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MASTERARBEIT / MASTER'S THESIS

Titel der Masterarbeit / Title of the Master's Thesis

„The Impact of Digitalization on the Labour Market in Austria – An Economic Analysis"

verfasst von / submitted by

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angestrebter akademischer Grad / in partial fulfilment of the requirements for the degree of

Master of Arts (MA)

Wien, 2025 / Vienna 2025

Studienkennzahl lt. Studienblatt / degree programme code as it appears on the student record sheet:	UA 066 589
Studienrichtung lt. Studienblatt / degree programme as it appears on the student record sheet:	Masterstudium Internationale Entwicklung
Betreut von / Supervisor:	ao. Univ.-Prof. Mag. Dr. Friedrich Edelmayer, MAS

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The Impact of Digitalization on Labour Market in Austria – An Economic Analysis

ABSTRACT

Digitalization creates new opportunities for growth and prosperity for all segments of the public and private sectors. Since the COVID-19 pandemic began, it has also changed the way of doing business. Digitalization, if seen as a transformation, enables businesses to stay competitive in the market and direct their strategies toward innovation. Digitalization comprehends the use of innovative technology, and trained people, and leads towards the transformation of processes for doing business. Although digitalization involves much more than the high level of integration of digital technologies, it implies transforming the way of thinking of the state, companies, and individuals. A transformed way of thinking is needed nowadays so that the use of digital tools and skills could add value to the company and create a competitive advantage. Besides companies' transformation in way of thinking for doing business, employees are involved in such a change which contributes to the changes in the labour market itself. The main supposition of this research is that the level of digitalization significantly impacts the main labour market indicators such as employment, unemployment, GDP per capita, and human capital index. In order to determine the level of digitalization impact on these indicators, a quantitative approach has been adopted. The main statistical tools used are descriptive statistics, correlation, and regression analysis. The timeline chosen for this analysis is 2017-2021, while the country chosen for modelling is Austria. Austria is one of the European countries that have slowly proceeded with the digitalization transformation of the market since the global health crisis began in 2020. The expected outcome of this research is that the level of digitalization has significant effects on the main labour market indicators. The results have shown that there is no significant impact of digitalization on the labour market indicators. This research contributes to the creation of knowledge and awareness about the quantified impact of digitalization on the labour market in Austria. Moreover, there are recommendations for decision-makers and labour market participants.

ABSTRAKT

Die Digitalisierung bietet dem öffentlichen und privaten Sektor neue Wege zu Wachstum und Erfolg. Besonders seit der COVID-19-Pandemie hat sich die Arbeitswelt grundlegend verändert. Unternehmen, die die Digitalisierung als Chance zur Transformation begreifen, können im Wettbewerb bestehen und Innovationen vorantreiben. Digitalisierung bedeutet den Einsatz neuer Technologien und die Qualifizierung von Mitarbeitern, um Geschäftsprozesse zu optimieren. Sie geht aber über die bloße Anwendung digitaler Tools hinaus und erfordert eine neue Denkweise bei Staat, Unternehmen und Individuen. Nur so kann die Digitalisierung einen echten Mehrwert schaffen und Wettbewerbsvorteile generieren. Diese Veränderung betrifft auch die Arbeitnehmer und den Arbeitsmarkt insgesamt. Die Studie untersucht den Einfluss der Digitalisierung auf wichtige Arbeitsmarktindikatoren wie Beschäftigung, Arbeitslosigkeit, BIP pro Kopf und Humankapitalindex in Österreich im Zeitraum 2017-2021. Österreich ist eines der europäischen Länder, das die Digitalisierung des Marktes seit Beginn der globalen Gesundheitskrise im Jahr 2020 langsam vorangetrieben hat. Mittels quantitativer Methoden wie deskriptiver Statistik, Korrelations- und Regressionsanalyse wurde untersucht, ob ein Zusammenhang zwischen Digitalisierung und den genannten Arbeitsmarktindikatoren besteht. Entgegen der ursprünglichen Annahme konnte kein signifikanter Einfluss festgestellt werden. Die Studie liefert wichtige Erkenntnisse über die Auswirkungen der Digitalisierung auf den österreichischen Arbeitsmarkt und gibt Empfehlungen für Entscheidungsträger und Arbeitsmarktteilnehmer.

CONTENTS

Acknowledgements

I express my deep and sincere gratitude to my supervisor, ao. Univ.-Prof. Mag. Dr. Friedrich Edelmayer, MAS, for supporting, inspiring and motivating me in the process of writing this thesis. Additionally, I want to thank my family and friends for accompanying me through this master program.

List of abbreviations

AI - Artificial Intelligence
% - per cent
DIG – digitalization
e.g. – for example
EMP – employment
etc. – and others, and so forth, and so on
GDP – gross domestic product
GDPpc – gross domestic product per capita
HCI – Human Capital Index
i.e. – that is, is to say
ILO – International Labour Organization
IMF – International Monetary Fund
ICT – Information Communication Technology
mln – million
UNEMP – unemployment
WB – World Bank
WW – World War

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INTRODUCTION

The basic principle of the functioning of digitalization is quite simple: the more digitalization is developed, the more labour markets are involved with digitalization. In particular, this is evident in the globalized world where digitalization is aimed to enable more efficient functioning of labour markets (Herman 2020). The basic assumption on which the labour market develops is that it cannot function without digitalization in the globalized world. The direct result that digitalization has brought in the last decade is the growth of the gross domestic product (GDP) in many countries. Digitalization increased employment and enabled the fight against corruption in many regions, mainly in the regions in development and transition countries.

A decade ago, according to a study conducted by McKinsey Global Institute (2013), it was found that digital technologies boosted global GDP by up to $2.2 trillion by 2025 (McKinsey Global Institute 2013). In the narrower sense, for example, Brynjolfsson and McAfee (2014) claim that digitalization can improve productivity by automating routine tasks, enhancing data-driven decision-making, and enabling more efficient business processes. Also, they claim that the impact of digitalization on GDP may vary depending on factors such as the level of digital infrastructure, and digital adoption. Similarly, digitalization has disrupted traditional industries, leading to the emergence of new business models and revenue streams (Varian 2016) bringing significant transformation in industries.

Digitalization practically does not work without the Internet. In a study conducted by the World Bank experts, it was found that a 10% increase in high-speed internet adoption leads to a 1.3% increase in GDPpc (World Bank 2016). Another research, conducted by the OECD experts, has shown that a 10% increase in the use of digital technologies can lead to a 0.5-0.6% increase in GDP growth (OECD 2022). Regarding the EU, a report by the European Commission found that the digital economy accounts for approximately 8% of the European Union's GDP (European Commission 2020).

Nevertheless, digitalization brings not only positive impact on GDP and GDP pc, but also some limitations and challenges people and institutions have to face. In other words, digitalization can also lead to job displacement, income inequality, and the need for digital skills development (Acemoglu and Restrepo 2018).

The aim of digitalization is to contribute to the maintenance and increase of labour market efficiency (Degryse 2016). Throughout the history of the development of digitalization, labour markets have followed several changes. The relevant changes in the labour markets have been experienced during the health crisis due to the COVID-19 pandemic. The labour market participants themselves established standard changes in order to be able to participate in market activities during the lockdowns and other COVID-19 restrictions. As a rule, the response to each new crisis was the introduction of new regulations and standards and the imposition of new restrictions by the state which led to changes in the labour market and an increase in digitalization (Radulescu, Ladaru, Burlacu, Constantin, Ioanăs, and Petre 2020; Coibion, Gorodnichenko, and Weber 2020; Eichhorst, Marx, and Rinne 2020).

COVID-19 heavily impacted the way of doing business and working (Donthu and Gustafsson 2020). A large number of companies, and consequently the employees, switched to smart or remote working. Smart working or remote jobs created a new working environment, and both companies and employees had to adapt to this change very quickly. Such a change in working impacted the software industry development and information technology education as well, changing the way of doing business and thinking from a different perspective (Barth, Roed, Schone, and Umblijs 2020, Brkljač, Bačvarević and Džamić 2022). It is still a question of what professions will be needed, i.e. which of them will vanish, and what are the positive and negative sides of such a change (Bührer and Hagist 2016).

In Europe, changes in the labour market have been applied as a consequence of restrictions due to COVID-19. The countries have made efforts in the digitalization of both public and private sectors (Nachit and Belhcen 2020; Cone et al. 2022). Some countries have experienced digitalization very quickly, such as Sweden, while in some other countries the digitalization of the public sector towards e-Governance

occurred in a slower way, such as in Austria. Digitalization started with e-Governance through the implementation of digital tools in both private and public practice. Companies adopted digitalization strategies such as training employees in smart working and increasing the amount of trainers of digital skills in order to survive in the market during the crisis (Bešić, Diedrich, and Aigne 2021).

The recent health crisis has led to rapid digitalization. This rapid change in the private and business environment causes changes in regard to the labour market structure. Although digital transformation is supposed to bring higher employee productivity, the implications of digitalization may comprehend struggles for (un)employment and the future functioning of the labour market (Larsson and Teigland 2020; Khan 2020; Vaughan-Whitehead, Ghellab, and de Bustillo Llorente 2021).

The aim of this research is to measure the impact of digitalization on the labour market's main indicators in Austria. The motivation for conducting this research consists of turbulent change in the labour market due to digitalization during COVID-19 and the lack of quantitative research in the recent period about the impact of digitalization on main labour market indicators in Austria.

Therefore, the structure of this master thesis is as follows.

In Chapter I, the theories and concepts about globalization and digitalization are discussed, with a view to their implications for Austria. Similarly, the theories and concepts of the labour market are discussed, with a reference to the Austrian labour market in Chapter II. The literature that is used for the master thesis includes official reports, scientific papers, conference papers, working papers, and subject-related books/monographs. When the theoretical part about digitalization and the labour market is complete, at the end of Chapter II research hypotheses are presented. The methods and data used in the master thesis are presented in Chapter III. The digitalization effects on the labour market are analyzed and discussed in Chapter IV. Finally, there are conclusions and recommendations for decision-makers, labour market participants, and further research. In the end, there is a list of references used in this work, as well as the Annexes. The annexes contain additional technical

and SPSS software information about the study, which are not compulsory for the main text of the research.

CHAPTER 1

GLOBALIZATION AND DIGITALIZATION – IMPLICATIONS FOR AUSTRIA

Globalization is often referred to the global market integration, free market, and democracy. Actually, globalization is a multifaceted phenomenon. Globalization is focusing on the economy: commodity market, capital market, and labour market (IMF 2008, pp. 2-7).

Nowadays, the concept of globalization is often considered a new phenomenon, but actually, it is not so recent. The timing of globalization is before and after the „two waves“, i.e. industrialization/deindustrialization phenomena that include international trade, divergence, growth and take-off, and urbanization (Black and Henderson 1999, pp. 252-253; Baldwin and Martin 1999).

The main characteristics of the world around 1400 are an agricultural economy and an overall population of approximately 350 million. The significant increase in population happened only around 1870 (Federico 2004, p. 20, Marks 2019, pp. 39-41). The three regions densely populated were China, India, and Europe which together counted for more than half of the world‘s population. The population was growing over the centuries and arrived at more than 7 billion nowadays. In terms of globalization, the size of the population matters, but also political and military power, well-organized system, efficient agriculture and highly esteemed handcraft, and developing money problems (such as „silverization“, coins, paper currency) (van der Spek 2015, pp 1-26, Marks 2019, pp. 39-41).

Growing at someone else’s expense was the world system during the 17th - 18th century. At that time, the world system was possible only by exploiting the environment (America) and labour (Africa). Prior to 1500, there were distinct regional spheres of influence and interconnectedness, such as the Chinese world, the Indian

Ocean world, the Mediterranean world, and the Americas, which were largely unknown to Asians and Europeans. However, after 1500, two new global connections emerged that brought the entire world into a single, unified global system for the first time (Kordas, Lynch, Nelson, and Tatlock 2022, pp. 218-233, Marks 2019, pp. 50-55).

During the 18th century, there was a change in patterns of consumption: increasing demand for former luxuries (sugar, chocolate, silks...) (Kordas, Lynch, Nelson, and Tatlock 2022, pp. 119, 178; Sugihara 2004, p. 84), and intensification of labour and land use to pay the bill for the expenses. In the switch from proto-industry to industrialization, the economies of scale and the use of unskilled cheaper workforce were developing (Kordas, Lynch, Nelson, and Tatlock 2022, pp. 119, 178).

The Industrial Revolution (18th-19th century) made a break with the past. At first, it occurred only in England, and the following industrial processes were called industrialization or the Second Industrial Revolution. This revolution determined an astonishing growth in GDP but very unevenly distributed. The mechanization and the use of technology (both inventions and innovations) motivated economic development and growth and affected the cultural framework. Empires started building and controlling the so-called world system, where the main outcome was cheap commodities and no competitors (Kordas, Lynch, Nelson, and Tatlock 2022, pp. 236-243).

Empires were the main way of organizing societies and economies until the 19th century, as the states do today. After geographical discoveries, the so-called Age of exploration, the colonies and slavery, and the fall of empires (e.g. Ottoman, Habsburg ...), as well as the rise of other regions (Americas, Africa), the world was left with highly developed commerce. The economic result, though, was debt, finance and the struggle for controlling international trade. From the Chinese point of view, it was a fight among Europeans to have the possibility of trading with them (Kordas, Lynch, Nelson, and Tatlock 2022, pp. 132-134, 155-164).

The preindustrial world economy is considered, therefore, until the 19th century. After that, the world experienced an industrial economy with industrial development. Soon, the world entered between two World Wars, with the consequences of the

Western retreat. Over the course of just 200 years, the global economic balance of power has undergone a significant shift. Whereas Asians once held the majority of the economic influence, today are primarily the Western countries, and until relatively recently, Japan, the country that dominated the global economic landscape. The GDP, as well as the GDPpc, has never grown so much and so fast before as in the period of the Industrial Revolution. So, the recent trend of globalization is Asia's return (Sugihara 2004, pp. 88-96).

Industrialization could happen in one country, but it is not possible to stay just in one country. It spreads. The spread of industrialization goes along with globalization, but globalization determines divergence (or limited convergence). WWI (1914) began a few decades after the beginning of the industrial revolutions, and there are Euro-centered and anti-globalization explanations: closed markets were the rule (tributary trade in Asia and Mercantilism in Europe), war was a way of finding free markets (for example the conquest of India and the Opium wars in China), and US, Europe and Japan were industrializing in order to survive. An alternative solution was found, and it was the so-called free trade. In free trade, competition and the risks of overproduction emerged, as well as free trade policies, the creation of an international capital market, and mass urbanization (workforce migration) (Bordo, Taylor and Williamson 2007, pp. 65-97).

The additional reason for WWI and WWII, in terms of globalization, was a focus on politics, which influenced the economy (for example the Great Depression between the wars). Generally, between 1914 and the 1970s, the system broke down: there were wars, closed markets, and stoppage of commerce. After that period, i.e. from the 1980s, there was the re-emergence of globalization, the spread of consumerism (Golden Age), increasing freedom of trade (openness), growth of GDP and GDPpc, as well as the rise of the „Third World" (especially China). This sequence of events used to be called the second wave of globalization (Bordo, Taylor and Williamson 2007, pp. 323-329).

