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ORIGINAL RESEARCH PAPER

STUDY ON THE IMPACT OF TELEWORKING ON LABOR PRODUCTIVITY IN EUROPEAN UNION COUNTRIES

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ABSTRACT

This research article examines the relationship between teleworking and labour productivity, as well as average working hours as an indicator of optimization and efficiency in the structural labour dynamics of European Union countries. To test the hypotheses, the Eurostat dataset for the period 2015 to 2024 was used with the following variables: share of teleworkers, average weekly working time in main employment, and real labour productivity per hour worked. Statistical panels and multiple regression models were created for the analysis after normality was checked using Shapiro-Wilk. The results showed that the proportion of telework has no significant correlation with an increase in labour productivity but does have a significant correlation with a reduction in average weekly working hours in the countries of the European Union. The results of this study suggest that telework is a variable that primarily changes the time spent on work and thus results in increased efficiency and optimization of work, which is currently considered an important factor for work dynamics in companies. In summary, it can be said that the productivity of the countries studied does not depend structurally on teleworking or is influenced by it, but is related to other country-specific variables. Nevertheless, it is seen as a tool for the organizational transformation of the working environment.

Keywords: Labor productivity, telework, EU, European Union countries, Eurostat Dataset

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1. Introduction

As a result of globalization, one of the biggest challenges for any company is to maintain its competitive position in the market. This requires a strategy that optimizes the company's resources and uses them profitably. To achieve this optimization, the company must be productive, i.e., it must be able to achieve its goals at the lowest possible cost and in the shortest possible time, as this enables it to master another major challenge, namely generating profits that ensure its continued existence (Giannakis & Mamuneas, 2022).

Roughly speaking, it is the people who make up the company who are responsible for producing the goods and services that enable these goals to be achieved. Therefore, the productivity of this human capital responsible for the production of goods and services is one of the main concerns of every company. The more productive employees are, the more goods and services they can produce, and the more efficient the company as a whole is (Calcagnini et al., 2021). It is therefore essential for companies to identify and promote those factors that have a positive impact on increasing employee productivity.

Numerous studies have identified some of these factors over time, including motivation, training, leadership, commitment, and teamwork (Giannakis & Mamuneas, 2022). Teleworking has become a growing trend in companies as it can bring benefits to both them and their employees.

However, it also presents challenges, and companies must adapt to this way of working in order to maximize its benefits and minimize risks or dangers as much as possible (Mitchell et al., 2022). This type of remote work can be understood as a change in the corporate structure and must be managed optimally by those responsible. Various questions have been raised about the relationship between teleworking and productivity. On the one hand, there are studies that assume that this form of work leads to an increase in productivity. Other studies, however, conclude that productivity generally declines when teleworking due to various factors, such as the lack of a suitable workplace, greater distractions, or inadequate IT systems (Fox et al., 2021).

This form of work has been gaining importance worldwide for more than a decade, and the countries of the European Union are no exception (Dulhofer, 2024). According to Eurostat, there have been differences between countries in the process of teleworking in recent years. It has been found that teleworking is more established in northern European countries, while it is less common in southern and eastern countries (Perelman & Serranheira, 2024). In recent years, most European countries have increased the prevalence of teleworking. Comparisons have been made with previous decades, and a trend has been identified that has gained momentum over the last eight years (Dulhofer, 2024). It has been found that the Netherlands, Sweden, and Estonia have shown a stronger trend in recent years. In connection with this form of work, differences can be observed from various perspectives, for example in terms of geography, gender of employees, age, time perspective, type of company, or type of activity (Abilash & Siju, 2021).

Various studies have shown that, due to the pandemic, employees are increasingly demanding teleworking because of its associated advantages (Dulhofer, 2024a, 2024b; 2025). However, companies need to maintain their productivity in order to achieve their goals. For this reason, promoting teleworking to the extent desired by employees leads to mistrust, as employees cannot be physically observed and their performance cannot be measured (Beckel & Fisher, 2022).

At the same time, teleworking makes it easier to manage working hours. Teleworkers can more easily balance their personal and professional lives or save time commuting to work. Despite these advantages, any flexibility also requires restrictions, so that working hours similar to those of employees who perform their services physically must be maintained (Ugwu et al., 2023). Excessive flexibility could lead to uncontrolled overload, which would paradoxically negate the employee's flexibility and reduce their productivity in relation to the company's activities. For this reason, teleworking requires a balance between flexibility in the employee's work performance and control of working time by the employer (Beckel & Fisher, 2022). In this context, reference should be made to new research findings on workload, social support and emotional stability (Huth, 2025b) as well as on job security, job stability and teleworking (Huth, 2025a).

