

REVIEW OF ECONOMIC AND BUSINESS STUDIES

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RESEARCH ARTICLE



DOES UNEMPLOYMENT LEAD TO THE BREAKDOWN OF A MARRIAGE? EVIDENCE FROM THE SLOVAK REPUBLIC

JAKUB HARMANⁱ

Abstract *In a sample of 79 districts of the Slovak Republic for the period 1997 - 2019, we examine the connection between the unemployment rate and the crude divorce rate. Our findings reveal a negative and statistically significant relationship, which suggests a pro-cyclical nature in terms of the economic cycle. The estimated coefficients are relatively consistent even after the addition of control variables considering socio - economic factors or fixed effects. The results of the regression analysis show that an increase in the unemployment rate by one percentage point is accompanied by a decrease in the crude divorce rate by an average of 0.024 units. These findings support the assumptions of the theory of the high costs of divorce that spouses must bear. In a period of high unemployment, it is more acceptable for spouses to stay married than to bear the high costs associated with legal proceedings or the loss of part of the joint savings. The analysis of possible non-linear relationships between the unemployment rate and the crude divorce rate also showed a negative relationship. Quantile regression also points to the U-shaped relationship between variables and supports the opportunity theory.ⁱⁱ*

Keywords: *crude divorce rate, unemployment, motivation, opportunity.*

JEL Classification: *E24, K42*

1. INTRODUCTION

The main institution that supports the creation of life is the family. The family is a place where the character of person is formed or a place where he

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Errors and omissions remain on the author of this article.

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acquires the basic values of society. Marriages and divorces are one of the most important demographic events shaping the family and influencing the change in the structure of family life in Slovakia. This paper deals with the factors that affect divorce rates in the Slovak Republic. The main determinant of divorce we examine is the unemployment rate. In this paper, we observe whether the crude divorce rate and the unemployment rate move in a cyclical or counter-cyclical trend. There are many scientific publications and studies that address this issue, identifying several possible perspectives (Amato and Beattie, 2011). One of the causes of divorce is the so-called stress effect. Stress has a major impact on the quality of marriage, and several studies (Conger and Elder, 1994; Johnson and Booth, 1990) have examined the impact of unemployment on divorce in this regard.

The effect of stress says that the unemployment rate is positively correlated with the divorce rate. Initially, however, optimistic expectations arise regarding the labour market situation for one of the spouses. However, if even after a long period of time one of the spouses is unable to find work, a situation with increased stress arises between spouses, e.g. a wife's frustration that her husband can't find a job makes her more likely to divorce. This hypothesis was confirmed by analyses by Jalovaara (2003) or Hansen (2005), who examined stress on the part of husbands and wives in Finland and Norway. Lewin (2005) and Bumpass (1991) also identified the effect of stress. Their studies confirmed that increased unemployment of husbands leads to higher divorce rates.

A very important work is the work of economists Becker, Landes and Michael (1977), who argue that the main benefit of marriage lies in the interdependence of spouses, which results from their differentiated roles. The husband is considered primarily the breadwinner of the family and the wife is responsible for the running of the household and the reproductive function. The authors point out that if the wife's income is higher than that of the husband, this results in a higher discomfort for the husband and an increase in his stress level. This can in turn lead to a higher probability of marriage breakdown. Cherlin (1979) argues that a husband's inability to provide the necessary resources for the family leads to increased stress even when the wife is employed. According to these authors, the effect should be greater if the variables are lagged, because the stress of reducing job opportunities takes time to affect the breakdown of the marriage.

The second perspective (Amato and Beattie, 2011) focuses on the costs associated with divorce and says that divorces are costly in terms of living standards and the accumulation of wealth. These costs include court costs, lawyers' costs, moving to a new home for at least one and often both spouses, the purchase

of new furniture, the division of matrimonial property and the general loss of economies of scale associated with splitting a household into two. During periods of high unemployment, spouses are reluctant to bear these costs for a number of reasons. One of them may be the unemployment of one of the spouses or the need to enter the labour market and start working due to the increased costs, even though there are few vacancies in the economy at that time. Another reason is that employed spouses may be concerned about future unemployment, which means that spouses value their current job more and are therefore reluctant to take the risk of divorce. McManus and DiPrete (2001) pointed out that economic interdependence between spouses has increased in recent decades due to the growing participation of women in the labour market, rising women's real wages, declining men's earnings (especially men without higher education) and greater domestic work sharing and raising children in marriage. We also include the variable for women's participation in the labour market in our research (see the Results chapter). According to this perspective, the relationship between unemployment and divorce rates should be negative and thus, with higher unemployment, the number of divorces will decrease. In the case of this perspective, the effect should be greater if the variables are contemporaneous, because the costs of divorce take effect immediately.

The third perspective, the so-called hybrid, combines the first two perspectives. According to this perspective, the relationship between the divorce rate and the unemployment rate should be negative if we measure both variables in the same period, because the effect of high divorce costs is manifested. On the contrary, we observe a positive relationship if the unemployment rate is measured in the previous period, as it expects a psychological factor of stress to manifest itself, which leads to an increase in divorce.

A study by Jensen and Smith (1990) used panel data for Denmark for analysis. In their work they came to the conclusion that unemployment really is a relevant source of instability marriages. The authors estimated the positive impact of male unemployment on the divorce rate.

Of course, there are analyses that negate the aforementioned research papers and did not find a statistically significant relationship between the rate of divorce and unemployment (Ariizumi and al., 2015). From this we conclude that it is correct to state that empirically based analyses show different results.

In our study we use panel data at the district level and unemployment over the same period and the rate of divorce for measuring variations in the economic cycle. Although from a theoretical point of view, the relationship between

unemployment and divorce is not entirely clear, our results suggest that the divorce rate and the unemployment rate are negatively correlated, even after including of variables controlling time and district fixed effects. Also in econometric models we include control variables for further characteristics of the individual districts, such as religious differences, changes in the structure of the population, the participation of women in the labour force, the legislative amendments introduced by the entry of the Slovak Republic to the European Union in 2004 and adopt the euro in 2009 as the new currency. Almost all the results show a strong pro-cyclical behaviour of crude divorce rate. A similar methodology was chosen by González - Val and Marcén (2015).

In his study, Schaller (2013) suggests that in the event of changes in the labour market, a situation may arise where married couples postpone important decisions. Therefore, it may happen that the effect of divorce will not manifest itself until the following years, when married couples make their decisions. As part of the solution to this problem, we also included delayed unemployment rates and delayed income levels in the analysis. Amato and Beattie (2011) apply the same approach, although it is not entirely clear, how long the delay can reveal this effect. Our results suggest that we can confirm this hypothesis, as the unemployment rate of one or two years has a statistically significant effect on divorce rates. The same applies to income.

In their contribution, González - Val and Marcén (2015) used a new approach to the analysis of the issue by examining the possible non-linear relationship between the crude divorce rate and the unemployment rate. The authors justify this by saying that the specific characteristics of the countries they studied, such as the unemployment rate, may not have the same distribution as the divorce rate. The authors use nonparametric methods and quantile regression, finding that the decrease in the divorce rate is greater if the unemployment rate is in the range of 15% to 25%. However, the divorce rate is still pro-cyclical. In addition, the quantile regression analysis points to a non-linear relationship between divorce rates and changes in the unemployment rate with a greater negative impact on divorce rates in countries with higher divorce rates. We apply similar methods in our paper (see chapter Results).

Hellerstein and Morrill (2011) confirmed that there is a robust negative relationship between divorce rates and unemployment in the US, with an increase in the unemployment rate by one percentage point resulting in a reduction in the divorce rate by 0.043 units. Their result suggests a pro-cyclical character and is robust to a number of alternative empirical specifications of the estimated models.

The authors Jimenéz-Rubio, Garoupa and Rosales (2016) chose an almost identical methodology as we did. On panel data from 50 provinces of Spain, they estimated the determinants of crude divorce rate. According to the results, the so-called Express Divorce Law (adopted in 2005) seems to be positively correlated with the divorce rate in the short term. Level of income and growth of income, female employment rate, and the proportion of economic migrants also positively associated with the rate of divorce.

The results of the analysis of authors Doiron and Mendolia (2012) show, that couples in which the husband experiences a job loss, are more likely to divorce. The authors also distinguish the way, in which the dismissed lost their jobs. Release in the event of redundancy has a small positive, but statistically insignificant impact on the divorce, while the release because of poor performance of the employee has a higher positive impact.

Eliason (2011) examined the impact of job loss for men and women on the risk of marriage termination in Sweden. In his study, he found that in the event of a husband losing his job, there was an average 13% higher chance, that the marriage would end in divorce. The estimated coefficient is statistically significant. If the wife loses her job, there is a chance, that the divorce will take place at about the same level, but it lacks statistical significance.

The impact of rising real estate and housing prices on divorce rates in China is being studied by Li (2018). Empirical results show that the growing housing prices significantly improve rate of divorce. With every 1 percent increase in housing costs, the divorce rate increases by 0.10 thousandths. The impact is, however, heterogeneous for different areas of China. Rising housing costs are significantly increasing the divorce rate in the eastern and central regions. In the western regions of China, the statistical significance of the increase in real estate and housing costs has not been demonstrated.

Very interesting conclusions of the study brought Weiss and Willis (1997), who argue that unexpected changes in income have an impact on the likelihood of divorce. Their results show that grow of husband's earnings reduces the likelihood, that the marriage falls apart. In the case of increased earnings of wives, the situation is exactly the opposite, higher wages of women lead to a higher chance of separation of spouses.

Compared to the previous literature, Kendall (2011) observed a non-traditional determinant of divorce rate - internet connection. In his paper, he assumed that the increase in Internet access significantly reduced the cost of finding a new partner. This should logically lead to an increase in divorce rates, as the costs of dissatisfied spouses would be at least partially reduced. Thorough examination of the theory,

however, suggests that even if the cost of finding a partner with the growth of the Internet dropped, it does not lead inevitably to increased probability of divorce.

The rest of this paper is divided into chapters, with Chapter 2 pointing to the data used. The third chapter describes the research methodology used. Chapter 4 shows the results obtained by our analysis and the last chapter 5 concludes.

2. DATA

All used data are recorded at the level of 79 districts of the Slovak Republic. Except for some variables, they all cover periods 1997 - 2019. The dependent variable in all econometric models is the crude divorce rate. It is calculated as the ratio of divorces per 1000 inhabitants during a reference periodⁱⁱⁱ. It is the crude divorce rate, that is a frequently used indicator used by scientific researchers in their analyses (Amado and Beattie, 2011; Friedberg, 1998). As reported by González-Val and Marcén (2015), the rate might be affected by the structure and marital status of the population. The divorce rate may be low either because the marriage rate is low or because the marriage is less likely to end in divorce. Despite these shortcomings, we consider the crude divorce rate to be the best indicator for monitoring the causes of marital breakdowns. We assume, that due to the fact, that we use a longer time series of the indicator, these effects will be negligible. Data on the gross divorce rate were collected from the databases of the Statistical Office of the Slovak Republic.

An excellent indicator, that can measure the fluctuation of the economic cycle is the unemployment rate. It is this indicator, that we use in our research. The unemployment rate represents the share of the labour force, that is out of work and looking for employment in the total number of economically active population. The economically active population includes both employed and unemployed workers in the labour market. The unemployment rate is commonly and widely used variable in the general research of the impact of the economic cycle because it can capture not only the situation in the labour market, but to some extent economic uncertainty. Despite the widespread use of this indicator in the literature, we assume, that it may have some weaknesses, for example that it does not capture the impact of the recession or expansion of the business cycle fully in the year under review. However, we confront this problem by estimating the impact of

ⁱⁱⁱ The exact calculation: Crude divorce rate = (number of divorces in a given territorial unit / average population of the territorial unit) * 1000

unemployment up to the previous three years using lagged variables. Data on the unemployment rate were collected from the databases of the Statistical Office of the Slovak Republic.

The average values of the gross divorce rate and the unemployment rate of 79 districts of the Slovak Republic in the period 1997 - 2019 are shown in Table 1^{iv}. The data are sorted by unemployment, from lowest to highest. At first glance, we can observe a large variance and a slightly negative relationship between the variables. Districts with a low unemployment rate more often have higher divorce rates and vice versa. Graphical representation of the unemployment rate and the crude divorce rate in individual districts provides Figure 1. However, the rule cannot be applied generally to all observed districts. Since the same legislative and legal conditions for obtaining a divorce apply throughout Slovakia, we must look for answers in other factors. For districts, that are considered strongly religious^v (Šprocha and Majo, 2016) we observe a significantly lower divorce rate compared to other districts. This statement is also confirmed by the display of data on Cartogram 1 and 2, where we observe an inverse relationship between unemployment and divorce rates in religiously oriented districts. The negative correlation is also confirmed by Figure 3, which shows data for all districts of the Slovak Republic for all observed periods. Fitted line points to a weak, but slightly negative relationship between variables. When looking at the quadratic shape of the curve with fitted values, we observe the shape to the letter U. This suggests that at lower unemployment rates, the divorce rate is at higher values and gradually decreases. From this we could conclude that there is a second perspective, which deals with the high costs of divorce. From a value of approximately 22.7 % of the unemployment rate, we observe a growing trend associated with a growing number of divorces.

