THE INFLUENCE OF INTERNET ACCESS ON THE EMPLOYMENT RATE IN THE EUROPEAN UNION AND IN THE E.F.T.A.

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Abstract: *In the context of the acceleration of the digital development in the current society, we can state that access to information is one of the most important factors in forming the work force. In the present paper, we will present a way of quantifying the influence of the internet access on the employment rate for the second level of the Nomenclature of Territorial Units for Statistics (N.U.T.S. 2) of several countries that are members of the European Union (E.U.) and the European Free Trade Association (E.F.T.A.), by using a G.M.M. vector autoregressive model with panel data. This study is important due to the way it connects the employment rate with the internet access rate for the several countries of the E.U. and E.F.T.A. because it offers an overview of how improving the internet access can lead to an increase in the employment rate of the general population. The countries used in the present study are: Austria, Belgium, Cyprus, Czech Republic, Estonia, Spain, Croatia, Italy, Netherlands, Norway, Portugal, Romania and Sweden for the time period between 2010 and 2020. The study leads to the conclusion that increasing the percentage of internet users in the total population has a significant influence on the employment rate for the analysed countries, when taking into account N.U.T.S. 2 regions.*

Keywords: *digital development; employment rate; vector autoregressive model.*

JEL Classification: *E24; E10.*

1. Introduction

In the present one of the most important subjects of the scientific literature is that of the digital development and the way in which this progress has a significant influence on the economic development. In the scientific literature there have been many papers treating the subject of the influence of technology on the economic evolution of the society, but the present paper presents a comparative approach of the influence of the access to technology on the main economic indicators (in this case represented by the employment rate) at a national level.
The present paper will investigate the relation between the percentage of households that have internet access and the percentage of population that is employed in the economy. This will be done by using a panel data vector autoregressive model, for the N.U.T.S. 2 regions of the E.U. and the E.F.T.A. for: Romania, Italy and Spain as particular cases and for Austria, Belgium, Cyprus, Czech Republic, Estonia, Spain, Croatia, Italy, Netherlands, Norway, Portugal, Romania and Sweden as a

general model. In this way, we will conduct an analysis that will lead to conclusions regarding the way in which the labour market is influenced by the increase in the percent of people using the internet.

2. Literature review

In the scientific literature the subject of the relation between the rate of internet access and the employment rate of the population is an important research subject. One of the articles that had an influence in choosing the way in which the present research hypothesis was approached is the one written by Hjort and Poulsen (2017). In this article, the authors develop an understanding of the way in which access to high speed internet has an influence on the employment rate for a data series composed of 12 countries from Africa. The authors observe positive effects for all the groups of employees, the employment rate noticing a raise even in the case of those with elementary studies. Also the internet had an influence on the productivity level and the exports for the analysed countries (Benin, D.R. Congo, Ghana, Kenya, Namibia, Nigeria, Togo, Tanzania, Madagascar, Mozambique, Senegal, South Africa), leading to the creation of new jobs. Other approaches of measuring the influence of technology access on the economic development are the one written by Magruder (2012) which uses the medium wage as a proxy for economic development and the paper written by Hardy and McCasland (2016) which adopts similar methodologies. The decision to focus on the employment rate allows us to make a comparison between countries, because the analysed countries are in the same economic area, and the purchasing power parity is different. It seems that access to technology leads to the increase in the demand for the jobs with high qualification, this aspect being suggested by several papers (Autor et al (1998), Autor et al (2003), Autor et al (2008), Katz and Margo (2014) and Akerman et al (2015)).
Another article that had a significant influence for elaborating the present paper is that written by Koutrompis (2009). In this article, the author analyses the effect of the percentage of internet users for 22 countries that are members of the O.E.C.D. and its effect on the economic development. The study concludes that the raise in the internet usage rate will determine an increase with 0.25% of the Gross Domestic Product.
In the present paper we decided to use the employment rate because, we considered that it is a more significant indicator in measuring the direct effects of the increase in the internet usage rate on the welfare and the life of the population. In the case of the direct correlation between the employment rate and the internet subscriptions there is a series of papers, from which a notable one is written by Huongbonon and Liang (2018), for the case of the French economy. The article concludes that the increase in the number of internet subscriptions is negatively correlated with the number of jobs in the economy, but has no influence on the unemployment rate. Another paper that deals with the relation between the employment rate and the percentage of internet users is the one written by Czernich (2014). In this paper the

