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A NEW TELEWORKING GROWTH MODEL

Abstract. *This paper assesses the impact of telework on economic growth in the European Union using Feasible Generalized Least Squares method, applied to a Panel of 27 Member States, in the period 2010-2019. The econometric model also analyses the impact of the rate of employed population not working from home on the economic growth, to facilitate the comparative analysis of telework and traditional work. The results indicate a greater impact of telework on economic growth, than that exerted by the rate of employed population not working from home, the effect being manifested through the channel of labour productivity. However, the paper examines the short-term relationship between these variables and does not exclude the reduction of the impact of telework on economic growth to a lower level than the specific effect of traditional work, on medium or long-term.*

Keywords: *telework, economic growth, productivity, impact, model, European Union.*

JEL classification: J08, J21, O47

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1. Introduction

"Telework" is a topic of interest for economic science, this being one of the ways through the efficiency of human resources can be instrumented. This concept was first brought into question by the engineer Jack Nilles in 1973, when he was in a traffic jam in Los Angeles (Kurland and Bailey, 1999). In this context, Jack Nilles indicated that telework can be a solution for continuing work in the case of people who cannot get to the office in due time. The main advantages of telework identified in the literature are: the ability to work from anywhere, flexibility, reduced travel, balance between personal and professional life, reduced administrative costs, etc. In addition to these benefits, there are also many challenges that teleworkers face, such as cyber security, the risk of working overtime, and social isolation.

The main objective of this paper is to develop a new model of economic growth based on telework, which will be achieved through the following specific objectives: (i) estimating the impact of the rate of employed population working from home on economic growth (ii) estimating the effect of the rate of the employed population not working from home on economic growth; (iii) estimating the effects of other relevant determinants of economic growth.

The motivation for choosing this theme is based on the emergence of the coronavirus pandemic, which facilitated the replacement of traditional work with telework. The SARS-CoV-2 virus appeared on December 12, 2019 in Wuhan (China), while the first cases in the European Union appeared at the end of January 2020. Besides that, in March 2020 the virus became present in all European Union Member States. In this context, all Member States have acted in a coordinated manner, applying restrictive measures to limit the spread of the virus throughout the EU, including: cleaning and sanitation of common areas, quarantine of foreigners, closing borders, implementing work at home on a large scale and forced closure of activities.

In the current epidemiological context, telework has been widely used by employers to ensure the safety of workers in the labour market and the continuation of economic activity (Belzunegui-Eraso and Erro-Garces, 2020). Many companies and organizations (excepting those operating in the health sectors) have never planned a response to a global emergency resulting from a pandemic, due to its very low probability of occurrence. However, in recent years, there have been several international health emergencies (SARS, H1N1, and Ebola), and the epidemiological history should have raised awareness among companies and national governments about the need to develop scenarios and emergency plans to ensure the continuity of activity and the health of employees. It worth to be mentioned that health of employees remains one one the most important driver of labour market participation (Militaru et al., 2018).

In the context of an epidemiological event, the continuity of a company's activity depends on the size of the business (a larger company is better prepared to deal with unforeseen events), the type of business (medical organizations are better prepared), respectively the skills of human resource specialists working on emergency programmes (Rebmann et al., 2013).

Following the reduction of pandemic risk, telework may evolve on two scenarios, as follows: firstly, companies may offer employees the opportunity to continue working from home, or in the second scenario, physical presence at work will be required, which will prove that telework is only a temporary measure, without long-term effects.

2. Literature review

The concept of "telework" was developed by Kurland and Bailey (1999), who identified four types of telework in the United States: (i) remote work, (ii) satellite offices, (iii) work centres in the neighbourhood, respectively (iv) mobile workers. However, telework depends on several elements. In this regard, Beauregard et al. (2019) identified the essential factors that make telework possible as follows: job characteristics, employee characteristics, and manager characteristics. Therefore, employers need to select and train their employees to appropriately respond to the specific challenges of working in the labour market, when they are working from home. Other factors were also identified by Vrchota et al. (2019), which specified that the implementation of the telework by the employer depends on the size of the company, digital skills, information and communications technology (ICT) infrastructure, and the implementation of project management.