The main objective of this research paper is to analyse the development of teleworking in the countries of the European Union and its impact on labour productivity, as well as the relationship with working time and its influence on efficiency and productivity.

2. Theoretical foundations

This research paper is based on a comprehensive literature review with the aim of gathering the necessary information to form a solid theoretical basis for this study. The search sources for this study were: Web of Science, Springer, Google Scholar, BASE, JSTOR. The terms used in these search engines included: "labour productivity," "telework," "remote work," "working hours," and "efficiency".

2.1 Teleworking. Context

The emergence of teleworking is a direct consequence of the drastic technological changes throughout history, which have necessitated an inevitable adaptation of working patterns (Ugwu et al., 2023). This phenomenon has had a profound impact on the way human social interactions take place via digital platforms, reducing the importance of physical proximity and direct contact between individuals (Mitchell et al., 2022).

Technology is a key factor in the growth of teleworking today. Thanks to technological advances, working remotely has become easier, leading to a radical change in the way we work. This is the greatest revolution in the history of work in recent years. Technology has created new work opportunities that allow employees to work from anywhere and at any time. This gives people more freedom in how they organize their time and strengthens the competitiveness of companies (Mitchell, et al., 2022).

This digital revolution brings obvious benefits in terms of employment opportunities: increased efficiency, improved working conditions, new organizational models, and an improvement in the quality of services and products. However, this transition also poses risks for workers and companies, as digitization will eliminate some tasks and change many others (Adrjan, 2023). This makes it necessary to anticipate potential changes and acquire the skills needed to succeed in the digital age. To achieve this, the European Union and national governments have a crucial role to play, as they are responsible for ensuring that legislation enables both employers and employees to seize the opportunities offered by digitalization.

The introduction of teleworking is closely linked to the increased use of information and communication technologies, which requires better training in these organizations, but at the same time leads to better results in the structure and functioning of the company through the use of these technologies. This approach is based on resource and capability theory, which states that a company's competitive advantage and success are based on the combination of resources and capabilities that the company itself possesses. These resources and capabilities are limited, valuable, unique, and irreplaceable (Perelman & Serranheira, 2024).

In order to analyse which population groups, make the most use of working from home, the professional and sociodemographic characteristics of groups that telework are compared with those that do not. The possibility of working from home depends on the type of work and the degree of preparation of the company to enable this activity from home, the conditions of the person's usual place of residence and their ability to work remotely, as well as the networks and infrastructure available in their place of residence (Adrjan et al., 2023).

2.2 Business objectives of teleworking

The first direct objective at the business level is that teleworking reduces investment in infrastructure, allowing companies with limited resources to lower their costs by implementing it. In this way, the entrepreneur takes on fewer risks and opportunities for loss (Jerbashian & Vilalta-Bufí, 2024). Another reason for its introduction is the promotion of talent. The human resources department, which is responsible for selecting a company's employees, has the opportunity to access the most competent professionals, as workers no longer need to live near the workplace. The contemporary job market is no longer constrained by regional or national boundaries; in certain cases, it has become a global phenomenon. This can be a competitive advantage for the company, as it improves the quality of its operations. Every company aims to work productively and efficiently in order to achieve the best possible results. At the same time, the labour market in the context of teleworking is not limited by regional or national borders. In some extreme cases, attendance may be required for meetings, and in certain cases, face-to-face meetings may occur. Teleworking enables the company to optimize its activities, as the flexibility offered by working from home makes it easier to cope with peaks in workload, since employees can now organize themselves according to actual work requirements rather than a fixed schedule (Dulhofer, 2024a).

2.3 Objectives of employees with teleworking

It is an indisputable fact that teleworking has a direct impact on the lives of employees. They are the protagonists of this form of work, which for the most part enables them to enjoy a higher quality of life, as they can organize their working hours better, thereby reducing stress and pressure. One of the goals from this perspective is to save money, as expenses for daily commuting, clothing, and meals are eliminated. In this sense, teleworking is intended to offer a higher quality of life, especially for people with children. It should enable them to spend more time with their families by being at home and more present in their lives, e.g., participating in their children's daily activities, spending more time with their families, and becoming more involved in their development and well-being (Mitchell et al., 2022). The goal in this case is to achieve a better work-life balance. The goal of teleworking for employees is to offer individuals who work from home more autonomy so that they can perform their tasks with greater focus and in the way that suits them best. The intention is to give them greater job satisfaction by allowing them to choose freely according to their own needs (Jerbashian & Vilalta-Bufí, 2024).