author demonstrates that at the level of the German municipalities there is a negative correlation between unemployment and the number of internet subscriptions. The importance of internet in the general economic development of a country is treated also in the article written by Lehr et al (2006), this article concludes that for the period between 1998 and 2002 U.S. communities that had internet access experienced a more significant economic growth, an increase in the employment rates and in the number of new businesses. These positive effects are not limited at only the urban area as stated in Whitacre et al (2014), in which the impact of internet use is presented for the rural area. Another topic connected to the present article is the one described in "The Effects of Broadband Internet Expansion on Labour Market Outcomes" by Atasoy (2013). In this paper the effects of the extension of internet access on the United States of America's economy is analysed for the period between 1999 and 2007. The federal programs have allocated in the analysed time period 18 billion dollars for subsidizing the installation of new technologies, these programs being mainly focused on improving internet access in the rural areas. The article also studies the correlations between technological development and the way in which companies are governed and manage their finances, in order to evaluate in which way the government can improve the information technology infrastructure and its possible effects on the business sector. It concludes that the improvement of internet access in an area is associated with a raise of 1.8 percentage points in the rate of employment in the rural and isolated areas. The majority of the gains generated by the increase in the employment rate is generated by the increase in the labour demand from the existing companies Other conclusions of the paper written by Atasoy (2013) that are also suggested by other articles such as that of Hardy and McCasland (2016), state that the internet access represents an advantage for the qualified work force, the positive effect of the adoption of internet being more significant in case of the industries that use more personnel with tertiary studies.

Another study which studies the relation between the digital development and the economy is the one written by Jung (2016). This article examines the way in which the investments in the I.T. (information technology) business sector have an influence on the employment rate of 76 small and medium businesses from the Republic of Korea from 2009 to 2013. The effect in the case of the data sample has been proved to be significant, this meaning that an increase in the I.T. investments lead to an increase in the occupation rate.

An article that studies a similar subject using 23 E.U. countries (the relation between the internet access and the unemployment rate), is written by Salem (2020). In this study the author uses a cross-section analysis in order to measure the effect of the percentage of internet users on the unemployment rate for 2016 and 2018, the conclusions lead to the idea that the increase in the internet access leads to the reduction of the unemployment rate.

In the analysis of the data we used the methodology of panel data vector autoregressive models, to analyse the influence between the percentage of households that have internet access and the employment rate. The methodology of vector autoregressive models has been at first developed by Sims (1980) and has

been in time adapted for the use of panel data. Other papers that have developed the methodology are the following Kiviet (1995), Bond (2002) and Anderson and Hsiao (1982). In the present paper a significant influence was the methodology described by Dahlberg and Johansson (2000), which is the use of a G.M.M. (generalized moments method) vector autoregressive model for panel data for quantifying the influence of social spending in the provinces of Sweden.
In the following sections of this paper we will describe the methodology and the used data in detail, the results and the conclusions of the study.

3. Methodology and data

In order to research the connection between the internet access and the employment rate of the population, we used a database containing the N.U.T.S. 2 regions of the E.U. and the E.F.T.A. from Eurostat. We opted to use N.U.T.S. 2 regions due to their comparability in terms of the number of inhabitants, in this way the results of the models are comparable. In this paper we will analyse the relation using a G.M.M. vector autoregressive model with panel data with a lag, by making four models one for Romania, Italy and Spain and one that contains: Austria, Belgium, Cyprus, Czech Republic, Estonia, Spain, Croatia, Italy, Netherlands, Norway, Portugal, Romania and Sweden. The data used is for the period between 2010 and 2020, the scope of the model being determining the influence of the percentage of internet users on the employment rate of the population.
The percentage of internet users was measured by using the „Households that have internet access at home by NUTS 2 regions" data series made available by Eurostat for the period between 2010 and 2020. The used data series contained 1254 observations for the percentage of households with internet access in the N.U.T.S. 2 regions of the selected countries. In Figure 1 we can see the histogram of the values of the data series, the country which had the biggest values for the households with internet access is Norway with several values of 100%. From the countries that presented regions with a low percentage of households with internet access in the data sample are Romania, Portugal and Spain.