Figure 2 shows the movement of the divorce rate and the unemployment rate at the aggregate level for the whole of the Slovak Republic. Showing of variables at the national level provides a simple view of their relationship and helps to identify the period of recession. We can see from the figure, that the divorce rate corresponds to the effects of unemployment in the pro-cyclical direction. However, we cannot draw conclusions from such an analysis. Therefore, we address this issue in more detail.

^{iv} All figures and tables can be found in the Annex.

^v Those are: Banská Stiavnica, Bardejov, Cadca, Detva, Dolný Kubín, Gelnica, Kezmarok, Kysucké Nové Mesto, Levoca, Namestovo, Poprad, Prešov, Sabinov, Spišská Nová Ves, Stará Ľubovňa, Svidník, Tvrdošín, Zvolen, Zarnovica, Žiar nad Hronom

Other control variables are also included in the estimated models to determine the robustness of the estimated coefficients at the unemployment rate. The male unemployment rate is one of the control variables, because we assume, that men are less likely to change jobs if there is a change in an individual's marital status. Data is collected from the database of the Statistical Office Slovak Republic and due to the lower availability cover the period of 2001 – 2019.

In order to be able to take into account the income of individuals and its impact on divorce rates, a variable explaining the average monthly wage in the relevant year is incorporated into the models. A better variable, that could explain the possible risk of divorce for financial and property reasons, would be gross domestic product per capita. Due to the lack of data at the district level, we chose the average monthly wage as a proxy variable expressing the level of wealth in the respective districts. The data were collected from databases of the Ministry of Labour, Social Affairs and Family of the Slovak Republic and cover the period 2008 - 2019. The amounts of monthly income as well as the distribution of wages at the national level are shown in Cartogram 3. Looking at Cartograms 1 and 3 we observe, that in districts with higher income there is also a higher divorce rate. This suggests a positive relationship between the variables. Of course, drawing such conclusions is ambiguous. We examine the relationship in detail in the Results chapter.

The consideration of the age structure of the population of individual districts is controlled by a variable showing the median age. We assume, that older people will have a lower motivation to divorce and also a lower motivation to change or leave their job. Therefore, we expect the divorce and unemployment rates to be lower with higher age. Data on the median age are obtained from the Statistical Office of the Slovak Republic and follow the entire time period 1997 – 2019.

The dummy variables that control changes in political and legislative norms like accession to the European Union in 2004 and the adoption of the euro as national currency in 2009. These variables become "1" if the country already belongs to the European Union or has adopted the euro. If this has not yet happened, the variables have a value of "0".

3. METHODOLOGY

The general equation to estimate has the following form:

$$CDR_{it} = \beta_0 + \beta_1 Unemployment_{it} + \beta_2 X_2 + \alpha_t + \psi_i + \psi_i \alpha_t + \varepsilon_{it} \quad (1)$$

where CDR is the crude divorce rate of the district i in year t , Unemployment it is the unemployment rate of the district i in year t . X_2 shows the

control variables, that are included in the model for checking the robustness of unemployment rate estimates. α_t is a vector of time effects individual districts ($\sum_{t=1}^{t-1} Year_t$), which captures the effect of unobserved characteristics, that differ at the level of districts and also in time. ψ_i is the vector of fixed effects, individual district $\sum_{i=1}^{n-1} District_i$, which captures the effect of unobserved characteristics that differ at the level of districts and are time-invariant. $\psi_i \alpha_t$ expresses a linear time trend specific to each monitored district ($\sum_{i=1}^{n-1} District_i * Year_t$). ε_{it} is the residual or error of the model.

This specification of the econometric model is used by several authors (Schaller, 2013; González - Val and Marcén, 2015; González - Val and Marcén, 2017). It is based on the exogeneity of differences in unemployment rates between districts, although some concerns may still arise. According to González - Val and Marcén (2015), it is likely, that if women's marital status changes, their approach to finding a job may change significantly, which in turn affects the unemployment rate. We will confront this problem in the next chapter.

The main interest of this paper is to find out the nature and size of the coefficient, which speaks to the effect of the unemployment rate on the divorce rate. From a theoretical point of view, we could not confirm, whether this coefficient will be positive and will be anti-cyclical in nature, or negative and thus pro-cyclical.

4. RESULTS

Table 2 shows the results of the correlation analysis of paired coefficients between individual variables. We observe a correlation coefficient between divorce rate and unemployment rate with a value of -0.297 (p-value = 0.000), which suggests, that there is a negative and significant relationship between the variables. From this we could conclude the pro-cyclical nature of this relationship. This result is also supported by Figure 3. The correlation coefficient acquires a very similar value, even if we observe the relationship between the male unemployment rate and the divorce rate, where it acquires a value of -0.236 (p-value = 0.000). There is almost no correlation between income and divorce (0.084; p-value = 0.010) and therefore these variables have no link between them. This statement seems unlikely to us, which we try to prove in the following pages using regression analysis. An interesting value is the correlation coefficient in the relationship between divorce rate and women participation in the labour market, which speaks of a strong link between variables (0.564; p-value = 0.000). In translation, this means that higher participation of women in the labour market leads to an increase in divorce rates.

We expect similar results in the case of regression analysis. The relationship between divorce and religion is expected to be negative. Divorces contradict the Christian faith, which is also reflected in the value of the coefficient -0.405 (p -value = 0.000). Legislative, legal and political changes according to the correlation analysis do not have a significant effect on the divorce rate. In the case of accession to the European Union, the value of the coefficient is even 0.000 (p -value = 0.993), which indicates zero correlation. In the case of the adoption of the euro as the new legal tender in 2009, it is 0.184 (p -value = 0.000), which indicates a weak but slightly positive correlation between the variables.

Table 3 shows the results of the regression analysis of the models from equation (1), all regressions being weighted by the population of the given district. The model in column (1) shows the estimated coefficient without any control variables or fixed district and year effects or their interaction, which acquires a negative and statistically significant value of -0.024 . After adding the fixed effects of districts, time effects and the interaction between them, column (2), the estimated coefficient remained consistent, statistically significant and changed only minimally to -0.026 . That implies, that the partial removal of unobserved characteristics results in a slight increase in the impact of unemployment on divorce. The result shows, that an increase in the unemployment rate by one percentage point leads to a reduction in the number of divorces per 1,000 inhabitants by an average of 0.026 . In the case of average crude divorce rate in the Slovak Republic it would lead to a reduction of approximately 1.32% . This statement is also confirmed by the estimated coefficient in column (3), where the variable crude divorce rate is in the logarithmic form. The results are consistent with those of other studies (Schaller, 2013; González - Val and Marcén, 2015).

There may be concerns among the variables as to whether exogeneity is guaranteed. There is a presumption, that the increased / decreased unemployment rate is caused by the divorce. Fernandez and Wong (2014) state that if women do not marry during their lifetime, or divorced women do not remarry, it is likely that more women will participate in the labour market. However, empirical confirmation of this relationship is lacking in the literature. González - Val and Marcén (2015) point out, that the increase in the divorce rate causes only a negligible change in the employment rate of women. Regarding male unemployment, we assume that men are more resilient and less prone to job loss in the labour market if they lose their married status. For this reason, we estimate

equation (1) again, but we use the male unemployment rate^{vi} as a dependent variable. Column (4) shows the estimated coefficient without the involvement of control variables and also without the control of fixed or year effects. The value of the estimated coefficient is very similar to that in column (1) and again remains negative and statistically significant. Consistent estimates are also provided by the models in columns (5) and (6), which include control variables for fixed and year effects, as well as their interaction and subsequently a logarithmic dependent variable in column (6). By including the variable for the male unemployment rate, we were able to make sure that the relationship between the overall unemployment rate and the crude divorce rate does exist and is slightly negative.

In addition to unemployment, which is undoubtedly an important determinant of divorce, it is highly probable, that the economic cycle also has a significant effect on the probability of divorce and thus also on the divorce rate. If the spouses are able to be sufficiently financially secure even after their divorce, so their standard of living will not fall, or will remain unchanged, we assume, that there will be a positive correlation between income and divorce. In the opposite situation, where divorce is likely to lower significantly the standard of living of individuals during an economic recession, we expect a negative relationship between income and divorce. Such people have a significantly lower motivation to undergo the divorce process and thus lose part of their income, which they shared as spouses. Becker and al. (1977) see another reason for the negative relationship between divorce rate and income in possibility of owning assets that are undervalued during a recession and, in addition, their sale can be lengthy and costly. Such assets include, for example, real estate, expensive cars, securities or art collections. In order to be able to control the impact of the economic cycle in the regression analysis, we use the amount of the average monthly income in a given district in a given year as a proxy variable evaluating household income. The estimated coefficients are found in Table 3 in columns (7) - (10). Without any control variables, we estimate the model in column (7). The income coefficient is positive but not statistically significant, which suggests that income does not affect the divorce rate in Slovakia. However, in another model (8), which controls year and district fixed effects, the statistical significance of income was demonstrated, and, in addition, the coefficient increased significantly to 1.165. From this it follows, that the increase in income in the household leads to an increased divorce

^{vi} The male unemployment rate is calculated as the share of unemployed men looking for work in the total economically active population in a given year.

rate, as increased income leads to the fact, that couples have more money to set up a new life after divorce or being able to easily cope with the loss of value of common assets. This is also confirmed by the estimated coefficient in the following model, column (9), which also includes the variable for the unemployment rate. The value of the coefficient of effect of income remained statistically significant and decreased slightly but remains positive. The unemployment rate is consistent even when including a variable that considers the economic cycle. The model in column (10) shows the estimate of income if the divorce rate is in logarithmic form and supports the previous results. If the amount of household income increased by 1%, the crude divorce rate would increase by 0.62%. Applying this value to the average divorce rate in Slovakia, we find that there would be approximately 0.12 more divorces per 1,000 inhabitants.

Important factors, that may affect whether a spouse separates forever or remains married, may not come from the economic environment alone. González - Val and Marcén (2015) state, that political and institutional changes in a country can also affect divorce rates. A significant event, that took place on the political scene during the period we monitored was the accession of the Slovak Republic to the political and economic union, the European Union. The second event was the adoption of the new legal tender in 2009 - the euro. In modelling these phenomena, we used the method of dummy variables. If the Slovak Republic belonged to the European Union in the observed year, the variable acquires the value "1". In the opposite scenario, it is the other way around and the value of the variable is "0". We use a similar principle in the case of the adoption of the euro. Since 2009, the variable has a value of "1" and in the previous period a value of "0". The results of the regression analysis are summarized in Table 4. The presence of the Slovak Republic in the European Union is statistically significant according to the model in column (1) and has a positive effect on the divorce rate. From this we can conclude that the opening of new markets on European soil, which opened the space for greater employment of women or men in the labour market, leads to the fact that Slovak marriages are falling apart to a greater extent. One of the factors may also be the easier inflow of foreign capital into the economy of the Slovak Republic, as the barriers that previously prevented expansion into the Slovak market have been removed. The coefficient for the unemployment rate remained statistically significant. Its value has not changed and continues to be pro-cyclical. Minimal differences are noticeable, when we replaced the overall unemployment rate with the male unemployment rate (2). The coefficient of the dummy variable remained statistically significant,

but its value decreased slightly. Taking into account the change in legal tender from the Slovak koruna to the euro in 2009, column (3), we observe, that the coefficient is not statistically significant, and the impact of the unemployment rate remains consistent. When the unemployment rate was replaced by the male unemployment rate, the coefficient of change of legal tender changed to a statistically significant one and its value increased significantly to the level of 0.361. This means, that even such a change has a significant impact on the stability of marriages in Slovakia. The impact of the male unemployment rate did not change and remained almost at its original level. Columns (5) and (6) include both dummy variables in the models, and we state that the coefficients at the unemployment rate are unchanged and remain statistically significant. The acquired values for dummy variables are also statistically significant and show a consistent character compared to previous models.

