TALLINN UNIVERSITY OF TECHNOLOGY
School of Business and Governance
Department of Economics and Finance

Eva Kolektor

TELEWORKING AND COVID-19

Bachelor's thesis
Programme Applied Economics

Supervisor: Simona Ferraro, PhD

Tallinn 2021

I hereby declare that I have compiled the thesis independently
and all works, important standpoints and data by other authors
have been properly referenced and same paper
has not been referenced previously presented for grading.
The document length is 11524 words from introduction to the end of conclusion.

Eva Kolektor ……

(signature, date)

Student code: 185566TAAB

Student e-mail address: evakolektor@mail.ru

Supervisor: Simona Ferraro, PhD:

The paper conforms to requirements in force

……

(signature, date)

Chairman of the Defence Committee:

Permitted to the defence

……

(name, signature, date)

TABLE OF CONTETS

ABSTRACT

The current dynamics of changes in the structure of the labor market in favor of telework, associated with the forced restrictive measures to counter the COVID-19 pandemic, brought the issue of the possibility of applying a new mode of operation in various industries to the fore. Within the framework of this bachelor's thesis, the probability of the influence of several factors on the possibility of continuous teleworking or the refutation of such effect is investigated.

Studies conducted on statistical data using correlation-regression analysis and the least-squares method (OLS) showed that the most likely impact on the possibility of permanent telework is provided by: a high level of education, permanent employment contracts, and the level of personal skills concerning digital and telecommunication technologies. However, none of the dependencies of the factor or the regression model has a natural, sustainable impact on the possibility of teleworking with all participating countries. The conclusions regarding the analysis of empirical data partially confirm the main Hypothesis 1 of this thesis since they refute the dependence of the possibility of teleworking on many factors determined by the author. At the same time, the review of Hypothesis 2 confirms Hypothesis 1 since it illustrates an outside study regarding the maximum probability of telework in the absence of the need for physical contact in the profession during the performance of official duties.

Keywords: Teleworking, COVID-19, European countries, correlation, regression analysis.

INTRODUCTION

This thesis is devoted to the study of the possibility of widespread use of telework as a type of labor activity, as well as the introduction of telework in the form of a modern manifestation of forced measures related to restrictions on freedom of movement to fight against the spread of the COVID-19 virus. Teleworking is “replacing physical presence in the workplace with an appropriate telephone and digital connection that allows all activities to be performed in the same way as in the office” (The Telework Advisory 2007).

The choice of the subject for research has been dictated by its topicality. The current pandemic (COVID-19) has brought a massive and sudden change in the way companies operate (McKinsey, 2020). In the aftermath of the COVID-19 outbreak, social distancing, which means deliberate physical space between people, was adopted as a reliable prevention method and therefore required telecommuting (ECDC, 2020). Information and communication technologies (ICT) allow employees to work anytime and almost anywhere, which made the development of telecommuting inevitable, but the pandemic made it necessary.

The thesis aims to quantify the extent of teleworking before and during the COVID-19 outbreak.

The tasks set in the paper have determined their structure. It consists of three chapters and a conclusion. The first chapter is a theoretical part, which summarizes the literature in the field of telework. The second chapter includes the analysis of data and an explanation of the empirical model. The third chapter is devoted to working with empirical data, which made it possible to analyze the situation in the format planned in this work.

The widespread adoption of telecommuting requires thinking about what makes certain professions acceptable to them and others not, except in the particular circumstances of social reorganization caused by the pandemic. Based on this, the thesis develops Hypothesis 1 and considers Hypothesis 2.

Hypothesis 1. Based on the current state of technological development and the work processes implemented in this environment, it can be argued that the ultimate factor determining the possibility of telework in professional activity is the lack of physical interaction.

Hypothesis 2. Proposed by ICP-INAPP in 2013, which is based on a certain level of detail of characteristics for the individual domain and consists of the assertion that there is a certain degree of the feasibility of implementation in teleworking mode for each profession.

Research questions that should help the author to achieve the goal of the dissertation:

1. Can teleworking, which began as a forced and temporary measure during the epidemic, now become a long-term solution for employees/firms?

2. How can telecommuting evolve after the current expansion?

The data sample used in this thesis covers the period from 2010 to 2020. For some variables, the data sample has a shorter time from 2020 to 2021 due to the availability of data or the relevance of the variable's data. The primary data sources are the European Working Conditions Survey 2020 and Eurostat database. The quantitative research method is used for all data with which calculations are carried out in work. As the main method, the empirical model used is the OLS regression data model to present the classification of professions in terms of the technical feasibility of teleworking, mainly in 27 European countries.

1. TELEWORKING AND COVID-19

The section is divided into two subsections. The first subsection analyzes the prerequisites for the emergence and spread of telework as a form of work before the COVID-19 pandemic. The second subsection describes the positive and negative impact of telework on labor efficiency and the structure of employment of workers in various fields of professional activity.

1.1. Development and escalation of telework implementation, labor efficiency

This type of work activity, as teleworking, occurred parallel with the development of information and communication technologies (ICT) (Allen, Golden, Shockley, 2015). The first prerequisites for performing work outside the employer's location using ICTs were high travel costs in the region. At the same time, sufficient access to ICTs was already provided. In addition to cost savings, there has been a positive environmental impact due to reduced transport use (EUSES, 2020).

At the beginning of telework research, work outside the office remained stationary since computers and telephones of that generation of ICT could not provide mobility for workers. Nevertheless, the scale of telework grew steadily, albeit slowly. Over time, technological progress has changed the world. In the 21st century, smartphones and other similar devices have fundamentally transformed the role of ICT in the work process of almost the entire world. The concept of "Home office" received new opportunities and, in the development of teleworking, was transformed into a "Virtual office" (Messenger, 2016). The current stage in the evolution of ICT allows you to store information in cloud services. Almost any modern computer technology with communication capabilities, up to shared access to data, is suitable for accessing it (ICPS, 2020).

Teleworking before the outbreak of the situation with the global pandemic COVID-19 was just one type of employment on the planet, moreover, far from the most common. According to Eurofound, on the eve of the onset of the pandemic, the number of employees of companies in different countries differed but hardly had an overwhelming majority. For example, Denmark (37%), Sweden (33%) and the Netherlands (30%) are among the most progressive in terms of telecommuting (Eurofound, 2021) and many countries of the world, before the pandemic, the percentage of employed on telecommuting was much less. Telecommuting was most common

among professionals and managers, but it was also trendy among clerical workers and salespeople in Europe.

1.1.1. Teleworking with the advent of COVID-19

It is important to emphasize that telework did not arise with the arrival of COVID-19. The trend towards teleworking workers has been around for a long time, and by 2025 it was predicted that 44% of the workforce would be migrated to teleworking (En + Group, 2019). The varying prevalence of telework in different countries has been associated at different times with the availability of ICTs, problems with the availability of the Internet, the level of education in the use of ICTs, the structure of the economy, the GDP of countries and the culture of work (Eurofound, 2020). However, not everyone understands that the term "telework" in 2020 became one of the most used words and has become an integral part of the working population in a relatively short period.

The pandemic has given impetus to developing new IT systems, and companies using these tools are increasingly convinced that their use is advisable in the future. The digital transformation of business models with the help of IT systems and the technological component pushed the development of personnel management technologies such as Agile modelling (AM). As a part of it, a progressive risk management model became available, as well as Scrum as a project management system (Acquisition Research Program, 2021). For the first time in history, millions of institutions almost instantly switched to an entirely new work format. To keep jobs, people had to adapt to their circumstances. Lessons learned by businesses during the crisis of 2008–2010, after which the unemployment rate became appalling (ILO, 2010), was the main factor pushing the rapid transformation of the human capital fund and its adaptation to new working conditions. The prompt response to the COVID-19 period restrictions allowed maintaining at least 30% of human capital at the same level of employment. The organizational measures taken to support the operation of remote work are industry-specific and depend on the availability of experience in organizing remote work. The accumulated experience in implementing organizational measures that ensure the transfer of employees to a remote mode of work will allow more active use of this mode after the end of the pandemic (Remoters, 2020).

Considering the features of the activities implemented by organizations that first encountered the introduction of remote work, it should be noted that control over the outcome of remote employees has become much more important. Less frequently, measures were taken to update and develop

new software, purchase new equipment, and increase staff motivation and protect trade secrets. Thus, it can be concluded that the organizational measures are taken to ensure the functioning of telework are industry-specific and depend on the availability of experience in organizing remote work. The knowledge gained in implementing organizational measures that ensure the transfer of employees to telework will make it possible to use this mode after the end of the pandemic more actively.

1.1.2. Telework as a factor in increasing labor efficiency

According to research by IT giants such as Google (The Telegraph, 2020) and Microsoft, employees' work at remote work has become much more productive (ZDNET, 2020). Improving the comfort of the workplace allows you to focus more on the tasks at hand. Also, the transition to telework provides an opportunity to save money on the trip to the place of work and an additional couple of hours of life a day, which ultimately helps to reduce the level of stress (Hamza, Salar, 2021).

Teleworking allows you to exclude risks associated with the inattention of people around you or unforeseen situations, which also improves the employee's psychological state. It should be named that there is also a factor that reduces the likelihood of exchanging microbes and viruses with colleagues, which was the goal of forced self-isolation measures (Béland, Brodeur, Wright, 2020). Teleworking provides an opportunity for employers to evaluate a new approach to controlling work schedules and for employees to feel more free about their daily life, using pauses at work to communicate with children, parents, friends or for sports.

However, teleworking from a gender point of view has tangible differences. When 49% of men are satisfied with working at home, women are pleased with this type of work only in 35% of cases, due to the greater involvement of women in household chores, taking care of children, etc. (Hamza, Salar, 2021). Working hours are often not clearly defined, and companies have to focus more on the result, which causes the employee to be more motivated to perform the work efficiently and on time (Acquisition Research Program, 2021). Thus, it can be concluded that many companies and their employees will express a desire to continue working remotely.

1.2. Risks of teleworking

The use of a wide range of telecommuting opportunities in the real world ensured the efficiency of solving many issues, at the same time providing an opportunity to reduce the time spent on transporting employees to the workplace, and in many cases, to exclude the concept of an office from the business model of the organization. However, this fact is only one side of the "coin", as for the second side, both employees and employers face some difficulties in various areas of activity. Purposeful strengthening of employee responsibility, awareness of relative autonomy, creating a trusting climate, problems with legal support for employees (ILOb, 2021), provision of material and technical working conditions and many other areas continue to manifest themselves against the background of prolonged, forced telework.

Teleworking also implies the need to find an adequate strategy for forming the organizational structure due to the main risk for employers in the form of weakening the association of employees with the organization and the potential weakening of employee loyalty to the organization. The factor of weakening loyalty can harm the employer undermine the efficiency of the employee's job duties and reduce the rate of professional growth (OECD, 2020).

Considering the organization of the workflow, one should approach this issue from several points of view at once. There are also several adverse effects associated with teleworking for workers, namely the length of work, which is arbitrarily increased so that there is no need to waste time commuting to work (Berg, Bonnet, Soares, 2020). There is a more significant amount of interference between work and home. Some factors distract the employee from performing his official duties. Because of the unfocused boundaries between work and personal life, the intensification of work and other personal issues are changing, including a severe risk when switching to remote work lies in the complexity of self-organization and the specifics of some activity directly depends on contact with people (Schlosser, 2002).

1.2.1. Legal risks

A common problem for both employers and employees was the unpreparedness of labor legislation in most countries of the world for the massive introduction of telework in industries that rarely encountered this manifestation of employment. After analyzing the statistics of search queries that users asked through the Google search engine, it turned out that all over the world, concerning the employment market, the most popular question was "Telework Policy". That indicates that society was not ready for a massive transition to remote work, including legislatively. In many countries,

the legal norms for determining the rights, freedoms and obligations of persons involved in a telework mode before the COVID-19 pandemic had significant differences in the scale and significance of this type of employment. The primary European regulation on teleworking was the European Framework Agreement on Teleworking, which was concluded in 2002 (ILO, 2020) and implemented by most Member States. Still, its effectiveness was found to be insufficient.

According to studies by the Institute of Technology and Business, VSTE and Prague University of Economy and Management, VSE conducted in 2021 (EDP Sciences, 2021), the national legislation of the 27 EU member states, as well as the EU supranational legislation to teleworking was far from ideal at the time of the emergence of forced measures with the massive transition to teleworking. For example, the Labor Code of the Czech Republic in article 262 of 2006 regulates the relations, rights and obligations of the employer and the employee. The Labor Code of Slovakia had corresponding articles since 2001. The Polish Labor Code has completely regulated the activities of teleworkers since 1974, as amended in 2007 (Law of June 26, 1974 No. 1974 No. 24 Article 141 of the Labor Code) (EDP Sciences, 2021). For instance, in France, although the national legislation of this state since 2012 had norms regarding telework, the country still faces many problems with the regulation of the rights and obligations of teleworkers.