Another important aspect of globalization is finance. In the globalized market, capitals were growing, as well as financial markets. While observing the development of financial markets from the beginning of industrialization, at the first stage there has

been strict rules and minor integration, followed by a multilateral system of rules that fostered high integration. During the world wars, there were new restrictions and a trend of capital market disintegration. After that and until the 1970s, there was a multilateral set of norms support and slow integration, while after that the capital and financial markets experienced deregulation and globalization. This last was determined by the freedom of moving capital, a fixed/stable exchange rate, and an independent economic policy (Bordo, Taylor and Williamson 2007, pp. 452-461). The consequences of free globalized capital markets have been reflected in global financial crises, such as at the beginning of the 21st century (2007/2008), and the development of new financial and monetary policies within the states, and particularly, within the framework of the international institutions, such as International Monetary Fund (IMF), World Bank (WB), etc. (Shahrokhi 2011, Moshirian, 2011).

Therefore, globalization and market integration were in the long run. This process has not been a straight line, and there have been steps back. Also, the main drivers of market integration have been transportation and policies. The new driver was born in the following industrial revolution, i.e. Information Communication Technology (ICT). The impact of new ICTs is reflected in geographical distance perception and, along with other technologies, it made the world even more globalized and „smaller" (Bordo, Taylor and Williamson 2007, pp. 183-186, 533-534). Nowadays, there is one more driver: digitalization, which has origins in ICT.

That globalization is not a straight line and since it is subject to crisis, the recent pandemic has demonstrated the great fragility of globalization, i.e. the ability of COVID-19 to operate geographically on a global level and to affect the world system. COVID-19 has confirmed the idea that in the era of hyperglobalization whatever happens, even in the smallest and most remote corner of the world, can trigger chain reactions, unpredictable and disastrous, capable of influencing world geopolitics, with disruptive effects, capable of affecting the mobility of citizens from all over the world, productive activities, world markets, and the monetary policies of central banks. Analysts and scholars hypothesize that the effects of COVID-19 will be fatal for global markets and, such as, to cause a strong economic-financial recession, comparable to that of 1929, if not worse. Analyzing the manifestation of the crisis in various areas of the world, IMF showed that the advanced countries, in particular

continental Europe, record the most conspicuous decline in economic growth (IMF 2020, pp. 1-17). From the labour market point of view, in April 2020 International Labour Organization (ILO) itself calculated that the pandemic had caused the loss of around 195 million full-time jobs worldwide (ILO 2020).

Globalization contributes to the increase of market turbulence and competitiveness that dictate the business conditions of the modern economy (Kudryavtseva, Skhvediani and Arteeva 2019). In order to survive in a turbulent environment, modern society strives for flexibility in adapting to constant change (Zemtsov, Barinova, and Semenova 2019). Whether the society (families, institutions, companies) is successful in adapting to market changes and digitalization, it is more likely to survive in a highly competitive environment.

Digitalization compromises the societal actors to adapt and change in the last few decades (Zemtsov, Barinova, and Semenova 2019). Even so, the concept of adapting to the new market environment became imperative during the novel global health crisis due to COVID-19 (Popelo et al. 2021). The company's management, government institutions and the population are in charge of adapting to the new digital market and creating strategies for survival in such an environment.

Society of all countries faces various challenges that the digital environment imposes. In that sense, it is necessary to react effectively to the opportunities and threats of the market environment by creating strategies for dealing with them. Strategic management within a turbulent digital market involves making adequate business decisions by management, state, and individuals (Barth, Davis, Freeman, and McElheranet al. 2022).

In order to respond to the novel health crisis, governments of all countries imposed several restrictions. The Austrian government executed the first lockdown in mid-March 2020. Due to the first lockdown, many companies in Austria have experienced closures of their businesses. Inevitably, these closures have impacted the labour market, reflected in the unemployment rate growth. The pandemic consequences have been reflected in the GDP decrease as well (Bešić, Diedrich, and Aigne 2021).

The first wave of the COVID-19 pandemic threatened to cause serious disruptions in the labour market. Industry, the overall economy, as well as healthcare system, during the first and second quarters of 2020 fell into serious difficulties, and from this arose the need to conduct research about the impact of this crisis on the economy and its components. During the next waves of COVID-19, there have still been concerns about the economy, but several strategies have been adopted (such as governmental support), and the crisis has been kept under control. Every economic crisis (recession) often spills over to a large extent to the labour market. Even if COVID-19 nowadays is under control, it is still unpredictable, and continuous research about its impact has to be conducted (ILO 2020).

The companies, especially the large companies, that have established the digitalization process as soon as the restrictions have begun, could keep the employees and their businesses thanks to smart working and the large use of digital tools. According to the qualitative study findings of Bešić, Diedrich, and Aigne (2021), the public sector in Austria was slowly implementing strategies for greater use of digitalization. The consequence of these strategies' implementation impacted the labour market and the way of doing business in this country. Namely, greater use of digital technology in business operations was found to be more of a burden rather than an opportunity for both companies and employees (Bešić, Diedrich, and Aigne 2021, pp. 8-9).

While large companies have had less need for government support during the COVID-19 pandemic, small companies struggled in doing business and needed the government's organizational and financial support. The government support to small companies was reflected in short-time work limited to six months in phase 1 of the crisis, later extended for one month in phase 2, and got back to six months again in phase 3. Short-time work consisted of changing the level of minimum working time (from 10 to 30%), while the maximum was at first 90% and later 80% of working time (Eichhorst, Marx, and Rinne 2020, p. 6). These companies engaged in providing training to the employees during this period through digital tools and working from home (Eichhorst, Marx, and Rinne 2020).

The COVID-19 pandemic has turned the digitalization process (use of digital tools and digital innovation) into a business imperative which impacted the employee's way of working and their status in the company (Wong 2022; Kothgassner and Probst 2020). This process could be called digital transformation, which means the use of data and technologies to improve the possibilities of products and services but also the creation of web pages for e-commerce and other e-platforms.

Even if the labour market participants had to be able to rapidly develop digital capabilities, this development is still critical for meeting customer needs and ensuring the survival of organizations because not all the participants are fully able or prone to be involved. For example, some participants are not able to build social networks (on Facebook, Instagram, and other social networks) and constantly engage with followers, digital marketing and new digital environment, nor to create a content calendar that maps outposts and sharing strategies and stick to it (Bin-Nashwan and Al-Daihani 2020; Syaifullah, Syaifudin, Sukendar and Junaedi 2021; Eachempati, Srivastava and Zhang 2021; Susanto et al. 2021). These participants are used to the more traditional ways of doing business instead of using a digital tool to measure the conversation rate optimization, stick to website architecture update and design, experiment with different messaging options, regularly review analytics, conduct online marketing research surveys, etc.

In another place, there is an important business field regarding investments. Assessing whether a new technology is suitable for the business and whether the company should invest in its testing and adoption remains one of the struggles during the period of mass digitalization. Innovation consists of using new technology to improve old processes, but not all companies nor employees are able to face this fast change. In order to remain competitive, companies are expected to improve the use of digital tools and train employees in digital experience (Hadzic et al. 2021).

There is a difference between digitalization and digital transformation. In this work, both expressions have been used. They are interconnected but there is a difference between them (Reis et al. 2020, Frenzel et al. 2021, Hagberg, Sundstrom, and Egels-Zandén 2016, Hellsten and Paunu 2020). Explaining the difference between digitalization and digital transformation implies the definition of digitization as well.

Digitization is the process where information is converted from a physical to a digital format. This means converting something that is not digital into a digital representation that will be used by information systems and automate processes or workflows. Digitization enables the creation of business value for those processes that require data. For example, an Excel spreadsheet can be converted into a Google sheet and saved and shared in the cloud.

Digital transformation is doing things in a digital way instead of in a traditional way. It is useful for the transformation of business processes and activities, and business products that take advantage of the possibilities of digital technologies. Improving efficiency, discovering new data monetization opportunities, managing risks etc. are the main goals of digital transformation. For example, using the digital operator instead of a human operator in the call centres. This process does not need much human interaction, it is automated and robotized. The result of digital transformation, from the companies' point of view, is an increase in efficiency and a reduction in costs. From the employees' point of view, it can be reflected in job loss.

Both digitization (converting information from analogue to digital format) and digitalization (a process of improving business, simplifying operations, creating new business models, etc.) are part of the digital transformation (switch from traditional to digital way of doing business or other things). As mentioned before, digitalization and digital transformation have implications for the labour market.

Digitalization and the rapid emergence of new technologies are reshaping various aspects of life, including education, work, and leisure. These shifts are increasing the demand for new skills related to ICT usage, computer literacy, internet navigation, and technical digital competencies. However, extensive research on digital inequality reveals significant disparities in computer skills across traditional social inequality factors. Given the pervasive nature of digital technologies in daily life, understanding the extent of digital inequality is crucial to ensure that social participation does not become a matter of social stratification in the Digital Age. For Austria, Zilian and Zilian (2020) claim that individuals from higher socio-economic backgrounds tend to have better digital problem-solving skills, while being female is associated with lower skills. However, when we account for daily ICT engagement, the positive

correlation with socio-economic background remains significant only for individuals with very high socio-economic status, while the gender effect becomes statistically insignificant. Additionally, Zilian and Zilian (2020) analyzed Eurostat data and showed that there is no consistent trend toward a reduction in digital inequality in the last decade in Austria. Moreover, their research results suggest that marginalized groups in Austria should be supported and empowered to incorporate ICT usage into their daily lives to help bridge the digital divide.

In terms of globalization, digitalization is a global process that changes the way of working but also the way goods and services are produced. It also changes the relationships between employers and employees, as well as relationships between people. In general, digitalization is changing people's lives, and therefore the so-called welfare society. The final outcome of digitalization will depend on how that process is directed. It can lead to a deeply polarized society with an unimaginable gap between the rich and the poor, but this outcome will probably be certain in the future.

In terms of labour market, there are many questions and concerns that are related to the consequences that changes in digitalization will have on the labour market and society as a whole. Some of these questions are: how many jobs will be closed, and how many will be opened due to the application of new technologies?, which economic sectors will disappear and which will appear?, which economic sectors are at the greatest risk?, what sort of employees will be overqualified or requalified?, is there enough personnel to train employees for the new technologies?, how digitalization will further impact on flexibilization of work?, to what extent it will erase the boundaries between formal and informal work?, what should the state do in this process?, and many others.

In the next chapter, there will be an attempt to get closer to the implications of digitalization on the labour market through the literature review, with specific reference to Austria.

CHAPTER 2

DIGITALIZATION AND LABOUR MARKET – IMPLICATIONS FOR AUSTRIA

The basic element of the labour market is human labour. Work is done by people, and people usually work to earn money. Since people work to earn money, their work must carry a certain value, which means that human labour has a certain value. Attempts by economists (such as Adam Smith, David Ricardo, and Karl Marx) to calculate the value of labour date back to when labour existed, creating from century to century theories about the value of labour. Economists try to clarify the reasons for goods and services exchange for some prices in the market. In the labour theory of value (for example Lange, Osborne, Alliez and Russell 2019; Chatzarakis, Tsaliki and Tsoulfidis 2022), the amount of labour power that transforms a certain economic good into a commodity (produces a certain commodity) is the source of the value of that commodity.

The development of technology is constantly changing the production process. Along with modern technology that is characteristic of the modern age, especially after the COVID-19 crisis began, the time of adoption and application of new technologies is no longer measured in decades, or years - but in months, even in weeks. As a result, the time required for the adjustment of all participants in the process is proportionally shortened. Any delay in adopting and applying them means falling out of the market competition and lagging behind in terms of production development. This leads to negative changes on the labour market and eventually the growth of poverty and inequality.

The new technology impacts the labour market, such as its main component employment, because it has impacted sectors with a high share of low-skilled manual labour that was believed to remain so, as well as the service sector and jobs that were previously thought to involve too many non-routine tasks to be automated. For

example, accounting softwares are automated and there is no need for a great number of accountants. Artificial intelligence (AI) replaces several human activities in the field of services that require high qualifications, such as accounting, a profession that refers to routine and analytical tasks, statistics, etc. Another example, there have been restaurants that „employed" robots instead of waiters, especially during the COVID-19 crisis. Furthermore, autonomous vehicles are not science fiction anymore, and there already exist vehicles (cars, trucks) without a driver. For instance, bus robot drivers are already present in Japan.

Digitalization impacts the structure of the labour market in several ways. First of all, the labour market is generally defined as a place where people offer themselves as labour and where employers choose to employ them or not. Nowadays, employer and employee can be the same person in the case of microenterprises or freelance (Eichhorst, Hinte, Rinne and Tobsch 2017). In the modern globalized world, these places are converting into digital places such as national agencies platforms, social networks, or private agencies platforms. For example, the curricula vitae are uploaded in digital format and job interviews are moving towards online meetings. The nature of job requirements is changing over time which, along with the digital transformation, changes the structure of the labour market.

On behalf of the digitalization impact on labour market factors, we found that its impact is quite multidimensional. More precisely the abovementioned impact on a specific labour market factor, i.e. human factor, is complex because it embraces labour market transformations from diverse points of view. We found that the most relevant concerns job displacement, job loss and job creation, nature of work changing, collaboration structure, communication models, engagement, and employee experience.

Regarding job automation, there is lots of research confirming that many routine tasks are being automated, and that the direct consequence is job displacement, particularly in sectors like manufacturing and customer service. However, digitalization also creates new jobs in tech-driven fields, such as data analysis and software development. For example, Acemoglu and Restrepo (2019) analysed how automation and other technological advancements impact labour demand. They based their

research on recent trends in US employment, i.e. the distribution of tasks between capital and labour in the US. They claim that automation allows capital to take over tasks traditionally performed by labour, leading to a shift that disadvantages employees due to displacement. Consequently, automation tends to lower the labour share of value-added and can decrease labour demand, even while enhancing productivity. By claiming so, the two authors analysed these effects on employees taking into consideration also the emergence of new tasks where labour has an advantage. Starting from the hypotheses that the introduction of such tasks modifies the production landscape in favour of employees, creating a reinstatement effect that increases both labour share and demand, they demonstrated how changes in the task content of production, i.e. stemming from automation and new task creation, can be analysed using industry-level data. The time frame used is over the last 3 years. The results of their empirical analysis indicate that the slower employment growth is largely driven by an intensified displacement effect, particularly in manufacturing. Also, they found that productivity growth is slower compared to earlier decades. Similar results were obtained by Hoque, Rasiah, Furuoka and Kumar (2022), even if they used different methodologies and samples. Hoque et al. (2022) employed a qualitative methodology to determine the effects of automation on job displacement and reshoring within the Bangladesh apparel industry. They employed 27 semi-structured in-depth interviews to gather primary data while using grounded theory to identify the drivers and barriers related to automation and reshoring. They found that initially, automation reduces human interactions in specific production areas while simultaneously enhancing productivity, quality, and cost-effectiveness, leading to growth and increased employment in clothing companies. Over time, the demand for unskilled workers diminishes as automation becomes fully integrated into operations. Notably, automation does not promote reshoring but may facilitate the relocation of production sites within global value chains (GVC). The highlight of their research is that this GVC-driven relocation could result in job losses in Asian apparel manufacturing while creating employment opportunities in Sub-Saharan Africa, Europe, and North America.

