by calculating the average mean of all trees, the final prediction of the model is calculated. This method brings further robustness and accurate predictions than simple decision trees as the use of multiple trees corrects any potential errors provoked by single trees. They are less likely to overfit and thanks to the use of randomness promote more diversity in the array of trees.

This methodology allows us to understand the importance of each of the variables into their probability of affecting occupations to become automated or not. It allows us to calculate automation probabilities again to compare methodologies and it shows new insights that enrich the outcomes obtained by the logistic regression. Since it is a tool that consumes a lot of resources, the results that can be obtained are limited though in comparison to the logistic regression model which is the preferred way of extracting data for this paper.

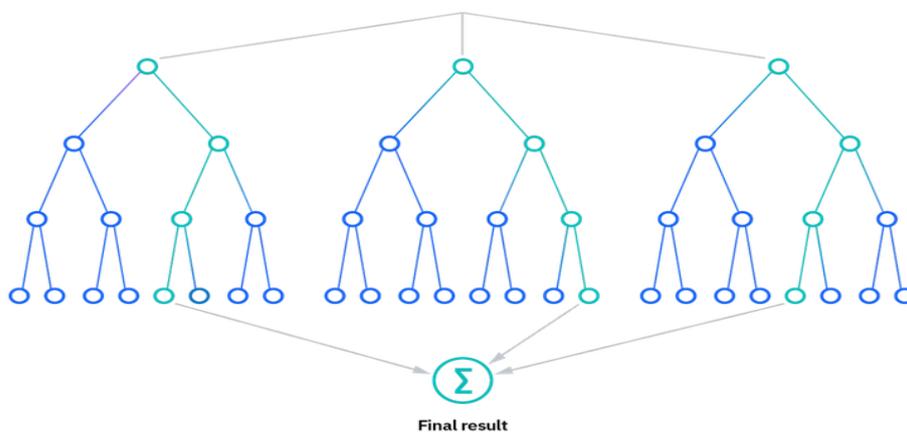


Figure 4 (What Is Random Forest? | IBM, 2023).

## 4. Results.

Run the relevant coding necessary to apply the logistic regression and the random forest model; these are the results that are worth highlighting. First, the main and most important figure that interests to share is the one that addresses the level of employment affected by automation. In quick sight, over half of the current employees are at high risk today. To visualize this outcome, it is relevant to divide all the employees into 4 sectors according to their automation probability level.

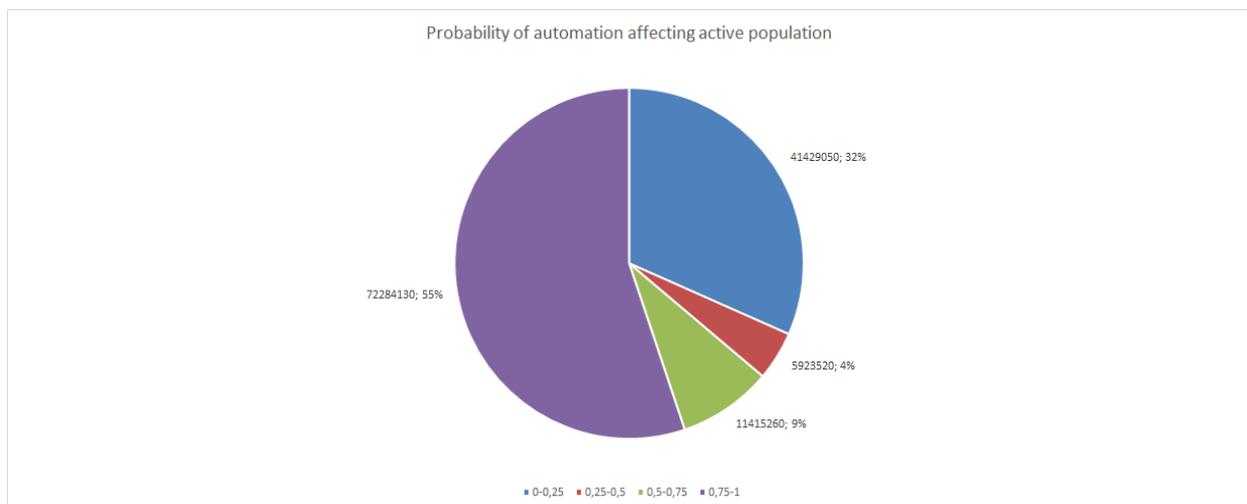


Figure 5. Probability of automation affecting population quartiles calculated with R.

Depending on which method we utilized, the percentage of employees under the high probability category reaches **51,3%** with random forest and **55%** for the logistic regression showing both relatable results despite these small differences. In both cases, the main part of the sample divides between the low probability and high probability sections offering less than 15% of employees the middle ground between a 0,25% and a 0,75% of probability of being automated. This picture represents a society in which significant groups are to be confident about their future, either transformed or protected from automation while just minor collectives could have reasonable doubts about their future.

If we consider the number of different occupations being affected by automation instead of the workers employed in them, the figures that reach the 75% probability of being automated are even higher reaching 53% and 60% respectively to the methods previously mentioned. In any case, this first outcome suggests that in a moderately short period, (next decade) about half of our current production system would be bound to change victim of automation capabilities.

Addressing the impact of each variable on this result it is relevant to mention which correlations can be confirmed out of this study. If we check the 9 variables that were taken from the O-Net describing the computation bottlenecks, we obtain strong negative correlations between them and automation but in the two manual ones: Only finger and manual dexterity offer correlations with automation results, suggesting that this is the first field on which robotics is remarkably improving its performance. All jobs that contain social or creative skills appear solid enough to be protected from automation while those with physical contact seem in a weaker position.

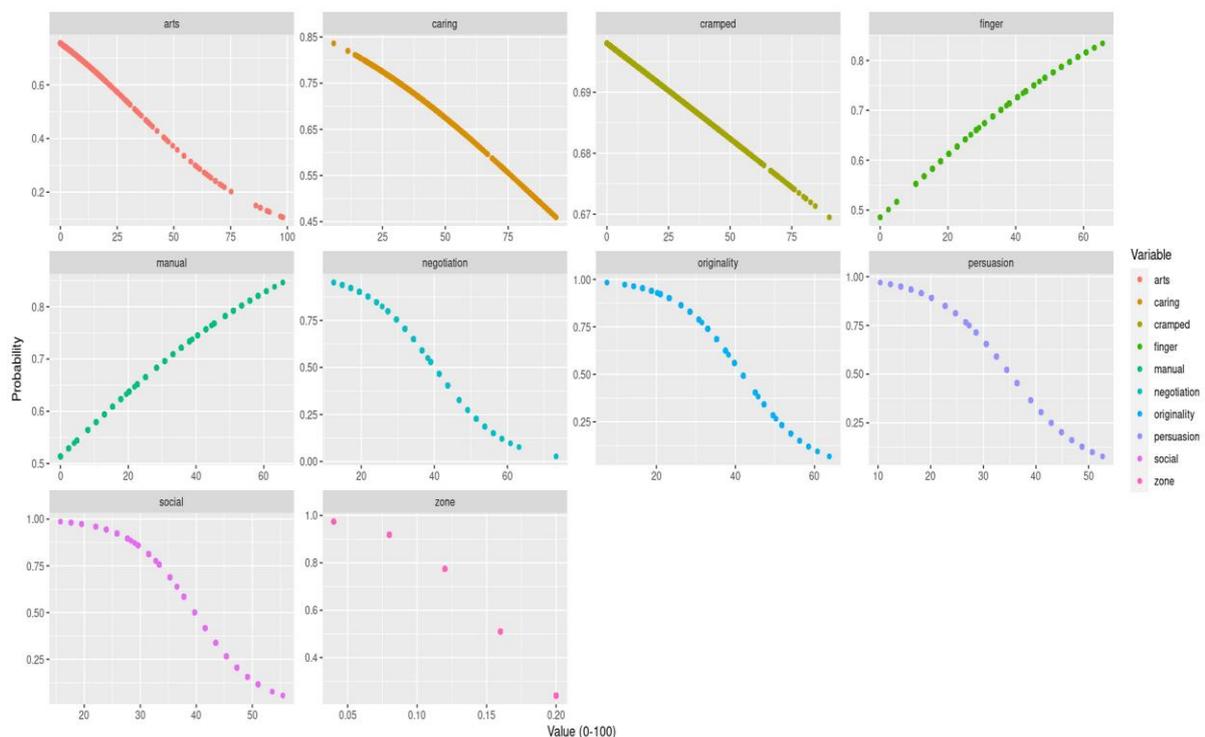


Figure 6. Probabilities calculated independently for each bottleneck and zone with R

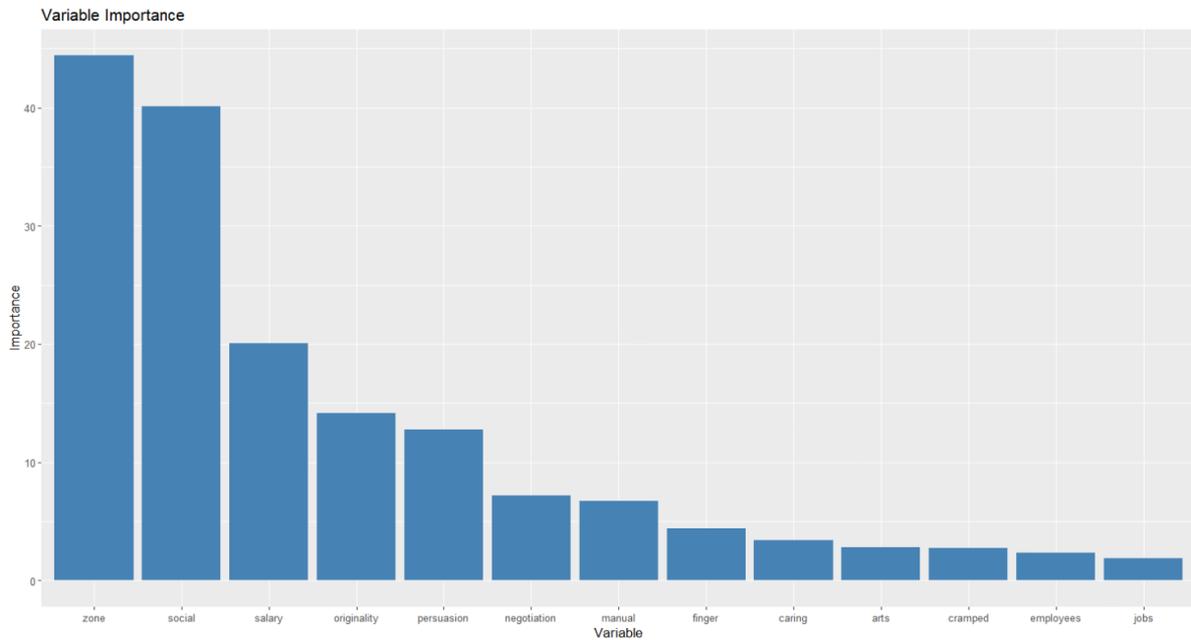


Figure 7. Variable importance for calculated summed probability with R.

Referring to these variables, it is important as well to highlight the importance each of them has in the outcome defining the automation probabilities. Thanks to the random forest applied, we know that social perceptiveness appears 3 times more relevant than originality or 8 times more than fine arts. In all these cases, the one that was more significant though was the job zone even higher than the social factor. This measure can tell us a lot about the importance of each of them in the labor market and how we value each of these characteristics today.

Another correlation that is worth sharing is the one between the Job zone and automation. This relation, which had already been briefly studied with the hand-picked dataset of 72 entries, confirms the previous findings with the whole dataset. The existent negative correlation between job zones or which is the same with the education and experience needed to access a position and automation is irrefutable. While job zone 1 has an 80% risk of automation, those low-skilled activities, job zone 5 with extended access processes barely suffer a 5% risk probability.

Finally, the last piece of data to present is the one that relates salary ranges and job automation probability. In this case and following the logic obtained from the previous relation with the job zones, a moderate negative correlation can be found between salaries and automation. However, in this case it is not as clear as in the previous case, obtaining on both sides good paid jobs being threatened by automation and vice versa.