A very important factor influencing whether spouses divorce or remain in the sacred union is their age. According to Peters (1986), older people are less prone to divorce than younger people, because they are used to each other and are less determined to make such a fundamental change in their lives. For this reason, we expect, that the age structure of the population will mean a lower divorce rate with older age. In order to be able to control the age structure of Slovakia, we use the median age indicator for each district as a proxy variable. This indicator divides the population into 50% of those who are younger than the value of the indicator and 50% of those who are older. The results are shown in Table 5. Column (1) includes this variable and its coefficient is statistically significant and positive. This suggests, that the higher the age of the Slovak population, the higher the divorce rate. As the population of the Slovak Republic ages, the number of divorces is also increasing. Interestingly, the impact of the unemployment rate remained negative but lost statistical significance. Women's participation in the labour market is also included as a control variable and is shown by the model in column (2). The coefficient is assumed to be positive and statistically significant. This suggests, that if there are more women in the labour market, the divorce rate also increases. We associate this phenomenon mainly with the fact that women, who find work, have an increased income, and therefore it is easier for them to become independent in the event of divorce. The unemployment rate coefficient remains pro-cyclical and statistically significant at the 90% significance level. The inclusion of both mentioned variables in model (3) does not change their statistical significance or their size. It is interesting, however, that for the first time, the sign of the unemployment rate has acquired a positive character, which, however, is very close

to zero and is not statistically significant. Religion is an important cultural element, that significantly affects divorce rates. In the Slovak Republic, the most common religion is Catholic. However, there are districts, where people are considered stronger believers who follow Catholic teaching more honestly (Šprocha and Majo, 2016). In order to control the influence of religion, we use a dummy variable, the value of which "1" is acquired by districts that are considered strongly religious. Other districts where devotion to the faith is more moderate acquire a value of "0". The results are again observable in Table 5. As expected, the coefficient for religion, column (4), is negative (-0.554) and statistically significant. This means that strong Catholicism leads to a lower divorce rate by an average of up to 0.5 divorces per 1,000 inhabitants. The unemployment rate maintains pro-cyclical value and statistical significance. The inclusion of all three variables (column (5)) confirms the effects of all variables identified so far. The unemployment rate is losing statistical significance and becoming positive. The models in columns (6) and (7) assert the findings from previous models even if the unemployment rate has been replaced by the male unemployment rate. However, it is not statistically significant and its values are equal and very close to zero.

Whether partners choose to end their marriage may be due to the accumulation of stress over a longer period of time. Loss of employment in the past can lead to accumulation of tension between spouses who either for financial or family reasons decided to continue living together despite the loss of job. Due to time and the growing number of disagreements and conflicts, the spouses decide to end their marriage even though their financial situation is not ideal and the costs of divorce are high. Amato and Beattie (2011) expect that in such a situation, the unemployment rate at time t will have a negative effect on the divorce rate and the delayed unemployment rate will have a positive effect. To point out the validity of this statement in the Slovak Republic, we included in the model the lagged variables for the unemployment rate up to the year $t-2$, as it is possible that there is a difference between the date of marriage and the date of divorce.

The results of the regression analysis are shown in Table 6. In column (1), we observe a negative relationship with the unemployment rate in *year t*, which, however, is not statistically significant and is very close to zero. However, the unemployment rate in the previous year ($t-1$) is statistically significant and is also negative. The cumulative effect of the unemployment rate is -0.032 with the common test F-statistic = 14.07 ($p > F = 0.000$). This means that the impact of the unemployment rate is consistent even after taking into account the time lag. As in previous models, we used the male unemployment rate in this case as a variable controlling potential bias

(column (2)). The effect of the unemployment rate again showed statistical significance only with a delayed unemployment rate with a cumulative effect of -0.030 and with a common test F-statistic = 34.57 ($p > F = 0.000$).

If we take into account the high costs of divorce, then we must also take into account household income. To account for fluctuations in income due to the economic cycle, we used the same method as for the unemployment rate, and we included in the models lagged variables for the amount of income, which we use as a proxy variable taking into account the economic cycle. Column (3) provides a view of the estimated coefficients. All the estimated coefficients are statistically significant and positive, indicating that higher incomes lead to an increase in the divorce rate. The total effect of income has a cumulative value of up to 1.095 with test F-statistics = 18.61 ($p > F = 0.000$). The effect will be halved if we add the unemployment rate, including lags (column (4)). Almost all the estimated coefficients in this model lost statistical significance, but their nature in the form of a negative effect of the unemployment rate and a positive effect of income remained. That implies that the psychological approach in relationship of divorce rate and the unemployment rate cannot be confirmed.

So far, we have assumed that the relationship between the crude divorce rate and the unemployment rate is linear. The next part of the analysis deals with the nonlinear possibilities of this relationship. A similar approach is used by studies by González - Val and Marcén (2015), who examine the relationship in a sample of 29 European countries. We assume that the districts where it is difficult to find a job, districts with higher unemployment rates, will show a lower rate of divorce because it is harder to keep living standards after job loss. The benefits of the spouses remaining married are higher in districts with a higher unemployment rate. In order to be able to test these effects and accept or reject them, we perform a kernel density analysis that gives us the answer to the distribution of data across the sample and a quantile regression that gives the answer to a possible nonlinear relationship between variables. The advantage of nonparametric tools is that they do not assume an exact functional relationship between the variables and therefore can take into account nonlinearity that changes over time. Figure 4 shows kernel density analysis of the relationship between the crude divorce rate and the unemployment rate. In the absence of a relationship between the variables, the data density would be concentrated on one of the axes. From the figure we observe that the relationship between the variables is not strong but still a certain one exists. The highest concentration of data is around 1.8 divorces per 1000 inhabitants and at the same time a 3% unemployment rate. There is a slightly negative relationship

between the variables, and thus if the divorce rate decreases, then unemployment increases, which follows and confirms the results obtained using linear methods. A similar display of data is provided by Figure 5, which shows the issue in 3D.

To further elucidate the relationship between the variables, we performed an analysis using a nonparametric method^{vii}. Figure 6 provides an overview of the estimated model with a 95% confidence interval. The expected negative relationship with the unemployment rate until around 22.5% was confirmed. At higher unemployment rates, the crude divorce rate increased significantly, indicating that the high rate of unemployment, which have economic and social problems in families and marriages leading to tension between spouses, resulting in increased divorce rate.

In order to be able to take into account possible heterogeneous effects in the relationship between divorce rate and unemployment rate, we estimate a quantile regression^{viii}. Quantile regression can take better account of data variability and possible fluctuations from the mean than the least squares method. The analysis also considers potential heteroscedasticity. Figure 7 provides an insight into the estimated model of quantile regression, which includes fixed effects as well as year effects and is weighted by the population of individual districts. The results are very similar to the previous ones. They support the assumption of a negative relationship between the variables in the first four quantiles, which suggests that in districts with a low divorce rate, the impact of the unemployment rate is higher than in other districts. From the 4th quantile, the relationship reverses and the curve becomes increasing. The values of the whole curve are very close to zero, which indicates that the relationship between the variables is weak.

5. CONCLUSION

The breakdown of a marriage is a very important moment in an individual's life. The paper deals with the relationship between the crude divorce rate and the unemployment rate. As for the theoretical aspects of the issue, the direction of the impact of loss of employment on the stability of marriage is not entirely clear. The potential impact of the unemployment rate can be understood from several perspectives. The effect of stress presupposes a positive effect of job loss on the probability of divorce, as the tension between the spouses increases. The opposite

^{vii} We used the STATA program and the `lpolyci` command.

^{viii} The estimated model has the form: $CDR_{it} = \beta_0(k) + \beta_1(k)Unemployment_{it} + \alpha(k)_{it} + \psi(k)_{it} + e_{it}$, it , where k is the quantile corresponding to the crude divorce rate.

effect is assumed by a perspective that considers the costs of divorce associated with, for example, legal acts, the division of property as a result of the breakdown of a marriage or the need to build a new background. Empirical research on a given relationship shows different results.

The paper examines data collected for all 79 districts of the Slovak Republic in the period 1997-2019. The results suggest that the relationship between crude divorce rate and unemployment rate is negative and statistically significant, suggesting a pro-cyclical nature of the response to changes in conditions with respect to the economic cycle. Several studies, the results of which are compared with ours, came to the same conclusions. Verification of the robustness and consistency of the estimates was performed by including control variables in the estimated models. Even after considering income levels, legislative changes, religion, women's participation in the labour market or the aging factor, the estimates were relatively stable. Minor fluctuations were observed in models that controlled population aging. However, the estimated coefficients were not statistically significant and were very close to zero. The inclusion of year fixed effects and district fixed effects also confirmed the consistency of the estimates.

The research results show that the effect of job loss is not very high. An increase in the unemployment rate by one percentage point leads to a decrease in the crude divorce rate by only 0.024 units (0.024 divorces per 1000 inhabitants). The results are almost identical even if the unemployment rate is replaced by the male unemployment rate, which we assume is more resilient to dismissal or change of employment due to a change in social status.

Nonparametric methods pointed to a U-shaped relationship. The effect of the unemployment rate first increases (in negative numbers) to about 30% and then approaches zero rapidly. Quantile regression also supports this finding.

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APPENDIX

Table 1 Average gross divorce rate and unemployment rate by district

District	Crude divorce rate	Unemployment rate
Bratislava IV	2,82	3,51
Bratislava I	2,10	3,74
Bratislava III	2,47	3,81
Bratislava V	2,73	3,84
Bratislava II	2,61	3,94
Senec	2,33	5,04
Pezinok	2,44	5,30
Trencin	1,91	5,36
Ilava	1,97	5,89
Piestany	1,96	6,70
Trnava	2,13	6,95
Puchov	1,71	7,16
Malacky	2,18	7,20
Banska Bystrica	2,46	7,65
Nove Mesto nad Vahom	2,07	7,87
Zilina	1,88	8,13
Hlohovec	2,02	8,34
Galanta	2,15	8,36
Myjava	2,03	8,47
Skalica	2,13	8,55
Nitra	2,09	9,30
Kosice IV	2,21	9,33
Martin	2,40	9,38
Zvolen	2,43	9,80
Kosice I	2,51	9,89
Dunajska Streda	2,27	10,05
Považska Bystrica	1,83	10,11
Prievidza	2,24	10,12
Banovce nad Bebravou	1,99	10,23
Kosice II	2,38	10,23
Senica	2,15	10,30
Liptovsky Mikulas	2,09	10,39
Kosice III	2,36	10,63
Topolcany	2,04	10,95
Cadca	1,46	11,17
Ruzomberok	1,93	11,33
Partizanske	2,01	11,58
Turcianske Teplice	1,94	11,83
Tvrdosin	1,03	11,95
Sala	2,20	11,99

District	Crude divorce rate	Unemployment rate
Namestovo	0,74	12,11
Poprad	1,71	12,11
Bytca	1,39	12,17
Stara Lubovna	0,82	12,62
Kysucke Nove Mesto	1,67	12,83
Zlate Moravce	1,75	12,91
Dolny Kubin	1,59	13,35
Nove Zamky	2,22	13,57
Ziar nad Hronom	2,20	13,77
Komarno	2,29	14,99
Presov	1,48	15,08
Detva	1,82	15,59
Levice	2,20	15,59
Humenne	1,73	15,63
Brezno	1,82	15,65
Banska Stiavnica	2,30	15,96
Spisska Nova Ves	1,53	16,79
Krupina	1,75	17,00
Stropkov	1,26	17,35
Levoca	1,25	17,39
Snina	1,50	17,63
Zarnovica	1,87	18,38
Svidnik	1,29	18,60
Bardejov	1,19	18,83
Medzilaborce	1,35	18,98
Michalovce	1,90	19,12
Gelnica	1,31	19,93
Kosice - okolie	1,49	20,03
Lucenec	2,43	20,58
Vranov nad Toplou	1,26	20,87
Poltar	1,94	21,22
Sabinov	0,85	21,53
Sobrance	1,29	21,85
Trebisov	1,68	22,96
Vel'ky Krtis	1,89	23,11
Kezmarok	1,23	23,89
Roznava	2,25	24,44
Revuca	2,13	26,68
Rimavska Sobota	2,17	29,09
Slovak Republic	1,97	12,44

Source: Statistical Office of the Slovak Republic

Note: The data show the average value of the gross divorce rate and the unemployment rate by district for the period 1997 - 2019.