Anyhow, from the literature it seem that the moral is that workers must adapt to automation by acquiring new skills to remain employable. Lifelong learning is becoming essential as job requirements evolve due to digitalization and automation. Also, it

seems that the changing nature of work is a new normal. Nowadays, digital tools have enabled remote work, and predictions suggest that remote work may become the norm, leading to new ways of evaluating people, teams, and organizations. Others argue that most workers will return to offices post-pandemic, producing less digital data. However, the extensive digital footprints generated during COVID-19 will significantly influence future organizational practices, policies, and ideologies, regardless of remote work's continuity (Leonardi 2021). Nevertheless, offering job flexibility has benefits for workers, but it is also blurring the lines between personal and professional life. This can impact work-life balance and employee well-being, causing negative changes in the mental health considerations of workers. The pace of digital change can lead to stress and burnout, necessitating a focus on mental health resources and supportive workplace cultures. For example, Kumpikaitė-Valiūnienė et al. (2021) examined the impact of digital proficiency on remote learning students' stress, burnout, and overall well-being during the COVID-19 lockdown in the spring of 2020, comparing results from four countries (Poland, Lithuania, Turkey, and India). Employing an exploratory approach, utilizing a cross-sectional research design on a total of 1097 participants, and using Psychological Stress Measure (PSM-9) instrument to asses stress, Copenhagen Burnout Inventory to assess burnout, via the Digital Competency Profiler (DCP) to assess digital competence, they found out, that social and informational aspects of digital competencies had a positive effect on students' ability to manage stress and burnout, as well as improve well-being during remote learning. Moreover, country-specific analyses showed that for Lithuanian and Indian students, the epistemological dimension of digital competence was crucial. Instead, the informational aspect was crucial for Polish learners, while for Turkish students crucial was the social dimension in managing stress and burnout.

According to a study founded by Austrian Science Fund, authors Fischer, Reuter and Riedl (2021) made and attempt to measure work-related digital stress, derived from the prevalence and usage of technology. To measure the abovementioned, these authors used the Digital Stressors Scale (DSS) to enhance the measurement of digital stress by building upon contemporary stress concepts and a comprehensive set of stressors. The DSS exhibits strong explanatory power for several digital stress outcomes, particularly emotional exhaustion and user satisfaction. The final

sample was based on 1,998 online surveys that took place from October 26th to November 8th, 2018, and were completed by a US employed population. The main results showed a strong and significant correlation between digital technologies and workers' stress. The DSS captured a broader range of digital stressors, such as information security, technology unreliability, data privacy issues, malignant aspects of technology, social environment pressure, lack of usefulness, lack of technical support, and technology not behaving as expected. Moreover, the DSS explained more variance for several criterion variables, such as: emotional exhaustion, job satisfaction, innovation climate, and user satisfaction.

In the context of employees, therefore, digitalization has accelerated significantly in Austria due to the COVID-19 pandemic. Many companies shifted to remote work, leading to changes in how employees engage with their jobs. This transition has highlighted the importance of digital skills and flexible job arrangements. During the pandemic, the demand for remote work surged. According to a Eurofund survey, 41% of workers in Austria switched to remote work at the peak of the pandemic (Bamieh and Ziegler 2022, p. 2) while around 50% of employees worked from home in later stages (Beno and Hvorecky, 2021 u Apstraktu). This shift not only changed work dynamics but also increased reliance on digital tools for communication and collaboration. The rise of flexible jobs has been notable, with many employers adopting hybrid work models. According to Beno and Hvorecky (2021), the majority of businesses planned to maintain some form of remote work even after restrictions were lifted. While remote work offers benefits like flexibility, it also presents challenges. Studies, as mentioned before, have shown that employees experience increased stress due to blurred boundaries between work and personal life, feelings of isolation, and the need for constant connectivity.

The COVID-19 pandemic has accelerated digitalization in Austria, fostering collaboration across geographical boundaries. Tools like Slack, Zoom, and Microsoft Teams have become essential for communication, enabling teams to collaborate effectively regardless of location. Using digital communication tools more frequently during the pandemic highlighted a shift towards remote collaboration (Bögenhold, Klinglmair, Parastuty and Kandutsch 2019).

According to the World Bank (World Bank 2019, World Bank 2022), the changes that occur in the production process have consequences for the world of work not only in terms of the number of employees but employment is differently perceived now. In other words, the nature of work is changing. The main explanation is that the robotization of the industry implies a big surplus of labour, especially for low and medium-skilled workers. Some occupations and jobs, however, require high qualifications, so highly qualified employees are subject to some lesser substitution by robots. New technology does not only create job losses. Nowadays, it also creates new working fields, occupations and jobs, especially in the digital and cyber world. For example, some companies have developed online call centres, where phone operators work within cyberspace, and phones are digital and connected to the Internet. But, since technology is developing so fast, it is only a question of time when these phone operators will be replaced by robots. There are already companies and institutions possessing call centres with a non-human (digital) operator, and only in case the robot does not understand the specific requirement of the client, the line is transferred to a human operator.

Said so, it is almost impossible to predict the type, nature, and number of jobs that will survive in the fourth industrial revolution (digitalization). Current trends, as well as recent studies, indicate that future jobs will be concentrated in occupations that require creativity, technical and digital knowledge, as well as interpersonal relationships. In terms of current trends, it is possible to claim the above-mentioned because there is a relative growth in demand for tourism, healthcare, entertainment and other similar service sectors, in which human labour cannot be replaced by machines yet (Falk, Hagsten and Lin 2022, Nurov, Khamroyeva and Kadirova 2021, Chauhan 2021, Kong et al. 2021). In terms of recent studies, it is popular the so-called war for talents, where the creativity of employees comes before the school degree, for example (Schaarschmidt, Walsh and Ivens 2021, Singh 2021, McKinsey&Company 2015).

Other concerns regarding digitalization and job, according to the studied pieces of literature, are the changes in the labour market under the influence of new global companies that conduct their activities over the Internet, such as Uber. New global

companies take out from the market traditional companies, and therefore their workers. New technologies bring a new way of doing business, but also a new way of doing business brings new terminology, such as "sharing economy", "collaborative economy", "new nature of work", "atypical jobs" etc., which represents the new service market. At the same time, this causes new ways of generating income, through intangible means, such as user data or advertising on the Internet, which are often not subject to tax because it is not clear how and where the taxable value is created. Therefore, the additional concern concerning digitalization and employment is the legal system and innovation (changes) that countries and regional communities are struggling with. For example, in the case of Uber, this company was the subject of litigation before the European Court of Justice based on an appeal by the taxi drivers' association from Barcelona. This company lost the case, and the Court claimed that this company is subject to the same laws as taxi companies (Court of Justice of the European Union 2017).

Unlike the market of goods (where the price is established on a global level), the labour market functions according to the principle of individual supply and demand. This means that there is no globally established labour price (minimum price, price by individual categories and so on). Jobs that are carried out today through web intermediaries (for example, the platforms "Upwork", „Fiverr“) are very diverse, such as ICT, financial, architectural, design and marketing, administrative and accounting jobs, data analysis, and other „smaller“ jobs (supplementary or second jobs) such as dog walking, ironing, shopping (eg. World Bank 2023). There are several studies about the impact of the COVID-19 crisis on the labour market around the world.

Bartik, Bertrand, Lin, Rothstein and Unrath (2020) analysed the U.S. labour market in the period between March to early July at the onset of the COVID-19 crisis. These authors used different data sets (traditional and non-traditional) to measure the consequences and small recovery of the labour market in the U.S. Official data about employment changes at a monthly level were collected using the Current Employment Statistics (CES) survey of employers. These data were combined with the data about 60,000 households collected using the monthly Current Population Survey (CPS) which is the source of the official unemployment rate data (Bartik, Bertrand, Lin, Rothstein and Unrath 2020, p. 2). Combining official data and interviews, the

results of their analysis showed that almost all hourly workers who work in the retail and leisure and hospitality sectors (employed both in the small and the large businesses), suffered a decline in employment between mid-March and the end of March. Not only have the workers suffered a decline in employment, but also many small businesses have closed their company, especially the companies that have already had business difficulties. Some of the small businesses reopened in April, but a small number of the companies that already had business issues have reopened their business activity, which was reflected in a permanent loss of jobs for the workers. These workers lose their hope of being rehired. The greater part of the workers has received a small share of money due to their job loss mainly from the small businesses that have received loans from the Paycheck Protection Program (governmental support). This study was conducted at the very beginning of the COVID-19 recession, which is why it has certain limitations about its consequences on the labour market in the examined country.

Similar to Bartik, Bertrand, Lin, Rothstein and Unrath (2020), Khamis, Prinz, Newhouse, Palacios-Lopez, Pape and Weber (2021) analysed the early impact of COVID-19 on the labour market in developing countries. The aim of their analysis was to provide evidence from the harmonized data from the World Bank's High Frequency Phone Surveys (HFPS), and a detailed description of the nature of these data, in order to evaluate the consistency of the HFPS data with other sources of data. The sample consisted of 39 countries (6 countries in Europe & Central Asia, 7 in East Asia & Pacific, 12 in Latin America & the Caribbean, 2 in the Middle East & North Africa, and 12 in Sub-Saharan Africa). The main methodology used is reflected in surveys that started in April 2020 and have been carried out not only once but several times. These authors combined survey data with macroeconomic data collected from IMF's World Economic Outlook (WEO), such as country-specific GDP data, in order to better measure the COVID-19 pandemic's impact on the labour market in the mentioned countries. For labour market data, they used the International Labour Organization's (ILO's) ILOSTAT as the data source, and they used quarterly data (1st and 2nd quarter of 2020), while the indicators they used were the following: a) employment-to-population ratio in per cent, b) number of persons who are employed as a per cent of the total working age population based on country labour force surveys, restricted to the group ages 15 years or older. In this way, the

authors were able to track the changes in employment by the official data, and those of the HFPS measure of the labour market in a similar time period. The overall result of their analysis showed that COVID-19 had a very large negative impact on labour markets, reflected in severe work reduction, large work stoppage, and reduced working hours, in all the examined countries. Because of these negative impacts, the counties' GDP decreased substantially and the overall economic system was suffering a recession.

Radulescu, Ladaru, Burlacu, Constantin, Ioanăș and Petre (2020) measured the impact of the COVID-19 pandemic on the labour market in Romania. For data collection, they used the macroeconomic data and the data provided by the questionnaire composed of 18 questions among the Romanian population, i.e. 548 respondents aged over 15. Using the semantic differential and ordering the ranks methods, these authors attempted to determine the effect that the new pandemic had on the Romanian labour market. The results of their analysis showed that the new pandemic had a severe effect on the labour market of this country, especially on the workers. The questioned workers mostly claimed to have maintained a similar income during the crisis. On the other side, they mostly claimed that the influence of the pandemic did not regard only the paychecks, but especially their mentality because they started to change jobs after the beginning of the health crisis. Workers had to change their jobs when their previous job position was lost mainly motivated by combating COVID-19 and preserving health insurance. From the macroeconomic analysis point of research, these authors found that there was an increase in unemployment due to the health crisis. Radulescu et al. (2020) claim that COVID-19 had a direct impact on the Romanian labour market during 2020, and they predict that this impact will continue during the development of the health crisis, even if in different measures, calling so the research to keep investigating.

In the research conducted by Bamieh and Ziegler (2020), the authors made an attempt to establish the nature of the COVID-19 crisis's impact on labour demand in Austria. Using data from the largest online job board in this country, AMS (public employment administration), they analysed labour-demand responses obtained during the first months after the beginning of the lockdown. Employing descriptive statistics and regression analysis as methods of estimation, the results of their study

showed that there was a decline in the number of job postings. This decline was reflected in a decrease of c.a. 30% (one third), and it remained at such a low level even after the restrictions (previously implemented) have been relaxed (Bamieh and Ziegler 2020, p. 2). Not only has the labour demand declined, but also lower wage offers have been detected. From the workers' perspective, they have been offered more remote options (working from distance), than traditional job options. Since these authors found that there have not been significant changes in occupation, they concluded that COVID-19 restrictions do not have a significant impact on the increase in demand for remote occupation in Austria.

Ebner, Schmidthaler and Brandstätter (2021) claim that after the beginning of the COVID-19 pandemic, there has been a remote job, home office and online work. These authors examined the motivational factor for the new job environment, analysing the benefits and challenges of remote working. To conduct the survey for the purposes of their research, these authors collaborated with the Human Capital Management (HCM) of Business Upper Austria. The survey has been constructed and sent to the HR managers who have forwarded it to the employees by email. The data (answers) from the online survey that has been collected from mid-August 2020 to the end of September 2020, has been used for their analysis. The sample consisted of 1074 participants. The results of their study showed that male workers are more desirable to work from home, while both male and female workers prefer flexible working hours. Among the different factors that impact the preference for remote working, the most significant is the physical distance. The more the traditional working place is far (in kilometres), the more the desire to stay and work from the home office. Such a preference is not only the cause of the COVID-19 health crisis and derived restriction, but it also involves personal factors and motivations.

Kim and Coghlan (2020) conducted a study in order to examine the direct and indirect factors of teleworking (working from home) and virtual working productivity during the first months of the COVID-19 crisis. The data for their study was collected through the market research survey of the organizations and industries in Germany, Austria and Russia. The empirical methodology used was structural equation modelling, through which the authors could establish the causality between variables. The variables used were working from home and management practices such as

supervisor support, team interaction, and competence development during this unique situation. The results of their study showed that there is a negative relationship between isolation and teleworking productivity. According to these findings, working from home impacted the decrease in productivity. Moreover, supervision support has had no impact on employees' productivity, while team interaction had a strongly positive impact on productivity. Team interaction resulted to be significantly relevant not only for employees' productivity but also for ensuring the engagement level and for reducing the sense of social isolation. For Austria only, they have found that both the well-being and engagement of remote workers are subject to less decline when there is social support, as well as support from their company's HR (human resource) department (Straus, Uhlig, Kühnel and Korunka, 2022).

In regard to the public institutions' workers during the COVID-19 restriction in Austria, their way of working also switched significantly from traditional to remote working. In their research, Edelmann, Schossboeck and Albrecht (2021) interviewed 40 public employees about their personal and working experiences during the initial COVID-19 phase, in an attempt to define the impact of remote working on their digital culture. The results showed that there is a significant change in the way of doing jobs in public institutions, in the way public employees collaborate, and that this great imposture of digital culture (digital transformation) will change even more in the future for both public workers and organizations. From the employees' viewpoint, this change is seen mostly as a positive change.