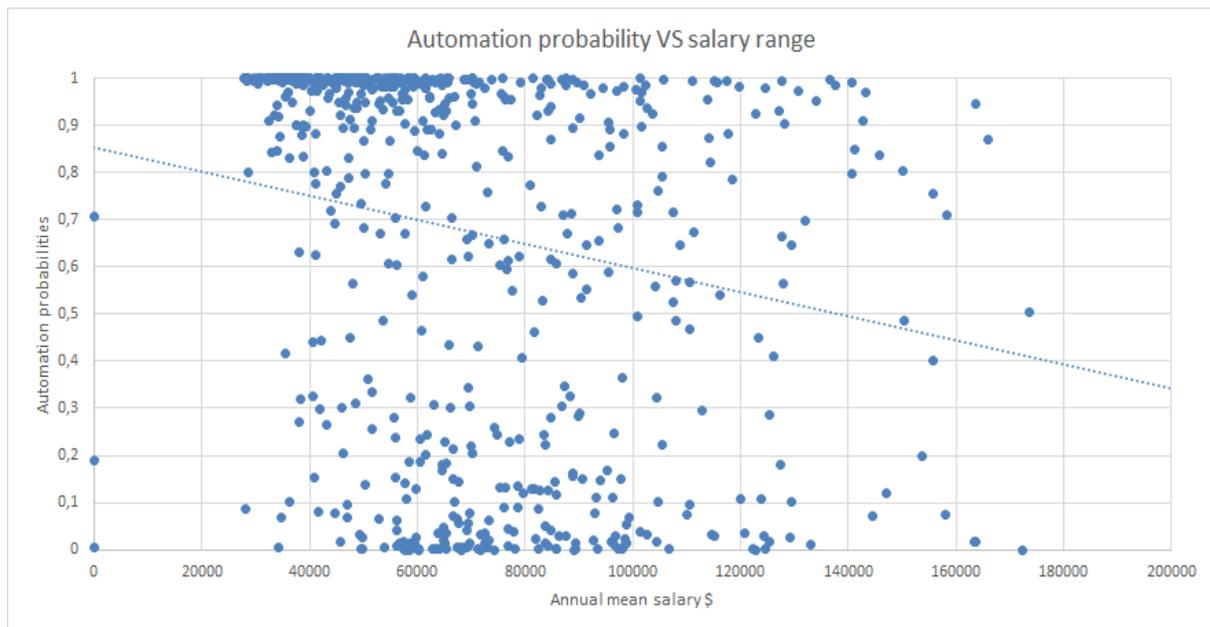


Figure 8. Correlation between automation probability and salary range with R.

## **5. Discussion.**

The presented data reinforces the trends defined one decade ago by the blueprint created by Frey and Osborne (2013). 10 years later, this corrected methodology, updated, and simplified, utilizes two probabilistic methodologies to be able to keep track of the evolving relationship between ML and MR innovation and job automation possibilities. The result; is quite consistent. Higher percentages of high risk than a decade ago are found to explain an evolution of capacity performance. Reliably, the same consensus and conclusions are obtained.

On the one hand, the negative correlation between education, training and experience, and automation is strongly confirmed. Following the opinion of the vast literature review, this position can be reinforced with the introduction of the concept of job zones not used in the previous methodology. On the other hand, the light negative correlation between salaries and automation, shaping a scenario mostly affects those on the low scale as corresponds to the one proposed by Frey and Osborne (2013). In the short run scenario, always approximately around two decades, automation is to focus heavier on those low-skilled, low-paid jobs.

### **5.1. Why if a job can be automated, it will be?**

The sum of results leaves written on stone one statement that should prevail clearly. Even under the most conservative scenario, automation seems unstoppable, limitless, and ready to make changes never seen before. The speed and dimension of current technological developments involve far-reaching consequences in all aspects of human lives including working time. The figures that foresee that this 4th industrial revolution will be capable of technically automatizing 51% of the jobs cannot be ignored.

Saying that over half of the occupations can be replaced does not really say much. What if they are not in the end? Can we know it? This paper says yes and

in the following pages is going to argue why. From the potential technical automation, we aim to reach one of the main conclusions that are to be taken away from this paper: The percentage of real automation to occur. If technical automation is a possibility, it is mandatory to assess if it might be a reality. After all, to understand if automation is to create job net destruction or construction, knowing how much real automation may occur is fundamental. Addressing this open debate, this paper aims to establish a clear ground on which to activate, needed political action.

During the following chapter, it is aimed to assess the critics that defend that just because an occupation or task can be automated it does not have to be in practice. (Wolters, 2020). During the previous sections of this thesis, it has been proven that indeed technical automation potential is a short-run reality and that in a matter of a generation, machines should be not only stronger but also smarter than humans. While this does not necessarily have to mean that automation will come by, it is the moment to explain why it is very likely. The reasons behind this consequence can be found in the following three arguments. Business interests, technology's nature, and people's interests. While the two first are straightforward and logically sound, the third will need further expansion to reach its conclusion.

If we are in front of a robot or software able to perform a task just as well as a human being, this machine is already doing it better. AI will always be faster, cheaper, and more loyal, and under these circumstances no employer would hire people if there were an alternative as such (Kurz et al., 2022). After all, we humans can be very adequate, but we can be expensive, we get tired, we need to stop to have lunch, and we like to go on vacation. As it has historically occurred, for a business owner, if a robot offers the same result with higher productivity levels, there is no economic argument why an employed person should continue there (Acemoglu & Restrepo, 2016). This same concept has occurred with outsourcing in cheaper countries. However, with machinery, this strategy reaches the maximum level of the business mindset. Production led

only by capital, dismantling all labor from the equation, allows for complete independence and control over the industry and this is probably the dream of any business owner.

The second argument relies on the fact that technology always leads to a later one and there is no way to stop it. While this has been true for decades, one invention leaving space for the next waiting for a new frontier of possibilities to expand, this time this concept adopts an additional dimension (Ford, 2015). AI is acquired with an automated learning capacity which means that what is known by a basic translator now, will be doubled after experiencing all idioms of a language. With this dynamic, in which technology is to keep growing exponentially it would be quite complicated to stop this expansion to occur till perfection. Stopping new techniques from developing has always led to them being evolved by different and faster means. At this point, if not one nation, another one will lead this relentless competition which has already acquired an important geopolitical conception (Mialhile, 2018).

The two mentioned arguments share one condition, and it is that they are led and addressed to a minority. This group is formed by the owners of capital and chairs of big tech and business, basically, the ones directly interested in leading technology development before competence does. They are the main benefited by the economies of scale produced and they are thus the principal defenders of innovation. These arguments defend the systemic reason why businesses should go in favor of automation if this continues to be its growing sector and source of wealth. These reasons explain the perception of automation on the side of the offer. However, to have a complete case, a detailed analysis of the line of demand is needed as well.

The demand side covers the job-demanding population that is aiming to consume and use the services and goods offered by automation but that is also going to be affected at their workplace. This demand is very wide in terms of actors and diversity regarding their profiles. For this reason, studying its role is quite challenging, probably biased, but fundamental. Regarding the question of demand, we have some options that need to be addressed first. On the one hand,

we need to assess the market impact of the demand, whatever its opinion is. On the other hand, we must decide if the demand's opinion is favorable or not to automation.

To check these variables, different schools of thought and opinions are to be asked. However, under the reasoning presented it is hoped to support enough the idea that seems stronger nowadays.

When we check the influence the demand side has on a given market, it is important to listen to those scholars that defend that, under this neoliberal landscape, in which companies hold extreme power, this influence equals zero since customers do not have any leverage and are exposed to the will of the big producers and sellers. (Donahue & Nye, 2004). Academics defending these premises believe that under current oligopolistic scenarios, the offer side has become, the price maker and the demand, price taker without any power of choice. (Donahue & Nye, 2004). They argue that customers' rights and decision capacity is jeopardized by the influence of media, marketing promotions, and poverty levels which hide pure extortion under a fake feeling of free choice. Following these positions, the offer side can freely guide the market without any relevant influence from the demand. Believing this, we should be accepting that automation is then going to occur as fast as technology allows, as it has been clear how it benefits those in control of it.

But what if this is not that true, to what extent the demand can decide what occurs in a market? According to the free market law of supply and demand, consumers are sovereign even under oligopolistic situations as they are the ones holding the final say (Moesta & Engle, 2020). They are the ones that put into action the whole system, deciding what to buy and what not. While companies focus a lot on attracting, convincing, and luring customers, clients are yet independent and hold a great power of decision. This situation could be comparable to the US political elections. Even if the voter has a reduced option range and their personal interests are quite forgotten on behalf of bigger powers, the citizen is yet the one to decide which direction to take. On top of this, in the

case of not liking enough of the two mainstream options, the voter can always bet for a third way and cancel the status quo.

The notion of demand power and the role of consumers is constantly a tricky argument. Charged with political and poetical connotations, it translates once again into the dichotomy between individual impotence against collective action (Filippi et al., 2023). It cannot be lied to; customers lose a lot of power the further they are from a perfect competence scenario. The current case, purely oligopolistic, with huge asymmetric information occurring and with a rigid elasticity because several crises have tightened the situation, is far from ideal (Moesta & Engle, 2020). Nonetheless, if we compare this situation with the one of historical syndicalism, for instance, it might be yet one of the most positive ones.

The consumers of this relation are both goods and job consumers, they are current workers and regarding the future of automation, they now have the biggest say they have ever had. In comparison with pre-war times when the average workday was 12 hours, or the median paycheck was of extreme poverty, today's power negotiation is considerably more stable and wealthier. The consumers and workers of today have a say, not only on what is produced deciding if taking it or not, but also at the front line accepting if automation is a positive change or not for the production system (Moesta & Engle, 2020). This power is immense, and this paper defends so, for the basic reason that most States are; democracies where people vote; systems supported by taxes paid by working people; structures organized on behalf of a middle class and directly depend on what this collectivity says. Agreeing with these premises means agreeing with the sovereign of the working classes, the employees, and the middle classes. It means accepting that they are the ones that create and decide the foundations of the current society, not only romantically, but politically and economically.

Once checked the change capacity held by the side of the demand is, it is the moment to analyze what perception of automation this social mass may have. After all, it will be this perspective that will significantly alter the final market

result. The third and final reason why job automation possibilities will become a reality is that job automation will be defended by the public. This paper believes as such that automation will be agreed upon by the vast majority because it is a necessary criterion to succeed. Since automation needs public acceptance to exist, this very innovation process will make sure of getting the people's okay.

The thesis of this investigation is that automation is to help the whole of humanity and it will, because otherwise it will have to be destroyed by the very people that should serve. After all, this is the trickiest part. No matter how cheap or beneficial for the seller it is, if people really stand for no automation, then definitely this revolution will be reduced (Lobel, 2017). If the consumer does not buy, technology will be condemned back to the laboratory to better improve. If consumers do not like it, no matter the price, the product will not succeed.

But what if automation is not desired by the people? Or what if a massive Luddism 2.0 movement becomes the mainstream belief in the future? While this is a possibility that needs to be considered, the likelihood of this chance remains quite low. This kind of posture can occur within some minorities, but it should not be big because people have a lot to win with automation (Thompson, 2015). In the following pages, this paper aims to properly expand this fundamental argument. The concept of popular acceptance comes under a complex set of variables that it is aimed to be presented now.

The factor "taste and preferences" conforming with price, and the existence of substituting items, the final demand of a product has been always the most challenging one to calculate for economists. In comparison to mere quantitative variables, dealing with a subjective matter that is not logical sometimes, has converted this into the complex social science it is (De Cremer et al., 2013). What people believe, need, and want is a matter of many reasons and emotions that cannot easily foresee. With automation, seeing that in terms of price, it will have no challenger and no substitution will be more efficient than another piece of AI, it is this mysterious factor that we need to cover right now.

Automation may become a reality in every sector where people want and may not occur in those places where people will be reluctant. Nonetheless, due to its

comparative advantages, it seems quite clear that it will have a big say everywhere where it reaches human equivalent capabilities. People may not want to see a job automated if they value the human factor above all the rest if they have a special connection with the person, if they enjoy human spontaneity, or suffer a hidden fear of machines (De Cremer et al., 2013). While these will be important factors why some popular resistance may occur, this paper believes that there are three reasons why automation will be desired by the public.

First, because services and goods will be cheaper and more universally available. As happened with the industrial revolution, automation costs will be reduced. Fully automated processes will produce everything way cheaper than nowadays. Basic resources such as the internet, a privilege for a few in the past, will be almost free. Under a scenario with automated distribution channels and green energy, the cost of a basic material condition of minimum life maintenance will be close to 0 (Ford, 2015). This way a general improvement of life, safeguarding a certain standard for everyone would be the new progress threshold.

Second, automation is attractive, comfortable, and allows for unlimited capacity (Kurz et al., 2022). Either communicating, imagining different worlds, improving physical conditions, enriching lives...Technology unleashes a new way of desired possibilities. Breaking barriers and bringing opportunities that our limitations do not allow. This new reality, this improvement and boosted capacity are flagships of automation that difficulty cannot be enjoyed and accepted by the people.

Third, it will free thousands from grizzly, overwhelming occupations which have nonsense for humans. Automation will universally retire those functions that nobody wants to perform. Cleaners, miners, and factory workers will be liberated from those tasks that destroy them physically today. Accountants, bookkeepers, and copywriters will see their boring routine canceled, offering them new alternatives to comply with. Automation will liberate them from their personal torture, and they will accept it if they have a way of living after it (Agrawal et al., 2019).

Automation will reach a point where it will be able to liberate occupations and it will be able to benefit everyone if we want this to be the case. While automation will put the physical and technical possibilities, it will be the social and political decisions that will bring the real future scenarios (Agrawal et al., 2019). Once explained how automation can benefit every side of society, this paper will move to explain which are the mechanisms that could be used to deploy this transition as smoothly as possible.

Seeing that employed people are the ones with the power of change and that automation may be perceived as a threat to this collectivity, the key to the success of automation is to offer this group something in exchange. Without reciprocity, employed people can today push back automation thanks to their strong labor rights and their consumer sovereignty (Acemoglu & Restrepo, 2016). But thanks to these two reasons, they can also benefit from automation while guaranteeing welfare not dependent on the middle class and employment as the current one. Against the risk of employment to occur as today, the *job-income dichotomy needs to be updated*.