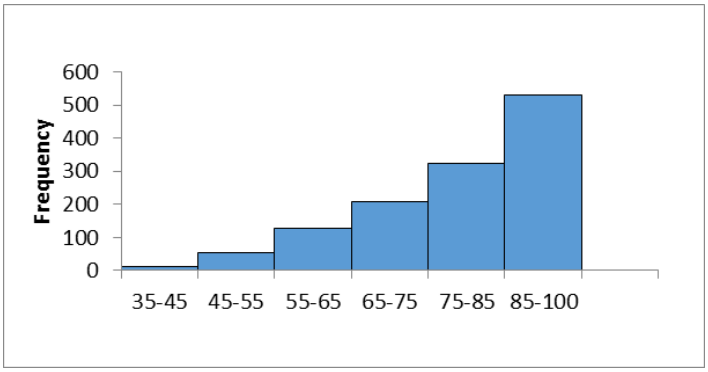

Figure 1: Histogram of the values of the percentage of households with internet access.
Source: Author's calculations

By analysing the histogram we can state that the majority of values is distributed at the end of the data sample with the percentage of households using the internet being in the 85 to 100 percent bin. The smallest values of the indicator regarding the percentage of households with internet access was registered for three regions in Romania in 2010: Sud-Vest Oltenia, Nord-Est and Sud-Muntenia, other regions with small percentages of internet use are in 2011 Alentejo region in Portugal, and Extremadura from Spain in 2010. The greatest percent of internet use has been observed in Gronigen and Flevoland in the Netherlands in 2016 and 2017 and the Hedmark og Oppland region in Norway in 2019.
For measuring the employment rate of the population, we used the „Employment rate of the age group 15-64 by NUTS 2 regions" between 2010 and 2020 from Eurostat. The histogram of the data series is presented in Figure 2. We can observe by analysing the histogram that the majority of regions are in the 65 to 75 percent employment rate bin. The lowest values of the employment rate have been registered in the Calabria region of Italy in 2015 and 2013 and Sicily in 2014. Other low rates of employment were registered in Melilla, Spain for 2015. The highest percent of employment has been observed in Utrecht for 2019 and 2020 and in Nord Brabant for 2019 in the Netherlands. From the countries that were members of the Eastern Bloc the largest value of employment percent has been observed in Prague region of the Czech Republic in 2018.

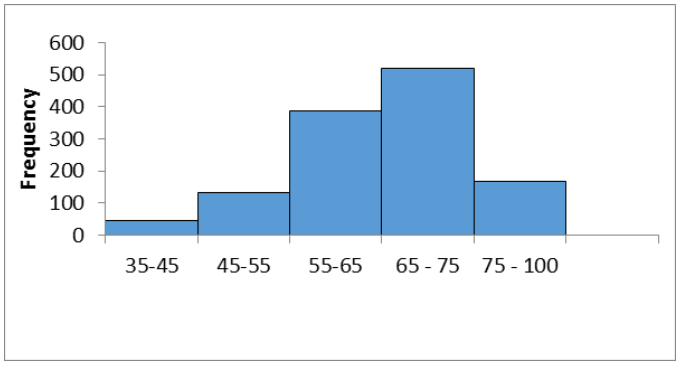

Figure 2: Histogram of the values of the employment rate.
Source: Author's calculations

In Table 1 we present the results of several descriptive statistics for the analysed data sets, we can see that the skewness, kurtosis and standard deviation are similar.