2.4 Positive and negative effects of teleworking

The main advantage of teleworking, which is positive for both the employee and the company, is that this method increases employee productivity and efficiency. If employees perform their work more efficiently and thus achieve good results, this has a positive effect on the company. In addition, the company benefits in this sense from the flexibility of this way of working, as it is possible to renegotiate the contracts and working hours of both senior managers and middle managers and employees (Barrero et al., 2025).

Secondly, by using teleworking, the company benefits from a reduction in the costs associated with its presence, with this reduction including both fixed and variable costs. When employees no longer come to the company's physical location, the costs of cleaning the premises, consumables, office supplies, and security personnel are significantly reduced. In addition, the company does not need very large premises, so the purchase of infrastructure or the rental of premises is not as costly (Alipour et al., 2023).

For employees, the most important advantages are time savings and location. First, this gives them the opportunity to organize themselves and allocate their time freely, as they can decide for themselves how, when, and where they want to use it. This advantage, in turn, gives employees the independence they need to recognize how much effort and commitment each task requires and to decide which tasks are a priority and which are not. If employees have the option of decentralizing their work, i.e., not having to physically travel to the workplace, commuting times are also likely to be reduced. Furthermore, when teleworking, it is neither necessary nor mandatory for the employee to live close to their usual workplace and the company's headquarters (Barrero et al., 2025). This makes it easier to find talent, as the location of the employee is irrelevant and more people have access to the same job. This means that the most qualified and suitable candidates get the job, and proximity to the workplace is not a deciding factor. Similarly, people with reduced mobility or disabilities benefit because they can work from home. It can therefore be said that teleworking promotes social inclusion.

Another advantage of teleworking is the reduction in costs associated with working on site. It is obvious that by working from home, we avoid traveling to our usual place of work, whether by car, taxi, or public transportation. This has a positive effect on employees, as they have lower transportation costs. However, this cost reduction also extends to other areas such as work clothing (Di Girolamo et al., 2023).

It is important to evaluate various variables related to teleworking, including productivity. In order to analyse the impact of teleworking on employee productivity, the advantages and disadvantages perceived by employees and the possible effects[1] on their productivity must be taken into account (Piasna et al., 2022). Some of these variables that affect productivity can be, for example, communication between colleagues, an optimal workplace, and work-life balance.

2.5 Productivity

Productivity can be defined as an economic measure that determines the relationship between the quantity of goods and services produced and the factors of production (labour, capital, or land) used. This theory was developed to measure the productivity of countries, but it can also be applied

1 It is imperative to emphasise at this juncture that novel working models are precipitating a transfer of cost components from companies to workers.
In the absence of adequate cost compensation from employers, the onus falls upon the workers themselves to cover expenses such as e.g. electricity, water, and sewage.

at the company level. The simplified formula for productivity is: Productivity = output achieved / quantity of production factors used. In the case of employees, productivity can be understood as the ratio between the goals achieved by each employee and the time required to achieve them (Tsiapa, 2023). In some variants of the function, the technological advances of the company are also added. Hourly productivity is a particularly good indicator. It is a precise variable of working time. Labor productivity is a very useful measure related to the most important factor of production, namely labour. It reflects labour productivity in relation to the personal skills of employees or the intensity of their efforts (Prenzel et al., 2018). The indicator allows the levels and growth rates of the ratio between GDP and labour to be assessed over time, thus providing general information on the efficiency and quality of human capital in the production process for a given economic and social context, including other complementary inputs and innovations used in production (Giannakis & Mamuneas, 2022). The following formula is used to calculate productivity in the context of this study:

$$Actual\ productivity\ per\ hour = \frac{Real\ annual\ GDP}{Number\ of\ hours\ worked\ by\ the\ total\ working\ population\ per\ year} \quad (1)$$

The implementation of technological processes in a company, such as teleworking, leads to a significant increase in employee productivity. Teleworking not only reduces costs for the company but also promotes more efficient handling of information and more informed decision-making by employees. Productivity summarizes the development of an economic environment in a unique and effective way, as it provides information on the extent to which the diversity of factors involved in the production process has been efficiently combined and, moreover, has a clear impact on the standard of living of the population. Depending on our understanding of the many elements that have a direct impact on productivity will always be a worthwhile task (Di Girolamo et al., 2023).