Even if remote working became a preference during the last couple of years for most employees and managers, there are new challenges that both of them are facing. In the qualitative study conducted by Beno (2022), 10 Austrian participants have been interviewed using Skype. The type of interview was semi-structured. The sample was structured by half male and half female participants (minimum age 40, maximum age 51). Beno analyzed hybrid work models, especially the difference between traditional (face-to-display) and remote (in-house) working. He claims that there is a preference for in-house working, although it brings different challenges, especially to managers. The most detected challenges and obstacles were of the space character, physical distance, lack of face-to-face interaction and social interaction. Instead

of this, the communication was conducted by writing emails or messages that influence the team spirit, miscommunication and cohesion. In his previous study, on the sample of 154 Austrian employees, Beno (2021, p. 25) found that the proportion of e-working increased by 59.74% (on average) during the COVID-19 crisis.

According to Vasilescu, Serban, Dimian, Aceleanu and Picatoste (2020), the rapid advancement of technology, automation, and digitalization is transforming how people work, live, and do business. In particular, since this digital revolution is bringing both opportunities and challenges, particularly in the labour market the authors examined how EU citizens perceive digitalization and identified differences among various demographic groups. Using a combination of statistical and econometric methods to analyze citizens' digital skills, identify vulnerable groups and countries, and understand the factors influencing their perceptions of digitalization, the authors found: a group of respondents who are less digitally skilled, a group who fear job displacement by robots, and those who have limited internet usage (mostly older individuals, less educated, manual labourers, unemployed, and those with lower incomes). Moreover, these authors claim there is a need to increase people's confidence in their digital skills and leverage the opportunities of digitalization. The findings reveal consistent patterns in how socio-demographic characteristics influence perceptions of digitalization, emphasizing the significant impact this transformation will have on the EU economy and society in the future. According to their results, a significant portion of workers in Bulgaria, Austria, Poland, and Romania believe their jobs could be fully or partially automated by robots or AI. In Austria, 60% of respondents expressed this concern, while Bulgaria (62%), Poland (58%), and Romania (57%) also showed high levels of perceived job vulnerability to automation (Vasilescu, Serban, Dimian, Aceleanu and Picatoste 2020, p. 9-10). Among the countries that fear the most job replacement by AI and robots is Austria. Therefore, the authors suggest that a positive attitude towards digitalization is crucial for turning this challenge into a positive opportunity for the future.

The research conducted by Piroșcă, Șerban-Oprescu, Badea, Stanef-Puică and Valdebenito (2021) aimed to analyze the potential impact of digital proficiency on the future of the labour market. Recognizing the ongoing challenges facing employment

and the influence of technology on the labour market, the study examined the correlation between digital skills, internet usage, and salary levels in EU member states. Their research demonstrates a strong statistically significant correlation between digital skills, internet usage, and higher wages across EU member states. Specifically, a strong positive relationship was observed between digital proficiency and income. However, there is a significant digital divide within the EU, with some countries lagging behind in terms of digital skills and internet access. Countries with higher digital proficiency and internet usage tend to have higher wages. Notably, countries like Northern Macedonia, Bosnia and Herzegovina, Romania, Cyprus, Latvia, Bulgaria, Turkey, and Poland have a higher proportion of adults with low or no digital skills, while countries like Finland, Sweden, Iceland, Norway, Germany, the Netherlands, Austria, Switzerland, and the United Kingdom have a significantly lower proportion. Interestingly, a group of EU member states, including Lithuania, Croatia, Czechia, and Slovakia, have digital proficiency and internet usage levels close to the EU average, but their wages remain below the average (Piroșcă et al. 2021, p. 2851). This suggests a potential for these countries to gain a competitive advantage in the global labour market. In general, their findings suggest a strong link between digital proficiency and higher salaries, indicating the importance of investing in digital skills development to create a more flexible and efficient labour market.

Starting from the main supposition that digital transformation involves leveraging new technologies to create value and gain a competitive advantage, Huseynli and Huseynli (2022) examined the impact of digital technologies on the labour market, focusing on the emergence of digital labour platforms. They used qualitative research methods to examine the effects of digitalization on the labour market, analyzing existing literature and conducting a systematic review of data. The findings of their study reveal that digital transformation has significantly impacted the labour market, and this impact is expected to continue. Digital labour platforms are emerging as flexible, efficient, and cost-effective solutions for both clients and independent contractors.

Kuznetsova, Selezneva, Askarov, Askarova and Gusmanov (2021) analyzed the impact of the development of the digital economy on the structure of the labour market,

i.e. on the labour force, and the growth of demand in the field of IT. Using monographic and statistical research methods on the official data from European and Russian statistics for the period from 2009 to 2018, the authors found that the specialist and professional use of the Internet increased in the countries of the EU, in the measure from 43 per cent to 55 per cent (Kuznetsova et al. 2021, p. 178). Accordingly, they claim that digitalization is affecting significant changes in the labour market, particularly in terms of the growing proportion of people with part-time jobs. Regarding the EU countries, in this period of time, this indicator increased to 18.5% (Kuznetsova et al. 2021, p. 178). Moreover, it was found that there is a positive and significant relationship between the percentage of part-time workers and the rate of computer and Internet use by employees in organizations. Regarding the Russian Federation, the total labour force in this country has increased by 6% in this period (Kuznetsova et al. 2021, p. 175). Based on the results, the authors claim that digitalization affects almost all spheres of the life of society while contributing to the increase of economic efficiency. The abovementioned increase affects the structure of employment, mainly in the sense of labour productivity growth. Similar results were found in the study of Başol and Yalçın (2021). i.e. digitalization in EU countries impacts the improvement in labour market indicators (in 2018).

In the study conducted by Piątkowski (2020), the author examined the current state of the labour market through the lens of a technological revolution that is transforming the labour market, and indirect requests to adapt to new conditions, for both employees and employers. Piątkowski identified groups of EU countries with similar labour market characteristics and highlighted the differences between them. Using methods such as the combination of literature review, content analysis, comparative analysis, and Eurostat data, the author analyzed factors such as employment patterns, work productivity, commitment to vocational training and lifelong learning, education, digital skills development, and government funding for R&D in higher education institutions, and compared results for EU member states that joined the Union before and after 2004. The results showed that on average EU member states joining after 2004 generally have lower values for all the abovementioned variables compared to member states joining before 2004 (Piątkowski 2020, p. 24),. The results confirmed the observed inequalities between EU member states regarding the variables.

Eder, Koller and Mahlberg (2022) analysed the potential impact of digitalization on employment in Austria over the next decade, focusing on the transition to a digitalized production and work environment known as Economy 4.0. Their study developed digitalization scenarios based on various assumptions and utilized an input-output model to estimate the macroeconomic effects of these scenarios. These projections were compared to a so-called “frozen technology” scenario where technological advancements remain at 2015 levels. The results of their study suggest that job displacement due to Economy 4.0 is likely to exceed job creation over the next 10 years, leading to a potential decline in overall employment by 0.80 to 4.81% (Eder, Koller and Mahlberg 2022, p. 28). According to the projections, this shift will also impact the occupational and skill structure of employment, with an increase in higher-skilled occupations (managers and professionals) and a decrease in medium-skilled occupations. Moreover, this study also predicts a shift in employment across economic sectors, with an increase in the tertiary sector (services) and a decline in the primary and secondary sectors (agriculture and manufacturing). This transformation should have a positive influence on value-added and income distribution. Even if this study presents a more optimistic outlook, it also acknowledges concerns about job losses due to digitalization. It highlights the potential for income inequality to increase in Austria by 2030, with women potentially losing income share compared to men.

Polozova, Kolupaieval and Sheikol (2021) studied the gaps in the digitalization process and productivity among EU member countries. Their aim was to understand how these gaps impact a country's competitiveness. Using DESI (Digital Economy and Society Index), International DESI, and Global Competitiveness Score the authors employed a cluster analysis to reveal the differences in digital development versus labour productivity among the countries. The results showed leading positions by Northern European countries, while several Eastern European countries are positioned at the opposite end of the spectrum. Moreover, the linkage between digital development and human development was found. Also, it was found that there is a digital and productivity divide among the EU member countries, with some countries being leaders in digitalization and productivity, while others are lagging behind. According to the authors, this gap can have a significant impact on the overall competitiveness of the countries.

Similarly, Boikova, Zeverte-Rivza, Rivza and Rivza (2021) investigated national competitiveness in terms of the growing importance of digitalization of enterprises. They used a holistic approach to analyze the main determinants of competitiveness performance in the EU, with the purpose to reveal the factors that contribute to the growth of EU economies and identify clusters of EU countries based on these factors. Using factor analysis, the study identified the most significant competitiveness factors such as macroeconomic stability, R&D and Digitalization, Foreign Direct Investment (FDI), and Trade Openness. The authors grouped the EU countries into five clusters based on the contribution of these competitiveness factors to economic growth. Accordingly, the results of their analysis showed the evolving nature of competitiveness determinants, with digitalization and innovation-related factors becoming increasingly crucial for the growth and competitiveness of the EU. Austria was among the countries that resulted sufficiently macroeconomically stable, to have a developed level of R&D and digitalization, and to have a good degree of trade openness.

In a broader sense, human labour represents the use of human power in order to produce a certain product that is intended for exchange on the market. The novel health crisis period has shown that human labour can be replaced with automatization and robotization processes which causes an increase in unemployment and a greater struggle for finding a job. This is why Austria has introduced short-time work, attempting to keep the employment level somehow balanced (Schnetzer, Tamesberger and Theurl 2020).

In that regard, this research will analyse the trends in employment during the crisis, with regard to the Austrian labour market. For this purpose, the indicators such as employment and unemployment will be used in order to analyse the trends of job loss in Austria during the pandemic with reference to the population ratio. The population ratio parameter is relevant because of the rate of deaths during the pandemic caused by the COVID-19 virus.

The amount of scientific literature in regard to the labour market and digitalization in the last two years is little but ever-increasing (for example Piroșcă et al. 2021, Beg 2021). The scientific community is strongly engaged in examining the consequences

of COVID-19 and its impact on different market indicators (Rahimić et al. 2022, Edelsbrunner et al. 2022). The generated knowledge about the impact of digitalization on the labour market in Austria, however, is not sufficient for a deep understanding of this impact. Moreover, to the best of my knowledge, in the literature is not found that the analysis of the impact of digitalization on the labour market in this country provides insights for future hypothetic scenarios based on both quantitative methods and past trends analysis.

In this regard, this master's thesis aims to measure the quantitative impact of digitalization on the labour market in Austria. Based on the existing literature, the following hypotheses will be tested:

Null hypothesis
H(0): Digitalization does not have a significant impact on the labour market in Austria.

Alternative hypotheses
H(1): Digitalization has a positive and significant impact on the labour market in Austria.
H(2): Digitalization has a negative and significant impact on the labour market in Austria.

Testing hypotheses conditions the existence of data that will be collected, systemized and elaborated. The data is presented in the following chapter, as well as the methods applied.

CHAPTER 3

METHODOLOGICAL APPROACH

In this chapter of the master thesis, the methodological approach is presented. It consists of the definition of the indicators that will be used in this research, as well as the method of data collection and presentation (3.1). After the data presentation, it is explained how the data are used for statistical purposes, the regression model, and the timeline used for modelling (3.2).

3.1 Data and method of collection

For conducting the analysis of trends in the digital era and in changes in the labour market, data is needed. The official annual data is provided from the most relevant institutions' data sources, i.e. from the World Bank (WB Data) and the International Labour Organization (ILO Stat). The time series is structured so to serve for the statistical analysis. This time series comprehends the indicators of digitalization and the labour market.

a) Digitalization indicator: "Individuals using Internet", is used with the purpose to analyse trends and compare them to the actual COVID-19 working situation. The official definition of this indicator is as follows. "Internet users are individuals who have used the Internet (from any location) in the last 3 months. The Internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV etc." The source of this definition is International Telecommunication Union (ITU) World Telecommunication/ICT Indicators Database, and the aggregation method is a weighted average (World Bank 2022a).

Labour market indicators, such as "Employment", "Unemployment", "Human Capital Index", and "GDP per capita" are used to describe the trends in the labour market in

Austria and apply them in the statistical processing. The official definitions of these indicators are as follows.

b) Employment: “Employment to population ratio is the proportion of a country's population that is employed. Employment is defined as persons of working age who, during a short reference period, were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period (i.e. who worked in a job for at least one hour) or not at work due to temporary absence from a job, or to working-time arrangements. Ages 15 and older are generally considered the working-age population.” The source of this definition is International Labour Organization, ILOSTAT database, and the aggregation method is a weighted average (World Bank 2022b).

c) Unemployment: “Unemployment refers to the share of the labour force that is without work but available for and seeking employment.” The source of this definition is International Labour Organization, ILOSTAT database, and the aggregation method is a weighted average (World Bank 2022c).

d) HCI: “HCI (Human Capital Index) calculates the contributions of health and education to worker productivity. The final index score ranges from zero to one and measures the productivity as a future worker of child born today relative to the benchmark of full health and complete education.” The source of this definition is the World Bank (i.e. staff calculations based on the methodology described in World Bank 2018) (World Bank 2022d).

e) GDP per capita: “Annual percentage growth rate of GDP per capita based on constant local currency. GDP per capita is gross domestic product divided by midyear population. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation

of fabricated assets or for depletion and degradation of natural resources." The sources of this definition are the World Bank national accounts data, and OECD National Accounts data files, and the aggregation method is a weighted average (World Bank 2022e).

The official definition of all the indicators is taken into consideration because of their methodological limitation as well as for the interpretation of the results of this research.

The data set and description of the indicators and variables are presented in Table 3.1. with respective sources and units of measure. The format of the data presentation was created according to Perić and Filipović (2021).

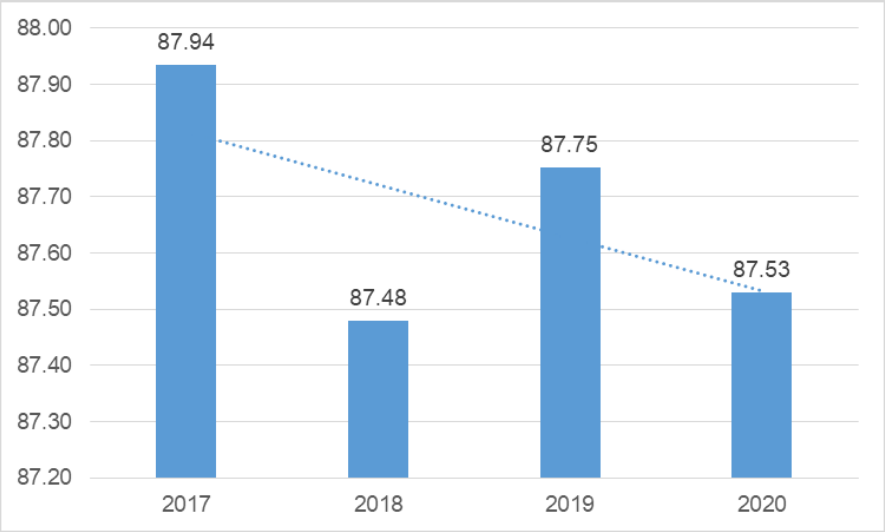
Table 3.1 Data set and variables

Indicator	Institutional label	Variable	Unit of measure	Source
Digitalization	Individuals using Internet	DIG	% of population	World Bank
Employment	Employment to population ratio, 15+	EMP	%, total	World Bank (modelled ILO estimate)
Unemployment	Unemployment, total	UNEMP	% of total labour force	World Bank (national estimate)
Human Capital Index	Human Capital Index	HCI	scale 0-1	World Bank
GDP per capita	GDP per capita growth	GDPpc	annual %	World Bank

Source: Author's preparation

The panel data for the period 2017-2021 is constructed with the scope of presenting the trends related to digitalization (Figure 3.1.) and the labour market (Figure 3.2. and Figure 3.3.). This time period is useful to observe the digitalization and labour market trends before and during the COVID-19 crises, and to evaluate the digitalization trends related to labour market trends in the future based on empirical studies, past experience, actual labour market situation within the country, and the results found.