Table 1: Descriptive statistics for the data series

Descriptive statistic	Internet users	Employment rate
Average	80.25	65.34
Median	82.00	66.00
Standard Deviation	13.16	9.13
Kurtosis	-0.11	0.07
Skewness	-0.69	-0.74
Maximum value	100.00	80.70
Minimum value	35.00	38.90

Source: Author's calculation

4. Results

In order to study the relation between the two variables, we decided to implement a G.M.M. vector autoregressive model with panel data with one lag by using the panelvar software package for R. For all the presented models we calculated the AIC and BIC information criterion and the number of lags has been chosen according to their values. Also the inverse roots of the polynomial equation have been calculated to be in the unit circle in order to conclude that the presented models are significant from a statistical standpoint.

The first model was calculated for the case of Italy, the results of the estimation of the parameters are presented in Figure 3. We can see that the employment rate is influenced by a unit increase in the internet users with 5%. We also conclude that the parameters for the employment rate (named Employment_rate in Figure 3) and for the percentage of households with access to internet (named Internet_users in Figure 3) are significant except of the lag one parameter of the employment rate in the equation for the internet users. In other words the percentage of internet users is an influence on the employment rate but the employment rate has no influence on the internet users.

```
-----------------------------------------------------
Dynamic Panel VAR estimation, two-step GMM
-----------------------------------------------------
Transformation: Forward orthogonal deviations
Group variable: Zone
Time variable: Year
Number of observations = 189
Number of groups = 21
Obs per group: min = 9
               avg = 9
               max = 9
Number of instruments = 36

=====================================================
                     Employment_rate  Internet_users
-----------------------------------------------------
lag1_Employment_rate   0.5532 ***      -0.2289
                      (0.0483)         (0.1435)
lag1_Internet_users    0.0547 ***       0.9639 ***
                      (0.0062)         (0.0226)
=====================================================
*** p < 0.001; ** p < 0.01; * p < 0.05
```

Figure 3: Output for the VAR model in the case of Italy.
Source: Author's calculations

The value of the parameters of the employment rate is 0.5532 and the parameter for the percentage of internet users is 0.0547 in the equation that estimates the current employment rate. In Figure 4, we present the impulse to response function for the case of the Italy. We can see that the impact of the internet users on the employment rate is positive and significant.

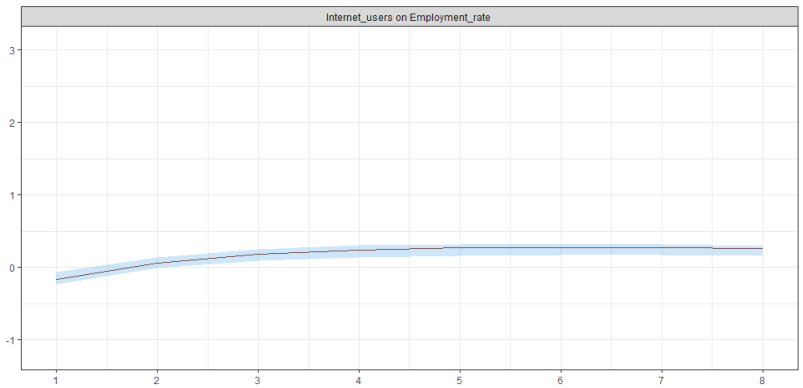

Figure 4: IRF for the internet user rate effect on the employment rate, Italy.
Source: Author's calculations

In the case of Spain the values of the parameter for the internet users with one lag is greater than in the case of Italy (0.1099 compared to 0.0547). In Figure 5 we present the results of the model estimation.

```
Dynamic Panel VAR estimation, two-step GMM
---------------------------------------------------
Transformation: Forward orthogonal deviations
Group variable: Zone
Time variable: Year
Number of observations = 171
Number of groups = 19
Obs per group: min = 9
               avg = 9
               max = 9
Number of instruments = 36

=====================================================
                     Employment_rate  Internet_users
-----------------------------------------------------
lag1_Employment_rate   0.5564 ***       0.0964
                      (0.0596)         (0.0704)
lag1_Internet_users    0.1099 ***       0.9528 ***
                      (0.0126)         (0.0221)
=====================================================
*** p < 0.001; ** p < 0.01; * p < 0.05
```