2.6 Quantification of working time and its distribution

In a world where efficiency and productivity are often the cornerstones of the economy and development, various important aspects of working time have been discussed. In the dynamics of the organization, the employer has a number of obligations regarding working time that must be fulfilled, e.g., recording the hours worked while taking into account the personal circumstances of the employees. With regard to telework, there is a tendency to assume that working time is easier to manage (Ugwu et al., 2023). Teleworkers can more easily balance their personal and professional lives or save time commuting. However, it has also been argued that, despite these advantages, any flexibility requires restrictions and that working hours similar to those of employees who work physically on site must be maintained (Calcagnini et al., 2021). Excessive flexibility could lead to uncontrolled overload, which would paradoxically negate the employee's flexibility and reduce their productivity in terms of the company's activities. It is also important to set limits on working hours that do not compromise the employee's personal well-being due to the nature of teleworking. A distinction must be made between work and leisure time. For this reason, telework requires a balance between flexibility in the employee's work performance and control of working time by the employer (Barrero et al., 2023).

3. Method

3.1 Aim of the study

This research article examines the relationship between teleworking and labour productivity, as well as average working hours as an indicator of optimization and efficiency in the structural labour dynamics of European Union countries in the period 2015 to 2024.

3.2 Research question

Q1: Does the development of labour productivity in the member states of the European Union differ significantly depending on the prevalence of teleworking?

Q2: Is there a significant reduction in the average weekly working hours of employees in the European Union countries with the strongest growth in teleworking, indicating higher efficiency and better structural effects of work?

3.3 Hypotheses

Hypothesis 1

H_0: The countries of the European Union with the highest growth in the proportion of teleworkers are not the most productive.

H_1: The countries of the European Union with the highest growth in the proportion of teleworkers are more productive.

Hypothesis 2:

H_0: As the presence of teleworkers increases in European Union countries, working hours do not decrease and there is no impact on productivity or efficiency.

H_1: As the presence of teleworkers increases in European Union countries, working hours decrease without any impact on productivity or efficiency.

3.4 Instrument, Source of the data set

The selected data comes from Eurostat (Statistical Office of the European Union), as Eurostat's public data provides information on the characteristics of teleworkers in Europe and other related variables that are relevant for social research with economic variables. This statistical office provides high-quality information on the European Union, candidate countries, and the European Free Trade Association. To this end, Eurostat harmonizes the statistical methods of the data-providing countries, allowing them to be compared with each other. Eurostat provides objective and accurate information that enables a better understanding of the current situation and answers a wide range of questions. For the present study, based on research questions and hypotheses, data sets for the period 2015 to 2024 were selected with variables on labour productivity, teleworkers, and working hours in the countries of the European Union.

In order to confirm or refute hypotheses H1 and H2, the following data sets (see Table 1) were selected from Eurostat: "Labor productivity and unit labour costs (online data code: nama_10_lp_ulc)," "Employees working from home as a percentage of total employment, by gender, age, and occupational status" (online data code: lfsa_ehomp) and "Average weekly hours worked in main job, by sex, age, occupational status, full-time/part-time and economic activity (online data code: lfsa_ewhun2). The data was collected directly from Eurostat (2025).

After receiving the data, it was processed and cleaned by removing empty fields (zero values) and incorrect values that did not correspond to the measurement scales of the selected variables using Microsoft Excel software in order to perform a statistical analysis of the data, which consisted of a descriptive analysis and an inferential analysis, both performed using IBM SPSS (Version 29) software. It should be noted that a normality test was performed to select a parametric or non-parametric statistical model for the conclusions, depending on the data distribution. Finally, the results obtained were compared with the selected literature to confirm or refute the research hypotheses and formulate the corresponding conclusions. The variables selected for the study to test the hypotheses were as follows:

Table 1.
Variables selected for the study (Source: Eurostat)

Variables	Meaning
Percentage of teleworkers	Percentage of the working population who work from home in the countries of the European Union.
Real labour productivity per hour worked	Real GDP generated per hour worked by an employee.
Average weekly working hours in main job	Average weekly hours worked in main job above zero of the employed population.
Country	Countries forming the European Union, 27 countries.
Years	Selected reference period for this study: 2015–2024.