Table 2 Correlation matrix

	Crude divorce rate	Unem. rate	Unem. rate (male)	Income	Age (median)	Women	Religious	Euro	EU
Crude divorce rate	1.000								
Unemployment	-0.297 (0.000)	1.000							
Unemployment(male)	-0.236 (0.000)	0.989 (0.000)	1.000						
Income	0.084 (0.010)	-0.654 (0.000)	-0.645 (0.000)	1.000					
Median age	0.405 (0.000)	-0.544 (0.000)	-0.523 (0.000)	0.532 (0.000)	1.000				
Women	0.564 (0.000)	-0.331 (0.000)	-0.252 (0.000)	-0.269 (0.000)	0.185 (0.000)	1.000			
Religious	-0.405 (0.000)	0.193 (0.000)	0.165 (0.000)	-0.166 (0.000)	-0.392 (0.000)	-0.198 (0.000)	1.000		
Euro	0.000 (0.993)	-0.240 (0.000)	-0.187 (0.000)	0.237 (0.000)	0.582 (0.000)	0.106 (0.000)	0.000 (1.000)	1.000	
EU	0.184 (0.000)	-0.392 (0.000)	-0.420 (0.000)		0.511 (0.000)	0.295 (0.000)	0.000 (1.000)	0.633 (0.000)	1.000

The p-value is given in parentheses.

Table 3 Regression models

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Unemployment	-0.024*** (0.006)	-0.026*** (0.007)	-0.014*** (0.004)						-0.016** (0.008)	
Unem_male				-0.019*** (0.006)	-0.028*** (0.007)	-0.014*** (0.004)				
Income(ln)							0.131 (0.154)	1.165*** (0.150)	0.829*** (0.195)	0.622*** (0.091)
Observations	1 817	1 817	1 817	1 501	1 501	1 501	948	948	948	948
R ²	0.099	0.145	0.123	0.063	0.194	0.148	0.004	0.387	0.412	0.335
District FE	NO	YES	YES	NO	YES	YES	NO	YES	YES	YES
Year FE	NO	YES	YES	NO	YES	YES	NO	YES	YES	YES
District x Year	NO	YES	YES	NO	YES	YES	NO	YES	YES	YES

Note: The dependent variable is the crude divorce rate. Robust standard errors clustered by district are given in parentheses. In model (3) (6) and (10) the logarithmic value of the dependent variable is used. All regressions are weighted by population of individual districts. Models with the variable Male unemployment rate have a lower number of observations due to data unavailability and map the period 2001 - 2019. Models with the included variable Income have fewer observations due to lack of data and take into account the period 2007 - 2019. *** p <0.01; ** p <0.05; * p <0.1

Table 4 Regression models taking into account legislative changes

	(1)	(2)	(3)	(4)	(5)	(6)
Unemployment	-0.024*** (0.007)		-0.027*** (0.008)		-0.025*** (0.008)	
EU	0.505*** (0.035)	0.320*** (0.044)			0.519*** (0.030)	0.320*** (0.046)
Unem_male		-0.025*** (0.007)		-0.033*** (0.008)		-0.030*** (0.008)
Euro			0.007 (0.065)	0.361*** (0.083)	0.103* (0.062)	0.361*** (0.081)
Observations	1 817	1 501	1 817	1 501	1 817	1 501
R ²	0.203	0.219	0.145	0.218	0.204	0.243
District FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
District x Year	YES	YES	YES	YES	YES	YES

Note: The dependent variable is the crude divorce rate. Robust standard errors clustered by district are given in parentheses. All regressions are weighted by population by individual districts. Models with the variable Male unemployment rate have a lower number of observations due to data unavailability and map the period 2001 - 2019.

*** p < 0.01; ** p < 0.05; * p < 0.1

Table 5 Regression models with control variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Unemployment	-0.009 (0.007)	-0.012* (0.006)	0.004 (0.005)	-0.019*** (0.006)	0.003 (0.005)		
Median age	0.111*** (0.016)		0.105*** (0.011)		0.086*** (0.013)	0.104*** (0.011)	0.081*** (0.013)
Women		0.101*** (0.018)	0.096*** (0.010)		0.092*** (0.011)	0.081*** (0.010)	0.076*** (0.011)
Religious				-0.554*** (0.110)	-0.196** (0.076)		-0.248*** (0.074)
Unem_male						-0.000 (0.005)	-0.001 (0.004)
Observations	1 817	1 817	1 817	1 817	1 817	1 501	1 501
R ²	0.329	0.374	0.536	0.293	0.549	0.527	0.549
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
District x Year	YES	YES	YES	YES	YES	YES	YES

Note: The dependent variable is the crude divorce rate. Robust standard errors clustered by district are given in parentheses. All regressions are weighted by population by individual districts. Models with the variable Male unemployment rate have a lower number of observations due to data unavailability and map the period 2001 - 2019.

*** p < 0.01; ** p < 0.05; * p < 0.1

Table 6: Regression models with lagged variables

	(1)	(2)	(3)	(4)
Unemployment	-0.002 (0.007)			-0.006 (0.008)
Unemployment (t-1)	-0.017*** (0.004)			-0.001 (0.008)
Unemployment (t-2)	-0.013** (0.005)			-0.012* (0.006)
Unemployment (Male)		0.010 (0.006)		
Unemployment (Male) (t-1)		-0.001 (0.005)		
Unemployment (Male) (t-2)		-0.039*** (0.006)		
Income (ln)			0.357** (0.171)	0.126 (0.193)
Income (ln) (t-1)			0.285* (0.171)	0.183 (0.159)
Income (ln) (t-2)			0.453*** (0.135)	0.367** (0.144)
Observations	1 659	1 343	790	790
R ²	0.189	0.295	0.333	0.371
District FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
District x Year	YES	YES	YES	YES

Note: The dependent variable is the crude divorce rate. Robust standard errors clustered by district are given in parentheses. All regressions are weighted by population by individual districts. Models with the variable Male unemployment rate have a lower number of observations due to data unavailability and map the period 2001 - 2019. Models with the included variable Income have fewer observations due to lack of data and take into account the period 2007 - 2019.