Figure 5: Output for the VAR model in the case of Spain.
Source: Author's calculations

As observed in the case of Italy, in the equation for estimating the value of the percentage of internet users, the parameter for the employment rate is not significant. In the equation for estimating the employment rate the value of the parameter of the percentage of internet users with one lag is significant for Spain as was in the case of Italy. In Figure 6 we can observe the impulse response function for the VAR model in the case of Spain.

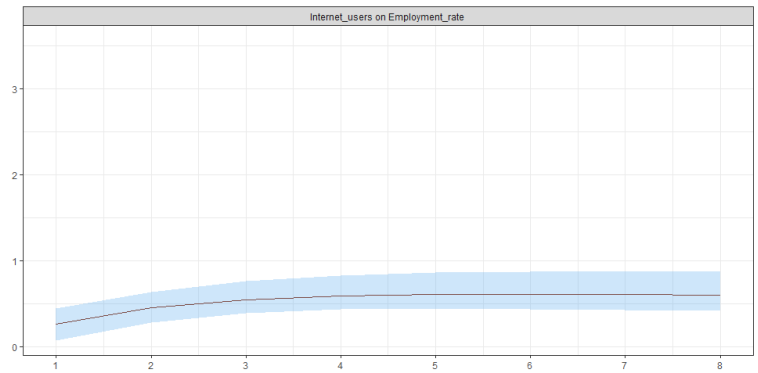

Figure 6: IRF for the internet user rate effect on the employment rate, Spain.
Source: Author's calculations

In the case of Romania, the model obtained has statistically insignificant parameters, this might be due to the fact that the internet access generates a demand for higher qualification jobs (Hardy and McCasland, 2016) and several regions of Romania have seen a migration of the work force to other countries. In this case even if the

internet access for the population increases we do not see an increase in the employment rate, because the workforce is not present in the region. In Figure 7 we can see the results of the VAR model for Romania.

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-----------------------------------------------------
Dynamic Panel VAR estimation, two-step GMM
-----------------------------------------------------
Transformation: Forward orthogonal deviations
Group variable: Zone
Time variable: Year
Number of observations = 72
Number of groups = 8
Obs per group: min = 9
               avg = 9
               max = 9
Number of instruments = 36

=====================================================
                     Employment_rate  Internet_users
-----------------------------------------------------
lag1_Employment_rate  -0.8702          -0.8947
                      (1.5986)         (0.9706)
lag1_Internet_users    0.2824           1.0880 ***
                      (0.2355)         (0.1491)
=====================================================
*** p < 0.001; ** p < 0.01; * p < 0.05
```

Figure 7: Output for the VAR model in the case of Romania.
Source: Author's calculations

For the panel data of the European Union and E.F.T.A. countries the model conteins the following countries: Austria, Belgium, Cyprus, Czech Republic, Estonia, Spain, Croatia, Italy, Netherlands, Norway, Portugal, Romania and Sweden. The results of the model are presented in Figure 8, we can see that in the equation that estimates the employment rate the parameter of the percentage of internet users is positive and the value of the coefficient is 0.0863, which is between the values registered for Italy and Spain.

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------------------------------------------------------
Dynamic Panel VAR estimation, two-step GMM
------------------------------------------------------
Transformation: Forward orthogonal deviations
Group variable: Zone
Time variable: Year
Number of observations = 1026
Number of groups = 114
Obs per group: min = 9
               avg = 9
               max = 9
Number of instruments = 36

=====================================================
                     Employment_rate  Internet_users
-----------------------------------------------------
lag1_Employment_rate   0.6505 ***       0.0742
                      (0.0529)         (0.1070)
lag1_Internet_users    0.0863 ***       0.8993 ***
                      (0.0131)         (0.0251)
=====================================================
*** p < 0.001; ** p < 0.01; * p < 0.05
```

Figure 7: Output for the VAR model in the case of the E.U. and E.F.T.A.
Source: Author's calculations

In Figure 8 we can see the impulse response function for the VAR model with the data for the selecte E.U. and E.F.T.A. countries.