Figure 3.1. Trends in digitalization: Austria, 2017-2021, %



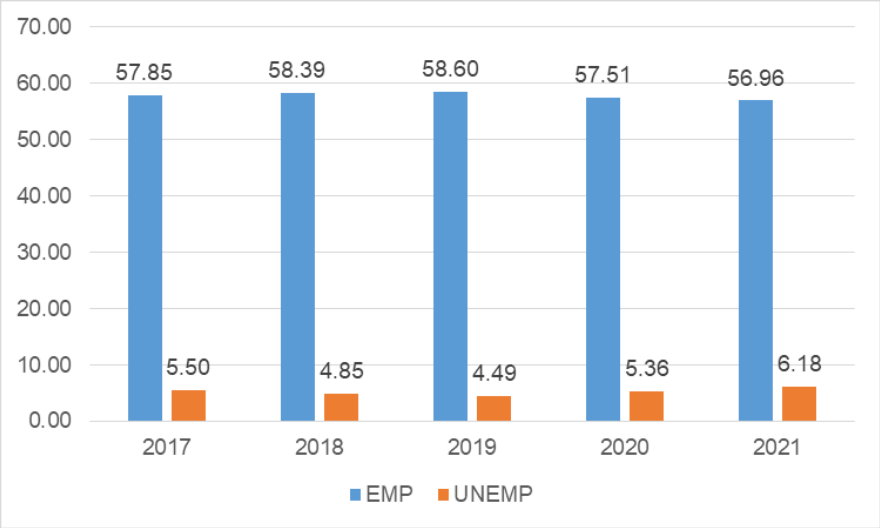
Source: Author's preparation based on the World Bank data series

According to the Figure 3.1., there is a decreasing trend line in using the Internet in Austria. In terms of % of the population, the use of the Internet slightly decreased from 2017 to 2020 in the measure of 0.39%. This slight decrease in % of individuals using the Internet is not the representative indicator itself when interpreting the actual situation in the labour market. This is why has to be interpreted properly and according to what the comparison is made. For example, this slight decrease is the consequence of the decrease in population due to the ageing population and, lately, due to a large number of deaths during the initial phase of the COVID-19 pandemic (Mkiyes 2021). In fact, the current coronavirus crisis has clearly shown that the use of digital tools has increased. According to the Digital report of Austria and the Digital Action Plan in this country, both for businesses and individuals it is crucial to have basic digital capability. Moreover, it is even essential for their maintenance, survival, and competitive advantage (Digital Austria 2022).

In 2021 and 2022, the Austrian government invested around 80 mln euros in the new Digitalization Fund. The pandemic that began in March 2020 brought the Austrian economy to a great economic recession, which is why the experts started with digital transformation to help governmental organizations, many companies, and individuals. The use of the Internet has increased, and 42% of all Internet connections in

Austria are gigabit-capable. The Austrian government considers the digital transformation a success because it brought, among others, an annual increase of 1.9% in GDP, and it created around 20.000 new jobs (Digital Austria 2022).

Figure 3.2. Labour market trends – employment and unemployment: Austria, 2017-2021, %

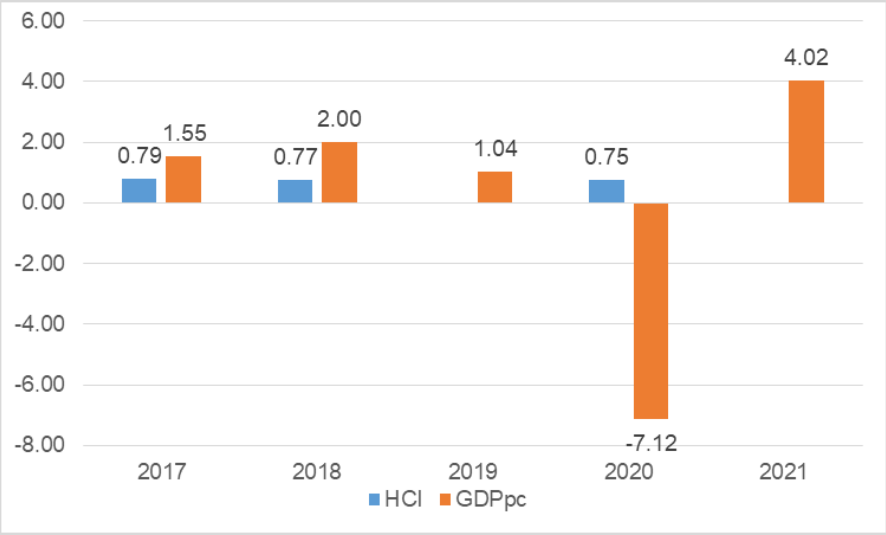


Source: Author's preparation, based on the World Bank data series

According to the Figure 3.2., there has been a progressive decrease in the employment rate from 2019 to 2021 (58.60% and 56.96% respectively). Consequently, the rate of unemployment has been increasing in the same period (from 4.49% in 2019 to 6.18% in 2021).

Even if a digital transformation in Austria brought new jobs during the COVID-19 pandemic, the unemployment rate is still higher than in the period before the pandemic started. It is expected the employment rate to grow, and achieve 0.6% growth by 2030, creating 25,000 to 26,000 net new jobs (Digital Austria 2022).

Figure 3.3. Labour market trends – HCI and GDP per capita: Austria, 2017-2021*



*Note: HCI is ranged from 0 to 1; GDP per capita is measured in %

Source: Author's preparation, based on the World Bank data series

Figure 3.3. shows the decrease in HCI in the period 2017-2021. Accordingly, it decreased by 0.4 points from 2017 to 2020. There is no data available for 2019 and 2021. Even though the data is unavailable, there is research conducted on human capital in Austria during the pandemic. For example, Kuncová et al. (2022) claim that the investments and efforts in human capital in Austria are much above those made in other countries. Therefore, it is expected that human capital will not be the subject of a greater decrease in this country.

Regarding the GDP per capita annual growth rate increase, it was subject to a dramatic decrease in 2020 (-7.12%), while in 2021 it recovered to 4.02%. According to this data, as well as to the WIFO reports on Austria (2022), Austria is one of the top third of the EU countries in GDP per capita increase.

3.2. Statistical methods

Statistical analysis comprehends descriptive statistics and regression modelling (Newbold, Carlson, and Thorne 2013), and consists in analysing digitalization and labour market in the period 2017-2021 in Austria.

Descriptive statistics comprehend the observation of mean, minimum, maximum, variance, distribution, deviation, and standard error. Descriptive statistics is used to present and examine the above-mentioned indicators. The analysis through the observation of descriptive statistics will contribute to determining whether there were significant changes in digitalization and labour market in Austria during the mentioned period.

- Mean – definition. There are different measures of central tendency in statistics, such as mode, median, and mean. In this master thesis, the adopted measure of central tendency is mean. Mean is a simple average of the given data set of values. In order to measure the mean of some data set, the total of the values have to be summarized, and their sum to be divided by the total number of that values (mean = sum of the data/total number of data). Mean has to symbolize the equal distribution of the values in a specific data set. The formula for the calculation of the mean is the following:

$$\bar{x} = \sum_{i=1}^{n} x/n$$

  where $\bar{x}$ represents the mean, $\sum_{i=1}^{n} x$ represents the sum of the data values, and *n* represents the total number of data (also called the number of observations).

- Minimum and maximum – definition. The statistical minimum is the lowest value observed in the set of values, while the maximum is the highest observed value. Their labels in statistics are simply “min” and “max”, respectively.

- Deviation – definition. It is the absolute measure of dispersion in the population or sample (data set). Deviation or standard deviation indicates how much, on average, the values of the data set deviate from the mean of the same data set. The standard deviation of the sample is denoted by *s* and the parameter by σ. The formula to calculate the standard deviation of the sample is the following:

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

- Variance – definition. Variance is the mathematical expectation of the deviation of a random variable from its mean value. Variance and standard deviation are the most commonly used measures of variability in statistics. The variance of the sample is represented by the symbol s^2 and the variance of the population by σ^2. Variance and standard deviation are always together in statistics because they are directly related. Their connection is relevant because the variance is the square root of the standard deviation, and the standard deviation is the square root of the variance. These measures are used on the data set, as the mean. The formula for sample variance is the following:

$$s^2 = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

  In other words, the average of the squared difference between the scores and the mean is called variance. When calculating the variance, the difference of each result from the mean is first calculated, then the difference is squared, and then the squared difference is divided by the number of results in the distribution.

- Distribution – definition. It is the set of observed values in the sample. It shows how the values are distributed for a specific sample. In this research, it is assumed the normal distribution, i.e. $N=(\bar{x}, \sigma^2)$. According to the normal

distribution, the values of x are normally distributed with mean $\bar{x}$ and standard deviation σ^2.

- Standard error – definition. The standard error is an important indicator in statistics because it shows how the mean of the population defers from the mean of the sample. This indicator informs about how much the mean of the sample would be subject to variation if the same study would be repeated using new sample (or samples) within the same population. In other words, it indicates how well the chosen sample of data represents the entire population. The formula to calculate the standard error (SE or σ) is the following:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

This is the standard error of the mean. There are other types of standard errors, such as standard error of the estimate. SE of the estimate is related to regression analysis, explained below. It represents the variability around the estimated regression line and the accuracy of the regression model. Using the SE of the estimate, it is possible to build a confidence interval for regression coefficients.

In this master thesis, both regression and correlation analysis are used. Correlation analysis was first applied by Karl Pearson, which is why the correlation coefficient is also called Pearson's coefficient. Correlation analysis explains how variables are related, i.e. how they vary together (covary). Changes in the value of one variable are followed by related changes in the value of another variable. The correlation coefficient (r) is a measure of the relative accordance of variations of two variables. Correlation does not mean causality (there the regression analysis is used). To calculate r it is necessary to calculate variance (average squared variables deviation), covariance (a measure of joint variables variation), and finally correlation (standardized covariance). The formula for the correlation coefficient is the following:

$$r = \frac{Cov\ (x, y)}{s_x s_y}$$

or

$$r = \frac{s_{xy}}{s_x s_y}$$

where Cov(x,y) is covariance, and s_x, s_y is the sample standard deviation of variables x and y.

A measure of the connection between two numerical variables has a range from -1 to +1. The direction of correlation is represented by the sign of the correlation coefficient (- or +). The intensity of correlation is represented by the absolute value of the r (between 0 and 1). Therefore, correlation analysis measures the degree of the linear relationship between two variables. The sign of the r defines the direction of the relationship:

- a positive correlation coefficient means that with an increase in the value of one variable, the value of another variable also increases; vice versa, as one variable decreases, the value of the other variable also decreases;
- a negative correlation coefficient indicates that as one variable increases, the other decreases and vice versa.

Graphically, the correlation is shown as follows (Figure 3.4.)

Figure 3.4. Correlation presentation

Source: Internet. Graphs have been taken from: https://byjus.com/jee/correlation-coefficient/#:~:text=The%20covariance%20of%20two%20variables,X%2CY)%20%2F%20%CF%83X [September 15th, 2022]

An r with a value of zero (r=0) means that there is no linear relationship between the variables, and correlation coefficients r=+1 and r=-1 show a perfect linear relationship. Therefore, the correlation between variables can be absolute, but more often it is strong or weak. The more the r is close to 0 (for example r=0.25), it indicates a weak relationship, while it is more close to 1 (for example r=0.85), it indicates a strong relationship between variables.

The regression analysis consists in building a regression model. Regression analysis in statistics and in science is a very important analysis. The main goal of a large amount of research is to describe, measure, and establish the connections between the different phenomena. To achieve this goal, it is possible by using equations (formulas) that relate the quantities (values) under observation. For example, a researcher may be interested in measuring the relationship between two or more phenomena (ex. between the rate of employment and inflation, or between a new virus and a new vaccine). The relationship is measured in numbers and explained according to the theory and logic. It indicates the level of the connection between phenomena. In other words, regression analysis deals with finding statistical connections between phenomena. In regression analysis, there are dependent and independent variables, which differentiates it from correlation analysis.

Regression is of great importance, both in economics and business, and other social and natural sciences. The correlation analysis and regression analysis often go together. The main difference between correlation analysis and regression analysis is that correlation analysis has the r which represents the degree and direction of the interrelationship between the observed phenomena, while the regression analysis indicates the level of interdependence between the observed phenomena. In other words, in the regression analysis, it is shown in what measure the independent variable impacts on the dependent variable. In regression analysis, there is a step forward, i.e. the measurement of the dependence between phenomena (variables).

The general formula of a linear regression model is the following:

$$y = \beta_0 + \beta_1 x + \varepsilon$$

where Y is dependent variable, β_0 is the intercept, β_1 is the slope, x is the regression coefficient, and ε is the error of the regression model.

For this research purpose, the regression model is built, with dependent and independent variables, for the period 2017-2022 on annual data for Austria. Its results will show the quantitative impact of digitalization on the labour market. The basis for the regression model construction is the general model specification:

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t$$

where:

y_t is the dependent variable
β_0 is the intercept
β_1 is the slope
x_t is the independent variable or regression coefficient, and
ε_t is the model error.
subscript „t" (time) is the year of reference.

When substituting the indicators in the general linear specification model, presented in the Table 3.2., it is possible to build the specific model.

Table 3.2. Description of variables for analysis

Variable	**Label**	**Unit of measure**
Dependent		
Employment	EMP	% of population
Unemployment	UNEMP	% of total labour force
Human Capital Index	HCI	score 0-1
GDP per capita	GDPpc	% of annual growth
Independent		
Digitalization	DIG	% of population

Source: Author's preparation

Therefore, a specific model can be built. Since there are four dependent variables, four regression models are built:

Model 1:

$$EMP_t = \beta_0 + \beta_1 DIG_t + \varepsilon_t$$

Model 2:

$$UNEMP_t = \beta_0 + \beta_1 DIG_t + \varepsilon_t$$

Model 3:

$$HCI_t = \beta_0 + \beta_1 DIG_t + \varepsilon_t$$

Model 4:

$$GDPpc_t = \beta_0 + \beta_1 DIG_t + \varepsilon_t$$

The formulated equations are simple linear regression models because each of them has one independent variable. In the case of measuring the reversed impact, i.e. the impact of labour market indicators on digitalization using the same sample, the regression model would be the following:

$$DIG_t = \beta_0 + \beta_1 EMP_t + \beta_2 UNEMP_t + \beta_3 HCI_t + \beta_4 GDPpc_t + \varepsilon_t$$

In this case, this is the multiple linear regression model, because it has more than one independent variable. This model will not be estimated in this research, since it does not relate to the research question.