3.5 Data analysis

To determine whether the data followed a normal distribution, the Shapiro-Wilk test was first performed, as the amount of data per variable (N) was less than 50. This test has the advantage of providing an objective assessment of normality and depends on the sensitivity of the sample size. After verifying that all variables followed a normal distribution, the hypothesis test was performed. The results obtained made it possible to accept or reject the sub-hypotheses and discuss them based on the selected literature in order to finally draw conclusions in the form of results with which this study could be concluded. For the null and alternative hypotheses, the data were normally distributed. A descriptive analysis of the variables was carried out, showing the level and proportion in relation to teleworkers, labour productivity, weekly working hours, and years in the countries of the European Union. For the inferential analysis, an analysis of models with fixed and random effects and panel data was chosen to answer the first hypothesis (H_1). Subsequently, a multiple regression analysis was performed to test the second hypothesis. This analysis makes it possible to predict the difference and reduction in hours per year and country due to teleworking.

4. Results

4.1 Descriptive analysis

Teleworking in the European Union has changed over the selected period under review (2015-2024), and as Table 2 shows, there have been significant changes between the minimum and maximum values in terms of the proportion of teleworkers in the 27 countries of the European Union, with varying ranges and standard deviations from the mean during the period under review. The fluctuations observed in the individual countries are predominantly upward. The percentages vary most frequently between countries in relation to the average. In terms of individual countries, the Netherlands has the highest percentage, reaching 53.90% in 2024, while this figure was 34.50% in 2015. This is followed by Luxembourg with 42.80% teleworkers, Sweden (45.60%), Denmark (41.00%), Finland (39.40%), Belgium (35.90%), Austria (28.10%), France (33.90%), and Germany (24.10%) are the countries with the highest share for 2024 and in recent years. The other countries are seeing a significant increase in the share of teleworkers. In contrast, countries such as Bulgaria (3%), Romania (3.50%), Greece (7.80%), Hungary (9.00%), Italy (10.30%) and Cyprus (10.70%) have the lowest figures for 2024. During the period under review, these countries have a low proportion of teleworkers, and the increase is small. Some countries saw an increase until 2020 or 2021, but the figures fell again in the following years.

In terms of productivity in relation to real GDP per hour worked based on 2015 (with a value of 100), the European Union countries that saw a relative increase in productivity with higher values from 2023 onwards were mainly Bulgaria, Romania, Latvia, Lithuania, and Poland (Figure 1). This suggests that there has been a change since 2015, reflected in a relative increase in recent years such as 2024. On the other hand, it should also be noted that there are countries that did not experience such significant relative growth compared to 2015, with countries such as France, Luxembourg, Germany, Belgium, and Italy showing low or slight growth in 2024.

The indicator for average weekly working hours in European Union countries, based on working hours excluding commuting time, sick days, and vacation, shows differences between European Union countries for the period 2015-2024 (Figure 2).

Figure 1.
Real labour productivity per hour worked in European Union countries from 2015 to 2024 (Source: Eurostat)

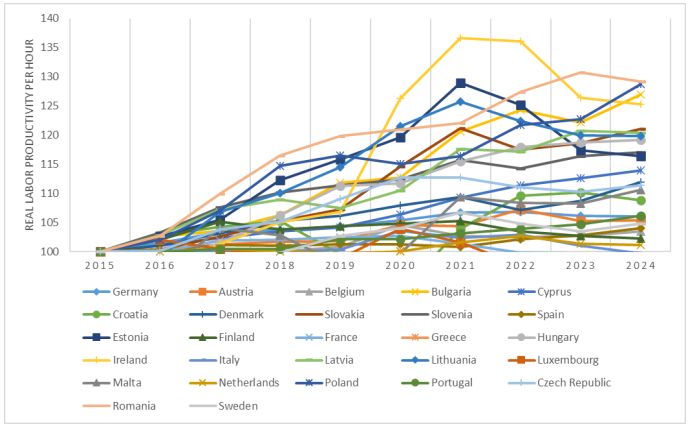
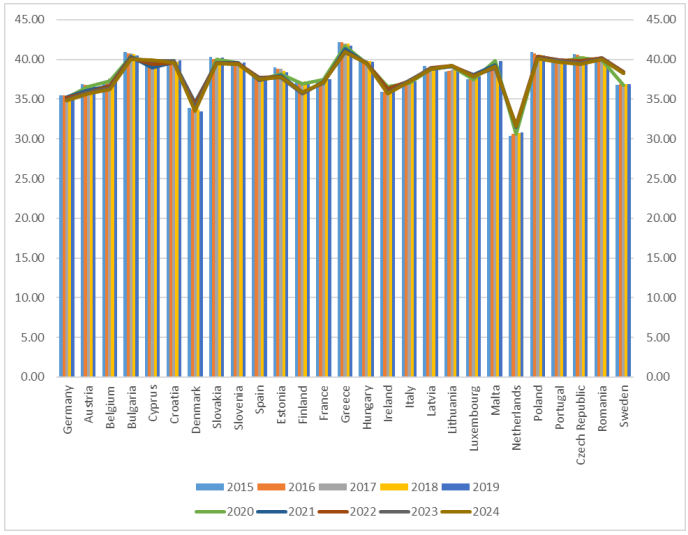