In recent years, many companies, regardless of size and field, have started working from home (Fried and Hainemeier Hansson, 2014), most often telework being implemented in microenterprises, in the ICT sector, respectively in the financial and insurance services sector. Furthermore, Sanchez et al. (2007) stated that teleworking provides a way to cope with overload and escape from fixed work schedules, which generates a positive impact on the company's performance. In line with economic, social, and informational developments from the recent years, Nițu et al. (2019) foresee an increasing orientation towards telework, which will become one of the most important forms of atypical employment.

At the same time, telework has the advantage of reducing the company’s costs for real estate, office space maintenance, consumables (Kurland and Bailey, 1999), equipment, electricity and water (Karia and Muhammad, 2016). On the other hand, the reduction of the employer costs may also leads to an increase in employee costs.

The benefits of a teleworker have been also identified by Fried and Hainemeier Hansson (2014), who point out that remote work has a positive impact on performance in performing creative tasks, while Hau and Todescat (2018), Dima et al. (2019), Lott and Abendroth (2020) stated that teleworkers have less stress and more free time, which could be invested in household activities.

However, teleworking could not be implemented without an adequate ICT infrastructure for workers. In this regard, Fried and Hainemeier Hansson (2014) identified a positive relationship between the ICT sector and telework, this conclusion being also supported by Kaplan et al. (2018).

Remote work has influenced several sectors, including transport. In this sense, telework has led to the elimination of time spent in traffic, reduction of congestion and implicitly of greenhouse gas emissions (Ellder, 2020). Starting from the idea of proposing an "alternative to transport", telework has proven to be a good solution, offering new ways to solve individual, societal, and organizational problems (Barber et al., 2016).

The benefits are not only at the level of individuals, but also at the level of companies, including increasing organizational productivity, improving organizational flexibility, reducing costs, recruiting people living away from the workplace (Bloom et al., 2014), reducing absenteeism (Kazekami, 2020), increasing flexibility in the labour market, reducing fatigue and promoting autonomy (Fried and Hainemeier Hansson, 2014). Lopes et al. (2014) consider that autonomy increases employee welfare, increases vitality, and stimulates mental stability.

Eurofound and the International Labour Office (2017), respectively Kazekami (2020) conducted a survey on telework, the results of the study highlighting the fact that remote work increases productivity, giving employees the opportunity to relax during working hours and encouraging more working hours. In this sense, Tavares (2017) confirmed that teleworkers are more productive than their counterparts in traditional offices because they have fewer distractions, can work more, and have a higher flexibility when planning their program. Solis (2017) supports this conclusion by indicating that unsupervised teleworkers are more proactive than supervised ones.

The main challenge for an employee when he works remotely is related to the individual ability to solve problems independently. For this reason, there is a need to train teleworkers in the field of managing problems, but also managers in supervising employees efficiently (Ansong and Boateng, 2018).

However, remote work also faces various disadvantages. Solis (2016) indicated that companies need to ensure that workers benefit from favourable conditions when working from home and must find solutions to prevent possible conflicts or negative effects on the activity of the enterprise if the remote work conditions are unfavourable.

Teleworking can cause political, cultural, ethical and livelihood issues. In addition, Raišien et al. (2020) stated that teleworkers face challenges in communicating and cooperating with colleagues and managers. From another perspective, Eurofound (2017) concluded that the lack of telework is caused by the

legislation and difficult negotiations between the employees and employers regarding work flexibility, this being allowed, in particular, to employees who have a higher status on the labour market. In this context, an important statement is that made by Dingel and Neiman (2020) who indicated that underdeveloped economies have a low share of remote jobs. This is also caused by the fact that the workforce with high digital skills prefer developed countries, while workers with low digital skills usually cannot find better opportunities in advanced countries (Marinaș et al., 2021).