Regression models were estimated in the statistical package IBM SPSS. Before running any statistical analysis, data were systematized in order to meet the requirements of the statistical package. Before running the regression analysis, preliminary statistical steps have been conducted: descriptive statistics, frequency histograms, and correlation analysis.

In this master thesis, the Ordinary Least Square (OLS) method was used for the regression analysis. Since there is to find coefficients of linear dependence, OLS means that the difference between the sum of the squares of the deviations of the observed data and the found regression line is the smallest.

For testing hypotheses, the two-sided confidence interval at the 95% level, and p-value are used. The definition of the null hypothesis (H_0) "Digitalization does not have a significant impact on the labour market in Austria" is the following:

$$H_0 : \beta_1 = 0$$

The definition of the alternative hypothesis (H_1) "Digitalization has a positive and significant impact on the labour market in Austria", and the alternative hypothesis (H_2) "Digitalization has a negative and significant impact on the labour market in Austria", instead, are the following:

$$H_1 : \beta_1 > 0$$
$$H_2 : \beta_1 < 0$$

A confidence interval is a way to describe probability. It is the mean of the estimate with addition (+) or subtraction (-) of the variation in that same estimate. This is the range of values within which the estimate is expected to fall. A confidence interval at the level of 95% means that there is a 5% probability that the results of the research are wrong. This is why the p-value, that explains the statistical significance of the obtained results, has to be under 5%. Otherwise, the interpretation is that the regression results are not statistically significant, in which case the tested hypothesis is rejected.

CHAPTER 4

DIGITALIZATION EFFECTS ON THE LABOUR MARKET IN AUSTRIA: RESULTS AND DISCUSSION

The purpose of this part of the thesis is to present the results of the econometric analysis (4.1.) and the discussion of results in the context of research and literature (4.2.).

4.1. Research results

Before presenting the results of correlation and regression analysis, in the Table 4.1., descriptive statistics is presented.

Table 4.1. Descriptive statistics

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Year	5	4	2017	2021	2019	0.707	1.581	2.5
DIG	4	0.46	87.48	87.94	87.674	0.105	0.211	0.044
EMP	5	1.65	56.96	58.6	57.864	0.298	0.666	0.444
UNEMP	5	1.69	4.49	6.18	5.276	0.289	0.647	0.418
HCI	3	0.05	0.75	0.79	0.770	0.013	0.023	0.001
GDPpc	5	11.15	-7.12	4.02	0.300	1.923	4.300	18.489
Valid N (listwise)	3							

Source: Author's calculation, based on the World Bank data series

Descriptive statistics is the summary or, as the name recalls the meaning, description of the characteristics of the data set. It consists of measures of central tendency (mean, minimum, maximum, range), measures of variability or spread (variance, standard deviation), and frequency distribution (the occurrence of data within the data set N).

In the sample of this study, the highest value of the individuals using Internet is 87.94%, while the lowest was 87.48%. The average percentage of individuals using Internet in the period 2017-2020 was 87.67% (std. error = 0.105, std. deviation = 0.211, variance = 0.044).

In the period 2017-2021, the minimum percentage of people employed was 56.96%, while the maximum was 58.6%, which on average is 57.87% (std. error = 0.298, std. deviation = 0.666, variance = 0.444).

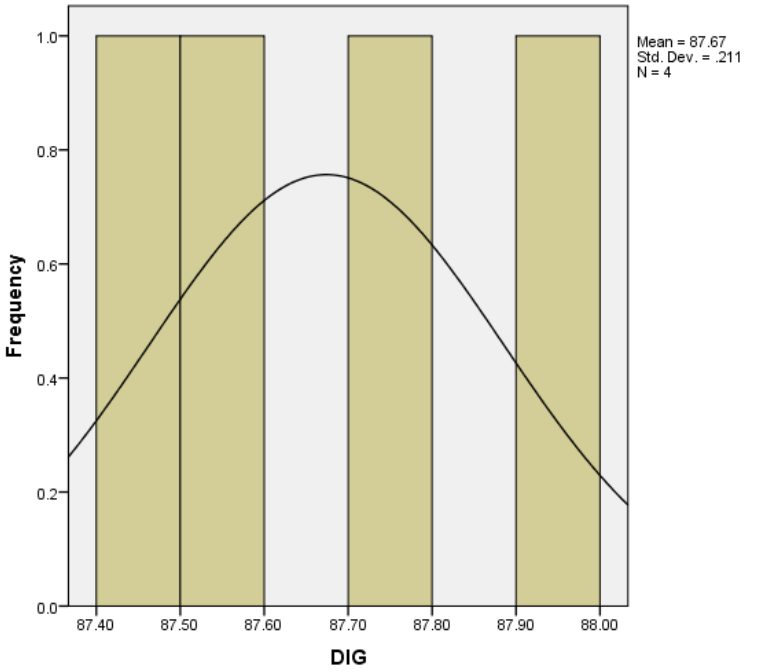
Similarly, 4.49% was the minimum percentage of unemployed people, and the maximum was 6.18% in the period 2017-2021. On average, the unemployment rate in this period was 5.28% (std. error = 0.289, std. deviation = 0.647, variance = 0.418).

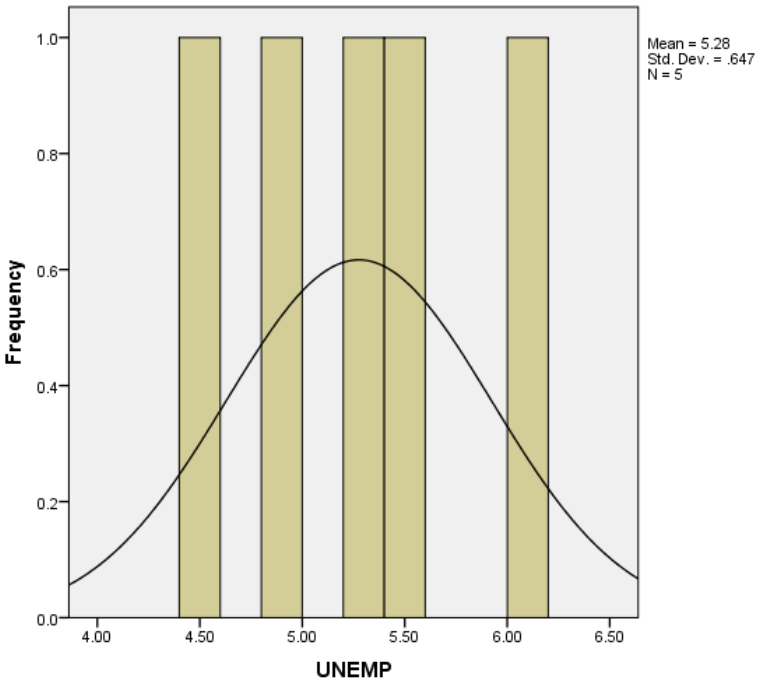
For the Human development index, data is missing for two years (2019 and 2021). Accordingly, on N = 3, the lowest value of this index was 0.75 and the highest was 0.79 (mean = 0.77, std. error = 0.013, std. deviation = 0.023, variance = 0.001).

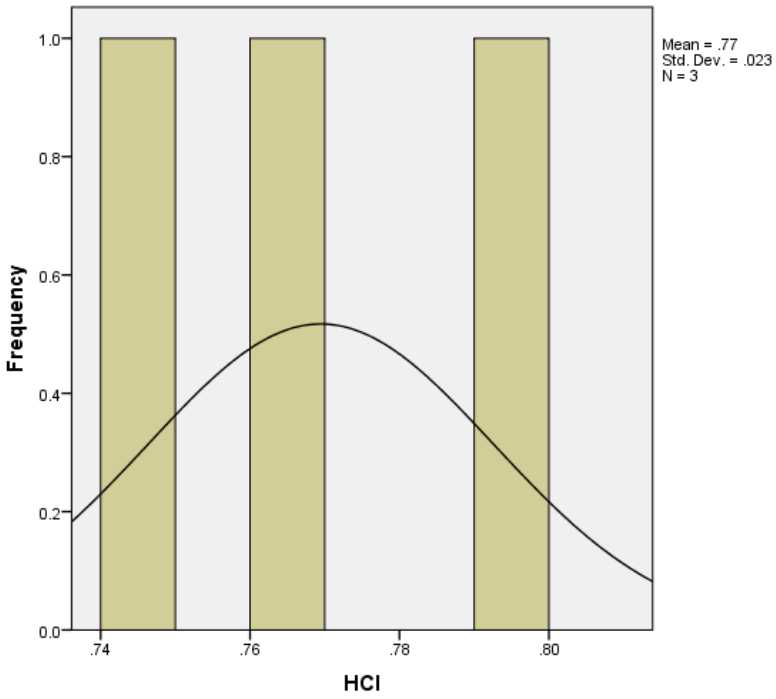
When it comes to GDP per capita, the average value in the period 2017-2021 was 0.3% (std. error = 1.923), but it was the subject of the maximum variation among all the variables used (variance = 18.49). In fact, the minimum value of GDP per capita was -7.12%, while the maximum was 4.02%.

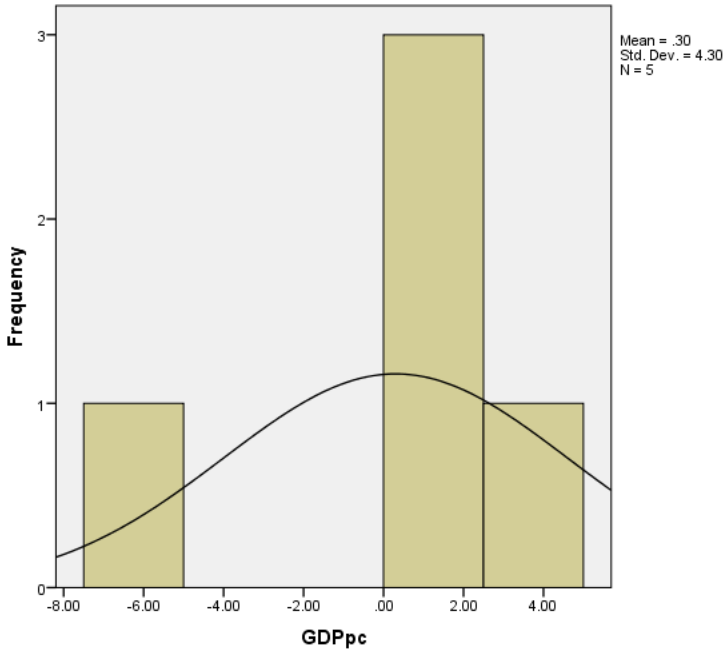
To observe the frequencies of the variables visually, histograms were used. In the Figure 4.1., histograms are presented.

Figure 4.1. Frequencies of the variables









Source: Author's presentation, based on the elaboration of World Bank data series

When the data is presented and described, the study continues with the correlation analysis. Correlation analysis was used to determine the connection between variables (Table 4.2.). More precisely, the relationship between digitalization and labour market indicators from the aspect of quantified interconnection is determined.

Table 4.2. Correlation matrix

		Year	DIG	EMP	UNEMP	HCI	GDPpc
Year	Pearson Correlation	1	-0.579	-0.634	0.457	-0.976	-0.154
	Sig. (2-tailed)		0.421	0.25	0.439	0.14	0.805
	N	5	4	5	5	3	5
DIG	Pearson Correlation	-0.579	1	0.008	0.231	0.828	0.41
	Sig. (2-tailed)	0.421		0.992	0.769	0.378	0.59
	N	4	4	4	4	3	4
EMP	Pearson Correlation	-0.634	0.008	1	-.963**	0.355	0.058
	Sig. (2-tailed)	0.25	0.992		0.009	0.769	0.926
	N	5	4	5	5	3	5
UNEMP	Pearson Correlation	0.457	0.231	-.963**	1	0.234	0.154
	Sig. (2-tailed)	0.439	0.769	0.009		0.85	0.804
	N	5	4	5	5	3	5
HCI	Pearson Correlation	-0.976	0.828	0.355	0.234	1	0.827
	Sig. (2-tailed)	0.14	0.378	0.769	0.85		0.38
	N	3	3	3	3	3	3
GDPpc	Pearson Correlation	-0.154	0.41	0.058	0.154	0.827	1
	Sig. (2-tailed)	0.805	0.59	0.926	0.804	0.38	
	N	5	4	5	5	3	5
** Correlation is significant at the 0.01 level (2-tailed).							

Source: Author's calculation, based on the World Bank data series

The results of the correlation analysis show that there are both positive and negative correlation, as well as strong and weak, and statistically significant and not significant correlations between variables. Namely, the correlation coefficient r=-0.579 indicates that there is the average relationship between digitalization and year, which is not

statistically significant (p=0.421). The negative correlation among digitalization and year indicator means that when one of the variables grows in value, the other one is decreasing. In this case, the variable year cannot decrease, therefore it is assumed that during time the percentage of individuals using the Internet will decrease. However, this correlation is not statistically significant, which is why this correlation result cannot be taken as true in reality. Similarly, there is negative correlation between time and employment (r=-0.634), time and HCI (r=-0.976), and time and GDP per capita (r=-0.154), which is not statistically significant (p=0.25, p=0.14, p=0.805, respectively). In regard to positive correlation, it is found that time and unemployment are positively correlated (r=0.457), but this result is not statistically significant (p=0.439).

Digitalization indicator is in positive correlation with all labour market indicators. Namely, digitalization and employment are correlated in the measure of 0.8% (r=0.008), which is a very weak correlation. If this correlation has shown statistical significance (p=0.992), it would be assumed that the changes in one indicator does not imply almost any change in another indicator. Similarly, there is a weak and statistically not significant correlation between unemployment and digitalization (r=0.231, p=0.769), and between digitalization and GDP per capita (r=0.41, p=0.59). Somehow differently, digitalization and HCI show a high degree of correlation (r=0.8280) which is not statistically significant (p=0.378).

Weak (positive) and statistically not significant correlation is found also between employment and HCI (r=0.355, p=0.769) and employment and GDP per capita (r=0.058, p=0.926), as well as between unemployment and HCI (r=0.234, p=0.85), and unemployment and GDP per capita (r=0.154, p=0.804). HCI and GDP per capita correlate positively and strongly (r=0.827), but this result is not statistically significant (p=0.38).

The only statistically significant correlation is found between the indicators of employment and unemployment. The correlation analysis shows that there is a very strong negative correlation between these two indicators (r=-.963, p=0.009), which means that the increase in one of them leads to a decrease in the other one in the

measure of 96.3%. In other words, the increase in employment will lead to a decrease in unemployment rate, and vice versa, in the measure of the correlation coefficient in the observed period.