Only while the working classes and middle ones have the power their job gives them; they will have the chance to modify laws and change the future of automation. Immersed in the progressive destruction of the middle class and the Welfare State, automation can be the decisive destroying factor of these key institutions or the safeguard of its principles before it is too late (Jordan, 2020). It is now on the verge of an automation revolution when the legal scenario must be defended before the new reality gets out of hand. Therefore, the solution to the widespread unemployment caused by the AI Revolution must in some way entail a broad transfer of wealth that decouples it from labor. This should imply a whole reinterpretation of what "work" means. Or a whole reinterpretation of what wealth is. To reflect on these ideas and the available options, it is the moment to introduce the following chapter.

## 5.2. Mechanisms to conduct automation transition while keeping a welfare state.

As long as automation gains the field, fewer people will be working as the number of human jobs will be comparatively reduced. No matter if new jobs are invented, automation will sooner or later learn them as well, equalizing human capacity for 2050 expected (Wallace, 2017). Individually many will not be able to adapt to new occupations and globally it will not be possible. Under a scenario where for the first time in history a lot of people will not be productively useful, many questions about identity, power, legitimacy and democracy need to be raised.

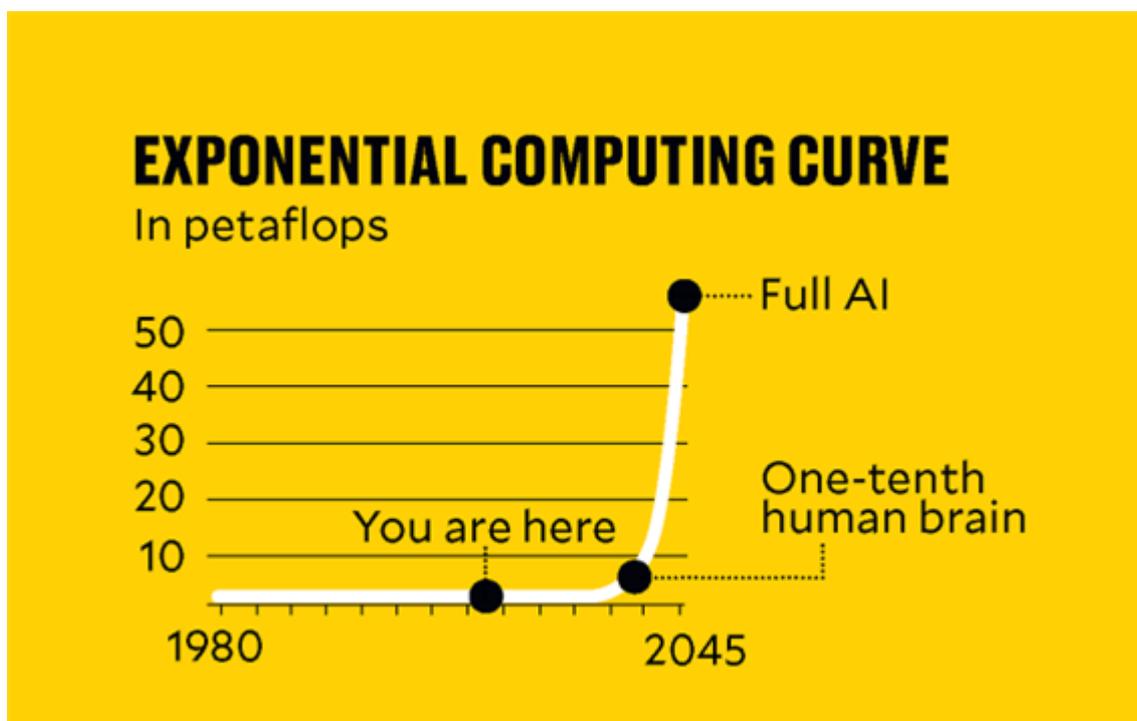


Figure 9. (Drum, 2017)

To invite further engagement in this needed conversation, this paper proposes three key measures to be jointly implemented to address the social opportunity challenge that technical automation possibilities will propose in the next generation. While the first may be seen as a rather symbolic measure since its impact and dimension are quite reduced, it is just the precursor of the two main

actions to be taken. One directly regarding social inequality and resources distribution and the second the identitarian and social impact of this change.

### 5.2.1. Tax on robots.

Historically, the main source of a State's revenues budget has been workers' income tax. Reaching around 50% of the total input, taxation on employees has built the welfare state current modern nations enjoy (Guerreiro et al., 2021). Education, healthcare, public pensions, and thus a safety net for everybody were designed depending on employment and those working. The premise, which was the main strength of the system, every one according to their salaries collaborating in the common box, offers today a weak trembling foundation.

Workers' income tax has been the strongest way of fixing public budgets as people always worked and did it in presence. Against companies that had demonstrated a great mobility capacity, it is only recently that employees do have the chance of working and paying taxes in different locations, further complicating the suitability of this tax. The flexibility of employment and its recent fluidity in terms of space, time, shape and numbers created the first question marks in the current system.

In front of this defy, automation just offers a step further into the expiring date of this tribute and the signals that a new tool appears necessary. In a scenario where automation is likely to replace human workers, the employees' taxation system threatens to be unable to deal with the government's needs for income. In front of a situation where an employee is substituted, it should be fair to ask, why not taxes too? Where before there was a worker and now there is a robot, an adaptation of taxation should occur to avoid income loss.

What happens with the taxes that were perceived by the employees should become a key question for public administrations before deficits keep growing. Since neither the default of systems nor the deterioration of the hardly obtained welfare state should be risked, how to save reliable income sources appears

critical these days. For this reason, while it may offer technical complications, as it might be more complicated to distinguish robots than it is with people or between applications, software and robots, a tax on the potential future sustainers of the production arises as a practicable solution to future gaps.

A tax that simply translates the piece of welfare that is created back into the public system. Without disincentivizing automation but without making it “free” for the employer or a huge loss for the State. Concerning this question, MIT economists defend the optimal policy includes a tax on robots, but only a modest one. In their studies, they concrete that a tax on robots should range from 1 percent to 3.7 percent of their value (Costinot & Werning, 2018). To make the taxation of robots practical, several factors should be considered such as the definition of the taxable person, allowing the tax base to be expanded, and identifying the most suitable taxes (Shome and Miura, 2022).

From 2017, one of the countries with the highest robotic implementations in the world, South Korea introduced the first, and so far, only one tax on robots. This first introduction could be seen as an example of how this measure can work. While little is known about the real effectiveness in comparison to the cost of opportunity, this implementation can serve to lead necessary debates about whether tax adaptation will need to be completely rethought. As the tax on robots is just a minor example of the whole system. We proceed to the second tax that could properly shake the table.

### 5.2.2. Tax on wealth.

*“Automation corresponds to new tools that enable capital to be substituted for labor in concrete responsibilities. As it generates a supplanting consequence, since it substitutes hard labor in duties formerly performing, automation translates into a higher productivity of capital”.* (Acemoglu et al., 2018).

The content of this syllogism has to tell us the level of importance capital has in all this discussion. As we live in a capitalist system it should not be a surprise to

see how capital holds a relevant role in our economic system. In addition, this paragraph tells us a lot about diversification and inequality. As working capacities are considerably better spread than capital among the citizens of the world, it has to be acknowledged how capital concentrations to the detriment of labor tend to always address a wealthy minority.

To address the extent to which capital and investment have developed a key figure in our historical development, we shall use the work led by Piketty (2020) in his book *the capital*.

Piketty explains historical economic growth as a joint dynamic of two different factors. These factors could be easily related to work and capital respectively. On the one hand, it would be  $g$  or the “real economy” at a historical growth mean rate of 1%, only relevant in the last 200 years. On the other hand, it would be  $r$  or the return to investment at a historical growth rate of 4,5%. As the following infographic shows, these trends have been constant, only disturbed in the last two centuries. In this period, real economy growth was boosted by factors such as the industrial revolutions and the massive population increase while capital was hindered by the two world wars.

Understanding this graphic and grasping the trends that the modified scale does not allow at first sight are fundamental for collecting the main working system of the economy. Citizens with money and those without it benefit from key different methods to make their wealth grow and this has to be highlighted. To the % of return rates, structural factors such as corruption and nepotism could be added as well to recognize how inequality is bound to be expanded under this situation (Naím, 2014). Keeping in mind this background to the arrival of artificial intelligence and automation appears as the best scenario to keep the historical trends of  $r$  and  $g$  back to their “natural” positions.

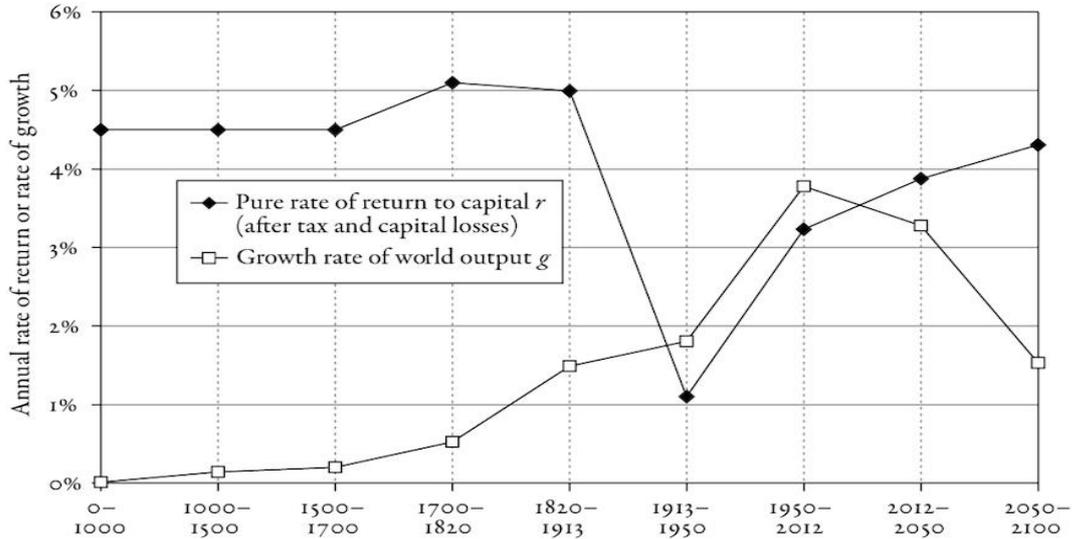


Figure 10. Tax return VS growth rate of the world. (Piketty, 2017)

Under a visible future in which capital boosted by automation is going to be advancing at growing rates, future inequalities are critical to be put on the table. One of the main consensuses of the literature review is the increase of social differences because automation needs to be tackled to avoid further harm. For this reason, again, a thorough analysis of the taxation system appears compelling to perceive where improvements and changes are required. With this regard, a second graph of historical marginal top income tax is revealed.

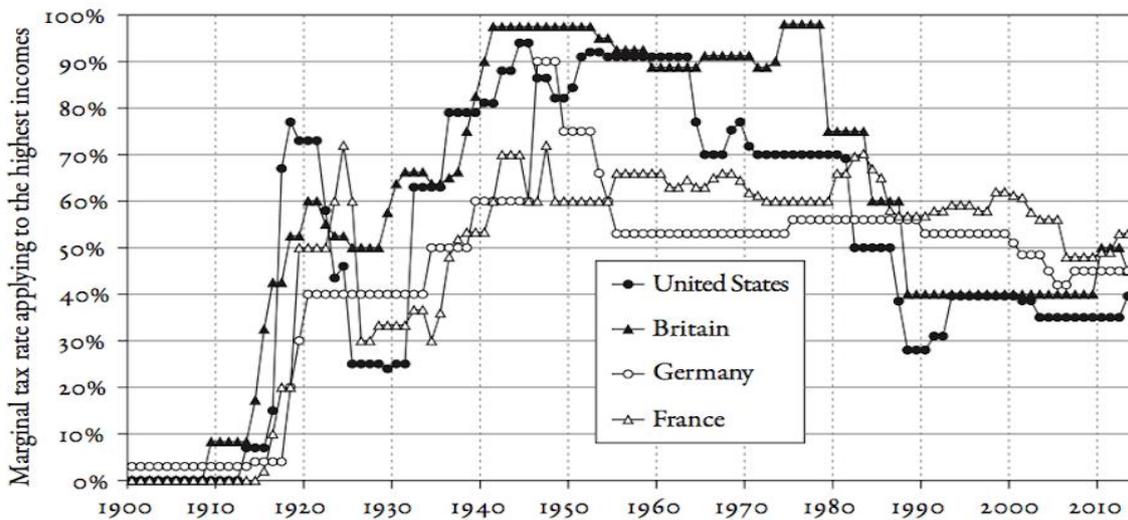


Figure 11. Top income tax rates of USA, UK, Germany, France (Piketty, 2017)

As the figure above shows, rates over 80% were the average during the decades of the 20th century in which the welfare state was born. As a result of world conflicts, governments created big structures needed for resources that distributed wealth among the citizens. After 1980 with the arrival of Reagan and Margaret Thatcher and their neoliberal stream, an important decrease in this taxation can be drastically distinguished. Top rich people have moved from paying on average 66% of taxes to less than 50% in less than 50 years. Thanks to liberal political advocacy on which working classes have been defending less taxation against their interests, modern states have created strong pressure for the low and middle classes for the benefit of those wealthier. With examples such as the abolishment of the inheritance tax being campaigned as a death tax, modern states have progressively threatened the progressive tax system to create rather flat ones where the rich are feared to be taxed. High mobility, influence, and job capacity have pressured the electorate to allow the rich to pay less, scared of them being even more elusive.