*** p < 0.01; ** p < 0.05; * p < 0.1

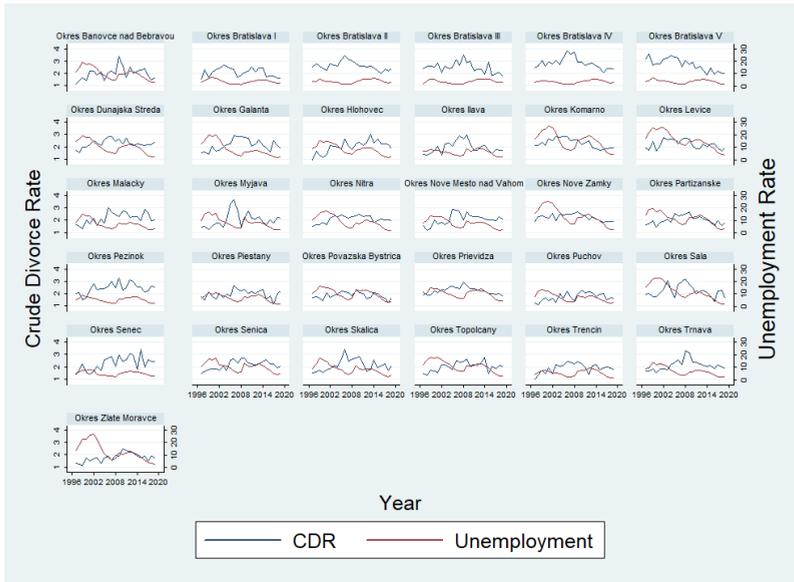


Figure 1 Crude divorce rate and unemployment rate by district

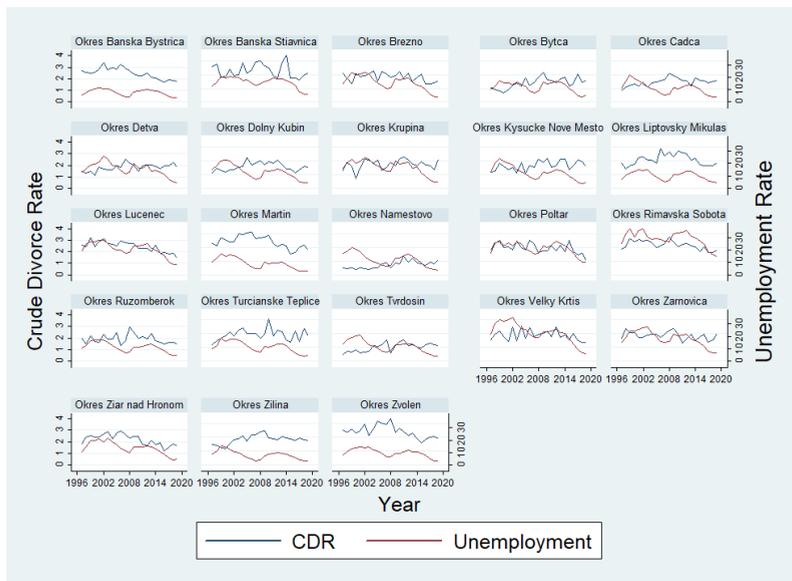


Figure 1 (continued) Crude divorce rate and unemployment rate by district

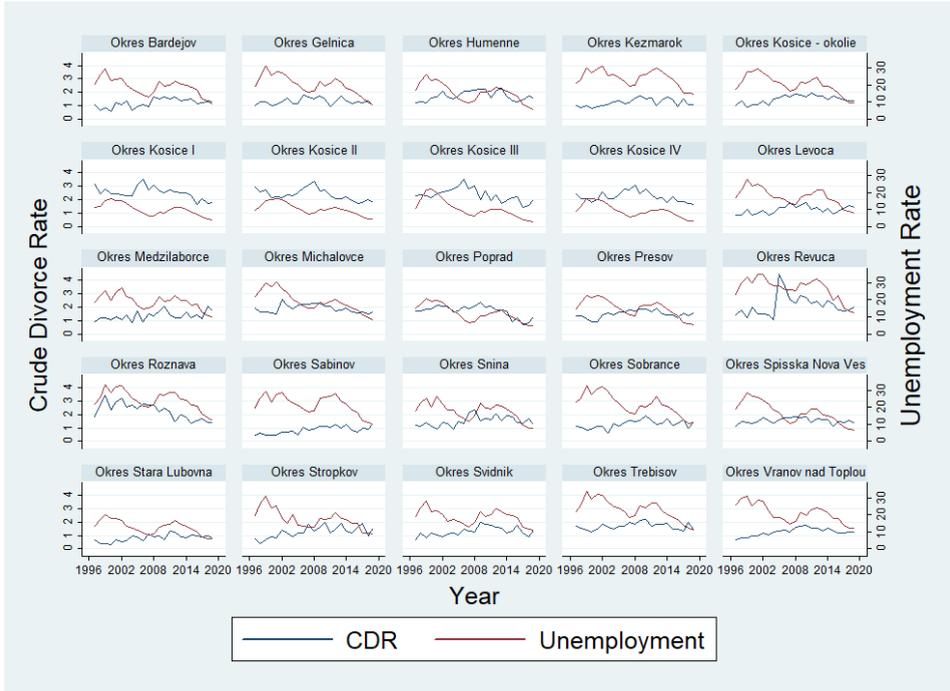


Figure 1 (continued) Crude divorce rate and unemployment rate by district

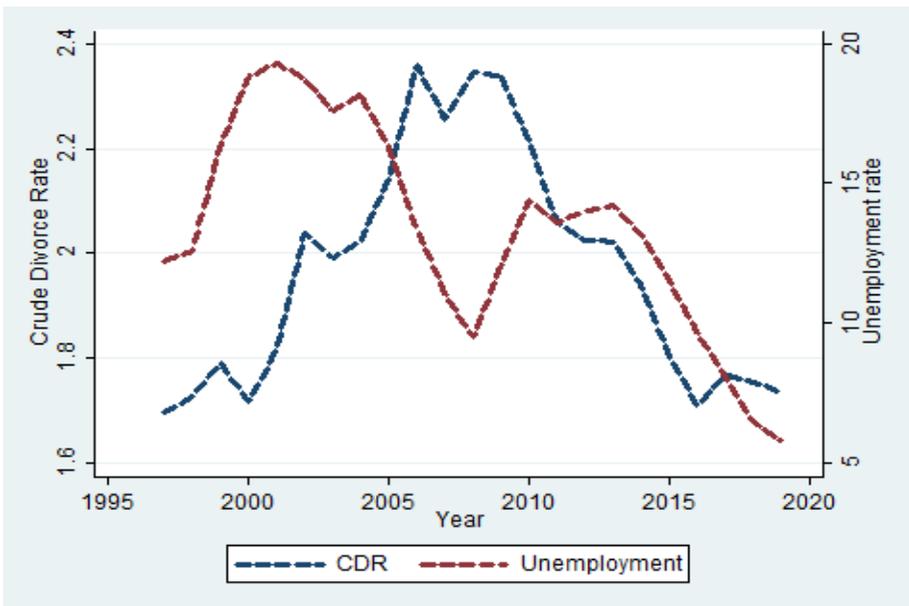


Figure 2 Crude divorce rate and unemployment rate in Slovak Republic

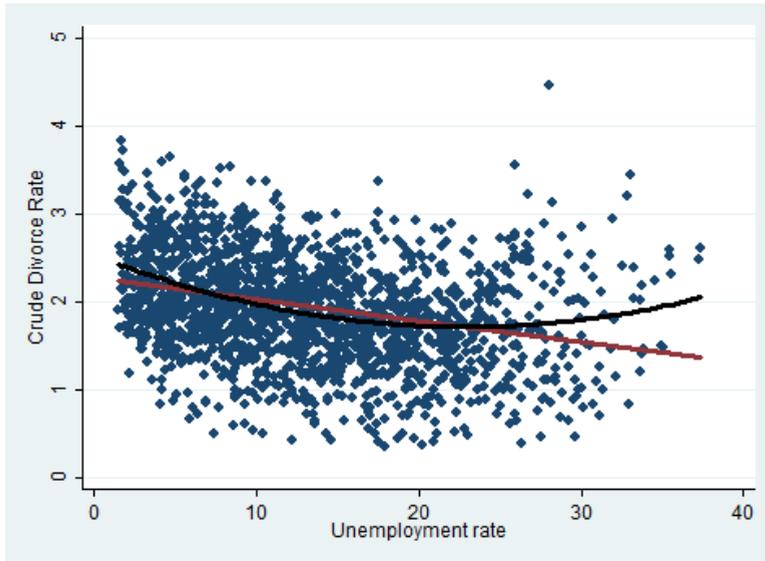
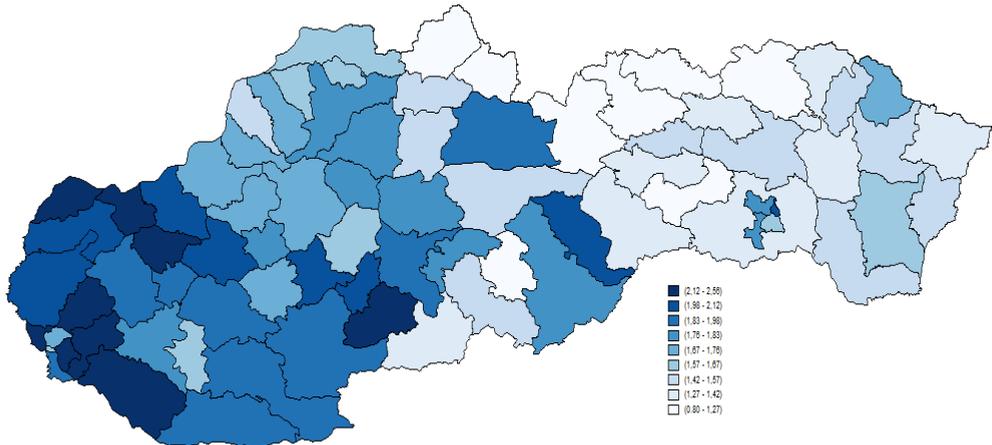
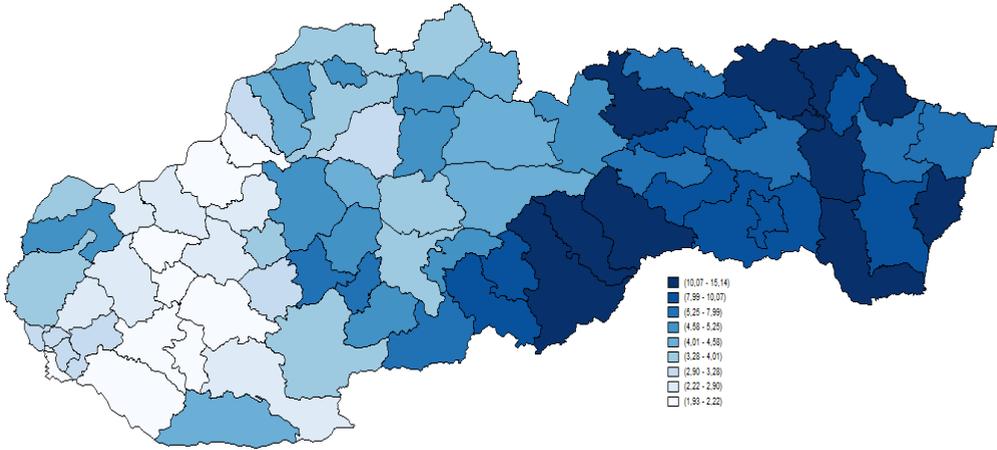


Figure 3 Scatterplot of the crude divorce rate and the unemployment rate

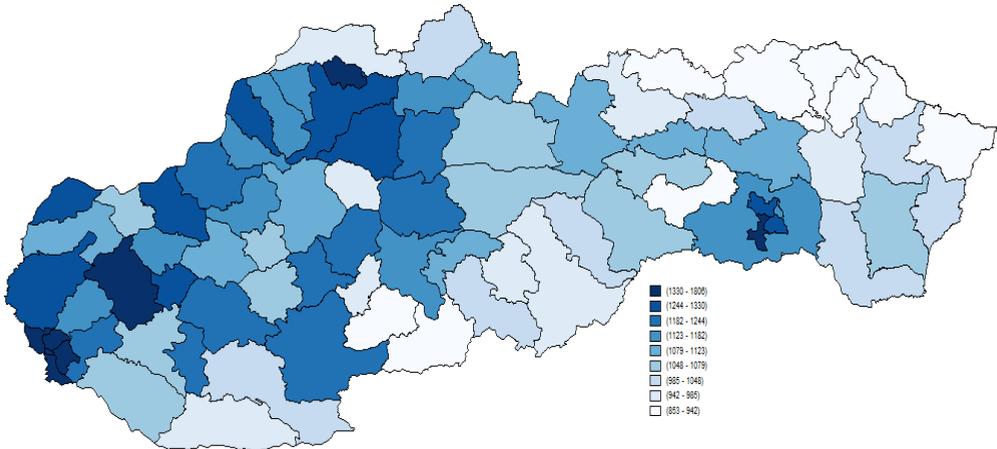
Note: The figure shows the data of both observed variables for the whole sample of 79 districts of the Slovak Republic and for the whole time period (1997 - 2019).



Cartogram 1 Crude divorce rate by district, 2019



Cartogram 2 Unemployment rate by district, 2019



Cartogram 3 Average nominal monthly income by district, 2019

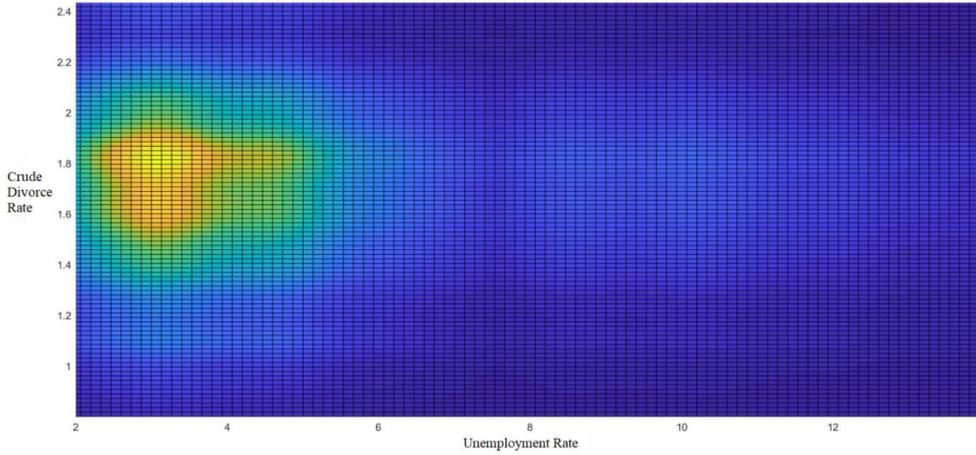


Figure 4 Kernel density analysis, 2D

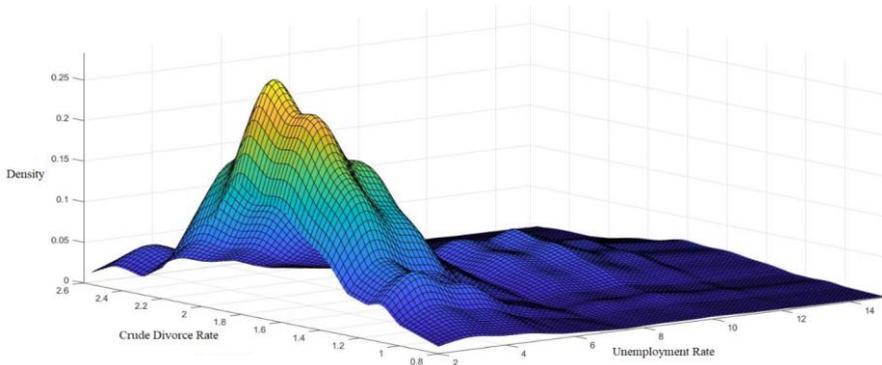


Figure 5 Kernel density analysis, 3D

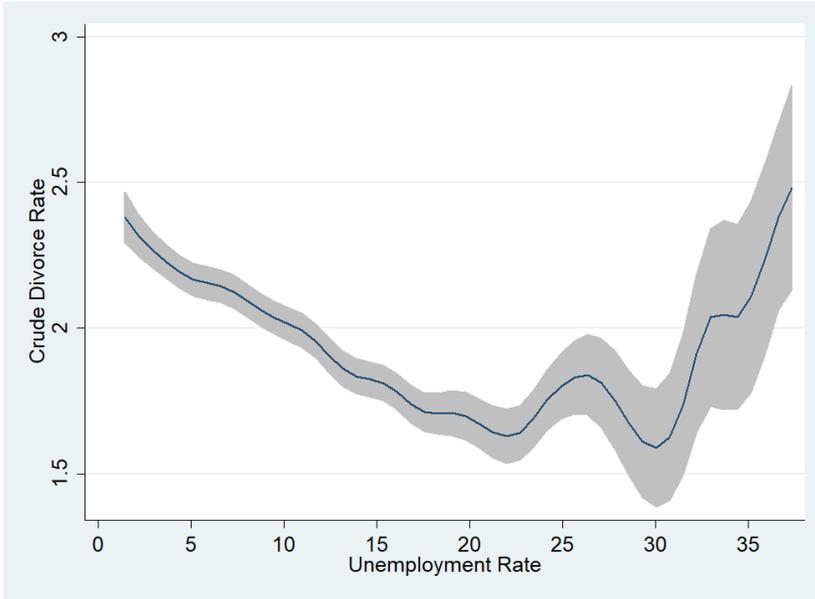


Figure 6 Nonparametric estimate of the relationship between the divorce rate and the unemployment rate

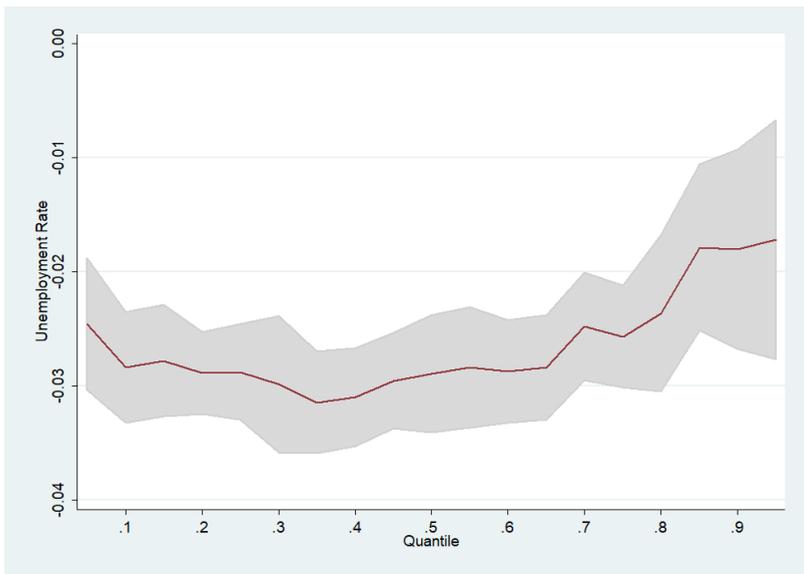


Figure 7 Quantile regression



THE IMPACT OF CORONAVIRUS PANDEMIC ON THE STOCK MARKET REACTION IN THE BANKING SECTOR. THE ROLE OF REGULATORY AND SUPERVISORY FRAMEWORK ACROSS EUROPEAN UNION MEMBERS

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Abstract: *The purpose of this paper is to assess the impact of COVID-19 outbreak upon the stock prices of the banking sector in the European Union evaluating the responses of banks from different jurisdictions with different regulatory policies and tax regimes. Using an event study technique, we examine the abnormal returns across a significant number of banks. The results show a broadly negative response of the investors to the COVID-19 pandemic official announcement. However, we found significant evidence of differences between banks from distinct jurisdictions. The investors have a stronger negative reaction for the banks from non-euro area, as well as for the banks from peripheral and semi-peripheral countries. From a regulatory perspective, the investors have an enhanced adverse reaction for banks in jurisdictions where the activities restrictions and supervisory powers are lower, and where capital requirements are tighter.*

Keywords: *bank stock prices, CDS spreads, event study, abnormal returns.*

JEL Classification: *G21, G32, G34*

1. INTRODUCTION

In this paper we aim to assess the impact of the coronavirus pandemic upon the stock market returns in the European Union banking sector, using a sample of significant financial institutions from European Union (EU) member countries. The

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rationale for choosing this theme consists of the importance to provide further evidence on the debate of the economic impact in light of coronavirus pandemic. Although, the repercussions of the pandemic are obvious and have a worldwide negative impact on multiple fields such as education, healthcare, as well as on the entire economy, in this paper we attempt to provide empirical evidence regarding the implications of the pandemic on investors behaviour from the banking sector. It is necessary to establish the extent to which the stock returns in the banking sector are influenced by the coronavirus pandemic announcement as well as the overall investors' reaction.