Figure 2.
Average weekly working hours in main occupation in European Union countries from 2015 to 2024 (source: Eurostat)



Differences of up to 8 hours per week can be observed between the countries surveyed. Denmark, Austria, Germany, and the Netherlands have the lowest average values for 2024 (33.53, 35.70, 34.80, and 31.60 hours per week). During the period examined, the average remained stable with relatively low values in these years. For 2020 and 2021, there was a slight decline in average working hours in several European Union countries. In contrast, the highest values were recorded in countries such as Bulgaria, Poland, Greece, and Romania (40, 41, 40.10, and 40 hours per week, respectively). Since 2015, the average values for these countries have remained constant.

Table 2.
Teleworkers (%) in European Union countries in the period 2015 to 2024 (Source: Own representation using IBM-SPSS)

	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
					Statistic	Std. Error
Germany	10.80	25.00	17.440	6.453	-2.388	1.334
Austria	21.60	29.20	25.020	3.385	-2.427	1.334
Belgium	22.30	39.80	29.670	7.0295	-2.132	1.334
Bulgaria	0.90	6.50	2.4780	1.863	1.074	1.334
Cyprus	2.09	13.00	6.7570	4.631	-2.174	1.334
Croatia	4.40	13.90	9.3780	3.711	-2.111	1.334
Denmark	27.20	41.00	32.800	4.578	-0.778	1.334
Slovakia	8.30	15.00	10.999	2.468	-1.590	1.334
Slovenia	17.50	22.90	19.260	1.879	0.392	1.334
Spain	6.40	15.40	10.960	4.051	-2.362	1.334
Estonia	13.00	29.20	21.540	5.757	-1.508	1.334
Finland	26.80	41.70	34.610	6.208	-2.192	1.334
France	19.40	34.20	26.830	6.630	-2.310	1.334
Greece	5.09	14.90	7.768	3.142	1.946	1.334
Hungary	4.50	13.40	8.5490	2.636	-0.104	1.334
Ireland	12.70	39.50	26.250	10.850	-2.132	1.334
Italy	4.30	14.80	8.569	4.381	-2.099	1.334
Latvia	3.09	13.60	7.389	4.034	-1.763	1.334
Lithuania	4.50	14.30	8.229	3.964	-1.871	1.334
Luxembourg	30.90	47.60	37.790	6.083	-1.517	1.334
Malta	4.90	29.10	17.450	10.113	-2.289	1.334
Netherlands	34.50	53.90	42.800	8.668	-2.180	1.334
Poland	12.80	18.30	14.870	1.511	2.420	1.334
Portugal	14.20	25.70	17.880	4.006	-0.208	1.334
Czech Republic	7.59	16.50	11.968	3.320	-1.949	1.334
Romania	0.59	6.59	2.526	2.006	0.101	1.334
Sweden	31.00	46.10	38.680	6.207	-1.988	1.334

4.2 Inference analysis

The data analysed using the Shapiro-Wilk test for the variables examined for the period 2015 to 2024 showed that they followed a normal distribution. The following assumptions were made for the analysis: Null hypothesis (H_0): The data follows a normal distribution. Researcher's hypothesis (H_i): The data do not follow a normal distribution.

Table 3.
Shapiro-Wilk test for the normal distribution of the variables to be analysed (Source: Own representation using IBM-SPSS)

	% teleworker		Real hourly productivity		weekly working hours	
	W	pValue	W	pValue	W	pValue
V2015	0.917	0.030	0.918	0.670	0.917	0.030
V2016	0.901	0.012	0.914	0.024	0.921	0.037
V2017	0.915	0.026	0.960	0.351	0.908	0.017
V2018	0.929	0.059	0.949	0.183	0.904	0.014
V2019	0.925	0.046	0.938	0.098	0.892	0.008
V2020	0.956	0.272	0.949	0.185	0.888	0.006
V2021	0.916	0.027	0.920	0.034	0.923	0.040
V2022	0.929	0.059	0.931	0.066	0.913	0.024
V2023	0.937	0.092	0.949	0.182	0.904	0.015
V2024	0.945	0.152	0.947	0.170	0.904	0.014

According to Table 3, most data sets showed a normal distribution, so the null hypothesis could be accepted. To calculate the statistical models, a logarithmic transformation was performed on the data that did not follow a normal distribution.