3. Methodology

In this section, we have presented the methodology used to estimate the impact of telework on economic growth in the European Union with 27 Member States, excepting the United Kingdom, in the context of Brexit. UK has left EU in 2020, but the referendum calling for Brexit took place in 2016, while the negotiations with EU started in 2017. Therefore, we opted to remove the UK from the analysis in to eliminate the tense moments caused by the Brexit negotiation process.

Teleworking is a concept difficult to quantify, but after examining the main statistics that assess this concept, we decided to use as a proxy - the percentage of people working from home in the occupied population. The analysis assesses the impact of telework on economic growth in the period 2010-2019 using the Panel technique (for 27 cross-sections and 10 observations per each cross-section), in the Eviews 10.0 program, using statistical data extracted from the Eurostat. Given the limited availability of data, it was not possible to capture the impact of the telework promoted during the COVID-19 crisis on economic growth, but even if this had been possible, we would encounter a structural break at the data level after the lockdowns. Although theoretically, telework could have been captured through a dummy variable in 2020, this approach would have created a confusion between telework and the restrictive measures. In this context, we limited the analysis period to 2010-2019, to capture the evolution of the time series after the financial crisis of 2009 and before the COVID-19 crisis, which started in early 2020.

To better capture the impact of telework on growth, we used other growth control variables, which were presented below. In addition, through this analysis we tried to analyse the extent to which overworking hours increases economic growth (using the percentage of the employed population working more than 49 hours per week). However, the paper stands out also by the fact that it assesses both the impact of telework on economic growth and that of traditional work, to examine the impact differences between the two indicators.

Initially, we tested the stationarity of all mentioned variables, using the "Summary" technique, which provides the results of several tests for the three hypotheses tested (existence of an individual constant, existence of a constant and a trend, absence of constant and trend), as follows: (i) Levin, Lin & Chu t *; (ii)

Breitung t-stat; (iii) Im, Pesaran and Shin W-stat; (iv) ADF - Fisher Chi-square; (v) PP - Fisher Chi-square. At the same time, the lag was selected according to the Schwarz information criterion. Following the application of these tests, we found that some of the variables are stationary at level, while the rest of the variables become stationary after applying the first difference. In this sense, to support the hypothesis of stationarity at the level of the model, we used a combination between data expressed in their initial form and the data expressed in the first difference, and we applied FGLS method on the following equation:

$$growth_{it} = \alpha_0 + \alpha_1 d(emplworkhome)_{it} + \alpha_2 d(emplnotworkhome)_{it} + \alpha_3 gfcfchange_{it} + \alpha_4 inflation(-1)_{it} + \alpha_5 rdexpchange(-1)_{it} + \alpha_6 longhworking_{it} + \alpha_7 d(neets)_{it} + \varepsilon_t \quad (1)$$

where:

- i = number of countries analysed;
- t = time period analysed;
- α_{0-7} = impact coefficients;
- growth = annual economic growth rate;
- d(emplworkhome) = the first difference of the percentage of the employed population aged 15-64 working from home - telework;
- d(emplnotworkhome) = the first difference of the percentage of the employed population aged 15-64 not working from home - traditional work;
- gfcfchange = percentage change in gross fixed capital formation;
- inflation(-1) = annual inflation rate lagged by 1 year;
- rdexpchange(-1) = percentage change in national expenditure (includes expenditure incurred by all sectors) on research and development (expressed in millions euro), lagged by 1 year;
- longhworking = the percentage of the employed population aged 15-64 working more than 49 hours per week;
- d(neets) = the first difference of the rate of young people aged 15-24, who do not carry out an activity on the labour market and are not enrolled or have not participated in educational or training programs in the last four weeks (NEETs);
- ε_t = residuals.