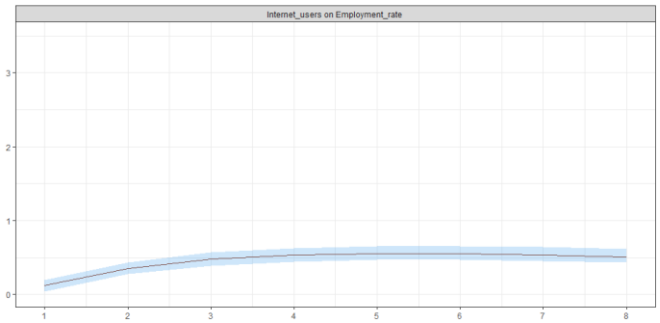

Figure 8: IRF for the internet user rate effect on the employment rate, E.U. and E.F.T.A.
Source: Author's calculations

In this case we can state that, for the selected E.U. and E.F.T.A. countries: Austria, Belgium, Cyprus, Czech Republic, Estonia, Spain, Croatia, Italy, Netherlands, Norway, Portugal, Romania and Sweden the percentage of internet users has a significant and positive influence on the employment rate, these findings confirm the ideas from the paper written by Lehr et al (2006).

5. In conclusion

In conclusion we can state that an increase in the percentage of households with internet access leads to an increase in the employment rate at the N.U.T.S. 2 region

level for the analysed E.U. and E.F.T.A. countries (Austria, Belgium, Cyprus, Czech Republic, Estonia, Spain, Croatia, Italy, Netherlands, Norway, Portugal, Romania and Sweden). We conclude, that a way to increase the employment rate in the analysed countries could be to raise the level of internet access for the population.

Additionally the observed effects of the percentage of households with internet access on the employment rate has been different for the analysed countries, an interesting fact is that Romania, a country considered as being from Emerging Europe, had a statistically insignificant relation between the variables. This could be due to the emigration phenomenon which happened in the last decades. The emigration leads to the lack of available work force and especially of skilled labour force. The lack of statistical significance could be also because according to the scientific literature (Hardy and McCasland, 2016) the access to internet leads to an increase in demand for skilled labour, which could be in short supply in some regions.

From the analysed data an interesting example is the case of Italy in which the influence of the percentage of internet users on the employment rate is approximately 0.05, even if we saw that Italy had a period of low employment rates in the South in the beginning of the analysed time series, fact that is interesting because it leads to the conclusion that increasing the percentage of internet users is effective even in the case of low employment. Also this idea is confirmed by the case of Spain which had the influence of internet usage on employment around 0.10, even though it had both zones with low internet usage (Extremadura) and low employment (Melilla). Both of these cases lead to the conclusion that the effect of an increase in internet usage has a probable effect on employment regardless of the level of the rates of the variables.

The limits of the present paper are represented by the incomplete sample due to the lack of information for some countries of the European Union at the N.U.T.S. 2 level. Further study directions could be represented by trying to measure the impact of the household access to internet on the employment rate for different generations. A possible supposition is that young people (under the age of 25) could benefit more from the access to internet when finding a job. Also an interesting direction of study is the relation between internet access and university enrolment.

We thus conclude, that the results of this paper confirm the hypothesis of the majority of the literature review cited papers in that the increase of the percentage of internet users lead to the increase in the employment rate in the case of the analysed countries from the E.U. and E.F.T.A.. An interesting case could be made for Emerging Europe countries (in the studied case, Romania) for which the analysed relation is insignificant from a statistical standpoint. We consider that the present study offers an interesting overview regarding the real relation between the internet use and employment at the E.U and E.F.T.A. level by using the G.M.M. vector autoregressive model with panel data for the period between 2010 and 2020.

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