One of the most relevant legislative acts of widespread introduction into the legislation of countries at the national level, with a complete transition to telework, is the law on the "right to disconnect", which will allow teleworkers not to communicate with the employer outside of working hours on a legal basis (Agius, 2020). Also, a new digitalization agreement reached in June 2020 was swiftly adopted, recognizing many of the key issues associated with increasing ICT-enabled flexible working arrangements.

1.2.2. Organization and control problems

The number of employees who work outside the office is growing steadily. According to estimates by the International Labor Organization, which has established a joint report with the European Fund for the Improvement of Living and Working conditions, the share of such employees in the labor market is 17%. In many countries, particularly in Japan and the United States, it already reaches almost 40% of all employees. The data provided is for the period up to 2019, excluding trends during the COVID-19 pandemic (Eurofound, ILO 2020). In most cases, telecommuters are employed in managerial or professional positions and meet the criteria for self-employed (Eurofound, ILO 2020). So, in the EU countries, about 10% of employees in 2015–2016 worked

remotely from time to time, 5% worked virtually outside the office, 3% of employees did remote work from home every day. The highest level of such employees was recorded in Denmark (9% working from home, 10% often working outside the office in various places, 15-18% working remotely from time to time), Sweden (5%, 10% and 18%, respectively) and the Netherlands (6%, 10% and 14%), the smallest - in the Czech Republic (2%, 3% and 5%), Greece (2%, 3% and 4%) and Italy (1%, 2%, 6%). The USA and Japan have the highest rates of remote work outside Europe - 37% and 32% of workers, respectively (Eurofound, ILO 2020).

Despite the difficulties in organizing a large-scale transition to telework, the main risk of changing the type of interaction was not the organization but control of activities. There are at least two forms of control over the performance of the function of a remote worker: control over the working time and control over the implementation of the long-term results of the tasks assigned to the employee during the work.

From the point of view of exercising control over an employee, author can talk about the presence of various control strategies. In one case, the employer may use software to monitor the workflow remotely. Another option for tracking an employee's telecommuting activities can be using data collaboration software solutions that allow all employees to see how completing a common task is organized (The Capital Markets Company, 2021). The use of such software and online services must be agreed upon with the employee and regulated by an employment contract.

2. DATA AND METHODOLOGY

This chapter provides an overview of the data and the methodology used in the analysis to confirm or disprove the hypotheses. Two subsections of the chapter describe the variables that empirical evidence from third-party research has shown to influence the likelihood of telecommuting and provide descriptive statistics and graphical results from the author's research. Also, within the framework, the author examines a third-party study, which is the only large-scale study in the framework of the likelihood of using telework in the EU countries since 2010.

2.1. Description of data and hypotheses

This section presents the data and the model used to conduct the empirical analysis based on the two hypotheses.

Hypothesis 1. The ultimate factor in working remotely is the lack of physical contact in the workplace. According to the results of various studies, starting with research on the future of teleworking (Handy & Mokhtarian, 1996), as well as research on considerations about time and space (Perin, 1998), every year it became more and more relevant to understand the factors affecting the employee's transition to teleworking as the main way of performing job duties. Based on studies of the quality of work and the balance between work and home (Rodríguez-Modrono, Lopez-Igual, 2021), the following variables were identified as potentially significant factors: educational level, the level of implementation of Information and Communication Technologies (ICT) in the workflow, the skill level of personal digital skills, type of employment contract. Concerning the dependence of telecommuting on socio-economic factors, the author uses such variables as the population of the countries of the study group and the unemployment rate (Avgitidou, 2021).

In some cases, the choice in favor of telework may be the logical conclusion of a series of events and innovations of the employer, making telework an integral part of the work process, regardless of the employee's wishes. In addition to influencing the transition to telework on the employer’s interest, such labor transformation can be influenced by factors of a forced nature in the form of

planned legislative initiatives or unique circumstances leading to forced decisions regarding the working regime (Belzunegui, Erro, 2020). The author uses information on the dynamics of changes in the percentage of employees performing their job duties remotely as the main factor for analyzing the dependence of these selected variables. The main body of data used for analysis is presented by annual data from 2010 to 2020 (Appendix 1).

The data set analyzed in the study types of labor contracts, educational level, the number of workers performing their job duties remotely are presented as dual variables of high and medium levels. The duplication of factors is necessary to clarify some variants' influence and conduct a more detailed analysis and forecast of the research results.

Table 1 summarizes the list of factors used in the analysis to test Hypothesis 1 for this thesis. The data presented in the table contains the name of the factor, the name of the variable, the date of the data update, and the online code for the classification of the Eurostat statistical dataset. The indication of the name of the variables is used to graphically display the calculated data, which will be presented in the follwing subsection of this chapter of the thesis.

Table 1: Variables chosen for the analysis of the truth of hypotheses of the thesis

Factor	Variable	Update	Online code
Location	country	-	-
Time range	year	-	-
Population, mill	population	05.07.2021	TPS00001
Percentage of population in the labour force, %	unemployment_rate	14.07.2021	TPS00203
Employees by type of employment contract, mill	unlim_duration	02.06.2021	LFSA_ESEGT
	lim_duration	02.06.2021	LFSA_ESEGT
Population by educational attainment level, (ISCED 2011), %	eduLevel_5_8	03.06.2021	EDAT_LFSE_04
	eduLevel_3_4	03.06.2021	EDAT_LFSE_04
Use of computers and the internet by employees, %	pc_Int_use_empl	11.03.2021	ISOC_CI_CM_PN2
Percentage of the ICT personnel in total employment, %	ict_personal	01.06.2021	ISOC_BDE15AP

Employed persons working from home as a percentage of the total employment, %	usualy_wh	02.06.2021	LFSA_EHOMP
	som_wh	02.06.2021	LFSA_EHOMP
Individuals who have basic or above basic overall digital skills, %	digital_skills	25.05.2021	ISOC_SK_DSKL_I

Source: The European statistics. Developed by the author of the thesis (2021) (Appendix 1).

Hypothesis 2. There is a certain degree of admissibility of implementing professional activity in the telework model for each profession. As part of the review of Hypothesis 2 are analyzed the ICP-INAPP studies from 2013, which are based on a certain level of detail of the characteristics inherent in professions structured according to the 5-character classification Codici Professionali (CP) using data from a unique Italian occupational-level survey on the skill, task and work contents (INAPP, 2013). Empirical data from studies and surveys are most often aimed at a narrow specificity of activities and, as a rule, do not have significant coverage of the majority of participants in the target audience. In connection with this fact, it complicates obtaining a precise result about factors that influence the choice of telework globally and not relying on individual situations or the massive influence of individual third-party factors, which are a statistical error. The author uses the review of Hypothesis 2 within the dissertation framework as an example of the only study similar to the author's reflection on the extended range of applicability of the final dependent variable with the level of influence of external and unforeseen factors.

2.2. Data visualization and descriptive statistics

Before proceeding with the data analysis, the author will review the current rates of telecommuting in the European Union according to data for Q2 2021, using Eurostat statistical dataset determines the proportion of employed persons working from home as a percentage of the total employment. According to the available statistics, Finland is the leader in terms of the number of employees performing their duties in telework mode, with an indicator of 25.1% of teleworkers. Bulgaria closes the list with its 1.2%, even though the trends of the epidemiological situation in the world and forced restrictions with this indicator are challenging to match. Data for all countries is in Appendix 1.

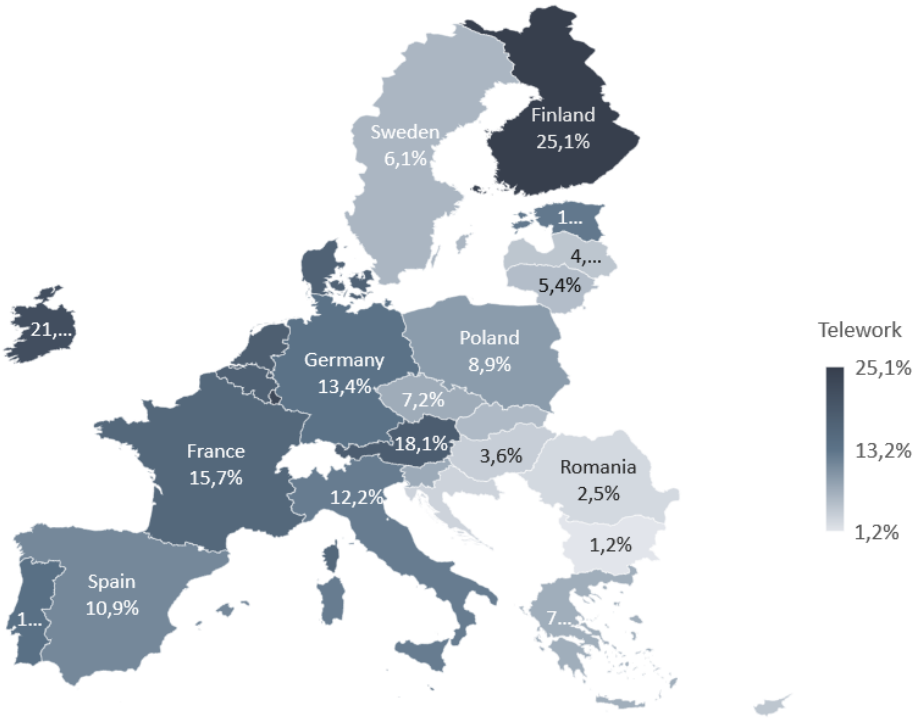

Figure 1. The level of telecommuting workers by EU countries in 2020 (Employed persons working from home as a percentage of the total employment, %, usualy_wh).
Source: The Eurostat database. Prepared by the author from the data in Appendices 1-2.

The dataset used in the analysis has time series structures for the period 2010–2020 for all the factors indicated above and the corresponding variables for each EU27 country separately. The author has transformed this array into a tabular set of panel data for import into the R data processing environment. It is subsequently divided into separate data sets by country for ease of analysis. Figure 2 shows the primary analysis of the main data set for the average indicators of variables for the EU27, as a single structure, to identify the most relevant variables (Appendix 1).

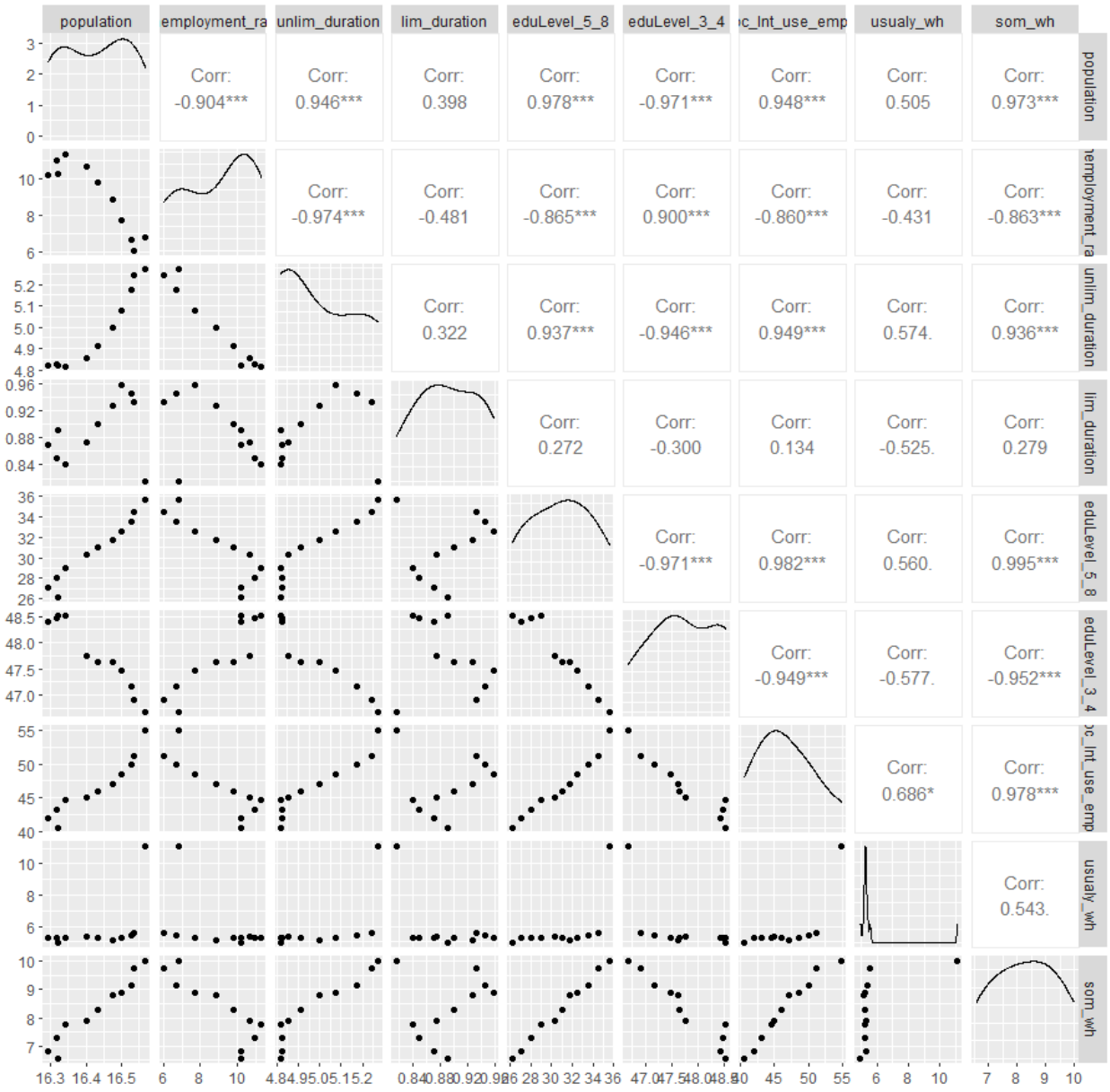

Figure 2. Summary of the primary correlation analysis of the main group of time series variables for the period 2010–2020 based on the EU27 averages.
Source: Author's calculations based on Eurostat data see Appendix 1.