Subsequently, we evaluated the compatibility of the model with a random / fixed effects model, the result of the Redundant Fixed Effects - Likelihood Ratio test supporting the use of a fixed effects model. To estimate the impact of telework on economic growth, we applied the Feasible Generalized Least Squares (FGLS / EGLS) method - accompanied by the Cross-section weighting option and by the

White cross-section covariance estimation method to solve the related issues of heteroscedasticity and cross-sectional dependence - on the following equation:

$$growth_{it} = \beta_0 + \beta_1 d(emplworkhome)_{it} + \beta_2 d(emplnotworkhome)_{it} + \beta_3 gfcfchange_{it} + \beta_4 inflation(-1)_{it} + \beta_5 rdexpchange(-1)_{it} + \beta_6 longhworking_{it} + \beta_7 d(neets)_{it} + \rho_1 dummy_1 + \rho_2 dummy_2 \ \dots + \rho_{26} dummy_{26} + \varepsilon_t \quad (2)$$

where:

- β_{0-7} = fixed effects model impact coefficients;
- dummy = a dummy variable, measured binary (with values 0 or 1), for each cross-section, except for the last country included in the analysis; this variable was used to facilitate the estimation of a model with fixed effects, the dummy variable having a stabilizing role;
- ρ_{1-26} = the slope of each dummy variable;

Following the estimation of the model, we applied all necessary tests to verify the feasibility of the results obtained, as follows: (i) the Jarque-Bera test, to check the normal distribution of residuals; (ii) the Breusch-Pagan LM, Pesaran scaled LM, Bias-corrected scaled LM and Pesaran CD tests to check the cross-sectional dependence; (iii) Breusch-Pagan and Durbin-Watson tests, to verify the autocorrelation of residuals hypothesis; (iv) the Breusch-Pagan-Godfrey test, to verify the absence of heteroscedasticity; (v) examining the degree to which economic growth is explained by the independent variables used; (vi) the Fisher test, to check the statistical validity of the model; (vii) testing the significance of the impact coefficients; (viii) checking the null mean of the residuals; (ix) multicollinearity testing - Klein's criterion based on comparing Pearson correlation coefficients with R-squared.

4. Results and interpretation

In this section, we analysed the impact of telework and that of the traditional office work on economic growth in the Member States of the European Union. At the same time, we checked the verisimilitude of the calculated effects, as specified in the previous section.

In *Figure 1*, we have presented the evolution of the share of teleworkers in the occupied population, respectively that of the traditional workers not working from home. As can be seen, in 2019, the highest levels of the percentage of individuals working from home were registered in the following countries: NL (14.1%), FI (14.1%), LU (11, 6%), AT (9.9%), and DK (7.8%). On the other hand, the lowest levels of this indicator were encountered in BG (0.5%), RO (0.8%), HU (1.2%), and CY (1.3%), these being followed by EL and HR (1.9%). With a view to the traditional workers, the highest rates were registered in BG (98.9%), RO

(98.6%), CY (97.5%), IT, and LT (95.5%), while the countries with the lowest rates of this indicator are SE (62.8%), NL (62.9%), LU (66.9%), FI (68.4%). %) and DK (71.5%).

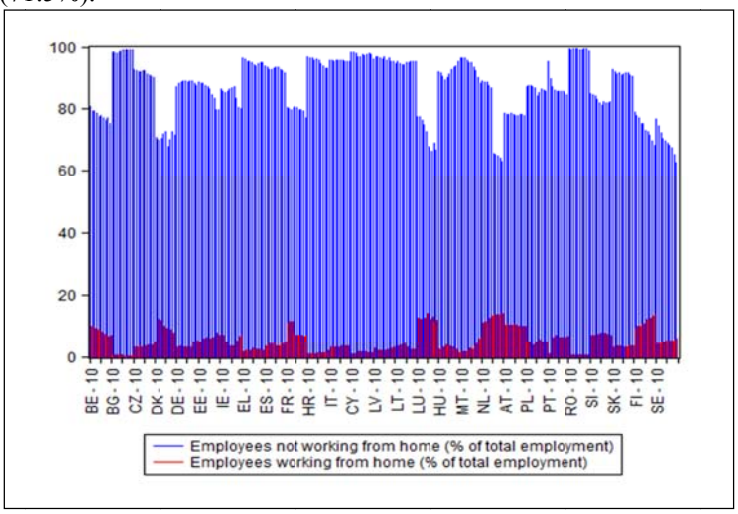

Figure 1. The evolution of employees working and not working from home (% of total employment) over the period 2010-2019
Source: Own processings using Eviews 10.0, Eurostat data

Following the calculation of the impact of the determinants of economic growth, we have provided the results obtained in *Figure no. 2*. According to the results, the calculated coefficients are statistically significant at 5%, excepting the percentage of the employed population working more than 49 hours per week, which is significant at 10%. The high coefficient of determination confirms the appropriate selection of the regressors (R squared having the value 79.237%), while the probability of Fisher test (0.00%) validates the econometric model.