The methodological approach involves an event study technique using the stock returns of European Union publicly listed banks. Our database comprises the stock returns of 141 banks from 21 member countries of the European Union, for approximately 2 years. The event date for our study is 11th of March 2020, the day World Health Organization declared COVID-19 a pandemic. In order to capture the investors' reaction, we compute the abnormal returns using the market model, as it is one of the largely used models for this purpose, as well as the hybrid Capital Asset Pricing Model, including both regional and global factors, addressing the integration problem. Moreover, we compute the average abnormal returns across countries, we use regulatory and supervisory indices, euro area membership status and the countries' classification in the world-systems theory in order to divide the banks in subsets with different characteristics. The purpose is to identify the differences between banks from distinct EU jurisdictions.

This paper is organized in five sections. Hence the first section contains the introduction, the second section presents the literature review regarding the banking sector's reaction in the context of a pandemic, the third section consists of the event study conducted using the stock returns in the banking sector, the fourth section provides the results of our study, and section five reports the conclusions.

2. LITERATURE REVIEW

2.1 General presentation

The events that lead to pandemics are recurring biological phenomena and they cannot be realistically prevented. Pandemics seem to occur every 10 or 50 years as a result of new virus subtypes from virus re-assortment (Potter, 2001). However, the rapid spread of the virus and the fast globalization distinguish the coronavirus from other pandemics, leading to uncertainty and consequences on a large scale. Considering the facts stated above, the overall impact of the pandemic

on the stock market within the banking sector and the spillovers to the entire economy are to be difficult to quantify or predict.

The global uncertainty reached high levels in the beginning of the COVID-19 outbreak. For example, the world uncertainty index – a quarterly measure of the global economic and political uncertainty, which covers 143 countries – indicates that, even though the uncertainty decreased by approximately 60% from the maximum observed in the beginning of the pandemic, in the first quarter of 2020, it remained with approximately 50% above the historical average from 1996-2010 (Ahir, Bloom, and Furceri, 2021). The COVID-19 pandemic forced many companies to close, leading to an unprecedented interruption in the majority of industries. Moreover, the COVID-19 pandemic started a sudden “deglobalization” process through lockdown of borders among many countries (Elnahass, Trinh, and Li, 2021). The economic repercussions of the COVID-19 pandemic were named "Corononomics" by Eichengreen (2020). The entire world was hit by a "macroeconomic flu" (Baldwin and Weder di Mauro, 2020), a transient supply and demand shock. The entire world was hit by a "macroeconomic flu" (Baldwin and Weder di Mauro, 2020), a transient supply and demand shock. The economic slowdown was certainly a setback for the corporate sector, forcing the companies to scrape for financial resources to cover the operating costs as a result of revenue shortage.

In light of the unprecedented circumstances, the central banks and the governments adopted a series of policy interventions. While some measures were aimed to reduce the sharp tightening of financial conditions in the short term, others sought to support the flow of credit to firms, either by direct intervention of credit markets (e.g., government sponsors credit lines and liability guarantees), or by relaxing banks' constraints on the use of capital buffers (Demirguc-Kunt, Pedraza, and Ruiz-Ortega, 2020). The majority of the governments responded immediately to manage the economic and financial shocks by providing fiscal, monetary and macro financial stimulus. However, the lockdowns, the postponement of loan payments and the uncertain political perspective increased the systemic vulnerability of the banking sector, especially in emerging countries (Rizwan, Ahmad, and Ashraf, 2020). While the credit institutions are being urged to play an important countercyclical role for the real sector, these measures can also have a series of implications on the banking sector's resilience, for example as the creditors exhaust their existent reserve, this can damage the asset quality, threatening the banking system's stability (Demirguc-Kunt, Pedraza, and Ruiz-Ortega, 2020).

2.2 The European Union banking sector and the COVID-19 impact

Due to the reforms created after the 2008 financial crisis, the European banks were much stronger, more stable at the beginning of the pandemic in comparison with previous financial crisis. The banks' resilience, in this unprecedented economic environment, depends primarily on their access to the central banks' liquidity. ECB replied accordingly to other central banks and avoided the risk of commercial banks' liquidity shortage, but the resilience of the latter depends as well on their loss absorbing capacity and thus on their capital level. (Coupey-Soubeyran, Perego, and Tripier, 2020).

Following the Basel III agreement, signed in 2010 and completed in 2017, the capital requirements were consolidated, liquidity requirements were introduced as well as a new simpler capital rate, not depending on the risk weighted assets. Two new instruments, one adjusting the capital requirements to the financial cycle and the other one to the systemic factor of the institutions added a macro-prudential note to the previous exclusively micro-prudential framework, dedicated to individual risks prevention (credit risk, operational risk) rather than systemic risk prevention.

The European Union temporary adopted a set of rules to maximize the loan activity of the banks and thus to support households and companies recover after the COVID-19 crisis. These changes allowed credit institution to entirely play their part managing the economic shock caused by the COVID-19 crisis, through promoting credit flow. The measures were adopted by the European Parliament on June 24th 2020 (Regulation (EU) 2020/873 of the European Parliament and of the Council of 24th June 2020).

2.3 Stock market evolution during COVID-19

While the COVID-19 shock was a strong hit for the entire world in the first quarter of 2020, the consequences of the pandemic were rapidly spread to the stock market (Goodell, 2020). The global stock market reacted in a negative manner to the COVID-19 turmoil. For example, S&P 500, Dow Jones, Russell 2000, Nasdaq Composite, FTSE 100 and Nikkei 225 dropped until the end of March by approximatively 30-40% from their January values (Elnahass, Trinh, and Li, 2021). The COVID-19 crisis had a major impact on banks all around the world and harmful effects on the stock market. Many of them reported the fastest stock price decline from history.

Actions taken by the governments in order to counter the virus from spreading, such as social distancing and temporary interruption of activity in several industries that are not vital, led to the need of external financing. In this

setting, the banks played a primary role. Demirguc-Kunt, Pedraza, and Ruiz-Ortega (2020) suggest that the negative impact of COVID-19 shock on banks is stronger and more persistent compared to companies from other industries and other non-bank financial institutions, uncovering the anticipation of banks to absorb at least a part of the shock to the corporate sector. Moreover, larger banks, public banks and, to some extent, better capitalized banks suffer greater reductions in their stock returns, reflecting their greater anticipated role in dealing with the crisis (Demirguc-Kunt, Pedraza, and Ruiz-Ortega, 2020).

3. DATA AND METHODOLOGY

3.1 Sample and event date

We compile a large dataset of banks using stock prices from investing.com. The data consists of daily returns of banks from European Union over approximately 2 years, i.e. 547 trading days, from the beginning of March 2019 to 5th of April 2021. Out of the 158 banks that we initially consider, we decide to eliminate 17 banks that do not have enough data for the case study. The following table reports the countries and the number of banks from each country and the average return of stock prices.

Table 1 The list of countries used in the study

Country	Number of banks	Average return (%)
1. Austria	6	-0.033
2. Belgium	1	-0.006
3. Bulgaria	2	-0.149
4. Czech Republic	2	-0.285
5. Cyprus	2	-0.025
6. Denmark	22	0.053
7. Finland	5	0.071
8. France	18	-0.021
9. Germany	12	-0.050
10. Greece	6	0.079
11. Ireland	3	-0.081
12. Italy	17	0.020
13. Malta	2	-0.108
14. Netherlands	8	0.015
15. Poland	12	-0.118
16. Portugal	1	-0.137
17. Romania	3	0.055
18. Slovenia	1	-0.042

Country	Number of banks	Average return (%)
19. Spain	8	-0.051
20. Sweden	8	0.026
21. Hungary	2	-0.003

In the event study methodology, the timeline is made of the event date, estimation window and observation period, including different event windows. The event date is often called day 0, which represents the date of the event in question appearance. Generally, it is described as the first public announcement of the event. As the event studies are based on the assumption of market efficiency, any information arising from a specific event is rapidly incorporated in the stock price, after the first official announcement. On January 7th 2020 the Chinese authorities identify the novel coronavirus temporarily named “2019-nCoV”, on January 13th the first case of coronavirus outside of China is reported, on January 30th World Health Organization declares the outbreak a public health emergency of international concern, following that on 11th of March 2020 to be declared a pandemic by WHO Director-General. Considering this timeline, we choose to use 11th of March as the event date of the current study.

3.2 Abnormal return computation

Using an event study approach, we measure the differences between the expected returns of stock prices and the actual returns. In literature the difference resulted is called abnormal return excess return, prediction error or residual (Skrepnek and Lawson, 2001). If no abnormal price movement occurs until the event date, the expected abnormal return should fluctuate randomly around zero. Contrarily, if there is a market response to the event, the abnormal returns should become measurable on the defined event date.

There are several methods for abnormal return estimation. In literature the most used models for computing abnormal returns are the market model, the Capital Asset Pricing Model, and the Fama and French factor models. As main technique for expected return estimation we use the market model, employing the following equation:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (1)$$

where R_{it} is the log-return of bank i 's stock price at a time t , α_i is the constant term, β_i is the slope, R_{mt} is the market portfolio log-return at time t and ε_{it} is the iid error term. As market portfolio we use Euro STOXX50 index.

Through the market model inherent assumptions, the company-specific return is independent of the global market return and has an expected value of zero. Therefore, the expected return on the day of the event, conditioned by the market return is:

$$E(R_0|R_{m0}) = \alpha_i + \beta_i R_{m0} \quad (2)$$

Adjusting the actual return by subtracting the expected return we obtain the abnormal return. For every bank i at a time t we determine the abnormal return using the following equation:

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) \quad (3)$$

Where AR_{it} is the abnormal return of bank i at a time t . A positive abnormal return shows an actual return greater than the predicted one, which translates as a positive reaction of the investors and the bank's market value increases, whereas a negative abnormal return reflects an actual return smaller than the expected return. In this case the investors' reaction is negative and the market value of the bank declines.

Following the methodology used by Andries, Nistor, Ongena, and Sprincean (2020), we employ as robustness the hybrid CAPM model proposed by Bekaert, Hodrick, and Zhang (2009). This model takes into account the market integration aspect, allowing for exposure to regional and global factors at the same time. Considering the fact that our sample contains banks from Europe, we use the MSCI world index to account for the global factor and the Euro STOXX 50 to account for the regional factor employing the following equation:

$$R_{it} - r_{ft} = \alpha_i + \beta_i (R_{mt_1} - r_{ft}) + \delta_i (R_{mt_2} - r_{ft}) + \varepsilon_{it} \quad (4)$$

where $R_{it} - r_{ft}$ is the excess log-return of bank i at time t , α_i is the intercept, $R_{mt_1} - r_{ft}$ is the excess log-return of MSCI world index at time t , $R_{mt_2} - r_{ft}$ is the excess log-return of Euro STOXX 50, r_{ft} is the risk-free rate, and ε_{it} is the error term which is assumed to be independent and identically distributed (iid) with a mean of zero and a constant variance. As the risk-free rate we employ the one-month Euro Interbank Offered Rate (1M EURIBOR).