Several data used in the primary analysis were excluded from the calculations presented in Figure 2. The excluded data includes the variables digital_skills and ict_personal due to the technological component and the excellent range of available statistics. This set was not used in the primary analysis as it will be analyzed separately, taking into account the factors of statistical error.

The results presented in the primary analysis of the data indicate that the unemployment rate has a negative correlation for employment in the teleworking mode permanently with a value of -0.431, and is also even more negatively correlated with periodic teleworking -0.863. Still, his

factor deserves special attention in terms of market characteristics labor. The decrease in the unemployment rate is a positive factor in the labor market, and the data is considered. It should be noted that the negative dependence in the primary analysis resalts about the remote performance of official duties is a factor in the positive correlation of the unemployment rate with the possibility of using telework. However, the dependence is less evident than other variables involved in the analysis. To confirm this conclusion, the author will conduct Pearson's and Spearman's correlation tests (STHDA, 2016), Table 2.

Table 2: Correlation Tests of Pearson's and Spearman's Variables for Permanent Telework as a Function of Unemployment Based on EU27 Averages 2010–2020

<table>
<tr><td>Pearson's product-moment correlation</td><td>Spearman's rank correlation rho</td></tr>
<tr><td>data:
es27$usualy_wh and
es27$unemployment_rate</td><td>data:
es27$usualy_wh and
es27$unemployment_rate</td></tr>
<tr><td>t = -1.4335, df = 9, p-value = 0.1855</td><td>S = 334, p-value = 0.1069</td></tr>
<tr><td>alternative Hypothesis:
true correlation is not equal to 0</td><td>alternative Hypothesis:
true rho is not equal to 0</td></tr>
<tr><td>95 percent confidence interval:
-0.8191522 0.2276114</td><td rowspan="2">sample estimates:
rho -0.5181818</td></tr>
<tr><td>sample estimates:
cor -0.4311293</td></tr>
</table>

Source: Author’s calculations based on Eurostat statistics (Appendix 1).

According to the results obtained during the Pearson and Spearman correlation tests, a *p*-value is higher than 0.05 (> 0.05) and is not statistically significant and indicates strong evidence for the Null Hypothesis. Based on the results of the primary analysis of dependence presented in Figure 2 and additional verification of the statistical significance of the disputed value of one of the factors, a narrower set of data was identified that is most likely to be able to correlate with the remote performance of job duties, Figure 3.

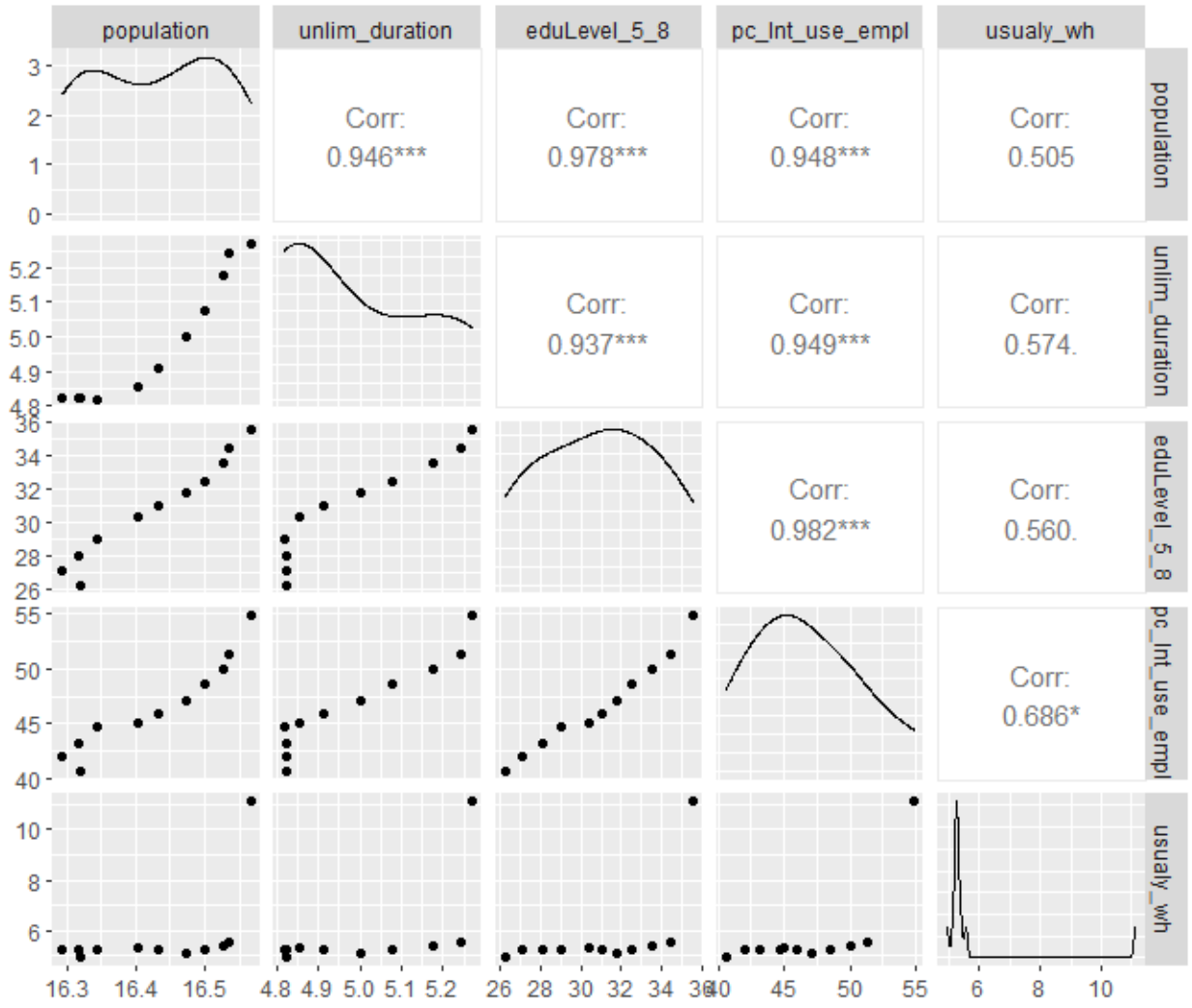

Figure 3. Primary correlation analysis of a reduced group of time series variables for the period 2010–2020 based on the EU27 averages.
Source: Author's calculations based on Eurostat data see Appendix 1.

Thus, the data remaining for the analysis forms the most likely dependent set of factors capable of influencing the likelihood of teleworking in the EU labor market27. For further research, the author will use an expanded dataset that presents a sample of variables for the same period 2010–2020, but now for each EU27 country separately. The author uses this division of data sets to compare the study's final results for the EU countries. In Figure 3, several notable features are visible in the scatter cloud plots precisely to the correlation of the variable of the remote work constant concerning influencing factors. The graphs show a statistical deviation in correlation with all aspects associated with the period, namely with the data for 2020. A remarkable feature is that none of the compared factors has this deviation except for remote work.

Table 3: Least squares p-value for EU27 countries for the period 2010-2020

	population	unlim_duration	eduLevel_5_8	pc_Int_use_empl	White's test
Belgium	0.6872	0.7616	0.3990	0.1198	0.23371
Bulgaria	0.2648	0.7122	0.0448	0.0017	0.580676
Czech	0.0320	0.1115	0.1048	0.8184	0.245532
Denmark	0.5707	0.9510	0.6490	0.5079	0.233859
Germany	0.3616	0.4136	0.0443	0.8807	0.223917
Estonia	0.4214	0.3144	0.2981	0.4820	0.274324
Ireland	0.0253	0.0183	0.3138	0.4814	0.301938
Greece	0.0585	0.3677	0.2472	0.0010	0.224775
Spain	0.0183	0.9877	0.4967	0.3179	0.24217
France	0.0098	0.3730	0.0051	0.0510	0.231348
Croatia	0.9727	0.1908	0.6554	0.0862	0.361431
Italy	0.6631	0.9022	0.6057	0.4119	0.24203
Cyprus	0.0240	0.5196	0.0108	0.0082	0.213825
Latvia	0.5114	0.0745	0.6086	0.6277	0.231742
Lithuania	0.4080	0.1450	0.2090	0.7464	0.898916
Luxembourg	0.5958	0.6658	0.3765	0.2218	0.246059
Hungary	0.1214	0.0221	0.6533	0.9428	0.255277
Malta	0.0083	0.0718	0.4471	0.6890	0.340405
Netherlands	0.1854	0.1211	0.0421	0.8218	0.263683
Austria	0.6695	0.7708	0.1277	0.0389	0.248663
Poland	0.0688	0.1565	0.0370	0.0015	0.284554
Portugal	0.0002	0.1253	0.0017	0.0142	0.354741
Romania	0.0764	0.1199	0.4138	0.8014	0.223803
Slovenia	0.0638	0.0014	0.0270	0.0896	0.668318
Slovakia	0.1502	0.2749	0.2003	0.1468	0.207406
Finland	0.0893	0.3423	0.1443	0.8107	0.203563
Sweden	0.1029	0.0263	0.4647	0.0373	0.407334

Source: Author's calculations based on Eurostat data (Appendix 2).

Table 3 presents the analysis results of the probability of the dependence of the possibility of permanent remote teleworking on some factors selected due to the preliminary investigation. Data analysis was performed using the Gretl econometric analysis and modelling suite (Mixon, 2010). To obtain the results for each of the 27 EU member states, a sample of data was formed based on the main dataset (see Appendix 1), in which the dependent variable and a number of regressor variables were present for analysis by the method of least squares (OLS) (Mixon, 2010). Also, White's test for each country was performed, which made it possible to verify the presence of autocorrelation of the model and confirm the absence of a stable dependence of the variable corresponding to the possibility of performing remote work on the regressor variables. In the

course of the analysis, it was determined that certain variables might have a certain degree of influence on the possibility of permanent remote work for some countries. However, according to analysis results, the author recognised the likelihood of impact as insignificant since it does not have a pattern and can be considered a statistical error. Figure 4 shows an example of a basic calculation of correlation-regression analysis of variable dependence by the least-squares method for Sweden. Sweden was chosen for these calculations due to the country's average population and unemployment rates from the entire EU27 set.

Sweden
Model 1: OLS, using observations 1-11
Dependent variable: usualy_wh

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−6.87751	4.95010	−1.389	0.2141	
population	2.06403	1.07352	1.923	0.1029	
unlim_duration	−3.98735	1.36161	−2.928	0.0263	**
eduLevel_5_8	0.0401766	0.0514679	0.7806	0.4647	
pc_Int_use_empl	0.0599628	0.0225038	2.665	0.0373	**

Mean dependent var	5.018182	S.D. dependent var	0.596353
Sum squared resid	0.060324	S.E. of regression	0.100270
R-squared	0.983038	Adjusted R-squared	0.971730
F(4, 6)	86.93149	P-value(F)	0.000019
Log-likelihood	13.02423	Akaike criterion	−16.04847
Schwarz criterion	−14.05899	Hannan-Quinn	−17.30255

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 8.2723
with p-value = P(Chi-square(8) > 8.2723) = 0.407334

Figure 4. An example of one of the stages of the performed correlation-regression analysis of the dependence of variables by the least squares method for the EU27 countries.
Source: Author's calculations based on Eurostat data (Appendix 2).