Based on the relationship between variables (for a description of variables, see Appendix 1), it is to evaluate the nature of their correlation. However, the correlation analysis does not show causality among them. To determine the degree of causality, i.e. the impact of one variable on another, the regression analysis has been conducted. In other words, the impact of the labour market impact on creating and improving the competitiveness of the company is determined through the regression models presented below.

4.1.1. Digitalization effects on employment

The effect of digitalization on employment is measured for the period 2017-2021 in Austria. The results show that digitalization has no significant impact on employment (0.018, p=0.992) (Table 4.5.). However, the R Square=0 (Table 4.3.), which means that it can be claimed that there is no significant impact of digitalization on employment in the measure of 0%. In other words, it cannot be concluded that digitalization has no effect on employment.

Table 4.3. Model 1: Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.008	0.000	-0.500	0.611
Predictors: (Constant), DIG				

Source: Author's calculations, based on the World Bank data series

R Square indicates how well the regression model explains the data that are observed in this analysis. For example, if R Square is 0.40, it means that 40% of the variability in digitalization is explained by the regression model where employment is the dependent variable (model 1). The Table 4.3. shows the summary of regression model 1. It is found that R Square=0, meaning that regression model 1 explains 0% of the variability in employment.

Moreover, the regression model itself is not statistically significant (p=0.992) (Table 4.4.).

Table 4.4. Analysis of variance (EMP)

ANOVA(a)						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.000	1	0.000	0.000	0.992(b)
	Residual	0.747	2	0.373		
	Total	0.747	3			
(a) Dependent Variable: EMP						
(b) Predictors: (Constant), DIG						

Source: Author's calculations, based on the World Bank data series

The results of ANOVA (analysis of variance) show the statistical insignificance of the model 1 (p=0.992, F=0.000). The statistics such as p-value and F-ratio indicate the statistical significance in ANOVA. The p-value greater than 5% indicates statistical insignificance. F-ratio measures if the means of different samples are significantly different or not. The lower the value of F, the more similarity exists in the sample means. In that case (p>0.05, F=0), the null hypothesis cannot be rejected.

The result of overall insignificant ANOVA usually indicates that the following analysis (such as regression coefficients and confidence interval) may be useless, but they will not lead to wrong conclusions. Therefore, the analysis continues with the estimation of the regression coefficients (Table 4.5.).

Table 4.5. Regression model 1 – coefficients

Coefficients (a)						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
1		B	Std. Error	Beta		
	(Constant)	56.476	146.664		0.385	0.737
	DIG	0.018	1.673	0.008	0.011	0.992
(a) Dependent Variable: EMP						

Source: Author's calculations, based on the World Bank data series

According to the results, the impact of digitalization on employment is 0.018 but is not significant. It means that the result obtained, i.e. one unit of increase in digitalization (1 unit or 100%) causes the increase in employment by 0.018 (or 18%), is not significant (p=0.992 or p>0.05). Similarly, the intercept of the regression curve is not significant (p=0.737). The intercept (or constant) is the expected mean value of the dependent variable (EMP) when all the independent variables are equal to zero (DIG=0). Therefore, it cannot be claimed that the expected mean value of employment is 56.476 when digitalization is 0.

Table 4.6. Confidence interval – Model 1

Confidence interval (a)					
Model		95.0% Confidence Interval for B		Collinearity Statistics	
1		Lower Bound	Upper Bound	Tolerance	VIF
	(Constant)	-574.567	687.518		
	DIG	-7.179	7.216	1.000	1.000
(a) Dependent Variable: EMP					

Source: Author's calculations, based on the World Bank data series

At 95% confidence interval, the value of digitalization based on the value of employment varies between negative (-7.179) and positive (7.216) values. So the range of digitalization values is between positive and negative. Therefore, it is not possible to determine either the positive or negative range that contains the values of the dependent variable (DIG). Moreover, the value of VIF and tolerance is only 1, meaning that multicollinearity is not present.

4.1.2. Digitalization effects on unemployment

It is found that the effect of digitalization on unemployment is not significant (0.51, p=0.769) (Table 4.9.). The R Square=0.053 (Table 4.7.). Therefore, it can be claimed that there is no significant impact of digitalization on employment in the measure of only 0.53%.

Table 4.7. Model 2 - Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
2	0.231(a)	0.053	-0.420	0.556
(a) Predictors: (Constant), DIG				

Source: Author's calculations, based on the World Bank data series

The Table 4.7. shows the summary of the regression model 2. It is found that R Square=0.053, meaning that digitalization explains 0.53% of the variability in unemployment.

Table. 4.8. Analysis of variance (UNEMP)

ANOVA(a)						
Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	0.035	1	0.035	0.113	0.769(b)
	Residual	0.617	2	0.309		
	Total	0.652	3			
(a) Dependent Variable: UNEMP						
(b) Predictors: (Constant), DIG						

Source: Author's calculations, based on the World Bank data series

Moreover, the Table 4.8. shows that the regression model itself is not statistically significant (p=0.769, F=0.113).

Table 4.9. Regression model 2 - coefficients

Coefficients(a)						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
2		B	Std. Error	Beta		
	(Constant)	-39.685	133.370		-0.298	0.794
	DIG	0.510	1.521	0.231	0.335	0.769
(a) Dependent Variable: UNEMP						

Source: Author's calculations, based on the World Bank data series

According to the results, the impact of digitalization on unemployment is 0.51 but is not significant. It means that the result obtained, i.e. one unit of increase in digitalization causes an increase in unemployment by 0.018, is not significant (p>0.05). Similarly, the intercept of the regression curve is not significant (p=0.794).

Table 4.10. Confidence interval – Model 2

Confidence interval (a)					
Model		95.0% Confidence Interval for B		Collinearity Statistics	
2		Lower Bound	Upper Bound	Tolerance	VIF
	(Constant)	-613.532	534.162		
	DIG	-6.035	7.055	1.000	1.000
(a) Dependent Variable: UNEMP					

Source: Author's calculations, based on the World Bank data series

At 95% confidence interval, the value of digitalization based on the value of unemployment varies between negative (-6.035) and positive (7.055) values. So, it is not possible to determine either the positive nor negative range that contains the values of the dependent variable. As in the previous model, the value of VIF and tolerance is only 1, meaning that multicollinearity is not present.

4.1.3. Digitalization effects on Human Capital Index

Based on the results, the effect of digitalization on HCI is 0.077, and it is not statistically significant (p=0.378) (Table 4.13.).

Table 4.11. Model 3: Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
3	0.828(a)	0.686	0.373	0.018
(a) Predictors: (Constant), DIG				

Source: Author's calculations, based on the World Bank data series

The R Square=0.686 (Table 4.11.), which means the model is reliable at the level of 68.6%.

Table 4.12. Analysis of variance (HCI)

ANOVA(a)						
Model		Sum of Squares	df	Mean Square	F	Sig.
3	Regression	0.001	1.000	0.001	2.189	0.378(b)
	Residual	0.000	1.000	0.000		
	Total	0.001	2.000			
(a) Dependent Variable: HCI						
(b) Predictors: (Constant), DIG						

Source: Author's calculations, based on the World Bank data series

However, the regression model itself is not statistically significant (p=0.378).

Table 4.13. Regression model 3 - coefficients

Coefficients(a)						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
3	(Constant)	-5.945	4.538		-1.310	0.415
	DIG	0.077	0.052	0.828	1.479	0.378
(a) Dependent Variable: HCI						

Source: Author's calculations, based on the World Bank data series

Model 3 shows that digitalization does not affect HCI in a significant manner (p>0.05).

Table 4.14. Confidence interval – Model 3

Confidence interval (a)					
Model		95.0% Confidence Interval for B		Collinearity Statistics	
		Lower Bound	Upper Bound	Tolerance	VIF
3	(Constant)	-63.606	51.717		
	DIG	-0.581	0.734	1.000	1.000
(a) Dependent Variable: HCI					

Source: Author's calculations, based on the World Bank data series

As in the case of model 1 and model 2, in the model 3 the confidence interval is between negative lower bound and positive upper bound, meaning that it is not possible to determine neither the range of dependent variables' values.

4.1.4. Digitalization effects on GDP per capita

According to the regression results, the impact of digitalization on GDP per capita in Austria it not significant in the observed period (Table 4.17).

Table 4.15. Model 4: Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
4	0.410(a)	0.168	-0.248	4.853
(a) Predictors: (Constant), DIG				

Source: Author's calculations, based on the World Bank data series

R-Square of this model shows the reliability of only 16,8%.

Table 4.16. Analysis of variance (GDPpc)

ANOVA(a)						
Model		Sum of Squares	df	Mean Square	F	Sig.
4	Regression	9.509	1	9.509	0.404	0.590(b)
	Residual	47.106	2	23.553		
	Total	56.615	3			
(a) Dependent Variable: GDPpc						
(b) Predictors: (Constant), DIG						

Source: Author's calculations, based on the World Bank data series

Moreover, the regression model itself is not significant (p=0.59).

Table 4.17. Regression model 4 - coefficients

Coefficients(a)						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
4	(Constant)	-740.808	1164.91		-0.636	0.590
	DIG	8.442	13.287	0.410	0.635	0.590
(a) Dependent Variable: GDPpc						

Source: Author's calculations, based on the World Bank data series

According to the results of the model 4, there is no significant effect of digitalizaiton on GDP per capita in Austria in the four years period (8.448, p=0.59).

Table 4.18.

Confidence interval (a)					
Model		95.0% Confidence Interval for B		Collinearity Statistics	
		Lower Bound	Upper Bound	Tolerance	VIF
4	(Constant)	-5753.01	4271.395		
	DIG	-48.726	65.611	1.000	1.000
(a) Dependent Variable: GDPpc					

Source: Author's calculations, based on the World Bank data series

At 95% confidence interval for regression coefficients, the range of values is between negative and positive values.

4.2. Discussion of the results

The discussion of the results found are presented in this part of the work. Overall results show that there is no significant impact of digitalization on labour market in Austria for the period 2017-2021. These results are based on purely quantitative analysis, and are not in accordance with the results of other authors' results analysed in this work. Therefore, the null hypothesis can not be rejected.

Although, these results have to be taken with caution for several reasons:

- the indicator of digitalization is limited on the measure of the individuals using internet, and it does not include other important characteristics of digitalization;
- the data used was limited to the official data (quantitative data set), and there has not been any qualitative data collection (such as survey);
- the timeline of the research is limited to 5 years, which can limit the outcome of the regression analysis.

Future developments of the study will concern, on the one hand, the verification of the model proposed to the extended timeline, when updated data will be available, in order to study the trend of digitalization over the years of the COVID-19 pandemic after 2021 and its impact on the labour market in Austria. On the other hand, future research should include qualitative data sets and combine them with the official data.

Nevertheless the results based on quantitative analysis, the literature has shown that digitalization impacts labour market. Accordingly, we could claim that there is dual impact of digitalization on labour market, in particular on employment. In recent years, the rapid advancement of digital technologies has transformed the labour market, creating new opportunities and challenges. Investment in digitalization has been shown to increase employment for high-skilled individuals while simultaneously reducing job prospects for low-skilled workers. This dichotomy is primarily driven by firms that employ machine-based digital technologies, which automate tasks and streamline operations. In contrast, non-machine-based digital technologies appear to have minimal impact on employment levels. Investment in machine-based digital technologies, such as automation, AI, and robotics, has led to a growing demand for high-skilled workers. These technologies require a workforce proficient in data analysis, programming, and technical problem-solving. As companies adopt these advanced solutions, they often seek individuals with specialized skills to manage, maintain, and optimize these systems. For instance, sectors like information technology, finance, and healthcare have witnessed significant growth in high-skilled job opportunities (Balsmeier and Woerter 2019). According to a report from the World Economic Forum, by 2025, the demand for roles in data science, software development, and AI is expected to surge, creating millions of new jobs for skilled professionals. This trend underscores the need for a workforce equipped with the necessary skills

to thrive in a digital economy. Conversely, the same investments in digitalization have adverse effects on low-skilled employment. Machine-based digital technologies often automate routine tasks traditionally performed by low-skilled workers, leading to job displacement. For example, in manufacturing and retail, automated systems can perform tasks such as assembly and inventory management, reducing the need for human labour (Balsmeier and Woerter 2019). This job automation disproportionately affects low-skilled workers, who are more likely to be engaged in repetitive and manual tasks. As businesses streamline operations and reduce labour costs through automation, many low-skilled workers find themselves at risk of unemployment or underemployment.

Interestingly, the employment effects of non-machine-based digital technologies are less pronounced. These technologies, which include tools like cloud computing, digital communication platforms, and online collaboration software, improve efficiency and connectivity but do not fundamentally change labour demand. While they enhance productivity and facilitate remote work, they do not typically replace jobs in the same way that machine-based technologies do. For example, a company that adopts cloud-based project management tools may improve team collaboration and workflow but still require the same number of employees to execute tasks. As such, the overall impact of non-machine-based digital technologies on employment levels remains neutral, highlighting the need to differentiate between types of digital investments when assessing their effects on the labour market.

Therefore, the dual impact of digitalization on employment raises important questions about the future of work and the necessary skills for success in a digital economy. As high-skilled job opportunities expand, there is a pressing need to invest in education and training programs that equip workers with the skills demanded by the evolving job market. This includes a focus on STEM (science, technology, engineering, and mathematics) education, vocational training, and continuous professional development. At the same time, policymakers must address the challenges faced by low-skilled workers who are at risk of displacement. Initiatives aimed at reskilling and upskilling these individuals are crucial to help them transition into new roles that leverage their existing skills in conjunction with emerging technologies. Social safety nets and support programs can also play a vital role in mitigating the impacts of job

loss due to automation. Anyhow, the investment in digitalization presents a complex landscape for employment. While it fosters growth and opportunity for high-skilled workers, it simultaneously poses significant risks to low-skilled employment. The effects are largely driven by firms that utilize machine-based digital technologies, whereas non-machine-based technologies do not exhibit the same employment dynamics. As the workforce continues to adapt to these changes, it is essential for stakeholders to prioritize education, training, and support to ensure that all workers can thrive in an increasingly digital world.

CONCLUSIONS

The outbreak of the COVID-19 crisis has deeply affected the attitude of governments and companies towards digital technologies. Namely, global dependence on digital technology has never been so relevant for industry, trade, business, labour market, education, healthcare, and all other aspects of society. The increasing global trend of digitalization and its impact on countries and individuals pushed somehow digitalization to have the great potential to provide various economic and social benefits, and countries are implementing regulatory policies to promote digital innovation.

Doing business and the way of working have changed around the globe. Remote work, distance learning, e-commerce and other branches have grown worldwide, as a consequence of the adoption of digital tools. Governments, companies, and also the academic auditorium have rapidly realized that new disruptive digital technologies (AI, Internet of Things, big data etc.) have great potential. Because of that potential, digital technologies were seen as tools that can significantly contribute to the fight against the COVID-19 crisis, for example to meet the need for timely and reliable access to data (business data, health-system data, labour market data). In fact, the power of digital technology has become so visible that companies, national economies, and lately individuals, have become aware that there is a need to use digital technologies even more than before the global health crisis in order to be able to transform their business models patterns, healthcare system patterns, and individual and social patterns.