Recognizing that globalization and automation are key boosters of tax evasion and thus wealth inequality, should lead to the conclusion that current tax systems are bound to fail under these new possibilities. A proper tax on wealth that guarantees rich distribution appears, historically feasible, socially necessary, and ethically inescapable. For this reason, once understanding the nexus between automation and capital and see that the former has been leaking from public distribution mechanisms, this paper defends the imposition of a global wealth tax that can alleviate this situation.

### 5.2.3. Universal Basic Income.

The last measure to guarantee a proper transition into a society that lives hand to hand-with automation is the universal basic income. A wise conversion from a world depending on human labor to one where it will not be any more necessary is the one that separates the concept of “making a living” from the one of working. Under a progressive transition in which fewer and fewer people

will be economically and possibly productive, only a solid framework in which people's life is valued as for what it is, should prevail. Otherwise, several ethical challenges are to be feared if production, money, and power keep concentrated in the same few hands.

With radical changes in employment law inevitable in the following years, in which fewer people will be able to contribute to the GDP on behalf of artificial intelligence and machines, individuals will need a sustain to make it through. In terms of materials, but also emotions and identity, being affected by automation can suppose a huge class that can be treated with the UBI measure.

Thanks to the tax revision addressed in the previous chapters and thanks to the amount of wealth automation will be able to build, the imposition of a basic income appears not only financially possible but also desirable in terms of bureaucracy effectiveness. Thanks to the reduction of costly measurable fund-based subsidies and the provoked cut of negative externalities caused by extreme poverty, this initiative can be cheaper than thought. In total and in the long run, this initiative, which is intended to cover the sufficient material needs of any individual no matter what is prone to save monetary and social costs.

The universal basic income should be implemented slowly as fast as automation affects working conditions but should be agreed upon as soon as possible. While right now it might not be necessary yet or it might be feared as it can create a work shortage or a dysfunctional work ethic, it is only today that the working class can guarantee its status. Waiting for the moment when it is necessary when vast groups of people do not have any production value anymore can be too risky for the weak political systems we have. The threat of having a capitalist minority too powerful over an irrelevant, powerless mass should always be a concern, as the current inclination points out if not changed differently.

UBI according to current experts could be the most efficient tool to redistribute the vast amount of wealth this current 4th industrial revolution is to create. The democratization and sharing process of the progress and development obtained by humanity to tackle with one stone, several of the most critical Sustainable Development Goals of the United Nations (Hasdell, 2020). Improved basic living conditions, with a minimal effect on the labor market, are what a basic income is theorized to provoke. While spread implementations of this mechanism are yet waiting, it remains clear that a lot of public attention will be required on those left out of jobs by the automation wave. People with no job should not be associated with people with no purpose but with an open future to discover which new opportunities for human development are to be unleashed.

As a flawed example of this measure, I believe this program can be taken as a good piece of advice. The fact that this master's degree offers the opportunity of being a scholarship student to a vast majority, while having some self-funded students offers some takeaways that fairly could be applied to the Universal basic income.

Thanks to the financial capacity, funded students are more independent to decide what to do, to study, and focus on the topics that interest them the most, leveraging this opportunity. Material scarcity reduces, at least where the income is properly measured with the living expenses of the place, and both the welfare and productivity of the person can improve. Social relations bloom and "superior" needs are pursued once materialistic ones are covered. In exchange, occasionally, scholarship holders may suffer the anxiety of having too much free time once they see that they do not need to worry about work to get paid. This new feeling that arises when we do not know what to do can provoke diverse kinds of activities; from extracurricular ones or sports to sleeping or non-productive leisure.

On the other hand, if we check with those students that are self-funded, augmented pressure due to income limitations can be perceived. The necessity of having a job that otherwise they would not take, or the pressure of making it through, can ruin their health and academic performance in the long run. While they do not have time to get bored, they can feel exhausted as they do not have the opportunity to freely decide what they want to do. Poor in time, they try to value it more as well as the free time available. However, the level of enjoyment and personal growth can be hindered due to this pressuring framework.

In the same way that happened in this master's degree, analyzing what is to be done with the augmented free time that automation can bring to all of us should be a main focus point. Exploring the other needs human beings have and boosting the learning opportunities and social exchanges can be key to socially tackling a transition in which economic restrictions could be remarkably reduced in comparison to previous economic revolutions. Evaluating how the life of those who benefited from UBI from those that does not as have been done in prototypical examples, should be carefully done as many of our current feelings are yet biased by the productive system.

We tend to depreciate ourselves when we are not productive, we tend to value people for how much they can create, we often feel the necessity of doing something and neither of these things should be intrinsically necessary. Living can be way richer than what we have seen under a working structure, and it can be way poorer as well, for this reason, deep reflection, ideologies, and ethics are to be constructed once this economic transition evolves into the social one that is to come.

## **6. Conclusion.**

Automation, computerization, and big data have increased the role they occupy in our lives reaching astonishing limits. Practically all our time, from the cradle to the grave, is now mediated by technology. The level of introduction automation has achieved and the one expected to obtain has risen again, and recurrent debates about the future relation robots and humans may have once the intelligence of the previous reaches the former. Under this scope, this paper has intended to bring more clarity on this topic and highlight what certainties we have today to prepare for tomorrow.

10 years have passed since the first attempt at calculating job automation based on machine learning probabilistic statistics with O-net USA data occurred. In this paper, we have aimed to update and revisit previous attempts led by Frey and Osborne (2013) to address the pertinence of these quantitative methods to current technological advancements. Seeing quick developments in Machine robotics and Machine learning capabilities, a reformulation of this peer-reviewed method, simplified and adapted to the current circumstances seemed compelling. Aiming to address the outgoing augmenting debate on artificial intelligence and automation in our lives, this paper has integrated new features to bring about this methodology.

This paper finds that the number of employees at high risk of automation has increased affecting already over 50% of existing jobs. This outcome, applied to the United States and related to the short future confirms a global job market picture that is to suffer extreme changes in the prospect years. From this data, this paper estimates that despite social values and consumer preferences most of the automatable jobs will be in the end automated as the benefits of doing so overcome the disadvantages. As a result of this tech wave, low-paid jobs, low-skilled, and manual-oriented will be the ones with a higher risk over those with a big social ability, multidisciplinary tasks, and intense training.

Once again, education and training appear as key tools to address the future challenges the economy will have to face. With structural changes on the horizon of the job market, societies and workers and their whole superstructure built over the institution of work are expected to quickly reformate. Following the premise on an ever-growing technology will gradually win over a bigger number of available jobs, further levels of unemployed and unemployable citizens are expected as a result. Because of this, social policy and the construction of new societies that untie the connection between salary and job will be needed to compensate for the effects of automation. A tax on robots, a tax on wealth, and the implementation of a universal income are part of the recommendations this paper makes reflecting on the future of societies traversed by automation.



## References

Abeliansky, A., & Prettner, K. (2017). *Automation and demographic change*. Available at SSRN 2959977.

Acemoglu, D. and Restrepo, P. (2015). *The Race Between Man and Machine: Implications of Technology for Growth, Factor Shares and Employment*. Mimeo

Acemoglu, D.; Restrepo, P. (2016). *The race between machine and man: implications of technology for growth, factor shares and employment*. NBER Working Paper No. 22252 .

Agrawal, A., Gans, J., & Goldfarb, A. (2019). *The Evereconomics of Artificial Intelligence: An Agenda*. University of Chicago Press.

Arntz, M., Gregory, T., & Zierahn, U. (2017). *Revisiting the risk of automation*. *Economics Letters*, 159, 157-160.

Arntz, M., T. Gregory and U. Zierahn (2016), "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis", *OECD Social, Employment and Migration Working Papers*, No. 189, OECD Publishing, Paris, <https://doi.org/10.1787/5jlz9h56dvq7-en>.

Atkinson, Rob & Wu, J. (2017). *False Alarmism: Technological Disruption and the U.S. Labor Market, 18500-2015*. *SSRN Electronic Journal*.

Autor, D. H. (2015). *Why Are There Still So Many Jobs? The History and Future of Workplace Automation*. *Journal of Economic Perspectives*, 29(3), 3-30.  
<https://doi.org/10.1257/jep.29.3.3>

Autor, D. (2022). *The Shrinking Share of Middle-Income Jobs | Econofact. Econofact | Key Facts and Incisive Analysis to the National Debate on Economic and Social Policies*. <https://econofact.org/the-shrinking-share-of-middle-income-jobs>

Balme, M. (1984). *Attitudes to Work and Leisure in Ancient Greece*. *Greece & Rome*, 31(2), 140–152. <http://www.jstor.org/stable/642580>

Brand J. E. (2015). *The Far-Reaching Impact of Job Loss and Unemployment*. *Annual review of sociology*, 41, 359–375.

Brandes, P., & Wattenhofer, R. (2016). *Opening the Frey/Osborne Black Box: Which Tasks of a Job are Susceptible to Computerization?* (arXiv:1604.08823). arXiv.  
<http://arxiv.org/abs/1604.08823>

*Cedefop (2018). Insights into skill shortages and skill mismatch: learning from Cedefop's European skills and jobs survey. Luxembourg: Publications Office. Cedefop reference series; No 106. <http://data.europa.eu/doi/10.2801/645011>*

*Crary, J. (2014). 24/7: Late capitalism and the ends of sleep. Verso.*

*Crowley, F., Doran, J., & McCann, P. (2021). The vulnerability of European regional labour markets to job automation: the role of agglomeration externalities. *Regional Studies*, 55(10-11), 1711-1723. <https://doi.org/10.1080/00343404.2021.1928041>*

*Costinot, A., & Werning, I. (2018). Robots, Trade, and Luddism: A Sufficient Statistic Approach to Optimal Technology Regulation. *The Review of Economic Studies*.*

*De Cremer, D., Zeelenberg, M., & Murnighan, J. K. (2013). Social Psychology and Economics. Psychology Press.*

*Donahue, J. D., & Nye, J. S. (2004). Market-Based Governance: Supply Side, Demand Side, Upside, and Downside. Rowman & Littlefield.*

*Downey, M. (2016). Partial automation: Routine-biased technical change, deskilling, and the minimum wage. San Diego: University of California.*

*Drum, K. (2017). You will lose your job to a robot—and sooner than you think. *Mother Jones*. <https://www.motherjones.com/politics/2017/10/you-will-lose-your-job-to-a-robot-and-sooner-than-you-think/>*

*Finn, J. D. (1957). Automation and education. *Audiovisual communication review*, 5(1), 343-360.*

*Ford, M. (2015). The Rise of the Robots: Technology and the Threat of Mass Unemployment; Oneworld Publications: Oxford, UK*

*Frey, C., & Osborne, M. (2013). The Future of Employment. How Susceptible Are Jobs to Computerization? Working Paper, Oxford: Oxford Martin.*

*Greenstein, T. N. (2000). Economic Dependence, Gender, and the Division of Labor in the Home: A Replication and Extension. *Journal of Marriage and Family*, 62(2), 322–335. <http://www.jstor.org/stable/1566742>*

*Guerreiro, J. F., Rebelo, S., & Teles, P. (2021). Should Robots be Taxed? <https://doi.org/10.3386/w23806>*

*Hasdell, R. (2020) What we know about Universal Basic Income: A cross-synthesis of reviews. Stanford, CA: Basic Income Lab.*

*Harari, Y. (2016). Homo Deus. Barcelona: Debate.*

Harvey, David (2010). *The Enigma of Capital and the Crises of Capitalism*. London: Profile Books.

Hill, L. (2007). Adam Smith, Adam Ferguson and Karl Marx on the Division of Labour. *Journal of Classical Sociology*, 7(3), 339-366. <https://doi.org/10.1177/1468795x07082086>

Johannessen, J. (2019). *Automation, Capitalism and the End of the Middle Class*. En Routledge eBooks. <https://doi.org/10.4324/9780429289415>

Jones, S. E. (2013). *Against Technology: From the Luddites to Neo-Luddism*. Routledge.

Jordan, B. (2020). *Automation and Human Solidarity*. Springer Nature.

Kurz, H. D., Schütz, M., Strohmaier, R., & Zilian, S. S. (2022). *The Routledge Handbook of Smart Technologies: An Economic and Social Perspective*. Routledge.

Leonor, M. D. (2018). *Unemployment, Schooling and Training in Developing Countries: Tanzania, Egypt, the Philippines and Indonesia*. Routledge.

Lobel, O. (2017). The gig economy & the future of employment and labor law. *USFL Rev.*, 51, 51.

*Logistic Regression: Equation, Assumptions, Types, and Best Practices*. (2022, April 18). Spiceworks. <https://www.spiceworks.com/tech/artificial-intelligence/articles/what-is-logistic-regression/>

McCloskey, D. N. (2016). *Bourgeois Equality: How Ideas, Not Capital or Institutions, Enriched the World*. [https://openlibrary.org/books/OL26936778M/Bourgeois\\_equality](https://openlibrary.org/books/OL26936778M/Bourgeois_equality)

McKraw, Thomas K. (2006). *Business History Review 80 (PDF)*. London: Cambridge Journals

Meyer, P. (2022). *Managing Robotics in Retail: A Service Systems Perspective*. Springer Nature.