The next stage of the study is to check the dependence of remote work on some particular factors for a short period, which has many features in the form of artificial factors of influence on the remote performance of official duties associated with the epidemiological situation. To expand the range of data in the studied short-term period, quarterly statistics of the factors used were accepted for research.

Table 4: P-value obtained from least squares analysis for EU27 countries for the period 2013-2020

	ict_personal	digital_skills	White's test
Belgium	0.1224	0.2150	0.0989997
Bulgaria	0.2781	0.4532	0.310697
Czech	0.8186	0.6376	0.157188
Denmark	0.6347	0.0227	0.495091
Germany	0.0380	0.0749	0.160972
Estonia	0.1457	0.4145	0.192485
Ireland	0.7602	0.0834	0.135622
Greece	0.9238	0.9725	0.164847
Spain	0.3922	0.2121	0.346213
France	0.1814	0.2338	0.123923
Croatia	0.4614	0.9787	0.383395
Italy	0.1895	0.2107	0.170448
Cyprus	0.2781	0.1245	0.669311
Latvia	0.0028	0.1391	0.360166
Lithuania	0.2598	0.0325	0.157197
Luxembourg	0.1814	0.0333	0.196173
Hungary	0.7602	0.5166	0.294087
Malta	0.0590	0.2392	0.158851
Netherlands	0.3720	0.3364	0.326524
Austria	0.0022	0.0032	0.156236
Poland	0.2001	0.3966	0.16274
Portugal	0.1895	0.2107	0.136779
Romania	0.1950	0.2124	0.166062
Slovenia	0.2815	0.0001	0.165896
Slovakia	0.0430	0.1562	0.156242
Finland	0.3720	0.3364	0.1643
Sweden	0.0024	0.0399	0.418246

Source: Author's calculations based on Eurostat data (Appendix 2).

Table 4 presents the results of the analysis of the possibility of permanent remote telework from the factors of technological orientation. Data analysis was performed for the previous batch of variables using the Gretl suite of applications. To obtain the results, as in the previous stage of calculations, technological variables of a shorter sampling period from 2013 to 2020 were taken for each of the 27 EU member states (see Appendix 1). The analysis was carried out using the least-squares method (OLS). Also, for each country, in addition to checking the basic model, White's test was performed, which made it possible to verify the presence of autocorrelation of the model and confirm the absence of a stable dependence on the regressor variables.

Returning to the formulation of Hypothesis 1 that the possibility of telework is influenced exclusively by the absence of mandatory physical contact in the work process, Hypothesis 1 can be considered true. The result of the data analysis about the confirmation of Hypothesis 1 concludes that none of the factors proposed in third-party empirical studies has a stable statistical effect on the ability to perform official duties in the telework model. As an additional factor in favor of the truth of Hypothesis 1, it will be further reviewed to identify factors affecting the possibility of telework in different professions.

Within the framework of Hypothesis 2 a technical telework index will be constructed based on an Italian study from Indagine Campionaria Delle Professioni conducted in conjunction with the European Research on Working Conditions. It was conducted using survey data with the participation of ICP in cooperation with the Italian National Institute for Public Policy Analysis (INAPP) in 2007 and 2013 regarding the definition of the properties and characteristics of a set of professions according to the 5-character codification level of the Codici Professionali (CP). To review the principles of building the index, consider a newer edition of the 2013 ICP-INAPP study (INAPP, 2013). In June 2020, Cetrulo et a The Privilege to Work from Home During Social Distancing (Cetrulo, 2020) was published, in which an attempt was made to adapt the calculation of telework indices based on the approach of Dingel and Neiman (Dingel, Neiman, 2020) to the analyses using the same 2013 ICP-INAPP studies. According to the data in Cetrulo et al. (2020), the estimate of the eligible occupations in telework mode was 30% of the total set in the codification (Cetrulo, 2020). In terms of physical interactions for domains, seven variables have been identified and presented in Table 5.

Table 5: Variables, for the Telework Technical Index

Variable	The scale is reported	Unit	Source
Sleight of hand	Importance (0–100)	CP 5 digit	ICP
Finger dexterity	Importance (0–100)	CP 5 digit	ICP
Performing general physical activity	Importance (0–100)	CP 5 digit	ICP
Handling and moving objects	Importance (0–100)	CP 5 digit	ICP
Inspection of equipment, structures or materials	Importance (0–100)	CP 5 digit	ICP
Service vehicles, powered devices or equipment	Importance (0–100)	CP 5 digit	ICP

Lifting or moving people	Importance (7th scale too)	ISCO 3 digit	EWCS

Source: EC JRC and Eurofound (European Commission JRC and Eurofound, 2020)

All variables accepted for research include the direct or physical impact on objects or people, usually requiring strength, agility, and hand-eye coordination and, as a result, cannot be performed using remote exposure methods, at least without additional technical equipment and special software. For standardization and aggregation, in the case of the EWCS, the original 7-point measurement scales were scaled down to a continuous scale from 0 to 100 (from the lowest to the highest intensity of physical tasks for each occupation). The ICP-INAPP survey data initially collected in surveys on a 7-point scale has already been presented on a scale of 0 to 100. In the case of the ICP-INAPP survey, for each 5-digit occupation codification, whenever any of the six variables physical tasks exceed the threshold of 40, it will be classified in the relevant profession as not eligible for remote work.

The study was based on the understanding that if respondents from the ICP-INAPP report identified at least one physical task for their work, then this work technically cannot be performed remotely. However, setting a numerical threshold to determine the limit value was an essential factor and picked the profession's classification, while the choice of this value was arbitrary. A value of 40 on a 100-point scale in this calculation (European Commission JRC and Eurofound, 2020), selected based on the occupational distribution of the baseline values of the importance score responses based on the ICP-INAPP and EWCS survey.

As a result, each of the 798 five-digit occupations in ICP was classified as likely telecommuting or not. Then, to allow international comparisons to be made, the occupational classification was aggregated from 798 5-digit Codici Professionali (CP) units into 121 3-digit ISCO units using the official correspondence map (ILO, 2008). Because three-digit ISCO groups can sometimes bring together occupations with different levels of physical interaction, when combining 5-digit CPs in 3-digits, ISCO weighted the binary values of the telework index based on the relative share of employment in each 5-digit occupation among the 3-digit group. Thus, the value of teleworking in the triple-digit profession reflects the employment-weighted proportion of the five-digit domains(Eurofound, ILO 2020).

According to the refinement of characteristics in the aggregation of codifications, only for the variable "lifting or movement of people" from EWCS-2015, it will be possible to calculate the average value for workers at the level of the three-digit ISCO codification. Concerning variables

taken from ICP-INAPP, the classification of occupations as not eligible for remote work will be provided if the value was above the established threshold of 40 (European Commission JRC and Eurofound, 2020). An example of indicators for calculating telework indices for all professions from the CP codification (Appendix 3).

2.3. Analysis methodology

For data analysis, several methods of correlation-regression analysis were applied using the construction of correlation matrices, graphical analysis using scatter cloud plots. A number of tests were performed for correlation, and the least-squares method was used in regression analysis with testing for the presence of autocorrelation and heteroscedasticity.

At the initial stage of calculations, for a quick assessment of the feasibility of analyzing the variables indicated during planning concerning a group of potentially influencing variables, the derivation of a graphical scattering matrix with partial correlation coefficients (Hut, 2017) was applied using scatter cloud plots. This technique allowed identifying potentially insignificant variables and narrowing the list of factors involved in further analysis. Also, at the stage of operational assessment, in terms of some variables, a number of correlation tests were performed, particularly the Pearson test and the Spearman test (STHDA, 2016), to clarify the controversial statistical significance of some variables.

Two environments for statistical analysis and data modelling were used. Correlation analysis was carried out using the R programming language using the free software environment for statistical calculations and graphics RStudio (Hut, 2017), in which graphical scattering matrices were constructed with partial correlation coefficients, graphical derivation of dependencies, and refinement testing. Correlation-regression analysis was performed using a cross-platform software package for econometric analysis Gretl (Mixon, 2010). Gretl analyzed the dependent variables using the least-squares method and tested for the presence of heteroscedasticity and autocorrelation of the analyzed variables.

Regression analysis within the study framework was carried out using the least-squares method with the construction of up to 4 regression models for each of the variables corresponding to the studied factors. The structure of models was accompanied by applying of some tests with the models and their parameters to confirm the adequacy of the constructed model and a group of their parameters.

Model 1. Calculations for the main group of factors (Park, 2013):

$$Y = \beta 0 + \beta 1 * population + \beta 2 * unlim\_duration + \beta 3 * eduLevel\_5\_8 + \beta 4 * pc\_int\_use\_empl + \varepsilon$$

Table 6. Regression parameters of Model 1 for the main variables.

Variable	Coefficient	Std. Error	p-value	R^2	Adjusted R^2
const	204.999	250.778	0.4449	0.805556	0.675926
population	−139.576	161.766	0.4214		
unlim_duration	−156.471	142.537	0.3144		
eduLevel_5_8	1.37591	1.20793	0.2981		
pc_Int_use_empl	0.343	0.457159	0.4820		

Source: Author's calculations using Gretl software.

Model 1. Calculations for an additional group of factors:

$$Y = \beta 0 + \beta 1 * ict\_persoal + \beta 2 * digital\_skills + \varepsilon$$
$$= 204.99 + (-139.57) * ict\_personal + (-156.47) * digital\_skills + \varepsilon$$

Table 7. Regression parameters of model 1 for additional variables.

Variable	Coefficient	Std. Error	p-value	R^2	Adjusted R^2
const	204.999	250.778	0.4449	0.818975	0.746564
ict_persoal	−139.576	161.766	0.4214		
digital_skills	−156.471	142.537	0.3144		

Source: Author's calculations using Gretl software.

Model 2. Calculations for the main group of factors:

$$Y = \beta 0 + \beta 1 * population + \beta 2 * unlim\_duration + \beta 3 * eduLevel\_5\_8 + \varepsilon$$
$$= 222.10 + (-141.51) * population + (-205.71) * unlim\_duration + 2.07 * eduLevel\_5\_8 + \varepsilon$$

Table 8. Regression parameters of Model 2 for the main variables.

Variable	Coefficient	Std. Error	p-value	R^2	Adjusted R^2
const	222.107	241.785	0.3889	0.787364	0.696234

population	−141.512	156.595	0.3962		
unlim_duration	−205.706	122.458	0.1369		
eduLevel_5_8	2.07055	0.749634	0.0280		

Source: Author's calculations using Gretl software.

Model 2. Calculations for an additional group of factors:

$$Y = \beta 0 + \beta 1 * digital\_skills + \varepsilon = -0.02 + 0.12 * digital\_skills + \varepsilon$$

Table 9. Regression parameters of model 1 for additional variables.

Variable	Coefficient	Std. Error	p-value	R^2	Adjusted R^2
const	−0.0254502	1.67767	0.9884	0.711597	0.663530
digital_skills	0.120495	0.0313167	0.0085		

Source: Author's calculations using Gretl software.

Model 3. Calculations for the main group of factors:

$$Y = \beta 0 + \beta 1 * unlim\_duration + \beta 2 * eduLevel\_5\_8 + \varepsilon$$
$$= 4.00 + (-103.11) * unlim\_duration + 1.47 * eduLevel\_5\_8 + \varepsilon$$

Table 10. Regression parameters of Model 3 for the main variables.

Variable	Coefficient	Std. Error	p-value	R^2	Adjusted R^2
const	4.00037	14.2584	0.7862	0.762557	0.703196
unlim_duration	−103.110	45.3650	0.0527		
eduLevel_5_8	1.47079	0.344519	0.0027		

Source: Author's calculations using Gretl software.

Model 3. Calculations for an additional group of factors:

$$Y = \beta 0 + \beta 1 * ict\_persoal + \varepsilon = -0.25 + 1.89 * ict\_persoal + \varepsilon$$

Table 11. Regression parameters of model 1 for additional variables.

Variable	Coefficient	Std. Error	p-value	R^2	Adjusted R^2
const	−0.254911	1.41742	0.8632	0.790337	0.755394
ict_persoal	1.89338	0.398122	0.0031		

Source: Author's calculations using Gretl software.

Model 4. Calculations for the main group of factors:

$$Y = \beta 0 + \beta 1 * eduLevel\_5\_8 + \varepsilon = -24.43 + 0.79 * eduLevel\_5\_8 + \varepsilon$$

Table 12. Regression parameters of Model 4 for the main variables.