To compute the abnormal return, we use the next equation:

$$AR_{it} = R_{it} - r_{ft} - [\alpha_i + \beta_i (R_{mt_1} - r_{ft}) + \delta_i (R_{mt_2} - r_{ft})] \quad (5)$$

where AR_{it} is the abnormal return of bank i at a time t .

Based on this output we compute the average abnormal return (AAR), the cumulative abnormal return (CAR) and the cumulative average return (CAAR). First, we compute the average abnormal return following Brown and Warner (1985):

$$AAR_T = \frac{1}{N} \sum_{i=1}^N AR_{it} \quad (6)$$

Second, to assess the tock reaction over a time frame we sum the abnormal returns in any interval in the event window ($[t_1; t_2]$) in order to obtain the cumulative average return as in Morgan. Peristiani, Savino (2014):

$$CAR_i [t_1; t_2] = \sum_{t=t_1}^{t_2} AR_{it} \quad (7)$$

Third, we compute the cumulative average abnormal return using the formula *proposed* by MacKinlay (1997):

$$CAAR [t_1; t_2] = \sum_{t=t_1}^{t_2} AAR_t \quad (8)$$

In our event study we use an estimation window of 250 trading days, from day -260 to day -11 ($[-260; -11]$), where $T=0$ is the event day. MacKinlay (1997) suggests that this interval is sufficient to conduct an event study using daily data. To measure the *abnormal* returns, we consider multiple event windows to capture the immediate effects: $[-1; 1]$, $[-3; 3]$, $[-5; 5]$, $[0; 0]$, as well as the changes following the event: $[1; 1]$, $[1; 5]$.

We test the *significance* of CARs using the t test., which is one of the most popular tests employed in the literature on event studies.

3.3 Regulatory and supervisory factors

Our case study involves two perspectives, the first one includes the consequences of the pandemic on the banks' stock prices and the second one combines the data regarding the stock prices and publicly available data about regulatory and supervisory framework. For a better understanding of the results and the implications of the regulation, we analyse in cross-section the abnormal returns, grouping the banks with respect to several the regulatory indices and tax regimes. In this manner we are not only examining the overall response to the event, but we report the differences between groups of banks with different regulatory positions.

One of the reasons for turning our attention towards banking regulations and supervision comes from the fact that all crises reveal a sign of regulation and supervisory issues. An example is the global financial crisis from 2007-2009, resulting in banking problems that still affected the banks in 2013 and over 100

other systemic banking crisis which devastated economies around the world since 1970 (Barth, Caprio Jr., Levine, 2013). There are four versions of the survey covering the period 1999-2012. Since the country level regulation variables measure different levels from one period to another, we use the most recent survey, the one from 2013.

In order to account for these differences, we use bank regulatory and supervisory police measures provided by Barth, Caprio Jr. and Levine (2013) in a public database based upon responses to hundreds of questions. The indices we employ in our study are:

- overall activity restriction index – measures the extent to which the bank can engage in securities transactions, real estate transactions, insurance activities and the possibility of owning nonfinancial firms, higher values indicating grater restrictiveness;
- supervisory power index – measures the degree to which the supervisory authorities have the power to take specific action for preventing and correcting reasons, higher values indicating grater supervisory power;
- overall capital stringency – measures whether the capital requirements reflect certain risks and deducts certain market value losses before determining minimum capital adequacy, higher value meaning grater stringency (Barth, Caprio Jr., Levine, 2013)

To allow comparisons between countries with different bank regulation levels, we group them in two subgroups using the median for each index leading to six subgroups: countries with lower/higher overall activity restrictions; countries with lower/higher supervisory power and countries with lower/higher overall capital stringency.

The table reports the indices values provided by the World Bank (Bank Regulation and Supervision Survey) for each country. The first column reports the country, the second column reports the overall activity restriction index values, the third column reports the supervisory power values and the last column reports the overall capital stringency values.

Table 2 Regulatory and supervisory indices

Country	Overall activity restriction index	Supervisory power index	Overall capital stringency index
Austria	4	12	2
Belgium	5	11	5
Bulgaria	5	11	6
Cyprus	7	11	6
Czech Republic	-	-	-

Country	Overall activity restriction index	Supervisory power index	Overall capital stringency index
Denmark	7	11	4
Finland	5	5	5
France	8	10	6
Germany	-	11	6
Greece	6	8	6
Hungary	5	13	2
Ireland	4	6	7
Italy	7	13	5
Malta	8	12	6
Netherlands	5	11	6
Poland	11	11	6
Portugal	5	12	2
Romania	4	12	6
Slovenia	6	14	5
Spain	5	9	6
Sweden	-	-	-

3.4 Tax regimes

Regarding the tax regime, we choose to divide the countries using two criteria: the eurozone membership and the world-systems theory position. At this moment, 19 countries out of 27 are members of Eurozone. In our sample, the Eurozone members are: Austria; Belgium; Cyprus; Finland; France; Germany; Greece; Ireland; Italy; Malta; Netherlands; Portugal; Slovenia; Spain. The countries in our sample outside the Eurozone are: Bulgaria; Czech Republic; Denmark; Poland; Romania; Sweden; Hungary. Thus, we grouped the banks in these categories according to the country they belong to.

In line with the world-systems theory, we group the countries in two subgroups: core countries and periphery or semi-periphery countries. The core countries are wealthy, industrialized countries that periphery and semi-periphery countries depend on. The countries from our sample belonging to this group are, according to Chase-Dunn, Kawano, Brewer (2000): Austria; Belgium; Denmark; Finland; France; Germany; Ireland; Italy; Netherlands; Portugal; Spain; Sweden and the periphery and semi-periphery countries are: Bulgaria; Czech Republic; Cyprus; Greece; Malta; Poland; Romania; Slovenia and Hungary.

4. RESULTS

4.1 Descriptive statistics

Descriptive statistics reported in Table 3 indicate an average return over the period selected for the study of -0,01% with a minimum return of -251,80%, a maximum of 274,08% and a standard deviation of 3,19%. Table 4 reports descriptive statistics over the period before the official announcement of the pandemic as well as over the period after the announcement. The average return before the announcement is -0,08% and after the announcement it reaches 0.05%. Although the average return shows an increased value, it also reports a higher standard deviation from 2,57% to 3,68% indicating a higher risk. The minimum value before the event is -25,60% and after the event it is -251,80% and regarding the maximum values, before the event the value is 274,08% and after the event the value being 83,41%.

The table reports descriptive statistics for the daily returns for the banks included in our sample.

Table 3 Descriptive statistics for the entire sample

Variable	N	Mean	Std. Dev.	Min	Max
Return	72,877	-0.0001	0.0319	-2.5180	2.7408

The table reports descriptive statistics for daily returns of banks included in our sample by variable Dummy COVID. The variable takes value of 0 for the period before the event and the value of 1 for the event day and after the event.

Table 4 Descriptive statistics before and after the announcement

Dummy COVID	N	Mean	SD	Min	Max
0	35576	-0.0008	0.0257	-0.2560	2.7408
1	37301	0.0005	0.0368	-2.5180	0.8341
The difference between returns before and after the COVID event		-0.0013	0.0002		
p-value		0.0000			

4.2 Cumulated average abnormal returns

Table 5 reports the average abnormal returns cumulated for all of the 141 banks within our sample. We use both the Market Model and the Capital Asset

Pricing Model to compute the abnormal returns, thus we report the results for both methods in Table 5.

This table reports the cumulated average abnormal returns and the p-values for six event windows.

Table 5 Cumulated average abnormal returns

	CAAR (-1,1)	CAAR (-3,3)	CAAR (-5,5)	CAAR (0,0)	CAAR (1,1)	CAAR (1,5)
CAAR (MM)	-0.0513***	-0.1236***	-0.1612***	-0.0120***	-0.0474***	-0.0903***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CAAR (Hybrid CAPM)	-0.0464***	-0.1081***	-0.1465***	-0.0013	-0.0429***	-0.0782***
	0.0000	0.0000	0.0000	0.5207	0.0000	0.0000

The cumulated average abnormal returns are useful for studying the aggregate results of abnormal returns over the entire sample or over sub-samples. Table 5 shows the average abnormal returns over the whole sample along with the associated p-values in order to express the significance of the results. The CAARs are reported for the six event windows that were used for computing the abnormal returns: [-1; 1], [-3; 3], [-5; 5], [0; 0], [1;1] and [1; 5]. The CAARs for event window [0; 0] and [1; 1] are the cumulated average abnormal returns on the event day and the day after.

On all of the event windows considered in the study, including the event day (11th of March 2020), the day the COVID-19 pandemic was announced, the market has a negative reaction, indicating a pessimistic behaviour of investors. The remark stated before results from the negative sign of the CAARs, which are also significant over all windows. These results and interpretations are valid for the CAARs calculated using the market model, as well as for the ones calculated with the hybrid CAPM. The CAARs obtained are similar for both methods of estimation.

The results indicate a “stigma effect” generated by the official announcement of the pandemic. The market participants perceive the announcement as a threat for the banks, thus the investors’ wealth suffer a drop. Investors’ reaction does not occur only on the event day, the negative reaction before the announcement indicating an anticipation of the event, potentially caused by the increasing number of the coronavirus cases all over the globe.

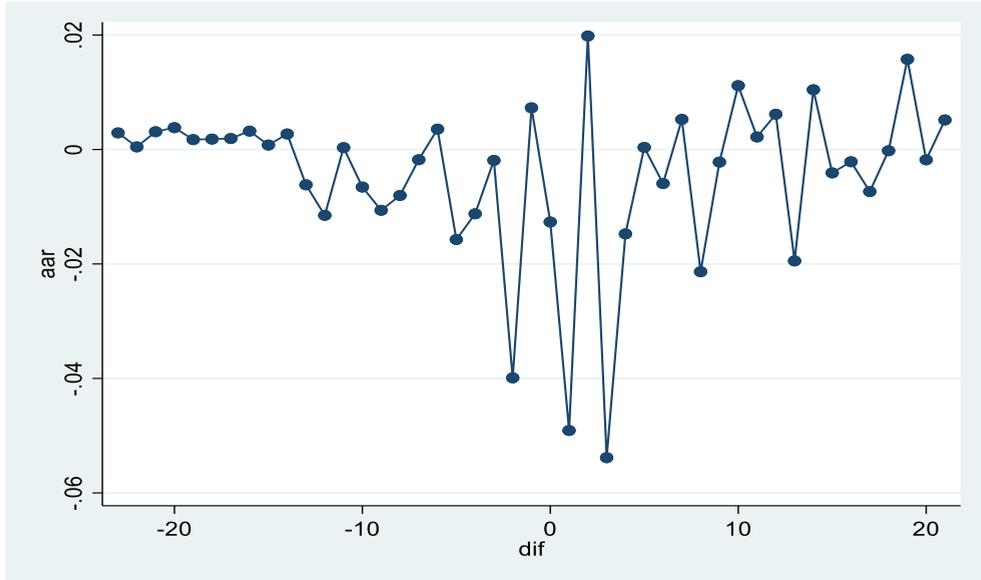


Figure 1 Average abnormal returns

The figure shows the evolution of average abnormal returns over the event window $[-20; 20]$, day 0 being the day of the official announcement of coronavirus pandemic. The abnormal returns are computed using the market model.

The graphic representation above denotes an increased volatility of average abnormal returns around day 0. Moreover, we can note that before February 25th, the average abnormal returns fluctuate around the value 0 and after that day the volatility starts increasing, reaching an extreme volatility around the official announcement day. The fluctuation that starts on February 25th can be explained by the Centers for Disease Control and Prevention announcement which detailed the characteristics of a pandemic and specified that the COVID-19 epidemic will perhaps classify as a pandemic.

4.3 Comparisons between cumulated average abnormal returns at country level

We conduct this study using European Union countries, so we consider appropriate a comparison between each country. In order to reflect the differences, we calculate the cumulated average abnormal return for every country.

The table reports the CAARs for each country for the six event windows¹.

¹ For the same sample, we ran the hybrid CAPM and we obtained similar results.