Miailhe, N. (2018). The geopolitics of artificial intelligence: The return of empires?. *Politique étrangère*, 1, 105-117. <https://www.cairn-int.info/journal--2018-3-page-105.htm>.

Moesta, B., & Engle, G. (2020). *Demand-Side Sales 101: Stop Selling and Help Your Customers Make Progress*.

Mokyr, J., Vickers, C., & Ziebarth, N. L. (2015). The history of technological anxiety and the future of economic growth: Is this time different?. *Journal of economic perspectives*, 29(3), 31-50.

Noguera, J. (2011). *El concepto de trabajo y la teoría social crítica*. *Travailleer*, 26, 161-192. <https://doi.org/10.3917/trav.026.0161>

Peters, M. A., Jandrić, P., & Means, A. J. (2019). *Education and Technological Unemployment*. Springer.

Piketty, T. (2017). *Capital in the Twenty-First Century*. Harvard University Press.

Pouliakas, K. (2018) "[The risk of automation in EU labour markets: a skill-requirements approach](#)", in [Economy, Employment and Skills: European and global perspectives in an age of uncertainty](#), Fondazione Giacomo Brodolini Quaderni Series, also IZA DP 11829.

Pratt, G. A. (2015). *Is a Cambrian Explosion Coming for Robotics?* *Journal of Economic Perspectives*, Vol. 29(No. 3):51–60.

Ricapito, J. V. (2013). *La figura del Escudero del Lazarillo de Tormes, sus gestos y vestimenta*. *Studia philologica valentina*, 15, 3-12.  
<https://dialnet.unirioja.es/descarga/articulo/4541885.pdf>

Rubbi, Lautaro N., Barlaro Rovati, Bruna, & Petraglia, Axel. (2020). *¿Perdidos o salvados? El futuro del trabajo frente a la cuarta Revolución Industrial*. *Desde el Sur*, 12(1), 307-342. <https://dx.doi.org/10.21142/des-1201-2020-0018>

Scholz, R. W., & Steiner, G. (2015). *Transdisciplinarity at the crossroads*. *Sustainability Science*, 10(4), 521–526. <https://doi.org/10.1007/s11625-015-0338-0>

Sahlins, M. (2013). *Stone Age Economics*. In Routledge eBooks. Informa.

Schumpeter, J., 2020. *Capitalism, socialism and democracy*. London: AAKAR BOOKS

Schwabe, H., & Castellacci, F. (2020). *Automation, workers' skills and job satisfaction*. *Plos one*, 15(11), e0242929.

Shome, P., & Miura, D. (2022). *Is it Time to Tax the Use of Robots?* | *Asian Development Blog*. <https://blogs.adb.org/blog/it-time-tax-use-robots>

Seitz, E. (2017). *What Is Money?: A Definition Beyond Materiality and Quantity*. *Social Analysis: The International Journal of Anthropology*, 61(4), 114–129.  
<https://www.jstor.org/stable/26593225>

Sennett, R. (2000). *The Corrosion of Character: The Personal Consequences of Work in the New Capitalism*. New York: Norton.

Thackray, A., Brock, D. C., & Jones, R. (2015). *Moore's Law: The Life of Gordon Moore, Silicon Valley's Quiet Revolutionary*. Basic Books.

Thompson, Derek (2015). *"A World Without Work"*. The Atlantic.

Vermeulen, B., Kesselhut, J., Pyka, A., & Saviotti, P. P. (2018). *The impact of automation on employment: just the usual structural change?*. *Sustainability*, 10(5), 1661.

Vivarelli, M. (2015). *Innovation and employment*. IZA World of Labor.

Wallace, F. (2017). *How many jobs will robots replace? And why does everyone disagree?* RSA. Retrieved march 17, 2023, from <https://www.thersa.org/blog/2017/08/how-many-jobs-will-robots-replace-and-why-does-everyone-disagree>

Wallace, F., Lambert, T., & Scully, D. (2017). *The human factor: what will really determine the pace of automation?* RSA. Retrieved January 17, 2023, from <https://www.thersa.org/blog/2017/08/the-human-factor-what-will-really-determine-the-pace-of-automation>

Weber, M. (2005). *The Protestant Ethic and the Spirit of Capitalism*. En Routledge eBooks. <https://doi.org/10.4324/9780203995808>

*What is Random Forest?* | IBM. (2023). <https://www.ibm.com/topics/random-forest>

Wike, R., & Stokes, B. (2018). *In advanced and emerging economies alike, worries about job automation*. Pew Research Center, *Global Attitudes & Trends*.

Wolters L(2020).*Robots, automation, and employment: where we are*. MIT Work of the Future: Working Paper Series.

Wycliffe, J. D., Forshall, J. M., & Madden, F. (1982). *The Holy Bible*. <http://ci.nii.ac.jp/ncid/BA03095415>

## Annex

### Annex 1.

List of employments and its calculated probability with decision tree model. 72 jobs are hand labeled and the total sample is organized according to probability and zone.

Job code	Occupation	zone	Label	Prob
29-1129	Art Therapists	5		0
29-1021	Dentists, General	5		0
29-9099	Midwives	5	0	0
29-1141	Acute Care Nurses	3		0
25-2059	Adapted Physical Education Specialists	5		0
29-9091	Athletic Trainers	5		0,000
25-9021	Farm and Home Management Educators	5		1
11-1021	General and Operations Managers	4		0,000
21-2011	Clergy	5	0	1
29-1161	Nurse Midwives	5	0	0,000
27-1022	Fashion Designers	3		2
29-2091	Orthotists and Prosthetists	5		0,000
49-3023	Automotive Service Technicians and Mechanics	3		3
19-3091	Anthropologists and Archeologists	5		0,000
29-1291	Acupuncturists	5		7
21-1094	Community Health Workers	4		0,000
29-1181	Audiologists	5		7
21-1013	Marriage and Family Therapists	5		0,000
21-1022	Healthcare Social Workers	5	0	8
33-3051	Customs and Border Protection Officers	3		0,001
21-1012	Educational, Guidance, and Career Counselors and Advisors	5		1
29-1171	Nurse Practitioners	5		0,001
35-1011	Chefs and Head Cooks	3		4
11-9032	Education Administrators, Kindergarten through Secondary	5		0,001
29-1123	Physical Therapists	5		6
25-1121	Art, Drama, and Music Teachers, Postsecondary	5	0	0,001
21-1023	Mental Health and Substance Abuse Social Workers	5		8
47-2111	Electricians	3	0	0,001
27-2022	Coaches and Scouts	4		9
19-1041	Epidemiologists	5		0,002
23-1021	Administrative Law Judges, Adjudicators, and Hearing Officers	5		2
27-2032	Choreographers	4		0,002
25-2021	Elementary School Teachers, Except Special Education	4	0	3
51-1011	First-Line Supervisors of Production and Operating Workers	3		4
27-1027	Set and Exhibit Designers	5		0,003
27-2042	Musicians and Singers	4		1
				0,003
				4
				6
				0,004
				5
				0,005
				4

Job code	Occupation	zone	Label	Prob
25-2032	Career/Technical Education Teachers, Secondary School	4		0,005 4
39-9032	Recreation Workers	4		0,005 5
25-4012	Curators	5		0,005 6
25-9031	Instructional Coordinators	5		0,005 7
19-4042	Environmental Science and Protection Technicians, Including Health	4		0,006 5
25-1072	Nursing Instructors and Teachers, Postsecondary	5		0,006 9
29-1031	Dietitians and Nutritionists	5		0,007 3
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	3		0,007 8
19-3093	Historians	5		0,008 2
29-1151	Nurse Anesthetists	5		0,008 4
41-4012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	4		0,009 5
17-1011	Architects, Except Landscape and Naval	5		0,010 7
17-2112	Human Factors Engineers and Ergonomists	5	0	0,012 2
29-1041	Optometrists	5		0,012 6
13-1121	Meeting, Convention, and Event Planners	4		0,012 7
11-1011	Chief Executives	5		0,013 6
29-1011	Chiropractors	5		0,013 6
49-3042	Mobile Heavy Equipment Mechanics, Except Engines	3		0,013 6
23-1022	Arbitrators, Mediators, and Conciliators	5	0	0,013 9
25-2051	Special Education Teachers, Preschool	5		0,014
29-1127	Speech-Language Pathologists	5		0,014
21-1021	Child, Family, and School Social Workers	4		0,014 3
25-2012	Kindergarten Teachers, Except Special Education	4	0	0,014 4
49-3011	Aircraft Mechanics and Service Technicians	3		0,015 4
29-1071	Anesthesiologist Assistants	5		0,015 6
49-2096	Electronic Equipment Installers and Repairers, Motor Vehicles	3		0,016 1
23-1011	Lawyers	5		0,016 9
11-9041	Architectural and Engineering Managers	5		0,017 3
19-1029	Bioinformatics Scientists	5		0,017 3
25-1031	Architecture Teachers, Postsecondary	5		0,017 7
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	3		0,018 6
21-1092	Probation Officers and Correctional Treatment Specialists	4		0,019 4
41-3011	Advertising Sales Agents	4		0,020 9
29-1122	Low Vision Therapists, Orientation and Mobility Specialists, and Vision Rehabilitation Therapists	5		0,022 2
25-1021	Computer Science Teachers, Postsecondary	5		0,023 7
19-5011	Occupational Health and Safety Specialists	4		0,025 1
49-3041	Farm Equipment Mechanics and Service Technicians	3		0,025 7
33-3031	Fish and Game Wardens	4		0,026 6
29-1131	Veterinarians	5		0,027 6
27-3023	News Analysts, Reporters, and Journalists	4		0,027 6

Job code	Occupation	zone	Label	Prob
19-3034	School Psychologists	5	0	0,0278
27-1011	Art Directors	4		0,0296
41-1012	First-Line Supervisors of Non-Retail Sales Workers	4		0,0302
11-9033	Education Administrators, Postsecondary	5		0,0304
29-1241	Ophthalmologists, Except Pediatric	5		0,0306
19-3033	Clinical and Counseling Psychologists	5		0,0323
19-1021	Biochemists and Biophysicists	5		0,0327
49-2093	Electrical and Electronics Installers and Repairers, Transportation Equipment	3	0	0,0334
27-1012	Craft Artists	3		0,0337
25-4011	Archivists	5		0,0342
11-3051	Biofuels Production Managers	4		0,0357
19-1023	Zoologists and Wildlife Biologists	5		0,036
43-1011	First-Line Supervisors of Office and Administrative Support Workers	3		0,0372
19-3041	Sociologists	5	0	0,0376
17-1012	Landscape Architects	4		0,0403
33-2011	Firefighters	3	0	0,0416
33-1021	First-Line Supervisors of Firefighting and Prevention Workers	3		0,0424
19-4092	Forensic Science Technicians	4		0,0431
13-1041	Compliance Officers	3		0,0481
25-4022	Librarians and Media Collections Specialists	5		0,0502
11-9013	Farmers, Ranchers, and Other Agricultural Managers	4		0,0537
25-1061	Anthropology and Archeology Teachers, Postsecondary	5		0,0567
25-2023	Career/Technical Education Teachers, Middle School	4		0,0574
25-2031	Secondary School Teachers, Except Special and Career/Technical Education	4		0,0609
29-1125	Recreational Therapists	4		0,0635
11-9081	Lodging Managers	4		0,0639
27-1025	Interior Designers	4		0,064
25-4013	Museum Technicians and Conservators	4		0,0671
29-1023	Orthodontists	5		0,0676
41-2031	Retail Salespersons	2		0,0676
33-1012	First-Line Supervisors of Police and Detectives	3		0,0676
49-2011	Computer, Automated Teller, and Office Machine Repairers	3		0,0701
21-1091	Health Education Specialists	4		0,0726
19-3032	Industrial-Organizational Psychologists	5		0,0732
29-1081	Podiatrists	5		0,0747
41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	4		0,0759
47-2011	Boilermakers	3		0,0761
49-3052	Motorcycle Mechanics	3		0,0785
25-1062	Area, Ethnic, and Cultural Studies Teachers, Postsecondary	5		0,0806
21-1093	Social and Human Service Assistants	4		0,0862