Digitalization of the economy is not a new phenomenon. Although it has been around for several decades, it seems that during the COVID-19 crisis it reached a tipping point. The integration between digital tools and robotization heralds the arrival of a new economy, and thus a new world of work. Still, it is not known to what extent will this new digital economy create, destroy or replace jobs, which sectors will be most affected, what new skills and qualifications will be needed, and so on. Similarly, global effects on the quality of employment, working forms and conditions are difficult to accurately assess.

The ongoing COVID-19 pandemic has dramatically shifted the economic landscape, highlighting the importance of digital skills in a rapidly changing labour market. While automation, robotization, and digitalization have already been transforming the workforce, the pandemic has accelerated these trends, demonstrating the ability of digitally skilled workers to adapt quickly to new circumstances.

The pandemic has exposed vulnerabilities in the labour market, such as supply chain disruptions and restrictions on movement, emphasizing the need for economic restructuring and keeping pace with technological advancements. Prior to the pandemic, concerns were already voiced about job volatility and the adaptability of workers to new job types.

Numerous questions arise, especially in connection with the emergence of a globalized and digitalized new labour market. The digital revolution appears to be exposing the great disparities between the masses of increasingly low-income workers and those at the top of the market who can take advantage of an increasingly rich array of digital instruments. The digital revolution, it seems, creates struggles for policymakers (in terms of job regulation, taxes etc), putting the whole market at risk of an unregulated market. The need to combat this risk is at the heart of the challenge facing policymakers and trade unions in the digital revolution and the social and labour struggles of the future.

The intersection of digitalization, the COVID-19 pandemic, and the labour market in Austria has led to significant changes in work patterns, highlighting the importance of flexibility and digital competency. However, these shifts also necessitate attention to employee well-being to mitigate stress associated with remote work. Overall, Austrian companies are leveraging a mix of digital tools and strategies to create a productive remote work environment. These adaptations not only enhance operational efficiency but also support employee well-being in a hybrid work landscape.

Some of the negative aspects of digitalization and flexible job is correlated to Gig Economy, i.e. platforms like Uber and Upwork have popularized gig work, providing flexibility but often lacking job security and benefits. It is obvious that the COVID-19

pandemic has given digitalization a new meaning and opened up space for it to rapidly spread to all areas of the economy, life and activity, leading the world to conclude that now is the time to focus on digital transformation at all levels and the need to accelerate it. However, this conclusion and the subsequent way of doing and living may lead the labour market to a great and irreversible struggle.

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ANNEXES

Annex 1

Variable view

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
1	Year	Numeric	12	0	Year	None	None	12	Right	Scale	Input
2	DIG	Numeric	12	2	DIG	None	None	12	Right	Scale	Input
3	EMP	Numeric	14	2	EMP	None	None	14	Right	Scale	Input
4	UNEMP	Numeric	15	2	UNEMP	None	None	15	Right	Scale	Input
5	HCI	Numeric	16	2	HCI	None	None	16	Right	Scale	Input
6	GDPpc	Numeric	17	2	GDPpc	None	None	17	Right	Scale	Input

Source: Author's calculations, based on World Bank data series

Annex 2

Model 1 – regression curve estimation

Warnings

The Quadratic model could not be fitted due to near-collinearity among model terms.

Model Description

Model Name		MOD_5
Dependent Variable	1	EMP
Equation	1	Linear
	2	Quadratic
Independent Variable		DIG
Constant		Included
Variable Whose Values Label Observations in Plots		Unspecified
Tolerance for Entering Terms in Equations		.0001

Case Processing Summary

	N
Total Cases	5
Excluded Cases[a]	1
Forecasted Cases	0
Newly Created Cases	0

a. Cases with a missing value in any variable are excluded from the analysis.

Variable Processing Summary

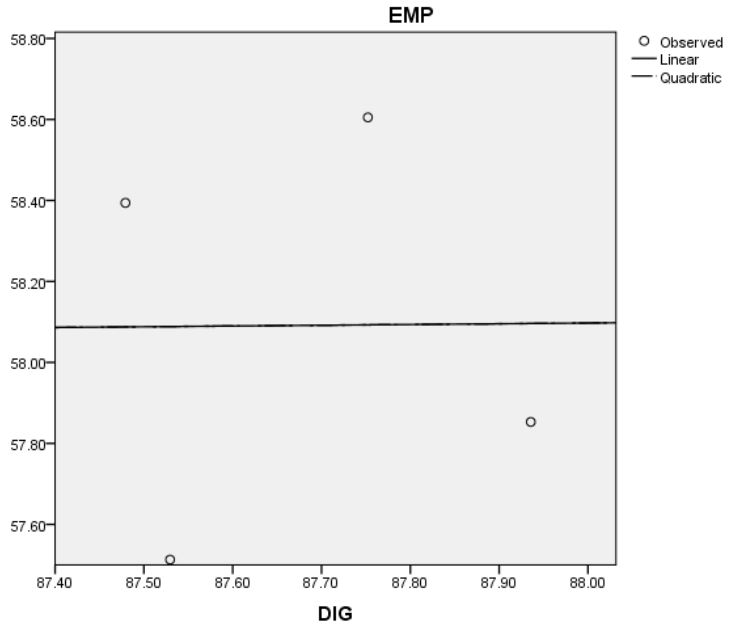
	Variables	
	Dependent	Independent
	EMP	DIG
Number of Positive Values	5	4
Number of Zeros	0	0
Number of Negative Values	0	0
Number of Missing Values User-Missing	0	0
System-Missing	0	1

Model Summary and Parameter Estimates

Dependent Variable: EMP

	Model Summary					Parameter Estimates		
Equation	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	.000	.000	1	2	.992	56.476	.018	
Quadratic	.000	.000	1	2	.992	56.476	.018	.000

The independent variable is DIG .



Source: Author's calculations, based on World Bank data series

Annex 3

Model 2 – regression curve estimation

Warnings

The Quadratic model could not be fitted due to near-collinearity among model terms.

Model Description

Model Name		MOD_4
Dependent Variable	1	UNEMP
Equation	1	Linear
	2	Quadratic
Independent Variable		DIG
Constant		Included
Variable Whose Values Label Observations in Plots		Unspecified
Tolerance for Entering Terms in Equations		.0001

Case Processing Summary

	N
Total Cases	5
Excluded Cases[a]	1
Forecasted Cases	0
Newly Created Cases	0

a. Cases with a missing value in any variable are excluded from the analysis.

Variable Processing Summary

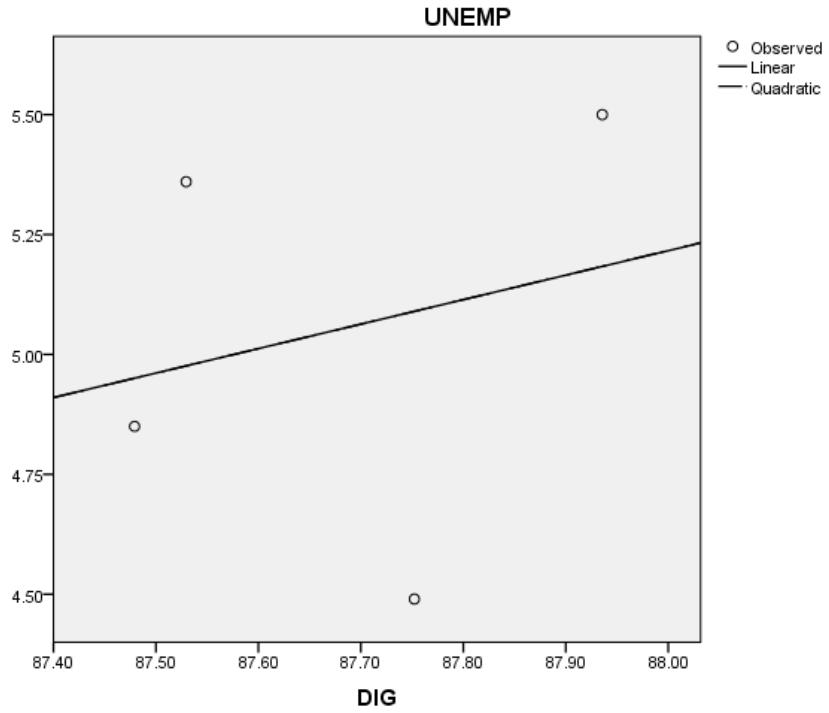
	Variables	
	Dependent	Independent
	UNEMP	DIG
Number of Positive Values	5	4
Number of Zeros	0	0
Number of Negative Values	0	0
Number of Missing Values User-Missing	0	0
System-Missing	0	1

Model Summary and Parameter Estimates

Dependent Variable: UNEMP

	Model Summary					Parameter Estimates		
Equation	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	.053	.113	1	2	.769	-39.685	.510	
Quadratic	.053	.113	1	2	.769	-17.352	.000	.003

The independent variable is DIG.



Source: Author's calculations, based on World Bank data series

Annex 4

Model 3 – regression curve estimation

Warnings

The Quadratic model could not be fitted due to near-collinearity among model terms.

Model Description

Model Name		MOD_6
Dependent Variable	1	HCI
Equation	1	Linear
	2	Quadratic
Independent Variable		DIG
Constant		Included
Variable Whose Values Label Observations in Plots		Unspecified
Tolerance for Entering Terms in Equations		.0001

Case Processing Summary

	N
Total Cases	5
Excluded Cases[a]	2
Forecasted Cases	0
Newly Created Cases	0

a. Cases with a missing value in any variable are excluded from the analysis.

Variable Processing Summary

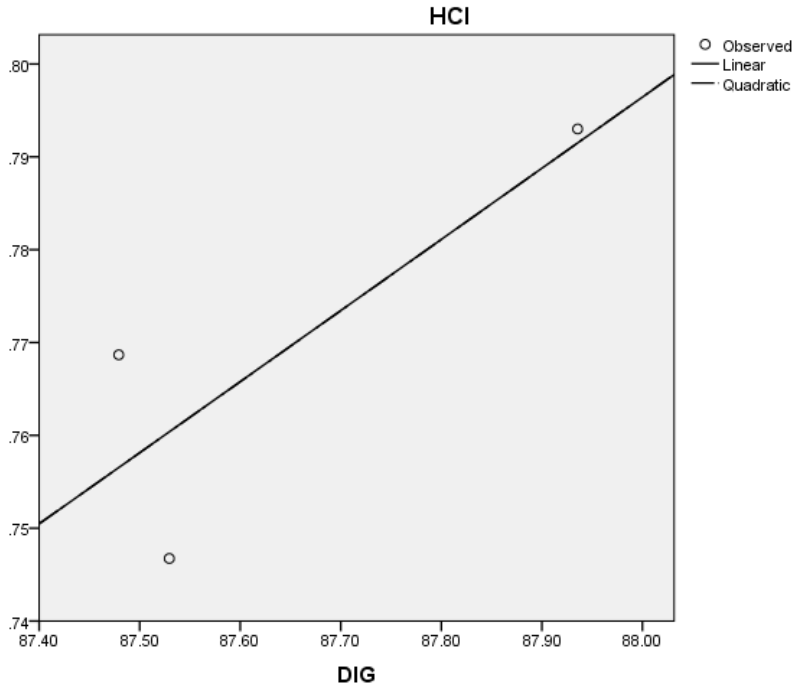
	Variables	
	Dependent	Independent
	HCI	DIG
Number of Positive Values	3	4
Number of Zeros	0	0
Number of Negative Values	0	0
Number of Missing Values User-Missing	0	0
System-Missing	2	1

Model Summary and Parameter Estimates

Dependent Variable: HCI

	Model Summary					Parameter Estimates		
Equation	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	.686	2.189	1	1	.378	-5.945	.077	
Quadratic	.687	2.191	1	1	.378	-2.585	.000	.000

The independent variable is DIG.



Source: Author's calculations, based on World Bank data series

Annex 5

Model 4 – regression curve estimation

Warnings

The Quadratic model could not be fitted due to near-collinearity among model terms.

Model Description

Model Name		MOD_7
Dependent Variable	1	GDPpc
Equation	1	Linear
	2	Quadratic
Independent Variable		DIG
Constant		Included
Variable Whose Values Label Observations in Plots		Unspecified
Tolerance for Entering Terms in Equations		.0001

Case Processing Summary

	N
Total Cases	5
Excluded Cases[a]	1
Forecasted Cases	0
Newly Created Cases	0

a. Cases with a missing value in any variable are excluded from the analysis.

Variable Processing Summary

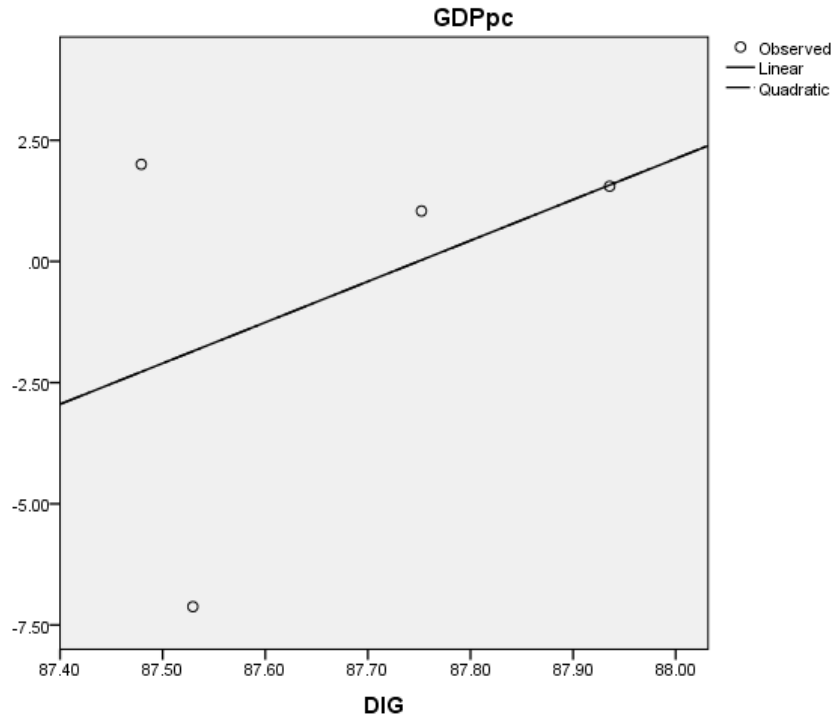
	Variables	
	Dependent	Independent
	GDPpc	DIG
Number of Positive Values	4	4
Number of Zeros	0	0
Number of Negative Values	1	0
Number of Missing Values User-Missing	0	0
System-Missing	0	1

Model Summary and Parameter Estimates

Dependent Variable: GDPpc

	Model Summary					Parameter Estimates		
Equation	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	.168	.404	1	2	.590	-740.808	8.442	
Quadratic	.168	.404	1	2	.590	-370.702	.000	.048

The independent variable is DIG.



Source: Author's calculations, based on World Bank data series