Variable	Coefficient	Std. Error	p-value	R^2	Adjusted R^2
const	−24.4374	8.27047	0.0161	0.609228	0.565809
eduLevel_5_8	0.797730	0.212964	0.0046		

Source: Author's calculations using Gretl software.

where

Y is the explained variable of the regression analysis;

β0 - coefficient of interception Y;

βn - coefficient variable;

population is a variable characterizing the population size in the countries of the target group in the dynamics of 2010 - 2020;

unlim_duration is a variable that reflects the level of workers with labor activity on the basis of contracts with no time limit;

eduLevel_5_8 is a variable characterizing the proportion of employees who at the time have received a higher education level from 5 to 8 levels;

pc_Int_use_empl - a variable characterizing the level of application for the operation of information and telecommunication technical solutions;

ict_persoal is a variable characterizing the proportion of employees with professional skills in the field of information and telecommunication technologies;

digital_skills - a variable characterizing the level of personal skills of employees in the field of digital technologies;

ε is a random value of the error.

In addition to these software packages, the analytical and graphical tools of the MS Excel program from the MS Office package were used in the calculation. This software was used for the formation and transformation of databases and the output of some graphical elements of the analysis.

3. EMPIRICAL RESULTS

The materials presented in the chapter interpret the substantiation of the hypotheses studied in the dissertation from the point of view of the author's correlation-regression analysis. In particular, it sets out the study's steps to identify the statistical significance of the factors of probable influence on the labor market, namely, to the likelihood of the impact of elements on the performance of official duties in the telework model. The conclusion of the third chapter is the final analysis and decisions regarding the truth of the hypotheses under study.

3.1. Primary analysis and search for multicollinearity

The initial stage of research about confirming Hypotheses within the dissertation framework consisted of two steps: the analyzed factors and their correlation analysis and the search for multicollinearity of variables. The first step was to explore current third-party research on telework to identify the factors suggested by the researchers that potentially influence the ability to telecommute. The author has compiled a list of potentially significant factors presented in Table 1 of Chapter 2 of this thesis. Based on statistical data, the author has formed and placed in a particular database (Appendix 1) variables that have a slightly expanded form compared to the list of factors presented. The expansion of the number of variables was an attempt to clarify the degree of influence of certain factors. Paired variables for expanding the range of significance of elements of the likely dependence of telework on the level of education and the type of employment contract, as can be seen in the scatterplots (Figures 5 and 6), although they refer to the same factor, have significant differences.

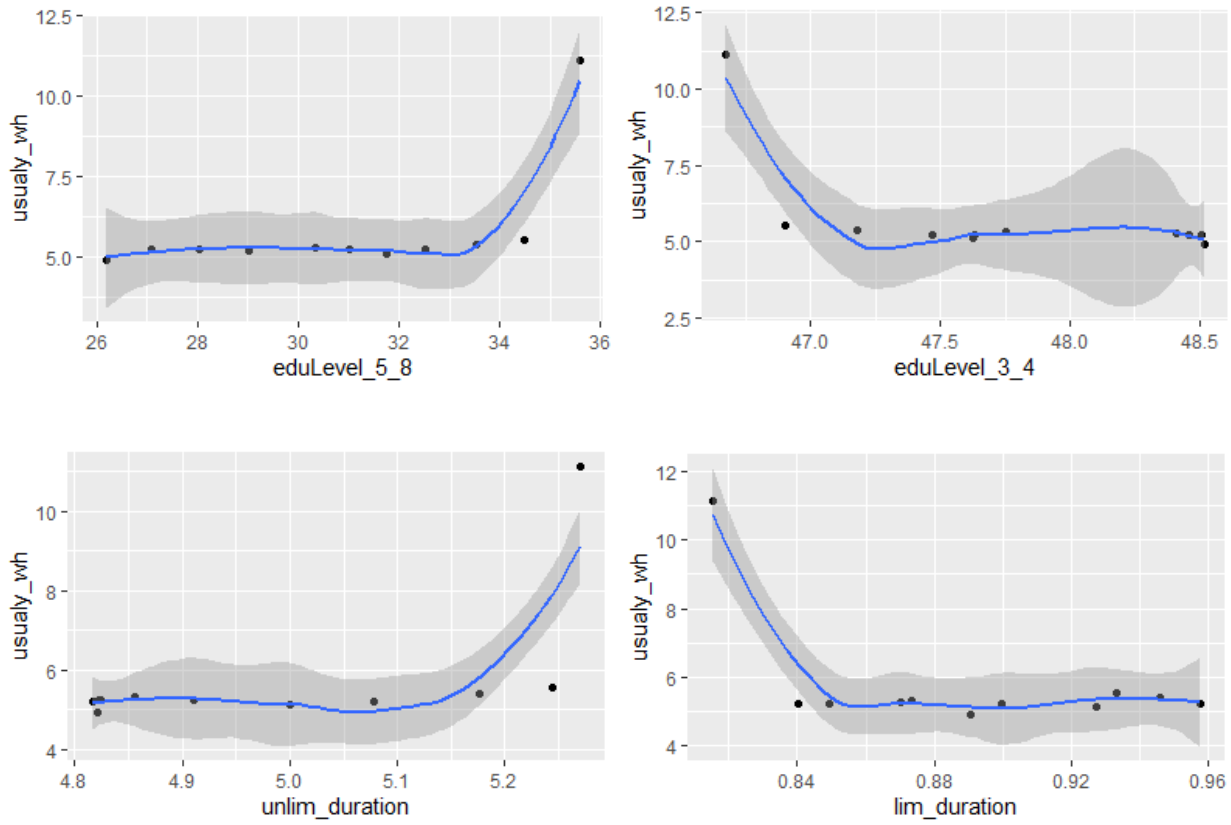

Figure 5. Correlation of paired variables of education level and type of employment contract with permanent telecommuting for 2010-2020 EU averages27.
Source: Author's calculations based on Eurostat data (Appendix 4).

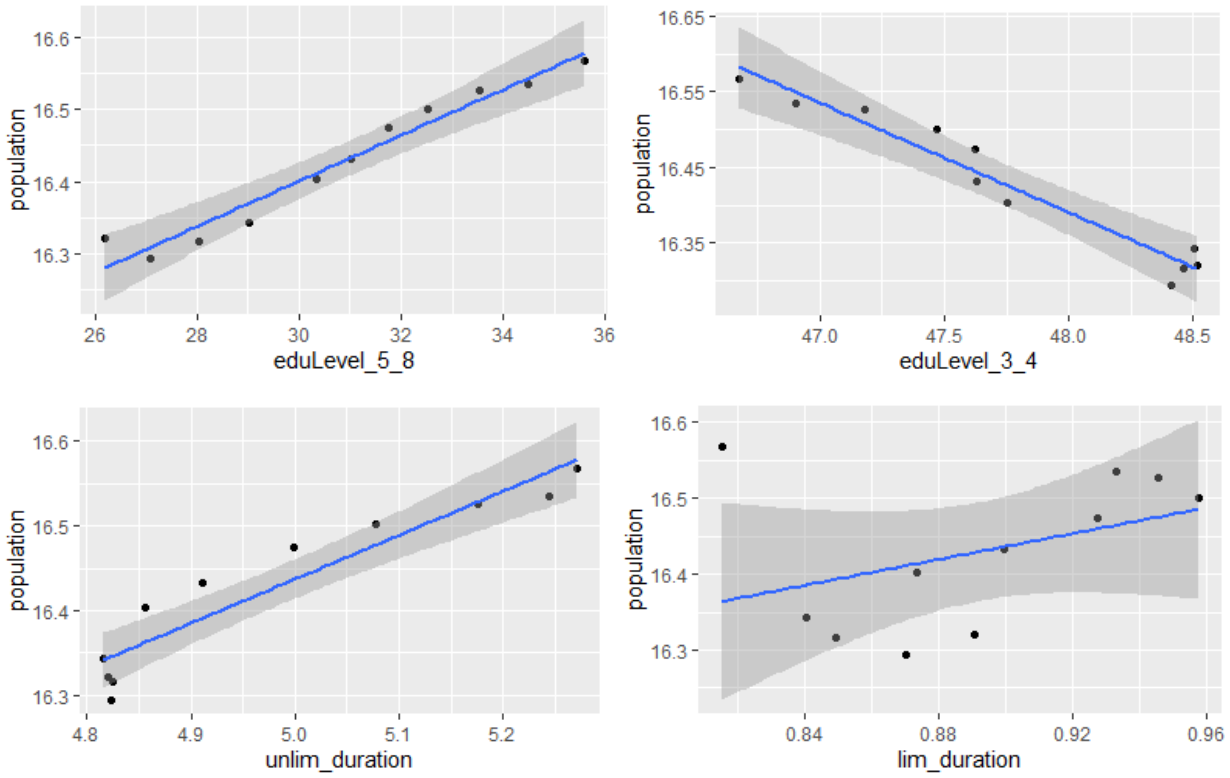

Figure 6. Correlation of paired variables of education level and type of employment contract with population size for 2010-2020 averages for the EU27.
Source: Author's calculations based on Eurostat data (see Appendix 4).

In the case of the dependence of these variables and variables of general importance for the labor market, a pattern of different significance is present concerning the likely impact on the possibility of telework (Figure 6). According to the primary analysis data presented on the correlation matrix (Figure 7), there are visible differences in the correlation of varying degrees of the significance of all variables to the variable usualy_wh, which corresponds to the constant fulfilment of job duties remotely.

		population	unemployment_rate	unlim_duration	lim_duration	eduLevel_5_8	eduLevel_3_4	pc_Int_use_empl	usualy_wh	som_wh
population	r	1,0000	-0,9035	0,9458	0,3975	0,9781	-0,9714	0,9484	0,5048	0,9730
	p		0,0001	0,0000	0,2260	0,0000	0,0000	0,0000	0,1133	0,0000
unemployment _rate	r	-0,9035	1,0000	-0,9744	-0,4812	-0,8647	0,9000	-0,8604	-0,4311	-0,8626
	p	0,0001		0,0000	0,1340	0,0006	0,0002	0,0007	0,1855	0,0006
unlim_duration	r	0,9458	-0,9744	1,0000	0,3220	0,9369	-0,9457	0,9487	0,5738	0,9358
	p	0,0000	0,0000		0,3341	0,0000	0,0000	0,0000	0,0649	0,0000
lim_duration	r	0,3975	-0,4812	0,3220	1,0000	0,2718	-0,3000	0,1344	-0,5246	0,2795
	p	0,2260	0,1340	0,3341		0,4187	0,3701	0,6935	0,0976	0,4052
eduLevel_5_8	r	0,9781	-0,8647	0,9369	0,2718	1,0000	-0,9708	0,9818	0,5604	0,9948
	p	0,0000	0,0006	0,0000	0,4187		0,0000	0,0000	0,0729	0,0000
eduLevel_3_4	r	-0,9714	0,9000	-0,9457	-0,3000	-0,9708	1,0000	-0,9494	-0,5770	-0,9524
	p	0,0000	0,0002	0,0000	0,3701	0,0000		0,0000	0,0631	0,0000
pc_Int_use_empl	r	0,9484	-0,8604	0,9487	0,1344	0,9818	-0,9494	1,0000	0,6858	0,9783
	p	0,0000	0,0007	0,0000	0,6935	0,0000	0,0000		0,0198	0,0000
usualy_wh	r	0,5048	-0,4311	0,5738	-0,5246	0,5604	-0,5770	0,6858	1,0000	0,5430
	p	0,1133	0,1855	0,0649	0,0976	0,0729	0,0631	0,0198		0,0843
som_wh	r	0,9730	-0,8626	0,9358	0,2795	0,9948	-0,9524	0,9783	0,5430	1,0000
	p	0,0000	0,0006	0,0000	0,4052	0,0000	0,0000	0,0000	0,0843	

Figure 7. Correlation matrix for the main group of variables for the period 2010–2020 based on the average for the EU27.
Source: Author's calculations based on Eurostat data see Appendix 1.

Graphical display based on scatter plots is illustrated on a graphic scattering matrix with partial correlation coefficients (Hut, 2017), presented in Figure 2. The correlation matrix calculation shown in Figure 7 is a summary matrix of the main dataset in which the author integrated the parameters r and p-value according to Pearson. The analysis was carried out using the software environment for statistical calculations and graphics RStudio, based on R's programming language.