Job code	Occupation	zone	Label	Prob
35-3023	Baristas	1		0,087
19-3051	Urban and Regional Planners	5		0,089 1
15-1231	Computer Network Support Specialists	4		0,089 5
25-1081	Education Teachers, Postsecondary	5	0	0,095 1
49-9071	Maintenance and Repair Workers, General	3		0,096 4
27-2012	Media Programming Directors	4		0,100 2
29-1051	Pharmacists	5		0,100 2
31-1131	Nursing Assistants	3		0,102
53-2031	Flight Attendants	2		0,102
13-1111	Management Analysts	4		0,108
17-3025	Environmental Engineering Technologists and Technicians	4		0,108 3
29-1299	Naturopathic Physicians	5	0	0,109
13-1011	Agents and Business Managers of Artists, Performers, and Athletes	4		0,110 6
19-2043	Hydrologists	5		0,111 2
29-9092	Genetic Counselors	5		0,118 1
19-1011	Animal Scientists	5		0,119
53-6051	Aviation Inspectors	3		0,120 5
11-2011	Advertising and Promotions Managers	4		0,125 9
13-1199	Business Continuity Planners	4		0,127
29-2032	Diagnostic Medical Sonographers	3		0,127 5
49-9081	Wind Turbine Service Technicians	3		0,127 6
27-1021	Commercial and Industrial Designers	4		0,129 6
13-1081	Logisticians	4		0,132 7
25-1113	Social Work Teachers, Postsecondary	5		0,133
19-1013	Soil and Plant Scientists	5		0,136 4
27-3031	Public Relations Specialists	4		0,136 6
49-3051	Motorboat Mechanics and Service Technicians	3		0,142
11-9031	Education and Childcare Administrators, Preschool and Daycare	4		0,144 3
25-2022	Middle School Teachers, Except Special and Career/Technical Education	4		0,144 6
49-9092	Commercial Divers	3		0,147 3
47-4021	Elevator and Escalator Installers and Repairers	3		0,149 1
25-1042	Biological Science Teachers, Postsecondary	5		0,149 4
17-2021	Agricultural Engineers	4		0,15
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	3		0,151 6
29-2053	Psychiatric Technicians	3		0,153 5
29-1128	Exercise Physiologists	4		0,157 1
11-9161	Emergency Management Directors	4		0,161 5
19-1022	Microbiologists	5		0,167 2
25-1052	Chemistry Teachers, Postsecondary	5		0,169 1
27-1024	Graphic Designers	4	1	0,180 8
17-3027	Automotive Engineering Technicians	3		0,181 1

Job code	Occupation	zone	Label	Prob
19-2011	Astronomers	5	0	0,182 2
29-2031	Cardiovascular Technologists and Technicians	3		0,185 1
39-4031	Morticians, Undertakers, and Funeral Arrangers	3		0,187 3
11-9179	Fitness and Wellness Coordinators	4		0,188 2
27-2011	Actors	2	0	0,197 5
23-1023	Judges, Magistrate Judges, and Magistrates	5	0	0,200 7
49-2022	Telecommunications Equipment Installers and Repairers, Except Line Installers	3		0,204 1
33-1011	First-Line Supervisors of Correctional Officers	3		0,204 3
51-9082	Medical Appliance Technicians	3		0,214 1
13-1131	Fundraisers	4		0,218 6
13-1151	Training and Development Specialists	4		0,221 2
17-2121	Marine Engineers and Naval Architects	4		0,224 2
19-2041	Climate Change Policy Analysts	5		0,228 3
47-2152	Plumbers, Pipefitters, and Steamfitters	3		0,229 6
17-3021	Aerospace Engineering and Operations Technologists and Technicians	3		0,234 6
25-1111	Criminal Justice and Law Enforcement Teachers, Postsecondary	5		0,236
21-2021	Directors, Religious Activities and Education	4		0,238 3
29-2061	Licensed Practical and Licensed Vocational Nurses	3		0,242 5
13-2099	Financial Quantitative Analysts	5		0,242 9
49-2091	Avionics Technicians	3		0,244 3
49-9044	Millwrights	2		0,248 2
25-1041	Agricultural Sciences Teachers, Postsecondary	5		0,257 2
47-4041	Hazardous Materials Removal Workers	3		0,258 2
29-1126	Respiratory Therapists	3		0,265 9
49-9063	Musical Instrument Repairers and Tuners	3		0,271 9
49-9095	Manufactured Building and Mobile Home Installers	2		0,281 6
37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	3		0,281 7
25-1122	Communications Teachers, Postsecondary	5		0,283 1
25-1192	Family and Consumer Sciences Teachers, Postsecondary	5		0,285 9
29-1211	Anesthesiologists	5		0,286 6
41-9031	Sales Engineers	4		0,289
25-1067	Sociology Teachers, Postsecondary	5		0,295 2
11-9021	Construction Managers	4		0,298
25-9044	Teaching Assistants, Postsecondary	5		0,300 5
31-2011	Occupational Therapy Assistants	3		0,301 9
21-1015	Rehabilitation Counselors	4		0,305 4
13-2011	Accountants and Auditors	4		0,305 6
19-1031	Conservation Scientists	4		0,308 1
25-3011	Adult Basic Education, Adult Secondary Education, and English as a Second Language Instructors	4		0,310 8
49-2097	Audiovisual Equipment Installers and Repairers	3		0,319

Job code	Occupation	zone	Label	Prob
39-6012	Concierges	3	1	0,321 2
45-1011	First-Line Supervisors of Farming, Fishing, and Forestry Workers	3		0,324
19-2042	Geoscientists, Except Hydrologists and Geographers	5		0,324 7
25-1066	Psychology Teachers, Postsecondary	5		0,324 7
31-9092	Medical Assistants	3		0,334
49-2092	Electric Motor, Power Tool, and Related Repairers	3		0,345 1
49-9012	Control and Valve Installers and Repairers, Except Mechanical Door	3		0,346 8
13-1075	Labor Relations Specialists	4		0,362
29-2099	Neurodiagnostic Technologists	3		0,365 3
25-1043	Forestry and Conservation Science Teachers, Postsecondary	5		0,400 7
15-1221	Computer and Information Research Scientists	5		0,406
11-9151	Social and Community Service Managers	4	0	0,410 9
19-3094	Political Scientists	5	0	0,415 1
53-3031	Driver/Sales Workers	2		0,432 8
25-2058	Special Education Teachers, Secondary School	4		0,436
17-3024	Electro-Mechanical and Mechatronics Technologists and Technicians	3		0,439 4
31-9097	Phlebotomists	3		0,444 2
37-2021	Pest Control Workers	2		0,450 1
49-9031	Home Appliance Repairers	2		0,450 2
53-2012	Commercial Pilots	3	1	0,461 9
25-1082	Library Science Teachers, Postsecondary	5		0,464 5
19-4043	Geological Technicians, Except Hydrologic Technicians	4		0,467
19-1042	Medical Scientists, Except Epidemiologists	5		0,485 7
19-4021	Biological Technicians	4		0,486
11-2022	Sales Managers	4		0,486 1
25-1011	Business Teachers, Postsecondary	5		0,496 4
17-2141	Automotive Engineers	4		0,503 8
11-3021	Computer and Information Systems Managers	4		0,526 9
25-1051	Atmospheric, Earth, Marine, and Space Sciences Teachers, Postsecondary	5		0,527 2
25-1124	Foreign Language and Literature Teachers, Postsecondary	5		0,534 3
19-2031	Chemists	4		0,539 2
19-2099	Remote Sensing Scientists and Technologists	5		0,539 5
47-2132	Insulation Workers, Mechanical	2		0,550 4
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	3		0,552 1
27-3043	Poets, Lyricists and Creative Writers	4		0,552 8
29-1216	General Internal Medicine Physicians	5		0,559 1
53-5021	Captains, Mates, and Pilots of Water Vessels	3		0,563 9
11-9111	Medical and Health Services Managers	4		0,565 5
51-9161	Computer Numerically Controlled Tool Operators	3		0,567 8
19-2032	Materials Scientists	5		0,570 8
17-2031	Bioengineers and Biomedical Engineers	4		0,579 9

Job code	Occupation	zone	Label	Prob
49-9041	Industrial Machinery Mechanics	3		0,585 5
19-3092	Geographers	5		0,588 1
13-2061	Financial Examiners	4		0,592 3
53-2011	Airline Pilots, Copilots, and Flight Engineers	4		0,594 7
13-1051	Cost Estimators	4	1	0,603 7
17-1021	Cartographers and Photogrammetrists	4		0,605 4
47-2022	Stonemasons	3		0,606 1
33-3012	Correctional Officers and Jailers	2		0,607 4
19-1012	Food Scientists and Technologists	4		0,612 9
41-3021	Insurance Sales Agents	4		0,615 4
19-3022	Survey Researchers	5		0,616 5
27-3041	Editors	4		0,622 3
25-2057	Special Education Teachers, Middle School	4		0,623 2
13-1161	Market Research Analysts and Marketing Specialists	4		0,624 5
35-1012	First-Line Supervisors of Food Preparation and Serving Workers	2		0,631 3
27-1026	Merchandise Displayers and Window Trimmers	3		0,645 6
11-3071	Supply Chain Managers	4		0,645 7
25-1053	Environmental Science Teachers, Postsecondary	5		0,646 2
15-1241	Computer Network Architects	4		0,650 6
13-1031	Claims Adjusters, Examiners, and Investigators	4		0,655 4
19-2021	Atmospheric and Space Scientists	4		0,660 1
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	3	0	0,660 2
53-7041	Hoist and Winch Operators	2		0,664 1
25-1071	Health Specialties Teachers, Postsecondary	5		0,669
47-4011	Construction and Building Inspectors	3		0,669 6
27-4011	Audio and Video Technicians	3		0,670 3
49-3021	Automotive Body and Related Repairers	2		0,672 1
25-1064	Geography Teachers, Postsecondary	5		0,673 9
17-2199	Energy Engineers, Except Wind and Solar	4		0,682 3
17-2051	Civil Engineers	4		0,683 3
43-4061	Eligibility Interviewers, Government Programs	3		0,691 8
31-9091	Dental Assistants	3	1	0,697 6
11-3131	Training and Development Managers	4		0,704 3
23-1012	Judicial Law Clerks	5		0,705 5
49-9043	Maintenance Workers, Machinery	3		0,705 7
27-2031	Dancers	3	0	0,710 9
11-2021	Marketing Managers	4		0,711 2
29-1221	Pediatricians, General	5		0,711 2
25-1126	Philosophy and Religion Teachers, Postsecondary	5		0,714 1
25-1125	History Teachers, Postsecondary	5		0,714 9

Job code	Occupation	zone	Label	Prob
15-1211	Computer Systems Analysts	4		0,715
25-1054	Physics Teachers, Postsecondary	5		0,718 3
49-3022	Automotive Glass Installers and Repairers	2		0,722 5
15-1244	Network and Computer Systems Administrators	4		0,724 4
29-1223	Psychiatrists	5		0,727 7
15-1232	Computer User Support Specialists	3		0,729 4
25-1123	English Language and Literature Teachers, Postsecondary	5		0,731 4
53-5031	Ship Engineers	3		0,733 9
47-2041	Carpet Installers	2		0,736 1
29-1229	Allergists and Immunologists	5		0,754 4
27-3011	Broadcast Announcers and Radio Disc Jockeys	4		0,756
19-4071	Forest and Conservation Technicians	3		0,757 3
13-1071	Human Resources Specialists	4		0,763
15-1299	Computer Systems Engineers/Architects	4		0,769 5
19-4012	Agricultural Technicians	3		0,773 5
27-4032	Film and Video Editors	4		0,776 1
49-2098	Security and Fire Alarm Systems Installers	3		0,777 8
43-4111	Interviewers, Except Eligibility and Loan	3		0,786 7
17-2072	Electronics Engineers, Except Computer	4		0,787 9
39-1022	First-Line Supervisors of Personal Service Workers	3		0,790 8
15-2041	Biostatisticians	5		0,796 6
33-3011	Bailiffs	3		0,796 9
11-3061	Purchasing Managers	4		0,798 5
27-4021	Photographers	3		0,800 2
29-2056	Veterinary Technologists and Technicians	3		0,802 2
41-2011	Cashiers	2		0,804 4
29-1022	Oral and Maxillofacial Surgeons	5		0,804 6
31-2012	Occupational Therapy Aides	3		0,804 7
19-2012	Physicists	5		0,814 2
17-1022	Geodetic Surveyors	4		0,822 2
25-1032	Engineering Teachers, Postsecondary	5		0,829 9
29-2051	Dietetic Technicians	3		0,831 1
49-3092	Recreational Vehicle Service Technicians	2		0,832 9
47-3012	Helpers--Carpenters	2		0,835 7
33-2021	Fire Inspectors and Investigators	3		0,836 9
39-5091	Makeup Artists, Theatrical and Performance	3		0,836 9
29-9093	Surgical Assistants	3		0,837 5
11-3121	Human Resources Managers	4		0,840 7
31-2021	Physical Therapist Assistants	3		0,844 7
35-3031	Waiters and Waitresses	2	1	0,845 1