Dependent Variable: GROWTH
Method: Panel EGLS (Cross-section weights)
Sample (adjusted): 2011 2019
Periods included: 9
Cross-sections included: 27
Total panel (balanced) observations: 243
Linear estimation after one-step weighting matrix
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EMPLWORKHOME)	0.248201	0.091070	2.725394	0.0070
D(EMPLNOTWORKHOME)	0.161401	0.024796	6.509092	0.0000
GFCFCHANGE	0.123573	0.009463	13.05913	0.0000
INFLATION(-1)	-0.409133	0.037232	-10.98863	0.0000
RDEXPCHANGE(-1)	0.011024	0.004016	2.744980	0.0066
LONGHWORKING	-0.232408	0.139560	-1.665289	0.0974
D(NEETS)	-0.471849	0.141407	-3.336814	0.0010
C	4.133966	1.082165	3.820087	0.0002

Effects Specification

Cross-section fixed (dummy variables)

Weighted Statistics

R-squared	0.792370	Mean dependent var	3.610064
Adjusted R-squared	0.759586	S.D. dependent var	3.611723
S.E. of regression	1.784530	Sum squared resid	665.5705
F-statistic	24.16965	Durbin-Watson stat	2.017656
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.635016	Mean dependent var	2.280247
Sum squared resid	730.4802	Durbin-Watson stat	2.401460

Figure 2. Estimation results: 2010-2019
Source: Own processings using Eviews 10.0, Eurostat data

Next, we presented the impact of the economic growth drivers. According to the results presented in *Figure 2*, the increase by one unit of the growth of the percentage of the employed population working from home leads to a 0.248201 percentage points hike in economic growth. This effect is also argued in the economic literature by the fact that teleworking generates more flexibility, increases the free time of employees, and, in most cases, reduces the level of stress, which also enhances the employees productivity.

On the other hand, the econometric model shows that the increase by one unit in the change of the rate of population not working from home generates a rise in economic growth, equivalent to 0.161401 percentage points. As can be observed, the impact of telework on economic growth is greater than that of the workers carrying their activity from traditional offices. This is due to a higher productivity of those who perform their activity on the labour market, at a distance, these workers not being distracted by colleagues, respectively carrying out their activity in a more pleasant environment, which eases the completion of the tasks for employees.

In addition, the model demonstrates that the increase in the percentage change in gross fixed capital formation by one percentage point improves the economic growth rate by 0.1353573 percentage points, given that new investments generate an additional increase in the gross domestic product. On the other hand, the increase by one percentage point of the inflation rate, lagged by one year, leads

to the reduction of economic growth by 0.409133 percentage points. This effect is due to higher prices, which leads to lower consumption, more than encouraging the increase in the production of companies.

Subsequently, we analysed the effect of government spending on research and development and demonstrated that the increase of the percentage change of this indicator by one percentage point have an positive impact on economic growth of +0.011024 percentage points, one year after this change, the effect not being materialized immediately. Through this factor we tried to capture the contribution of technological progress to economic growth, but this indicator captures only a part of technology, both automation and digitization being quite important elements. However, these concepts are quite limited in terms of their availability.

Regarding the rate of employed population aged 15-64 working more than 49 hours per week, we have shown that its increase by 1 percentage point leads to a reduction in the economic growth by 0.232408 percentage points. This effect can be argued by the fact that labour productivity begins to decline as potential working capacity is exceeded. Clearly, the individual capacity for effort is different, but when the saturation threshold is exceeded at the level of the labour force, fatigue intervenes, which decreases the productive efficiency at the level of the workers, implicitly the economic growth.