According to the results obtained, several basic variables have been identified for further analysis in the EU countries, which are more likely to be statistically significant for confirming Hypothesis 1 of this thesis. The most likely significant variables are: population; unlim_duration; eduLevel_5_8; and pc_Int_use_empl. This set was used as the main set of regressor variables for the least-squares regression analysis for the explained variable usualy_wh. For the refined set of variables, they were also calculated in the form of a graphical scattering matrix with partial correlation coefficients and a summary correlation matrix r and p-value (p) (Figure 8).

		population	unlim_duration	eduLevel_5_8	pc_Int_use_empl	usualy_wh
population	r	1,0000	0,9458	0,9781	0,9484	0,5048
	p		0,0000	0,0000	0,0000	0,1133
unlim_duration	r	0,9458	1,0000	0,9369	0,9487	0,5738
	p	0,0000		0,0000	0,0000	0,0649
eduLevel_5_8	r	0,9781	0,9369	1,0000	0,9818	0,5604
	p	0,0000	0,0000		0,0000	0,0729
pc_Int_use_empl	r	0,9484	0,9487	0,9818	1,0000	0,6858
	p	0,0000	0,0000	0,0000		0,0198
usualy_wh	r	0,5048	0,5738	0,5604	0,6858	1,0000
	p	0,1133	0,0649	0,0729	0,0198	

Figure 8. Correlation matrix for the adjusted group of variables for the period 2010–2020 based on the average for the EU27.
Source: Author's calculations based on Eurostat data see Appendix 1.

The study considered many factors that are not used in this correlation analysis due to the lack of sufficient statistical data or the discrepancy between the sampling range of the main set of characteristics. One group excluded from the core dataset consists of the variables ict_personal and digital_skills (Table 1), with a sampling range of statistics from 2013 to 2020.

Two factors that probably have a significant impact on the truth of Hypothesis 1 are excluded from the set of factors of the main analysis. They include the dynamics of the spread of the COVID-19 virus (Appendix 1) with a range of statistical data from 2020 to 2021, as well as data from a sociological study of the labor market (Eurofound, 2021) regarding the need for physical interaction in the performance of official duties, data on which are available exclusively for 2020 (Appendix 1). A separate analysis has been carried out for a limited period for these exceptions.

3.2. Regression analysis

Further analysis is carried out about the leading defined group of variable factors of potential influence to each EU27 country separately to identify a stable model for predicting the dynamics of statistical significance with the likelihood of performing job duties remotely for the labor market of the member countries. Regression analysis for the main group of variables was conducted in

the Gretl cross-platform econometric analysis software (Mixon, 2010) using an adjustable least squares (OLS) analysis model (Hamilton, 1992).

Table 6: Calculation of an adjustable least squares estimation model for the main group of variables for Estonia for the period 2010 - 2020.

Model 1: OLS, using observations 1-11
Dependent variable: usualy_wh

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
const	204.999	250.778	0.8175	0.4449
population	−139.576	161.766	−0.8628	0.4214
unlim_duration	−156.471	142.537	−1.098	0.3144
eduLevel_5_8	1.37591	1.20793	1.139	0.2981
pc_Int_use_empl	0.342518	0.457159	0.7492	0.4820

White's test for heteroskedasticity
with p-value = P(Chi-square(8) > 9.86923) = 0.274324

Model 2: OLS, using observations 1-11
Dependent variable: usualy_wh

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	222.107	241.785	0.9186	0.3889	
population	−141.512	156.595	−0.9037	0.3962	
unlim_duration	−205.706	122.458	−1.680	0.1369	
eduLevel_5_8	2.07055	0.749634	2.762	0.0280	**

White's test for heteroskedasticity
with p-value = P(Chi-square(9) > 10.9998) = 0.275725

Model 3: OLS, using observations 1-11
Dependent variable: usualy_wh

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	4.00037	14.2584	0.2806	0.7862	
unlim_duration	−103.110	45.3650	−2.273	0.0527	*
eduLevel_5_8	1.47079	0.344519	4.269	0.0027	**

White's test for heteroskedasticity
with p-value = P(Chi-square(5) > 8.13463) = 0.14897

Model 4: OLS, using observations 1-11
Dependent variable: usualy_wh

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−24.4374	8.27047	−2.955	0.0161	**
eduLevel_5_8	0.797730	0.212964	3.746	0.0046	***

White's test for heteroskedasticity
with p-value = P(Chi-square(2) > 7.99108) = 0.0183975

Source: Author's calculations based on Eurostat data (see annex 4).

The following studies were performed to check the significance of the model and the significance of the coefficients. Checking the normality of the critical residuals for model 1 has the result - Fcrit. (Calculated critical value) = 4.53368 <Fobl. (Observed critical value) = 6.214284 (Hamilton, 1992). Provided that the calculated critical value is less than the observed one, the Null Hypothesis is rejected with a probability of error of 0.05, the model is recognized as adequate to the sample data. In addition to checking the critical distribution of the residuals, the significance level of the model 1 P-value (F) = 0.025118, which rejects the Null Hypothesis with a probability of error 0.05. The model is also recognized as adequate to the sample data. For the Student's 1 p-value model (Taroni, 2016), all the variables set out have no statistical significance for the explained variable. To correct the model at this stage, the pc_Int_use_empl variable with the smallest p-value will be excluded from model 1.

Residue normality for model 2: Fcrit. 4.34683 <Fobl. 8.640021, with a probability of making a mistake of 0.05, the Null Hypothesis is rejected, the model is recognized as adequate to the sample data. In addition to checking the critical distribution of the residuals, the significance level of the model 1 P-value (F) = 0.009427, which with a probability of error of 0.05 rejects the null Hypothesis. The model is also recognized as adequate for the sampled data. For model 2, according to the Student's p-value data, for the variables remaining in the model, is excluded the next most insignificant variable.

Residue normality for model 3: Fcrit. 4.45897 <Fobl. 12.84616, with a probability of making a mistake of 0.05, the null Hypothesis is rejected, the model is recognized as adequate to the sample data. In addition to checking the critical distribution of the residuals, the significance level of the model 1 P-value (F) = 0.003179, which with a probability of error of 0.05 rejects the null Hypothesis and the model is also recognized as adequate to the sampled data. Since model 3 with two remaining variables unlim_duration and eduLevel_5_8 (see table 6), which, according to the Student's p-value, both have statistical significance for the explained variable, it is necessary to perform a multicollinearity check. To analyze model variables for the presence of multicollinearity, the variance increase factor (VIF) index was used in the analysis (Fox, 2016). The analysis revealed the presence of an exact multicollinearity of 3.828 for both remaining variables. To adjust, remove the variable with a large Student's p-value and apply the regression model for the remaining data.

Residue normality for model 4: Fcrit. 5.11736 <Fobl. 14.03131, with a probability of making a mistake of 0.05, the null Hypothesis is rejected, the model is recognized as adequate to the sample data. In addition to checking the critical distribution of the residuals, the significance level of the model 1 P-value (F) = 0.004584, which with a probability of error of 0.05 rejects the null Hypothesis and the model is also recognized as adequate to the sampled data. Thus, after excluding one of the significant variables, due to the presence of exact multicollinearity, the most significant regression model of the current type was obtained with the only explanatory variable eduLevel_5_8 (see table 6). As for the coefficient of determination of the model (Cameron, Windmeijer, 1997), model 3 has a preferable value. However, due to the presence of exact multicollinearity for the variables of model 3, it was adjusted to model 4.

The construction of the regression model was carried out in several stages until the moment when the stable significance of the model was achieved. Table 6 provides an abbreviated example of calculation for Estonia. In addition, the analysis with modification of models was carried out for

six more EU countries, based on a significant difference between countries in terms of population (see Appendix 4). In addition to the variables of the main group, according to the same principle, an analysis was carried out for an additional group of variables for the time interval 2013 - 2020 (Table 7).

Table 7: Calculation of an adjustable least squares estimation model for an additional group of variables for Estonia for the period 2010 - 2020.

Model 1: OLS, using observations 1-8
Dependent variable: usualy_wh

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−0.0785079	1.45635	−0.05391	0.9591	
ict_persoal	3.84723	2.23396	1.722	0.1457	
digital_skills	−0.133253	0.149829	−0.8894	0.4145	

White's test for heteroskedasticity
with p-value = P(Chi-square(5) > 7.40099) = 0.192485

Model 2: OLS, using observations 1-8
Dependent variable: usualy_wh

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−0.0254502	1.67767	−0.01517	0.9884	
digital_skills	0.120495	0.0313167	3.848	0.0085	***

White's test for heteroskedasticity
with p-value = P(Chi-square(2) > 1.90849) = 0.385103

Model 3: OLS, using observations 1-8
Dependent variable: usualy_wh

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−0.254911	1.41742	−0.1798	0.8632	
ict_persoal	1.89338	0.398122	4.756	0.0031	***

White's test for heteroskedasticity
with p-value = P(Chi-square(2) > 3.03067) = 0.219735

Source: Author's calculations based on Eurostat data (Appendix 4).

The construction of a regression model for the additional group of variables was carried out in several stages, as for the main group of variables. Based on the analysis carried out for 26% of the studied group of member states (7 countries) of the EU27, the author has formed the summary data presented in Figure 9.

Country	Population, 2020	Variable	White's test p-value	Pearson's test p-value	Spearman's test p-value
Estonia	1 328 889	eduLevel_5_8	0,0184	0,0046	0,0017
Belgium	11 522 440	pc_Int_use_empl	0,0053	0,0858	0,7186
Romania	19 328 838	population	0,0287	0,0372	0,0399
Poland	37 958 138	pc_Int_use_empl	0,0442	0,0040	0,3548
Spain	47 332 614	population	0,0118	0,0004	0,0001
France	67 320 216	population, eduLevel_5_8	0,0869	0,5104	0,3391
Germany	83 166 711	eduLevel_5_8	0,0071	0,0013	0,3391

Figure 9. P-value of the final adjusted least squares estimation model for a sample of countries with different populations as of 2020.
Source: Author's calculations based on Eurostat data (Appendix 4).

Representatives of the EU27 with significantly different population sizes were selected as a sample of countries for conducting multi-model regression analysis. The population size was recognized as the determining factor for the sample due to its high degree of correlation with most of the factors in this study regarding the labor market (see Figure 7). The main idea of the pooled analysis of the group of countries shown in Figure 9 are variables that have statistical significance for the explanatory variable of the OLS analysis of this thesis within each country of the studied data sample (Appendix 4). As follows from Figure 9, there is no regularity of the statistical significance of the variables for different countries of the target group. According to the author, it is not advisable to carry out a multi-model regression analysis for the entire target group of EU27 countries since the results will not have a regular structure, as in the selected group of 7 analyzed countries. For all countries in the target group, Chapter 2 provides an example of a baseline regression analysis model. A complete list of baseline country models is provided in Appendix 2.

To assess the models presented in the regression analysis of their significance and the significance of the coefficients, the methods of checking the normality of the critical value of the residuals (F-Fisher-Snedecor test), the analysis of the essential distribution of the residuals of the model significance level (P-value (F)), checking the presence of multicollinearity using variance increase factor (VIF) analysis, White's test, and Pearson and Spearman's tests for additional quality control analysis (Krzywinski, Altman, 2013).

3.3. Empirical interpretation of results

The purpose of this dissertation is to prove the Hypothesis that the only factor that can affect the ability to perform official duties in telework mode is the elimination of the need for physical contact while working on the employer's territory. The author used 8 factors, one of which was excluded from the group of likely influencing factors at the initial stage of the study, and one of the factors is explainable.

According to the initial level of analysis, the factor of the use of computers and information and communication technologies in the performance of official duties (variable pc_Int_use_empl), according to the initial level of analysis, as well as model 1 of the regression analysis for Estonia, has the least statistical significance for the explained variable. However, in regression analysis of multilevel least-squares modelling for other countries of the EU27 target group, such as Belgium and Poland, this factor is of crucial importance with maximum statistical significance in the final model 4. This fact indicates that such statistical significance is not a stable indicator. for the studied group and at this stage confirms Hypothesis 1.

The population size (Population) has the most direct impact on the labor market of all countries since it has a direct relationship with the amount of potential human capital. For countries such as Romania, Spain, and part of the final model for France, population size is most statistically significant for the variable being explained. However, within the study framework, namely in terms of the impact on the possibility of telework, regression analysis in model 1 did not reveal the factor of statistical significance for the explained variable. It was excluded for model 2 and did not participate in model 3 for Estonia. This fact testifies to the unstable statistical importance of the defined variable in the studied group of EU27 countries, confirming the truth of Hypothesis 1 at this stage of the study.

The statistical significance of permanent employment contracts (variable unlim_duration) is more significant for the explained variable than the two previous options in the case of the regression analysis for Estonia. In model 3 of this regression analysis, a permanent employment contract is statistically significant with a probable error not significantly exceeding 5%. It is statistically significant in the research on a par with higher education levels 5 and 8. Despite such statistical significance for the explained variable, Model 3 requires adjustment due to accurate multicollinearity, which excludes the variable from the final regression model. For none of the

analyzed countries of the studied group, this factor is not statistically significant with the explained variable. This fact indicates that Hypothesis 1 is confirmed at this stage.

The variable eduLevel_5_8 is part of a likely influencing factor, and at the stage of regression analysis in models, 1-3 for Estonia indicates a significant statistical significance for the explained variable. However, given the fact that, given the regression analysis for other countries of the EU27 target group Belgium, Romania, Poland and Spain, the factor is not significant, the element can be considered unstable insignificance. Thus, Hypothesis 1 is confirmed at this stage of the study.