Job code	Occupation	zone	Label	Prob
51-8099	Biofuels Processing Technicians	2		0,845 7
35-2014	Cooks, Restaurant	2		0,847
13-1141	Compensation, Benefits, and Job Analysis Specialists	4		0,848 5
11-9199	Brownfield Redevelopment Specialists and Site Managers	4		0,855 1
11-9071	Gambling Managers	3		0,855 7
17-2131	Materials Engineers	4		0,868 1
41-1011	First-Line Supervisors of Retail Sales Workers	2		0,868 4
47-2042	Floor Layers, Except Carpet, Wood, and Hard Tiles	2		0,869 5
11-3031	Financial Managers	4		0,871 5
27-4012	Broadcast Technicians	3		0,873 6
17-2071	Electrical Engineers	4	1	0,876 8
35-3011	Bartenders	2		0,878 6
31-1133	Psychiatric Aides	2		0,881 6
53-2022	Airfield Operations Specialists	3		0,882 3
17-2041	Chemical Engineers	4		0,882 5
43-4051	Customer Service Representatives	2		0,883 6
25-1065	Political Science Teachers, Postsecondary	5		0,888 8
33-9021	Private Detectives and Investigators	3		0,891 1
49-2021	Radio, Cellular, and Tower Equipment Installers and Repairers	3		0,891 8
51-4041	Machinists	3	1	0,892 7
27-3091	Interpreters and Translators	4	1	0,893 3
15-2031	Operations Research Analysts	5		0,893 9
49-9011	Mechanical Door Repairers	2		0,894
47-2061	Construction Laborers	2		0,894 7
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	3		0,898
25-2011	Preschool Teachers, Except Special Education	3		0,899 2
17-2081	Environmental Engineers	4		0,899 2
39-5011	Barbers	3	1	0,900 7
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	2		0,900 7
39-9041	Residential Advisors	3		0,900 9
39-5012	Hairdressers, Hairstylists, and Cosmetologists	3		0,901
11-9051	Food Service Managers	2		0,903 5
19-4099	Quality Control Analysts	3	1	0,905 3
19-3011	Economists	5		0,907 9
27-2041	Music Directors and Composers	4	1	0,909 6
49-9062	Medical Equipment Repairers	3		0,910 2
17-3023	Electrical and Electronic Engineering Technologists and Technicians	3		0,911
53-6031	Automotive and Watercraft Service Attendants	2		0,911 1
13-2071	Credit Counselors	4		0,911 4
17-2171	Petroleum Engineers	4		0,912 5

Job code	Occupation	zone	Label	Prob
43-3031	Bookkeeping, Accounting, and Auditing Clerks	3		0,915 6
25-1022	Mathematical Science Teachers, Postsecondary	5		0,919 4
27-1023	Floral Designers	2		0,919 6
29-1217	Neurologists	5		0,921
51-7032	Patternmakers, Wood	3		0,922 2
15-2099	Bioinformatics Technicians	4		0,922 7
53-3011	Ambulance Drivers and Attendants, Except Emergency Medical Technicians	2		0,923 2
47-2221	Structural Iron and Steel Workers	2		0,924 3
25-1063	Economics Teachers, Postsecondary	5		0,925 5
17-2111	Fire-Prevention and Protection Engineers	4		0,927 4
17-3026	Industrial Engineering Technologists and Technicians	3		0,927 9
29-1215	Family Medicine Physicians	5		0,929 9
33-2022	Forest Fire Inspectors and Prevention Specialists	3		0,930 3
17-2011	Aerospace Engineers	4		0,930 7
25-1194	Career/Technical Education Teachers, Postsecondary	3		0,931 7
19-4031	Chemical Technicians	3		0,932
13-2072	Loan Officers	4	1	0,932 5
51-9191	Adhesive Bonding Machine Operators and Tenders	2		0,934 7
47-2044	Tile and Stone Setters	2		0,934 7
47-5043	Roof Bolters, Mining	2		0,936 4
51-2041	Structural Metal Fabricators and Fitters	3		0,936 9
15-1251	Computer Programmers	4	1	0,938 5
41-3041	Travel Agents	3		0,94
29-1292	Dental Hygienists	3		0,942 2
49-9061	Camera and Photographic Equipment Repairers	3		0,944 8
37-2011	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	2	1	0,945 1
29-2034	Radiologic Technologists and Technicians	3		0,946 1
11-9121	Clinical Research Coordinators	4		0,947 6
51-7031	Model Makers, Wood	3		0,947 8
53-7021	Crane and Tower Operators	3	1	0,948 8
35-2013	Cooks, Private Household	3		0,949 4
49-9094	Locksmiths and Safe Repairers	2		0,949 5
49-3091	Bicycle Repairers	2		0,949 5
47-2131	Insulation Workers, Floor, Ceiling, and Wall	2		0,949 7
51-4062	Patternmakers, Metal and Plastic	3		0,952 5
25-1112	Law Teachers, Postsecondary	5		0,953 2
53-3032	Heavy and Tractor-Trailer Truck Drivers	2		0,953 8
17-2151	Mining and Geological Engineers, Including Mining Safety Engineers	4		0,954 4
15-2021	Mathematicians	5		0,955
47-5041	Continuous Mining Machine Operators	2		0,955 8

Job code	Occupation	zone	Label	Prob
49-9097	Signal and Track Switch Repairers	3		0,955 9
33-3052	Transit and Railroad Police	3	1	0,956 5
47-2031	Carpenters	2	0	0,957 4
31-9099	Endoscopy Technicians	3		0,957 5
43-4131	Loan Interviewers and Clerks	3		0,959 4
41-9022	Real Estate Sales Agents	3	1	0,959 4
43-9111	Statistical Assistants	4	1	0,959 5
47-5044	Loading and Moving Machine Operators, Underground Mining	2		0,960 5
53-7065	Stockers and Order Fillers	2	1	0,960 9
11-9141	Property, Real Estate, and Community Association Managers	4		0,961 2
51-6092	Fabric and Apparel Patternmakers	3	1	0,961 6
47-2021	Brickmasons and Blockmasons	2		0,963 1
29-1218	Obstetricians and Gynecologists	5		0,963 3
49-9051	Electrical Power-Line Installers and Repairers	2		0,963 4
29-2055	Surgical Technologists	3		0,966 2
27-4014	Sound Engineering Technicians	3		0,966 3
33-9011	Animal Control Workers	2		0,967
49-9064	Watch and Clock Repairers	3		0,967 7
47-5013	Service Unit Operators, Oil and Gas	2		0,968 2
13-2041	Credit Analysts	4		0,968 3
27-1013	Fine Artists, Including Painters, Sculptors, and Illustrators	3		0,969 2
31-1132	Orderlies	2		0,971 3
11-3111	Compensation and Benefits Managers	4		0,971 4
45-4011	Forest and Conservation Workers	3		0,971 7
53-5022	Motorboat Operators	2		0,972
15-1255	Video Game Designers	4		0,973
29-2052	Pharmacy Technicians	3		0,973 4
51-2051	Fiberglass Laminators and Fabricators	2		0,974 3
19-4051	Nuclear Monitoring Technicians	3		0,974 7
53-2021	Air Traffic Controllers	3	1	0,977
19-4061	Social Science Research Assistants	4		0,977 6
41-3031	Securities, Commodities, and Financial Services Sales Agents	4		0,978 1
17-3031	Surveying and Mapping Technicians	3		0,978 3
17-3022	Civil Engineering Technologists and Technicians	3		0,979 1
13-2053	Insurance Underwriters	4		0,979 2
53-3033	Light Truck Drivers	2		0,979 5
51-2031	Engine and Other Machine Assemblers	2		0,979 5
17-2161	Nuclear Engineers	4		0,979 8
51-8021	Stationary Engineers and Boiler Operators	3		0,98
17-3011	Architectural and Civil Drafters	3		0,980 2

Job code	Occupation	zone	Label	Prob
19-3099	Transportation Planners	4		0,981 6
51-9011	Chemical Equipment Operators and Tenders	2		0,981 8
43-4011	Brokerage Clerks	3		0,981 8
29-1124	Radiation Therapists	3		0,982 3
29-2081	Opticians, Dispensing	3		0,982 7
39-3092	Costume Attendants	2		0,982 9
39-4011	Embalmers	3		0,983 5
15-1212	Information Security Analysts	4		0,983 7
43-9031	Desktop Publishers	3		0,983 8
43-9061	Office Clerks, General	2	1	0,984
19-4013	Food Science Technicians	3		0,984 1
51-8031	Water and Wastewater Treatment Plant and System Operators	3		0,984 5
15-1242	Database Administrators	4		0,984 8
41-9021	Real Estate Brokers	4		0,985
49-9091	Coin, Vending, and Amusement Machine Servicers and Repairers	2		0,985 3
39-9031	Exercise Trainers and Group Fitness Instructors	3		0,985 5
13-2052	Personal Financial Advisors	4		0,985 8
47-5022	Excavating and Loading Machine and Dragline Operators, Surface Mining	2		0,986 3
51-7011	Cabinetmakers and Bench Carpenters	2		0,986 7
51-9162	Computer Numerically Controlled Tool Programmers	3		0,986 8
13-2031	Budget Analysts	4		0,987 2
25-3041	Tutors	3		0,987 2
47-3013	Helpers--Electricians	2		0,987 4
47-3015	Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	2		0,987 6
51-9041	Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders	2		0,987 8
49-3053	Outdoor Power Equipment and Other Small Engine Mechanics	2		0,988
43-4081	Hotel, Motel, and Resort Desk Clerks	2		0,988 6
11-9171	Funeral Home Managers	3		0,990 1
47-5012	Rotary Drill Operators, Oil and Gas	2		0,990 2
51-9071	Gem and Diamond Workers	3		0,990 3
43-6011	Executive Secretaries and Executive Administrative Assistants	3		0,990 4
13-1032	Insurance Appraisers, Auto Damage	3		0,990 6
17-3029	Non-Destructive Testing Specialists	2		0,990 7
49-3043	Rail Car Repairers	2		0,990 8
51-4061	Model Makers, Metal and Plastic	3	1	0,990 9
19-5012	Occupational Health and Safety Technicians	3		0,991 2
47-3011	Helpers--Brickmasons, Blockmasons, Stonemasons, and Tile and Marble Setters	2		0,991 3
29-2033	Nuclear Medicine Technologists	3	1	0,991 3
49-3093	Tire Repairers and Changers	2		0,991 3
39-1013	First-Line Supervisors of Gambling Services Workers	2		0,991 5

Job code	Occupation	zone	Label	Prob
11-3012	Administrative Services Managers	3		0,9917
41-2022	Parts Salespersons	2		0,9918
53-7071	Gas Compressor and Gas Pumping Station Operators	2		0,9922
53-5011	Sailors and Marine Oilers	2		0,9924
43-5031	Public Safety Telecommunicators	2		0,9924
51-8091	Chemical Plant and System Operators	2		0,9924
49-9096	Riggers	2		0,9925
29-1224	Radiologists	5		0,9925
51-4022	Forging Machine Setters, Operators, and Tenders, Metal and Plastic	2		0,9927
17-3013	Mechanical Drafters	3		0,9927
47-5081	Helpers--Extraction Workers	2		0,9927
47-5032	Explosives Workers, Ordnance Handling Experts, and Blasters	2		0,9929
31-9011	Massage Therapists	3		0,9929
53-6041	Traffic Technicians	3		0,993
17-2061	Computer Hardware Engineers	4		0,993
43-5041	Meter Readers, Utilities	2	1	0,9932
51-6093	Upholsterers	2		0,9933
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	2		0,9934
33-9093	Transportation Security Screeners	2		0,9935
49-9098	Helpers--Installation, Maintenance, and Repair Workers	2		0,9935
15-2051	Business Intelligence Analysts	4		0,9936
47-2141	Painters, Construction and Maintenance	2	1	0,9937
51-9195	Glass Blowers, Molders, Benders, and Finishers	2		0,9938
35-2015	Cooks, Short Order	2		0,9938
47-2151	Pipelayers	2		0,9939
47-5011	Derrick Operators, Oil and Gas	1		0,9941
39-2021	Animal Caretakers	2		0,9941
53-7051	Industrial Truck and Tractor Operators	2	1	0,9943
49-9045	Refractory Materials Repairers, Except Brickmasons	2		0,9943
47-2121	Glaziers	2		0,9944
51-5111	Prepress Technicians and Workers	3		0,9945
47-4031	Fence Erectors	2		0,9946
31-9096	Veterinary Assistants and Laboratory Animal Caretakers	2		0,9947
39-9011	Childcare Workers	2		0,9948
51-2011	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	2		0,9949
51-9196	Paper Goods Machine Setters, Operators, and Tenders	2		0,9949
15-2011	Actuaries	4		0,995
49-9052	Telecommunications Line Installers and Repairers	2		0,995
51-4111	Tool and Die Makers	3		0,9952
39-5094	Skincare Specialists	3		0,9955

Job code	Occupation	zone	Label	Prob
43-4141	New Accounts Clerks	3		0,995 8
25-4031	Library Technicians	3		0,995 9
27-1014	Special Effects Artists and Animators	4		0,996
35-9031	Hosts and Hostesses, Restaurant, Lounge, and Coffee Shop	2		0,996 2
37-3012	Pesticide Handlers, Sprayers, and Applicators, Vegetation	2		0,996 2
29-2092	Hearing Aid Specialists	3		0,996 3
51-8011	Nuclear Power Reactor Operators	3		0,996 3
43-4161	Human Resources Assistants, Except Payroll and Timekeeping	3		0,996 4
51-9032	Cutting and Slicing Machine Setters, Operators, and Tenders	2		0,996 6
51-9151	Photographic Process Workers and Processing Machine Operators	2		0,996 6
47-5023	Earth Drillers, Except Oil and Gas	2		0,996 7
49-9099	Geothermal Technicians	2		0,996 8
31-2022	Physical Therapist Aides	2		0,996 8
53-4011	Locomotive Engineers	2		0,997
45-2011	Agricultural Inspectors	2		0,997 1
43-5051	Postal Service Clerks	2		0,997 1
51-4191	Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic	2		0,997 2
15-1253	Software Quality Assurance Analysts and Testers	4		0,997 3
51-8093	Petroleum Pump System Operators, Refinery Operators, and Gaugers	2		0,997 5
17-3012	Electrical and Electronics Drafters	3		0,997 6
51-4072	Molding, Coremaking, and Casting Machine Setters...	2		0,997 6
51-4021	Extruding and Drawing Machine Setters, Operators, and Tenders, Metal and Plastic	2		0,997 7
47-2081	Drywall and Ceiling Tile Installers	2		0,997 7
51-3091	Food and Tobacco Roasting, Baking, and Drying Machine Operators and Tenders	2		0,997 7
51-9111	Packaging and Filling Machine Operators and Tenders	2		0,997 7
31-9094	Medical Transcriptionists	3		0,997 7
51-9021	Crushing, Grinding, and Polishing Machine Setters, Operators, and Tenders...	2		0,997 8
51-9198	Helpers--Production Workers	2		0,997 8
47-2211	Sheet Metal Workers	2		0,997 8
29-2057	Ophthalmic Medical Technicians	3		0,997 9
51-9012	Separating, Filtering, Clarifying, Precipitating and Still Machine	2		0,997 9
53-4022	Railroad Brake, Signal, and Switch Operators and Locomotive Firers	2		0,997 9
51-4051	Metal-Refining Furnace Operators and Tenders	2		0,998
27-3042	Technical Writers	4		0,998
51-9124	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	2		0,998
47-2181	Roofers	2	1	0,998 1
39-2011	Animal Trainers	2		0,998 1
51-8013	Biomass Plant Technicians	2		0,998 2
43-3011	Bill and Account Collectors	2		0,998 2
51-4192	Layout Workers, Metal and Plastic	2		0,998 2