However, this indicator faces some limitations and the calculated impact may be slightly different from the "real" one. The limitations are due to the fact that the data depends on the companies' reports, which are not always in line with the reality in all countries (in some less, in others more). Although there are no official sources of statistical data to confirm this, the reality of the labour market in some Member States is different from the reported data, given that underreporting is a mean that some companies use to not increase salaries and to avoid paying higher contributions. According to *Figure no. 3*, in 2019, only 0.4% of the population aged 15-64 in Lithuania worked between 50-59 hours in a week, which is also the lowest percentage in the EU, the next ranked countries being Bulgaria (0.7%), Latvia (1.4%) and Romania (1.8%). It should be noted that the highest rates of this indicator are recorded in Poland (6.8%), France and Slovakia (by 7.1% each), and Czech Republic (8.0%).

Moreover, it is noted that Lithuania, Bulgaria, Latvia, and Romania are the countries with the highest levels of income inequality, which also draws attention to the effectiveness of trade unions in adequately representing the interests of workers, which does not exclude a margin error in reporting hours worked by employees.

In addition, according to the results obtained in the period 2010-2019, the increase by one unit in the change of the NEET rate has led to a reduction of economic growth by 0.471849 percentage points. In particular, economic growth responds to any development that may limit worker productivity or the integration

of the active population into the labour market. In this case, economic growth also reacts negatively to the registration of a higher percentage of young people who do not work in the labour market and do not follow some educational or training programs, as a result of which they can bring a value added to the labour market.

Table no. 1 demonstrates the maximum verisimilitude of the results obtained, given the findings of the residuals analysis. The first test used is Breusch-Pagan (prob: 15.0%> 5%), its results indicating the absence of autocorrelation, while the Breusch-Pagan-Godfrey test confirms the homoskedastic feature of the model (prob: 57.2%> 5%).

On the other hand, to examine the dependence on the level of cross-sections, we used the tests Breusch-Pagan LM, Pesaran scaled LM, Bias-corrected scaled LM and Pesaran CD. Among the tests used, the results of Breusch-Pagan LM are not relevant given that the number of observations per cross-section is less than the number of cross-sections. In this context, the decision was made according to the results of the three available tests, the hypothesis of no cross-sectional dependence being confirmed, since two tests confirmed this feature of the model (Pesaran scaled LM and Bias-corrected scaled LM). At the same time, the Jarque-Bera test, which provides a probability of 35.4%, confirms the null hypothesis of the normal distribution of residuals, which strengthens the robustness of the results.

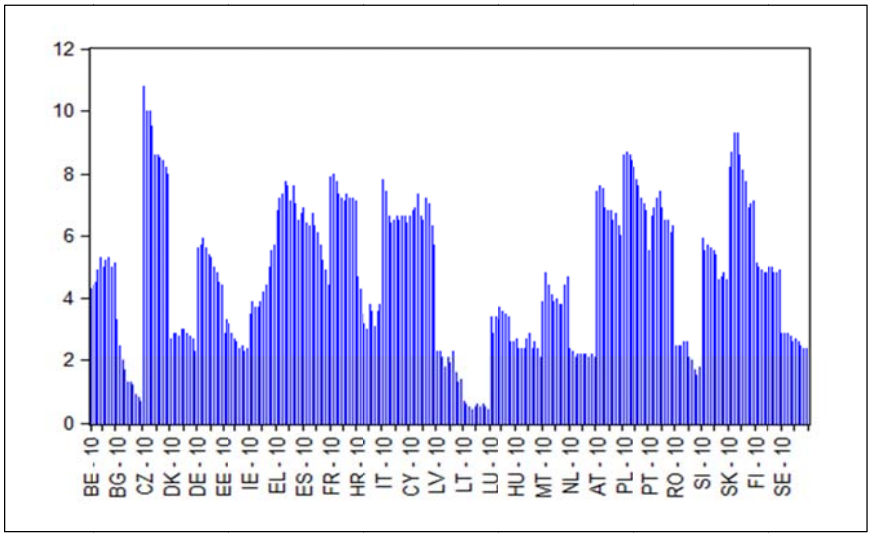

Figure 3. Percentage of employed persons (15-64 years) working 50-59 hours in a week in 2010-2019