An element of a different group of factors in the form of the ict_personal variable, which characterizes the density of the share of specialists in information and telecommunication systems among labor market participants, in regression analysis of statistical significance concerning the explained variable, shows importance only at the level of the second-level model, as well as the digital_skills variable (the level of personal skills regarding digital technologies) the third. From the point of view of regression analysis for other EU27 member countries from the target group, the statistical significance changes significantly. For example, for germanium, the statistical significance of an additional group of parameters is achieved already in model 1 for both regressors simultaneously. Thus, as for the previously studied variables, the statistical significance is not stable relative to the labor market of the studied group of countries, which confirms Hypothesis 1 at this stage of the study.

In the case of the research of the author of the thesis, the type of labour contract, two main types, namely temporary and permanent labor contracts, at the initial stage of the analysis demonstrated critically different significance from each other. The essence of a temporary contract (variable lim_duration) lies in the insignificance of the employee for the employer permanently. If a parallel is drawn between temporary contracts, in this interpretation, and the level of education, or rather secondary education of levels 3 and 4 (variable eduLevel_3_4), then can be noted their shared tendency to have weak statistical significance with telecommuting. The same relationship can be observed with the unemployment rate, which is characterized in the study by the unemployment_rate variable (Percentage of population in the labor force). For this reason, at the initial level of analysis, the listed variables were excluded from further research. For the same reason, these variables, or rather the unemployment rate variable and the variables of the factors of education and the type of employment contracts, are part of the apparent insignificance of human capital with a low level of education for long-term cooperation and, consequently, for the permanent performance of official duties in telecommuting mode.

Studies concerning two groups of factors of probable influence on the explained variable reflecting the ability to perform official duties in telework mode show that despite the statistical dependence of some aspects about the studied group of EU27 countries, the overall significant factors are not confirmed. The variability of significance for different countries without an evident and stable pattern of dependence options confirms the truth of Hypothesis 1 of this thesis. For the dependence of the dynamics of the spread of coronavirus infection COVID-19 at this stage, it cannot be analyzed by the least-squares method due to the insufficient sample size. However, based on the study and statistical data presented in Appendix 2, it can be assumed that the increase in the number of employees in telework mode associated with the forced transition to telework does not have a sustainable natural effect on the continuous performance of official duties in telework mode.

CONCLUSION

Summing up the results of this work, it should be noted that telework did not appear suddenly but was present and developed, occupying more and more space on the labor market along with the development of information and communication technologies. Hypothesis 1 of this thesis is intended to refute the influence of various factors on the possibility of teleworking on an ongoing basis and confirm that the only factor that can influence it is the absence of the need for physical interaction in the performance of official duties. If it does not consider the current situation with forced restrictions due to countering the spread of COVID-19, the development of telework has been at a sufficiently significant level for several decades. It was separated from the full implementation in all segments of labor activity available for the use of this type of work by a variety of factors that did not have a self-objective justification. The forced introduction of telecommuting has been the catalyst to redefine all remote collaboration and workflow control concerns. Hypothesis 2 of this dissertation was a review of a third-party study, which is the only related study closely intertwined with the main Hypothesis of this dissertation.

The primary data set used in the analysis of Hypothesis 1 was formed by the author of the thesis based on statistical data on hypothetically significant factors for telework, which were obtained from the Eurofond database and some third-party open sources (Appendix 1). Correlation and correlation-regression analysis using the least-squares method was used as the main analysis method. The study was carried out in several stages. It consisted of the primary analysis of the aggregate averaged data for the entire target group of the EU27 member states, the distribution of variable factors of probable significance into several groups, the exclusion of some variables at the initial stage of the analysis, as well as the calculation of basic (Appendix 2) and multilevel regression models (Appendix 4) for the entire composition of the target group and, according to the author of the thesis, a sample of countries of the target group in the amount of 26%.

As a result of the primary regression analysis of the aggregate averaged data, the author of the thesis excluded several variables concerning factors of potential influence, such as unemployment rate (unemployment_rate), temporary labor contracts (lim_duration) and the average level of education (eduLevel_3_4). Also, two groups of variables were formed, which were used to construct further basic regression models and multilevel regression modelling using the least-squares method. The leading group of data selected at the initial stage of the analysis and used for different correlation and regression analyses included: a high level of education at levels 5 and 8

(eduLevel_5_8), permanent labor contracts (unlim_duration), population and the level of implementation of computer and information and communication technologies for work (pc_Int_use_empl). The additional variables included the percentage of ICT specialists in the labor market (ict_personal) and the level of technical education of the working-age population (digital_skills).

The correlation-regression analysis resulted in the identification of a different level of statistical significance of the regressors concerning the explained variable, corresponding to the stable performance of official duties in the telework mode (usualy_wh). The result of this analysis was the identification of the absence of a long-lasting regular statistical significance of the regressors concerning the explained variable, both when constructing primary models for each country of the EU27 target group and a sample of 7 EU27 member states based on a diverse population of 1.3 million for Estonia to more than 80 million inhabitants for Germany. At each stage of constructing regression analysis models, the adequacy of the models was tested. The significance of variables and groups of variables was tested, although for almost every country from the target group of EU27 countries, and up-to-date forecasting model was built, with an error probability of less than 5%, a stable relationship was not identified for all members of the target group. Thus, it can be argued that at the present stage of the development of the labor market in the target group countries, the only factor of the likely impact on the possibility of telework is precisely the lack of physical interaction in the performance of official duties and other factors that have a stable natural statistical significance cannot be identified. In favor of confirming the truth of Hypothesis 1, the ICP-INAPP study from 2013, considered in the framework of Hypothesis 2 of this thesis, is also advocated, which aims to assign an index of telecommuting opportunities by type of professional activity. According to this study, the maximum telework opportunity index was explicitly set to professions without physical interaction when performing official duties. Based on the results of the author's research and the ICP-INAPP studies, Hypothesis 1 is recognized as true.

KOKKUVÕTE

KAUGTÖÖ JA COVID-19

Eva Kolektor

Tööturu struktuuris kaugtööd soodustavate muutuste praegune dünaamika, mis on seotud sunnitud piiravate meetmetega COVID-19 pandeemia vastu võitlemiseks, tõstis päevakorda uue tööviisi rakendamise võimaluse erinevates tööstusharudes. Kaugtöö on "füüsilise kohaloleku asendamine töökohal sobiva telefoni- ja digiühendusega, mis võimaldab teha kõiki tegevusi samamoodi nagu kontoris" (The Telework Advisory 2007).

Lõputöö eesmärk on kvantifitseerida kaugtöö ulatust enne COVID-19 puhangut ja selle ajal. Kaugtöö laialdane kasutusvõtt nõuab läbimõtlemist, mis teeb ühed elukutsed neile vastuvõetaks ja teised mitte. Sellest lähtuvalt uuritakse Hüpoteesi 1 ja käsitletakse Hüpoteesi 2.

Hüpotees 1. Tuginedes tehnoloogilise arengu hetkeseisule ja selles keskkonnas rakendatavatele tööprotsessidele, võib väita, et ülim kaugtöö võimalikkust määrav tegur kutsetegevuses on füüsilise suhtluse puudumine.

Hüpotees 2. ICP-INAPPi poolt 2013. aastal välja pakutud, mis põhineb konkreetse valdkonna tunnuste teataval detailsusel ja seisneb väites, et iga kutseala puhul on kaugtöörežiimis rakendamine teatud määral teostatav.

Valimiperiood hõlmab ajavahemikku 2010 kuni 2020. Mõne muutuja puhul on andmevalim lühem 2020. aastast 2021. aastani seoses andmete kättesaadavuse või muutuja andmete asjakohasusega.

Esmased andmeallikad on Euroopa töötingimuste uuring 2020 ja Eurostati andmebaas. Kogu töös on kasutatud kvantitatiivseid uurimismeetodeid.

Statistiliseks analüüsiks ja andmete modelleerimiseks kasutati kahte keskkonda. Korrelatsioonianalüüs viidi läbi programmeerimiskeele R abil, kasutades statistiliste arvutuste ja graafika vaba tarkvara keskkonda RStudio (Hut, 2017), milles konstrueeriti graafilised hajusmaatriksid osakorrelatsioonikordajate, sõltuvuste graafilise tuletamise ja täpsustustestidega. Korrelatsioon-regressioonanalüüs viidi läbi ökonomeetrilise analüüsi jaoks mõeldud platvormideülese tarkvarapaketi abil Gretl (Mixon, 2010). Gretl analüüsis sõltuvaid muutujaid

vähimruutude meetodil ning testis analüüsitud muutujate heteroskedastilisuse ja autokorrelatsiooni olemasolu.

Uuringu raames viidi regressioonianalüüs läbi vähimruutude meetodi, konstrueerides kuni 4 regressioonimudelit iga uuritavale faktorile vastava muutuja kohta. Heteroskedastiivsust, autokorrelatsiooni, mudeli kuju hindamist, jääkliikmete allumist normaaljaotusele ja multikollineaarsust on testitud mudelispetsifikatsioonis.

Koondkeskmistatud andmete esmase regressioonanalüüsi tulemusena välistas autor potentsiaalse mõjutegurite osas mitmeid muutujaid, nagu töötuse määr, tähtajalised töölepingud ja keskmine haridustase. Samuti moodustati kaks muutujate rühma, mida kasutati edasiste põhiliste regressioonimudelite ja mitmetasandiliste regressioonimudelite koostamiseks vähimruutude meetodil.

Korrelatsioon-regressioonanalüüsi ja vähimruutude meetodi (OLS) abil statistiliste andmete põhjal tehtud uuringud näitasid, et kõige tõenäolisemalt avaldavad püsiva kaugtöö võimalusele: kõrge haridustase, tähtajalised töölepingud ja isiklike töösuhete tase. digitaal- ja telekommunikatsioonitehnoloogiaalased oskused. Ükski teguri või regressioonimudeli sõltuvus ei avalda aga loomulikku ja jätkusuutlikku mõju kaugtöö võimalusele kõigi osalevate riikidega. Järeldused empiiriliste andmete analüüsi kohta kinnitavad osaliselt käesoleva lõputöö põhihüpoteesi 1, kuna need lükkavad ümber kaugtöö võimaluse sõltuvuse paljudest autori poolt määratud teguritest. Samas kinnitab hüpoteesi 2 ülevaade 1. hüpoteesi, kuna see illustreerib välisuuringut kaugtöö maksimaalse tõenäosuse kohta, kui ametiülesannete täitmisel puudub vajadus füüsilise kontakti järele.

LIST OF REFERENCES

Appendices 1-4. A Google Disc link: https://drive.google.com/drive/folders/1TbVfbAB1PVIC-lQEuqOVsKFrKo21P8jc?usp=sharing

The Telework Advisory, 2007in URL: http://www.workingfromanywhere.org/ online 7. 1. 2009

Mazmanian, Melissa et al. "The Autonomy Paradox: The Implications of Mobile Email Devices for Knowledge Professionals." Organization Science 24, 5 - October 2013

Sewell, G., Taskin, L. (2015) Out of Sight, Out of Mind in a New world of Work? Autonomy, Control, and Spatiotemporal Scaling in Telework. Organization Studies, 36, 1507-1529

K. Boell, S., Cecez-Kecmanovic, D., Campbell, J., (2016), Telework paradoxes and practices: the importance of the nature of work, New Technology Work and Employment - July 2016, Wiley

Bloom, N., Liang, J., (2015), Does working from homework? Evidence from a Chinese experiment, The Quarterly Journal of Economics - 2015, 165–218

Lister, K., (2019), State of Remote Work 2019, Global Workplace Analytics - Owl Labs - 2019

Eurofound (2021), COVID-19: Implications for employment and working life, COVID-19 series, Publications Office of the European Union – 2021, Luxembourg.

Eurofound (2021), Working conditions and sustainable work: An analysis using the job quality framework, Challenges and prospects in the EU series, Publications Office of the European Union – 2021, Luxembourg.

Eurostat (2018), Quality report of the European Union Labour Force Survey 2018, 2020 edition

Eurofound, ILO (2020), COVID-19: Guidance for labour statistics data collection – June 2020

ILO (2017), Inception Report for the Global Commission on the Future of Work International Labour Office – 2017, Geneva.

ILO (2008), ISCO-08 Structure, index correspondence with ISCO-88, https://www.ilo.org/public/english/bureau/stat/isco/isco08/, March, 2008

Acquisition Research Program (2021), Applying Agile Beyond Information Technology and Software, https://dair.nps.edu/bitstream/123456789/4391/1/SYM-AM-21-084.pdf, May 11–13, 2021

Umer, Hamza and Khan, Muhammad Salar, 2021, Benefits and Challenges of COVID-19 Induced Telework Across Gender: Policy Lessons for Sustainable Future Telework, https://ssrn.com/abstract=3848640, May 18, 2021.