To answer the study's first hypothesis, "The European Union countries with the highest growth in the proportion of teleworkers are the most productive," an analysis of the panel data model with fixed or random effects was used. For the model, the fixed effect was applied to the country in order to be able to compare the differences between countries. The result of the analysis showed that the effect of the telework variable in European Union countries is not statistically significant (Table 4), p = 0.737; F = 0.892. Despite these insignificant results, a possible trend can be seen at the conventional threshold. The intersection is highly significant. On this basis, the null hypothesis is accepted, and the alternative hypothesis is rejected. An important value of this analysis is the variance between countries, which was significant (p = 0.000; σ^2 = 72.859; see Table 5), indicating that there are significant differences in productivity between countries, which supports the analysis of the multilevel/panel model. This suggests that the variable teleworking is not an explanatory variable for assessing production differences between European Union countries.

Table 4.
Type III Tests of Fixed Effects[a] (Source: Own representation using IBM-SPSS)

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	76.000	37654.432	0.000
Teleworker	203	76.000	0.892	0.737

a. Dependent variable: Productivity

Table 5.
Estimates of Covariance Parameters[a] (Source: Own representation using IBM-SPSS)

Parameter	Estimate	Std. Error	Wald Z	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Residual	72.859	11.819	6.164	0.000	53.015	100.130

a. Dependent Variable: Productivity

To test the second hypothesis ("With the increasing presence of teleworkers in European Union countries, working hours are shorter without any impact on productivity or efficiency"), a multiple linear regression analysis was performed. The results of the analysis in Table 7 showed that the proportion of teleworkers in European Union countries has a negative (B = -0.133) and significant (p < 0.001) correlation with the average weekly working hours in the main occupation. The results show that there are fewer teleworkers in countries with longer working hours. The R^2 = 0.495 and the standard error = 1.611, showed in Table 6, reflect a good explanation of the model with 49.5% of the total variance in relation to the average weekly working hours. The variables selected for the analysis were significant, which means that the alternative hypothesis is accepted, and the null hypothesis is rejected. No collinearity problems were found for the analysis. According to the Durbin-Watson value (= 0.318), adjustments to the model may be necessary.

Table 6.
Model Summary[b] (Source: Own representation using IBM-SPSS)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.704[a]	0.495	0.490	1.611	0.495	90.312	3	276	0.000	0.318

a. Predictors: (Constant), Country, Year, Teleworkers

b. Dependent Variable: weekly working hours

Table 7.
Coefficients[a] (Source: Own representation using IBM-SPSS)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	-259.067	71.157		-3.641	0.000	-399.148	-118.987		
	Teleworkers	-0.133	0.008	-0.733	-16.253	0.000	-0.149	-0.117	0.899	1.113
	Year	0.148	0.035	0.189	4.200	0.000	0.079	0.217	0.903	1.107
	Country	0.045	0.012	0.158	3.682	0.000	0.021	0.070	0.994	1.006

a. Dependent Variable: weekly working hours

5. Discussion

Based on the results obtained, official Eurostat data, and the econometric and statistical analyses performed, relevant data was obtained that could be used to test and critically evaluate the hypotheses put forward in the study.

In the case of the first hypothesis, the model with fixed or random effects showed that there was no significant correlation between the variables share of teleworkers and labor productivity ($p = 0.737$; $F = 0.892$). It is important to emphasize that countries such as Romania, Bulgaria, and Poland have experienced relative productivity growth compared to 2015 in recent years. Growth in these countries may be related to structural changes in the country's economic system. On the other hand, countries such as Luxembourg, the Netherlands, France, and Germany have not shown relative growth in labor productivity per hour during these years. The growth of these countries may reflect a significant degree of maturity in the country's economic system and its labor organization. Thus, if these countries have a low relative productivity growth rate, this reflects that their economic structure is already well optimized and that productive changes are not taking place on a large scale, as may be the case in emerging economies (Di Girolamo et al., 2023). Countries such as Bulgaria and Romania, for example, are not more productive despite a change in relative growth in absolute terms. Based on the results and the hypothesis put forward, it can be concluded that the proportion of teleworkers does not have a significant impact on productivity levels in European Union countries, but that these productivity differences may be directly related to industrial dynamics, the degree of digitization, and human capital. In countries with a high absolute level of productivity, teleworking is used to a greater extent, and their labor structure may develop differently than in other countries with a lower proportion of teleworkers (Letta, 2024).