Source: Own processings using Eviews 10.0, Eurostat data

Table 1. Tests performed

Test	Test results (prob.)	Hypothesis accepted
Compatibility with fixed effects model		
Redundant Fixed Effects Test	0.000 (p<.05)	Fixed effects model is better than the random effects model
Autocorrelation test (Breusch-Pagan)		
R-squared (dependent variable: resid01)	0.009	There is no serial correlation between residuals
Observations (n)	216	
n*R-squared	2.070	
Degrees of freedom	1	
Prob. Breusch-Pagan	0.150 (p>.05)	
Heteroskedasticity test (Breusch-Pagan-Godfrey)		
R-squared (dependent variable: resid01^2)	0.023	Homoskedasticity
Observations (n)	243	
n*R-squared	5.723	
Degrees of freedom	7	
Prob. Breusch-Pagan-Godfrey	0.572 (p>.05)	
Cross-section dependence (CD) test		
Breusch-Pagan LM	0.0063 (p<.05)	CD (but this test is not appropriate to models taking into account smaller periods than cross-sections)
Pesaran scaled LM	0.1084 (p>.05)	No CD
Bias-corrected scaled LM	0.9344 (p>.05)	No CD
Pesaran CD	0.0001 (p<.05)	CD
Normality test		
Prob. Jarque-Bera	0.354 (p>.05)	Normal distribution

Source: Own calculations using Eviews 10.0 and Microsoft Office Excel 2016

Finally, we analysed the average and the evolution of the residuals and we identified a stationary evolution of this factor, but also a null average of the standardized residuals (*Figure 4*).

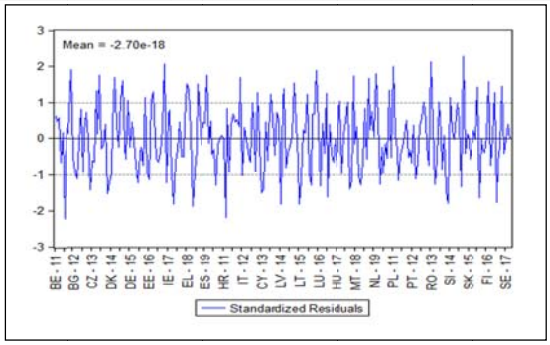

Figure 4. Standardized Residuals

Source: Own calculations using Eviews 10.0, Eurostat data

The last hypothesis verified is the one regarding the absence of multicollinearity, this being confirmed considering the Pearson correlation coefficient, which is lower than the R-squared value. Finally, we confirmed the maximum verisimilitude of the estimators, but it should be taken into consideration the small sensitivity / limitation of the indicator that assesses overworking on the labour market.

5. Conclusions and recommendations

In this paper, we examined economic growth from a different perspective than usual, one much closer to the current challenges and to the need of a flexible labour market. The main results confirm that telework influences economic growth to a greater extent than the traditional work. However, the paper examines the short-term relationship between these forms of employment and economic growth and does not exclude the reduction of the impact of telework on economic growth to a lower level than the specific effect of traditional work, on medium or long-term. In the case of the lack of a balance between traditional work and telework, combined with an exclusive use of telework, the employees are unlikely to maintain the higher level of productivity from the early stages of tekework, since in the long run increase the possibility of an unproductive monotony, affected by stress. Given these arguments, the paper recommends continuing to promote a hybrid model of employment, which ensures a balance between traditional work and telework.

Another conclusion by which the paper stands out is the negative impact of the high number of hours worked (above the normal work schedule) on economic growth, as a result of the effect of overworking on reducing labour productivity. However, regarding this conclusion, there are some limitations given that the data provided by Eurostat may be influenced by the underestimation of that indicator in the case of some countries, in the context of underreporting of hours worked at the company level. In this context, there is a possibility that the actual impact will be slightly different from the estimated one (without a change in the sign of the

relationship), with the mention that the calculated impact was based on the official statistical data available.

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