Chuanchuan and Jingwen, (2021). Gender roles and women's labor market outcomes (2), 97-108. https://doi.org/10.1016/j.ceqi.2021.04.002.

Agius, A., (2020), BRIEFING European Added Value in Action EPRS | European Parliamentary, the right to disconnect – July 2020, Malta

ILO (2020), Teleworking during the COVID-19 pandemic and beyond - A practical guide – july 2020, Geneva.

US Government, 2010, Telework Enhancement Act of 2010, PUBLIC LAW 111–292. United States Government. - July 2012

CBRE Research Global, (2020), Global real estate market outlook 2020 Midyear review - 2020

Eurofound (2020), Living, working and COVID-19: First findings – April 2020, Dublin

Ahrendt, D., Sandor, E., Leoncikas, T., Wilkens, M. and Mascherini, M. (2020), Living, working and COVID-19: Methodological note of wave 1 (of survey), Dublin: Eurofound.

Adams-Prassl, A., Boneva, T., Golin M. and Rauh C. (2020), Inequality in the Impact of the Coronavirus Shock: Evidence from Real Time Surveys.

Pulley, M. L., and Sessa, V. I. (2001). E−leadership: tackling complex challenges. Indust. Commer. Training 33, 225–229.

Allen, T. D., Golden, T. D., and Shockley, K. M. (2015). How effective is telecommuting? Assessing the status of our scientific findings. Psychol. Sci. Public Interest 16, 40–68.

Azarbouyeh, A., and Naini, S. (2014). A study on the effect of teleworking on quality of work life. Manage. Sci. Lett. 4, 1063–1068

Agarwal, 2021. Overwhelmed but smiling: human resource management and the well-being of hotel staff during COVID-19. International Journal of Hotel Management, 93, 102765. https: //doi.org/10.1016/j.ijhm.2020.102765

Bathini, D. R., and Kandathil, G. M. (2019). An orchestrated negotiated exchange: Trading home-based telework for intensified work. J. Bus. Ethics 154, 411–423.

Béland, L. P., Brodeur, A., and Wright, T. (2020). "The short-term economic consequences of Covid-19: exposure to disease, remote work and government response," in IZA Institute of labor economics Discussion Papers, No. 13159, (Bonn: IZA Institute of labor economics).

Bentley, T. (2014). How can organisations realize the positive benefits of 'anywhere working'? Hum. Resour. Magaz. 2014, 8–11.

Bosua, R., Kurnia, S., Gloet, M., and Moza, A. (2017). “Telework Impact on Productivity and Well-Being,” in Social Inclusion and Usability of ICT-Enabled Services, eds J. Choudrie, S. Kurnia, and P. Tsatsou (New York: Routledge), 201.

Bouziri, H., Smith, D. R., Descatha, A., Dab, W., and Jean, K. (2020). Working from home in the time of Covid-19: how to best preserve occupational health? Occupat. Environ. Med. 77, 509–510.

Cetrulo, A, Guarascio, D., Virgillito, M. E. (2020), “The privilege of working from home at the time of social distancing”, Intereconomics 2020:3: 142-147

Coenen, M., and Kok, R. (2014). Workplace flexibility and new product development performance: the role of telework and flexible work schedules. Eur. Manage. J. 32, 564–576.

Khalil M. Dirani, Mehrangiz Abadi, Amin Alizadeh, Bhagya Shree Barhate, Rosemary Capuchin Garza, 2020, Leadership competencies and the essential role of human resource development in times of crisis: a response to Covid-19 pandemic, 23(4), 380-394. https://doi.orr/10.1080/13678868.2020.1780078

De Vries, H., Tummers, L., and Bekkers, V. (2019). The benefits of teleworking in the public sector: reality or rhetoric? Rev. Public Person. Administr. 39, 570–593.

DeSanctis, G., and Poole, M. (1994). Capturing the complexity in advanced technology use: Adaptive Structuration Theory. Organiz. Sci.5, 121–147.

Dingel, J and B Neiman (2020) “How Many Jobs Can be Done at Home?,” Covid Economics: Vetted and Real-Time Papers 1, 3 April.

EDP Sciences, 2021, Legal Issues of Teleworking, https://www.shs-conferences.org/articles/shsconf/abs/2021/01/shsconf_eccw2020_01020/shsconf_eccw2020_01020.html, January 2021

Schlosser, F. K. (2002). So, how do people really use their handheld devices? An interactive study of wireless technology use. Journal of Organizational Behavior, 23, 401-423. doi:http://dx.doi.org.er.lib.k-state.edu/10.1002/job.146

Schwaber, K., Sutherland, J., 2017. The Scrum Guide: The Definitive Guide to Scrum: The Rules of the Game. https://scrumguides.org/docs/scrumguide/v2017/2017- Scrum-Guide-US.pdf

World Health Organization (WHO) (2020). Getting your workplace ready for COVID-19: How COVID-19 spreads. Geneva: World Health Organization.

Baldwin, R. (2019). The globotics upheaval: Globalization, robotics, and the future of work. Oxford University Press.

Barrot, J.-N., B. Grassi, and J. Sauvagnat (2020): “Sectoral effects of social distancing,” Working paper, SSRN.

Global employment trends for youth: August 2010: special issue on the impact of the global economic crisis on youth / International Labour Office. - Geneva: ILO, 2010

Cetrulo, A, Guarascio, D., Virgillito, M. E. (2020), "The privilege of working from home at the time of social distancing", Intereconomics 2020:3: 142-147.

Dingel, J and B Neiman (2020) "How Many Jobs Can be Done at Home?," Covid Economics: Vetted and Real-Time Papers 1, 3 April.

Fana, M, Tolan, S, Torrejón, S, Urzi Brancati, C and E Fernández-Macías (2020), The COVID confinement measures and EU labour markets „ EUR 30190 EN, Publications Office of the European Union, Luxembourg.

Fernández-Macías, E., Klenert, D., Antón, J. (2020). Not so disruptive yet? Characteristics, distribution and determinants of robots in Europe. JRC Working Papers on Labour, Education and Technology, No. 2020/01. Seville: Joint Research Centre, European Commission.

The Telegraph, 2020, Margi Murphy, Google employees 'more productive working from home', https://www.telegraph.co.uk/technology/2020/11/19/google-employees-productive-working-home/, 19 November 2020

ZDNET, 2020, WFH has kept us productive. But it may have made us less creative, too, Daphne Leprince-Ringuet, https://www.zdnet.com/article/wfh-has-kept-us-productive-but-it-may-have-made-us-less-creative-too/, October 2020

Matteo Sostero, Santo Milasi, John Hurley, Enrique Fernandez-Macias and Martina

Bisello (European Commission JRC and Eurofound), 2020, Teleworkability and the COVID-19 crisis: a new digital divide? May, 2020.

Fernández-Macías, E. (2018). Automation, digitalisation and platforms: Implications for work and employment. Eurofound Working Paper.

Fernández-Macías, E., Klenert, D., Antón, J. (2020). Not so disruptive yet? Characteristics, distribution and determinants of robots in Europe. JRC Working Papers on Labour, Education and Technology, No. 2020/01. Seville: Joint Research Centre, European Commission.

The Capital Markets Company, 2021, Team to market : an emerging approach for creating dream teams for the post-pandemic world, 2021

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? Technological forecasting and social change, 114, 254-280.

Guyot, K. and Sawhill, I. (2020), "Telecommuting will likely continue long after the pandemic", Brookings Institution web posting

Hurley, J., Fernández-Macías, E., Bisello, M., Vacas-Soriano, C. and Fana, M. (2019), European Jobs Monitor 2019: Shifts in the employment structure at regional level, European Jobs Monitor series, Publications Office of the European Union, Luxembourg.

Mascherini, M. and Bisello, M. (2020), Covid-19 fallout takes higher toll on women, Social Europe

Newport, C. (2020), “Why Remote Work Is So Hard—and How It Can Be Fixed”, The New Yorker.

Toffler, A. (1980). The third wave/Alvin Toffler. New York: Morrow.

Pouliakas, K; Branka, J (2020). EU jobs at highest risk of Covid-19 social distancing: Is the pandemic exacerbating the labour market divide? Luxembourg: Publications Office of the European Union. Cedefop working paper; No 1

Schwind, L. and Vargas Llave, O. (2019), “Telework and its effects in Europe”, in Messenger, J (ed.) (2019).

Rodriguez-Modrono, P., Lopez-Igual, P. Job Quality and Work—Life Balance of Teleworkers. Int. J. Environ. Res. Public Health 2021, 18, 3239

Avgitidou, S., The role of Human Resources during a crisis: the role of teleworking and other information systems, MSc Human Resources Management, 2021

Belzunegui, A., Erro, A. Teleworking in the Context of the Covid-19 Crisis, MDPI Sustainability, March 2020, 12, 3662

Hut I. 2017, Correlation Tests, Correlation Matrix, and Corresponding Visualization Methods in R. Available from: https://rstudio–pubs–static.s3.amazonaws.com/240657_5157ff98e8204c358b2118fa69162e18.html

STHDA. 2016, Correlation Analyses in R. Available from: http://www.sthda.com/english/wiki/correlation-analyses-in-r

Mixon, J. (2010), "GRETL: an econometrics package for teaching and research", Managerial Finance, Vol. 36 No. 1, pp. 71-81.

Fox, John. 2016. Applied Regression Analysis and Generalized Linear Models. 3rd ed. Los Angeles: Sage Publications.

Hamilton, Lawrence C. 1992. Regression with Graphics: A Second Course in Applied Statistics. Pacific Grove, CA: Brooks/Cole.

Taroni, F. 2016, Statistical hypothesis testing and common misinterpretations: Should we abandon p-value in forensic science applications? : [англ.] / F. Taroni, A. Biedermann, S. Bozza // Forensic Science Internationalruen. — 2016. - Vol. 259

Cameron, A. C. and Windmeijer, A. G. (1997) An R-squared measure of goodness of fitfor some common nonlinear regression models. Journal of Econometrics,77, 329-342.

Krzywinski, M., & Altman, N. (2013). Points of significance: Power and sample size. Nature Methods, 10(12), 1139-1140.

Park, H. C. (2013). Non-linear regression model considering all association thresholds for decision of association rule numbers. Journal of the Korean Data and Information Science Society, 24(2), 267–275.

Berg, J, F Bonnet and S Soares (2020), "Working from home: Estimating the worldwide potential", VoxEU.org, 11 May 2020.

OECD, 2020. Productivity gains from teleworking in the post COVID-19 era: How can public policies make it happen? OECD Tackling the Coronavirus (Covid-19), Contributing to the Global Effort.

ILOb, 2021." Teleworking arrangements during the COVID-19 crisis and beyond" Paper prepared for the 2nd Employment Working Group, April 2021.

McKinsey & Company. How COVID-19 has pushed companies over the technology tipping point—and transformed business forever [internet, accessed 10 Feb 2021]. McKinsey; 2020. Available from: https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/how-covid-19-has-pushed-companies-over-the-technology-tipping-point-and-transformed-business-forever

European Centre for Disease Prevention and Control, 2020. Considerations relating to social distancing measures in response to COVID-19 – second update. Stockholm: ECDC; 2020.

APPENDICES

Appendix 5. Non-exclusive licence

A non-exclusive licence for reproduction and publication of a graduation thesis[11]

I Eva Kolektor

1. Grant Tallinn University of Technology free licence (non-exclusive licence) for my thesis Teleworking and COVID-19

supervised by Simona Ferraro,

1.1 to be reproduced for the purposes of preservation and electronic publication of the graduation thesis, incl. to be entered in the digital collection of the library of Tallinn University of Technology until expiry of the term of copyright;

1.2 to be published via the web of Tallinn University of Technology, incl. to be entered in the digital collection of the library of Tallinn University of Technology until expiry of the term of copyright.

2. I am aware that the author also retains the rights specified in clause 1 of the non-exclusive licence.

3. I confirm that granting the non-exclusive licence does not infringe other persons' intellectual property rights, the rights arising from the Personal Data Protection Act or rights arising from other legislation.

16.12.2021

[1] *The non-exclusive licence is not valid during the validity of access restriction indicated in the student's application for restriction on access to the graduation thesis that has been signed by the school's dean, except in case of the university's right to reproduce the thesis for preservation purposes only. If a graduation thesis is based on the joint creative activity of two or more persons and the co-author(s) has/have not granted, by the set deadline, the student defending his/her graduation thesis consent to reproduce and publish the graduation thesis in compliance with clauses 1.1 and 1.2 of the non-exclusive licence, the non-exclusive license shall not be valid for the period.*