It is important to note that productivity growth in European Union countries has slowed significantly in recent decades, leading to a decline in income and wage growth. Labor productivity is one of the determining factors of income and wage growth (Tsiapa, 2023). There are various factors that

contribute to these productivity figures. In response to this slowdown, many OECD and EU countries have set up commissions to advise governments on promoting productivity-related measures. The most productive countries in the EU have their own commissions, which were established between 2017, when Denmark took the lead, and 2023, the year the Swedish commission was established. However, it is important to emphasize that despite the decline, there are significant differences between countries in different regions in terms of industry, labor dynamics, and economy (Furceri et al., 2021).

When analyzing the second hypothesis, the results clearly show a negative behavior and a negative trend between the average weekly working hours in the main job and the proportion of teleworkers ($p < 0.001$; −0.133), which means that with a higher proportion of teleworkers in European Union countries, working hours may be significantly reduced. This result suggests that teleworking is associated with more flexible working conditions and better time management without compromising effectiveness, productivity, and performance within the company. The countries with the highest absolute productivity are those where this form of work is most used (Perelman & Serranheira, 2024).

In terms of teleworking and time allocation, self-organization of working hours means that employees can determine the order of tasks and when they are carried out. Employees can use their most productive times for more demanding tasks or better tailor their working hours to their needs. This would be ideal if the tasks are already included in the work schedule (and are not added during the working day) and it is assumed that these tasks will be completed within a number of hours that does not exceed the maximum hours specified in the collective agreement (Ugwu et al., 2023). For this reason, most companies include corresponding provisions in their teleworking agreements. However, this self-organization cannot be guaranteed if very strict deadlines are set or new tasks arise as soon as the previous ones have been completed.

6. Conclusion

The findings of the study, based on the data and verified hypotheses, suggest that there is no significant correlation between actual labour productivity per hour worked and the increase in teleworking in the countries of the European Union. It is therefore not an explanatory variable for productivity, and other structural factors specific to each country come into play.

On the other hand, the increase in teleworkers was significantly associated with average regular working hours in the main occupation, with a negative trend, i.e., a reduction in working hours is associated with a higher presence of teleworkers. In contrast, countries that use their working time more effectively and achieve higher production volumes without depending on the number of hours worked reflect an optimized level of work organization with fewer working hours, supporting the second hypothesis of the study. The results confirm that productivity depends on various factors and systems related to the dynamics of each country and that teleworking has no direct influence on it. In order to understand productivity at a statistical and econometric level, other fundamental variables must be taken into account. At the same time, teleworking can be understood as a model or instrument in the work structure and transformation to optimize work dynamics.

The present study entails several limitations that are relevant to the interpretation of its findings. First, the analysis is based exclusively on macroeconomic Eurostat data, which means that individual, organisational and work-psychological factors remain unaccounted for. Second, no differentiation is made between sectors or occupational profiles, although teleworking may function very differently across economic domains. In addition, important control variables such as the degree of digitalisation, human capital or innovative capacity are absent from the models. The period of investigation includes the pandemic years 2020 and 2021, during which teleworking reached exceptionally high levels. As a result, pandemic-related exceptional circumstances may distort the outcomes. Furthermore, potential measurement errors in the teleworking data must be acknowledged, as these are partly based on self-reported information.

These limitations give rise to several avenues for future research. There is a particular need for microeconomic studies that capture individual productivity, work behaviour, stress levels and home-office conditions. Sector-specific analyses are also required to better understand structural differences between industries. Moreover, further research should employ causal econometric methods in order to depict underlying mechanisms more reliably. It would also be worthwhile to examine more closely the influence of structural national factors such as infrastructure, education systems and firm size distributions.

Overall, the findings indicate that, while teleworking does affect working time, it is not a determining factor for macroeconomic productivity. At the same time, the identified research gaps demonstrate the necessity of more differentiated analyses to fully understand the complex role of teleworking within modern organisational structures.

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