Job code	Occupation	zone	Label	Prob
47-2231	Solar Photovoltaic Installers	2		0,998 2
53-7121	Tank Car, Truck, and Ship Loaders	2	1	0,998 4
47-4051	Highway Maintenance Workers	2		0,998 4
41-9011	Demonstrators and Product Promoters	2		0,998 5
43-3021	Billing and Posting Clerks	3		0,998 6
43-4181	Reservation and Transportation Ticket Agents and Travel Clerks	2		0,998 6
51-9192	Cleaning, Washing, and Metal Pickling Equipment Operators and Tenders	2		0,998 6
51-9194	Etchers and Engravers	2		0,998 6
29-1222	Physicians, Pathologists	5		0,998 7
47-2142	Paperhangers	2		0,998 7
25-3021	Self-Enrichment Teachers	3		0,998 7
51-4032	Drilling and Boring Machine Tool Setters, Operators, and Tenders, Metal and Plastic	2		0,998 7
51-6091	Extruding and Forming Machine Setters, Operators, and Tenders, Synthetic and Glass Fibers	2		0,998 7
35-2012	Cooks, Institution and Cafeteria	2		0,998 7
39-3011	Gambling Dealers	2		0,998 7
11-9131	Postmasters and Mail Superintendents	2		0,998 8
33-9092	Lifeguards, Ski Patrol, and Other Recreational Protective Service Workers	2		0,998 9
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	2		0,998 9
15-1243	Data Warehousing Specialists	4		0,998 9
51-3021	Butchers and Meat Cutters	2	1	0,999
51-9081	Dental Laboratory Technicians	2		0,999
43-6012	Legal Secretaries and Administrative Assistants	3		0,999
37-1011	First-Line Supervisors of Housekeeping and Janitorial Workers	2		0,999
51-9141	Semiconductor Processing Technicians	2		0,999
41-9041	Telemarketers	2		0,999 1
43-4041	Credit Authorizers, Checkers, and Clerks	2		0,999 1
43-5071	Shipping, Receiving, and Inventory Clerks	2		0,999 1
43-4151	Order Clerks	2		0,999 1
51-4081	Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	2		0,999 1
53-4031	Railroad Conductors and Yardmasters	2		0,999 1
53-7081	Refuse and Recyclable Material Collectors	2		0,999 1
53-7031	Dredge Operators	2		0,999 2
51-5113	Print Binding and Finishing Workers	2		0,999 2
51-4052	Pourers and Casters, Metal	2		0,999 2
41-2021	Counter and Rental Clerks	2		0,999 2
43-5021	Couriers and Messengers	2	1	0,999 3
23-2011	Paralegals and Legal Assistants	3		0,999 3
43-4031	Court, Municipal, and License Clerks	2		0,999 3
43-5032	Dispatchers, Except Police, Fire, and Ambulance	2		0,999 3
51-5112	Printing Press Operators	2	1	0,999 3

Job code	Occupation	zone	Label	Prob
47-4061	Rail-Track Laying and Maintenance Equipment Operators	2		0,999 3
53-3052	Bus Drivers, Transit and Intercity	2	1	0,999 4
47-2171	Reinforcing Iron and Rebar Workers	2		0,999 4
51-3011	Bakers	2	1	0,999 4
43-4021	Correspondence Clerks	2		0,999 4
47-3016	Helpers--Roofers	2		0,999 5
43-9021	Data Entry Keyers	2	1	0,999 5
29-2035	Magnetic Resonance Imaging Technologists	3		0,999 5
51-4023	Rolling Machine Setters, Operators, and Tenders, Metal and Plastic	2		0,999 5
43-4071	File Clerks	2		0,999 5
43-5011	Cargo and Freight Agents	2		0,999 5
43-5052	Postal Service Mail Carriers	2		0,999 5
41-9091	Door-to-Door Sales Workers, News and Street Vendors, and Related Workers	1		0,999 6
47-2082	Tapers	2		0,999 6
43-3061	Procurement Clerks	2		0,999 6
15-1254	Web Developers	3		0,999 6
53-7061	Cleaners of Vehicles and Equipment	2		0,999 6
39-3021	Motion Picture Projectionists	2		0,999 6
53-4013	Rail Yard Engineers, Dinkey Operators, and Hostlers	2		0,999 6
51-4122	Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders	2		0,999 6
41-2012	Gambling Change Persons and Booth Cashiers	2	1	0,999 6
39-3031	Ushers, Lobby Attendants, and Ticket Takers	2		0,999 6
43-3041	Gambling Cage Workers	2		0,999 6
39-5092	Manicurists and Pedicurists	2		0,999 6
43-2011	Switchboard Operators, Including Answering Service	2		0,999 7
51-6063	Textile Knitting and Weaving Machine Setters, Operators, and Tenders	2		0,999 7
27-3092	Court Reporters and Simultaneous Captioners	3		0,999 7
47-2073	Operating Engineers and Other Construction Equipment Operators	2		0,999 7
43-6014	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	2		0,999 7
43-5111	Weighers, Measurers, Checkers, and Samplers, Recordkeeping	2		0,999 7
51-9023	Mixing and Blending Machine Setters, Operators, and Tenders	2		0,999 7
51-2021	Coil Winders, Tapers, and Finishers	2		0,999 7
43-5053	Postal Service Mail Sorters, Processors, and Processing Machine Operators	2		0,999 7
51-6051	Sewers, Hand	2		0,999 7
43-4171	Receptionists and Information Clerks	2		0,999 7
33-9099	Retail Loss Prevention Specialists	2		0,999 7
51-3093	Food Cooking Machine Operators and Tenders	2		0,999 7
33-9031	Gambling Surveillance Officers and Gambling Investigators	2		0,999 7
13-2082	Tax Preparers	3	1	0,999 7

Job code	Occupation	zone	Label	Prob
53-4041	Subway and Streetcar Operators	2	1	0,999 7
47-2072	Pile Driver Operators	2		0,999 7
43-9081	Proofreaders and Copy Markers	4	1	0,999 7
51-7041	Sawing Machine Setters, Operators, and Tenders, Wood	2		0,999 8
37-3013	Tree Trimmers and Pruners	2		0,999 8
39-4021	Funeral Attendants	2		0,999 8
51-8012	Power Distributors and Dispatchers	3		0,999 8
51-6061	Textile Bleaching and Dyeing Machine Operators and Tenders	2		0,999 8
51-9022	Grinding and Polishing Workers, Hand	1		0,999 8
51-2061	Timing Device Assemblers and Adjusters	2		0,999 8
51-4194	Tool Grinders, Filers, and Sharpeners	2		0,999 8
53-7072	Pump Operators, Except Wellhead Pumps	2		0,999 8
51-4034	Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	2		0,999 8
51-6041	Shoe and Leather Workers and Repairers	2		0,999 8
51-6052	Tailors, Dressmakers, and Custom Sewers	2		0,999 8
43-3071	Tellers	2	1	0,999 8
51-4033	Grinding, Lapping, Polishing and Buffing Machine Tool Setters	2		0,999 8
53-6011	Bridge and Lock Tenders	2		0,999 8
33-3041	Parking Enforcement Workers	2		0,999 8
51-4071	Foundry Mold and Coremakers	2		0,999 8
47-2053	Terrazzo Workers and Finishers	2		0,999 8
47-5071	Roustabouts, Oil and Gas	1		0,999 8
39-6011	Baggage Porters and Bellhops	2		0,999 8
51-7042	Woodworking Machine Setters, Operators, and Tenders, Except Sawing	2		0,999 9
51-7021	Furniture Finishers	2		0,999 9
31-9093	Medical Equipment Preparers	2		0,999 9
39-3012	Gambling and Sports Book Writers and Runners	2		0,999 9
13-2081	Tax Examiners and Collectors, and Revenue Agents	3	1	0,999 9
47-2071	Paving, Surfacing, and Tamping Equipment Operators	2		0,999 9
43-6013	Medical Secretaries and Administrative Assistants	2		0,999 9
43-3051	Payroll and Timekeeping Clerks	3	1	0,999 9
45-2092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	1		0,999 9
31-9095	Pharmacy Aides	2		0,999 9
51-3092	Food Batchmakers	2		0,999 9
43-9041	Insurance Claims and Policy Processing Clerks	2		0,999 9
43-9071	Office Machine Operators, Except Computer	2		0,999 9
53-7073	Wellhead Pumps	2		0,999 9
47-2051	Cement Masons and Concrete Finishers	1		0,999 9
51-4035	Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	2		0,999 9

Job code	Occupation	zone	Label	Prob
53-6021	Parking Attendants	2	1	0,999 9
35-2021	Food Preparation Workers	1		0,999 9
47-4071	Septic Tank Servicers and Sewer Pipe Cleaners	1		0,999 9
35-3041	Food Servers, Nonrestaurant	2		0,999 9
33-9032	Security Guards	2		0,999 9
51-4121	Welders, Cutters, Solderers, and Brazers	2		0,999 9
53-7063	Machine Feeders and Offbearers	2		0,999 9
51-6062	Textile Cutting Machine Setters, Operators, and Tenders	2		0,999 9
39-3093	Locker Room, Coatroom, and Dressing Room Attendants	2		0,999 9
51-6064	Textile Winding, Twisting, and Drawing Out Machine Setters, Operators, and Tenders	2		0,999 9
43-2021	Telephone Operators	2	1	0,999 9
39-5093	Shampoosers	2		0,999 9
51-9051	Furnace, Kiln, Oven, Drier, and Kettle Operators and Tenders	2		0,999 9
51-9197	Tire Builders	2		0,999 9
47-2043	Floor Sanders and Finishers	1		0,999 9
37-3011	Landscaping and Groundskeeping Workers	1		0,999 9
35-2011	Cooks, Fast Food	1	1	0,999 9
43-9051	Mail Clerks and Mail Machine Operators, Except Postal Service	2		0,999 9
13-1074	Farm Labor Contractors	2		0,999 9
51-3023	Slaughterers and Meat Packers	2		0,999 9
43-5061	Production, Planning, and Expediting Clerks	2		0,999 9
51-3022	Meat, Poultry, and Fish Cutters and Trimmers	1		0,999 9
53-7011	Conveyor Operators and Tenders	1		0,999 9
39-3091	Amusement and Recreation Attendants	1		0,999 9
43-4121	Library Assistants, Clerical	2		0,999 9
33-9091	Crossing Guards and Flaggers	2		0,999 9
51-9123	Painting, Coating, and Decorating Workers	1		0,999 9
35-9021	Dishwashers	1	1	0,999 9
47-3014	Helpers--Painters, Paperhangers, Plasterers, and Stucco Masons	1		0,999 9
47-2161	Plasterers and Stucco Masons	1		0,999 9
27-2023	Umpires, Referees, and Other Sports Officials	2	1	0,999 9
23-2093	Title Examiners, Abstractors, and Searchers	2		0,999 9
35-9011	Dining Room and Cafeteria Attendants and Bartender Helpers	1		0,999 9
45-4021	Fallers	1		0,999 9
45-2091	Agricultural Equipment Operators	1		0,999 9
45-4022	Logging Equipment Operators	1		0,999 9
37-2012	Maids and Housekeeping Cleaners	1		0,999 9
51-6011	Laundry and Dry-Cleaning Workers	1		0,999 9
43-9022	Word Processors and Typists	2		0,999 9

Job code	Occupation	zone	Label	Prob
53-7064	Packers and Packagers, Hand	2		0,999 9
51-9031	Cutters and Trimmers, Hand	1		0,999 9
51-6042	Shoe Machine Operators and Tenders	2		0,999 9
47-5051	Rock Splitters, Quarry	1		0,999 9
51-6031	Sewing Machine Operators	1		0,999 9
45-2041	Graders and Sorters, Agricultural Products	1		0,999 9
51-6021	Pressers, Textile, Garment, and Related Materials	1		0,999 9
27-2021	Athletes and Sports Competitors	2		0,999 9