Table 6 Cumulated average abnormal returns at country level using the market model

	CAAR (-1,1)	CAAR (-3,3)	CAAR (-5,5)	CAAR (0,0)	CAAR (1,1)	CAAR (1,5)
Austria	-0.0668*** 0.0000	-0.1550*** 0.0000	-0.2715*** 0.0000	-0.0254*** 0.0001	-0.0489*** 0.0000	-0.2094*** 0.0000
Belgium	-0.0114 0.6088	-0.1088*** 0.0049	-0.0092 0.8404	0.0122 0.2616	-0.0629*** 0.0000	-0.0889*** 0.0023
Bulgaria	-0.1422*** 0.0003	-0.4482*** 0.0000	-0.5632*** 0.0000	-0.0160 0.4008	-0.1305*** 0.0000	-0.3653*** 0.0000
Czech Republic	-0.0559*** 0.0018	-0.1890*** 0.0000	-0.3550*** 0.0000	-0.0166* 0.0551	-0.0437*** 0.0003	-0.2986*** 0.0000
Cyprus	-0.0658** 0.0324	-0.3317*** 0.0000	-0.4024*** 0.0000	0.0163 0.2736	-0.0872*** 0.0000	-0.2692*** 0.0000
Denmark	-0.0534*** 0.0000	-0.1143*** 0.0000	-0.1380*** 0.0000	-0.0116** 0.0401	-0.0426*** 0.0000	-0.0806*** 0.0000
Finland	-0.1348*** 0.0000	-0.2322*** 0.0000	-0.2707*** 0.0000	-0.0485*** 0.0000	-0.0700*** 0.0000	-0.1358*** 0.0000
France	-0.0657*** 0.0000	-0.2142*** 0.0000	-0.2276*** 0.0000	-0.0065 0.1987	-0.0686*** 0.0000	-0.1355*** 0.0000
Germany	-0.0239 0.1442	-0.0443 0.1162	-0.0883*** 0.0090	-0.0060 0.4483	-0.0291*** 0.0088	-0.0616*** 0.0040
Greece	0.0690 0.3465	-0.0895 0.4776	-0.2218 0.1412	-0.0590* 0.0982	0.0193 0.6955	-0.0898 0.3462
Ireland	0.0901** 0.0226	0.0014 0.9835	-0.2330*** 0.0042	0.0205 0.2849	0.0153 0.5633	-0.2461*** 0.0000
Italy	-0.0359* 0.0642	-0.0023 0.9456	-0.0542 0.1725	0.0188** 0.0461	-0.0294** 0.0247	0.0391 0.1202
Malta	-0.0352 0.1887	-0.0432 0.3481	-0.1405** 0.0112	0.0058 0.6551	-0.0314* 0.0830	-0.1139*** 0.0012
Netherlands	-0.0484*** 0.0002	-0.1364*** 0.0000	-0.1540*** 0.0000	0.0001 0.9842	-0.0444*** 0.0000	-0.1113*** 0.0000
Poland	-0.1428*** 0.0000	-0.2155*** 0.0000	-0.1644*** 0.0006	-0.0618*** 0.0000	-0.0971*** 0.0000	-0.0229 0.4439
Portugal	0.1302*** 0.0002	0.0159 0.7853	-0.0137 0.8451	0.0004 0.9796	0.0675*** 0.0036	0.0388 0.3815
Romania	-0.0607*** 0.0005	-0.1612*** 0.0000	-0.1922*** 0.0000	-0.0464*** 0.0000	-0.0349*** 0.0028	-0.0873*** 0.0001

	CAAR (-1,1)	CAAR (-3,3)	CAAR (-5,5)	CAAR (0,0)	CAAR (1,1)	CAAR (1,5)
Spain	-0.0276	-0.1001**	-0.1346***	0.0198*	-0.0475***	-0.1093***
	0.2249	0.0110	0.0042	0.0738	0.0022	0.0003
Slovenia	-0.1018***	-0.3029***	-0.3381***	-0.0221**	-0.0997***	-0.2310***
	0.0000	0.0000	0.0000	0.0499	0.0000	0.0000
Sweden	-0.0650***	-0.1026***	-0.1502***	-0.0038	-0.0587***	-0.1380***
	0.0009	0.0022	0.0002	0.6819	0.0000	0.0000
Hungary	-0.1845***	-0.2970***	-0.3472***	-0.0960***	-0.1050***	-0.2027***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Markets from Austria, Czech Republic, Cyprus, Denmark, Finland, Romania, Slovenia and Hungary have negative CAARs over the six event windows, meaning that the investors on these markets have a negative reaction. The Belgium market reports negative but statistically non-significant CAARs on the following windows: [-1;1], [-5;5], [0;0]. The results for both Bulgaria and France are negative and statistically significant except for the event day. Germany reports negative but statistically non-significant results on [-1; 1], [-3; 3], [0; 0] event windows. Greece has a single statistically significant result, representing the event day and it shows a negative reaction. Ireland presents positive CAARs but statistically significant only on [-1;1], on event windows [-5;5], [1;5], indicating a longer term, the results are negative. The Italian capital market reveals positive significant results on the vent day and negative on [-1;1] and [1;1] windows. Malta and Netherlands note negative CAARs except for the event day when the results are positive but statistically non-significant. Poland has negative and statistically significant CAARs except for the last event window and Sweden reports a negative and significant CAARs except the event day. Regarding Portugal, there are only two statistically significant CAARs on [-1;1] and [1;1]. In Spain, the market shows a negative reaction on all of the windows, except for the event day.

4.4 Comparisons between average abnormal returns by tax regimes

Regarding the tax regime, we decide to divide the sample by two criteria: eurozone membership and the position of each country in the world-systems theory. Eurozone consists of the countries from European Union that use euro (EUR) as the official currency. In the world-systems theory the countries can be separated in three main groups: core countries, periphery countries and semi-periphery countries. For simplifying the interpretation of our results, we separated them in two groups, combining the last two divisions into one.

The table reports cumulated average abnormal returns for the sub-groups divided by the two criteria: eurozone membership and the world-systems theory. On the columns are presented the CAARs for each event window. The estimation model used is the market model¹.

Table 7 Cumulated average abnormal returns by tax regime using the market model

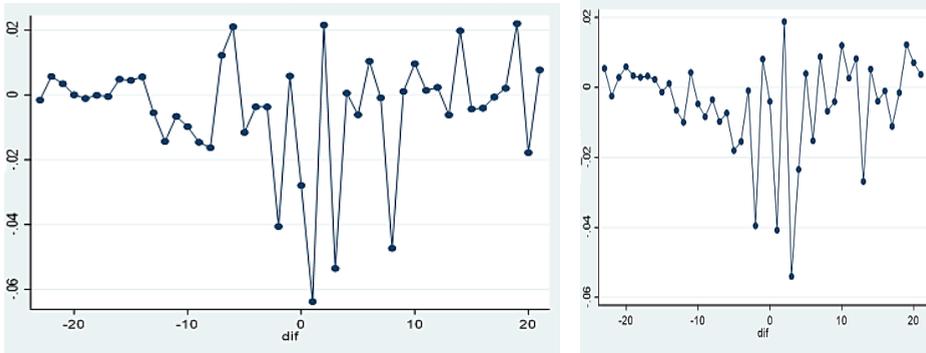
	CAAR (-1,1)	CAAR (-3,3)	CAAR (-5,5)	CAAR (0,0)	CAAR (1,1)	CAAR (1,5)
Euro vs. Non-euro						
Eurozone countries	-0.0220*	-0.1216***	-0.1798***	-0.0053	-0.0356***	-0.1214***
	0.0644	0.0000	0.0000	0.3614	0.0000	0.0000
Non-eurozone countries	-0.1003***	-0.2176***	-0.2725***	-0.0360***	-0.0730***	-0.1704***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Difference (eurozone countries – non-eurozone countries)	-0.0491***	-0.0488**	-0.0159	-0.0239***	-0.0229**	-0.0056
	0.0008	0.0397	0.5840	0.0002	0.0216	0.8179
Core countries vs. periphery and semi- periphery countries						
Core countries	-0.0252**	-0.0976***	-0.1434***	-0.0025	-0.0342***	-0.1021***
	0.0361	0.0000	0.0000	0.6687	0.0000	0.0000
Periphery and semi- periphery countries	-0.0808***	-0.2327***	-0.3045***	-0.0328***	-0.0686***	-0.1878***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Difference (core countries – periphery and semi-periphery countries)	-0.0331*	-0.0948***	-0.0947***	-0.0430***	-0.0197*	-0.0284
	0.0525	0.0004	0.0039	0.0000	0.0874	0.3091

Table 7 shows that, on short term, there are statistically significant differences between CAARs of eurozone banks and non-eurozone banks, hence the differences are statistically significant on all of the windows except [-5;5] and [1;5]. The CAARs although negative in both cases, are stronger for non-eurozone banks. These phenomena can be explained by the investors' expectations that eurozone banks will receive more support from the European Central Bank relative to non-eurozone banks. The fact that on the [-5;5] and [1;5] event windows, the differences are statistically non-significant proves that on a long term, the investors react in a similar manner regardless of the eurozone membership.

¹ Using the same sub-samples, we ran the hybrid CAPM and the results remained similar.

Concerning the position in the world-systems theory, there are statistically significant differences. The investors have an enhanced adverse reaction in the case of banks from periphery and semi-periphery countries compared to the ones from core countries. However, on a longer term, after the event day, there are no statistically significant differences.

Panel A. AARs in periphery and semi-periphery countries versus core countries



Panel B. AARs in non-Eurozone countries versus Eurozone countries

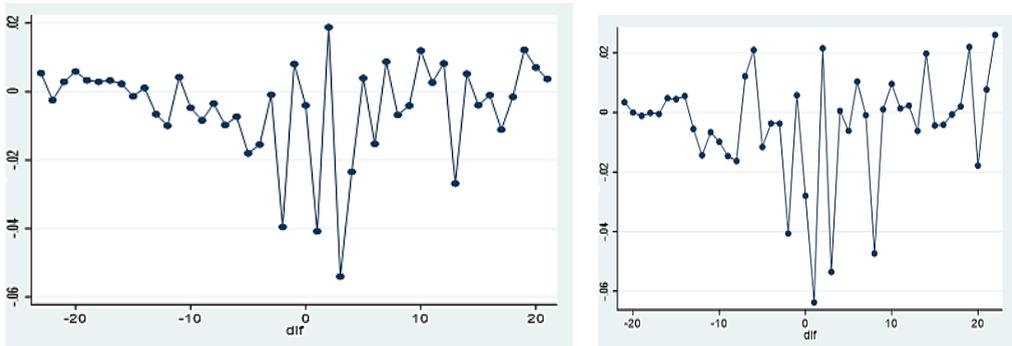


Figure 2 Average abnormal returns by world-systems theory and eurozone membership

The figure reports the evolution of AARs on $[-20; 20]$ window, day 0 representing the official announcement of the coronavirus pandemic. The top two graphs present the AARs for the periphery (and semi-periphery) countries and the core countries, respectively. The bottom section illustrates the AARs for the eurozone countries and the non-eurozone countries, respectively. The ARs are computed using the market model.

The graphs from Figure 2 depict the AARs for banks from core countries versus periphery and semi-periphery countries. We notice a higher volatility for a longer period of time for banks from periphery and semi-periphery countries,

compared to banks from core countries. Regarding the banks from non-eurozone countries and eurozone countries, the findings reflect that for the ones from non-eurozone countries, the volatility is higher, similarly to periphery and semi-periphery countries.

4.5 Comparison between average abnormal returns by regulatory and supervisory factors

In order to identify the differences between banks from a regulatory perspective, we use the banking regulation and supervisory measures available for the public in a database created through the Barth, Caprio and Levine (2013) questionnaire.

We use three main indices in our study: overall activity restriction index, supervisory power index and overall capital stringency index. The overall activity restriction index measures the extent to which the bank can engage in securities transactions, real estate transactions, insurance activities and the possibility of owning nonfinancial firms, higher values indicating grater restrictiveness; the supervisory power index measures the degree to which the supervisory authorities have the power to take specific action for preventing and correcting reasons, higher values indicating grater supervisory power and the overall capital stringency index measures whether the capital requirements reflect certain risks and deducts certain market value losses before determining minimum capital adequacy, higher value meaning grater stringency (Barth, Caprio, and Levine, 2013).

The table reports cumulated average abnormal returns for sub-groups divided by the median of each index. The first two lines report the CAARs calculated by overall activity index, the next lines report the CAARs by supervisory power index and overall capital stringency, accordingly. The columns contain the results for each event window. The estimation model used for computing the abnormal returns is the market model¹.

Table 8 Cumulated average abnormal returns by regulation

	CAAR (-1,1)	CAAR (-3,3)	CAAR (-5,5)	CAAR (0,0)	CAAR (1,1)	CAAR (1,5)
Overall activity restriction index						
Low activity restriction	-0.0438*** 0.0004	-0.1584*** 0.0000	-0.2155*** 0.0000	-0.0180*** 0.0027	-0.0445*** 0.0000	-0.1495*** 0.0000
High activity restriction	-0.0500***	-0.1523***	-0.2103***	-0.0142***	-0.0500***	-0.1249***

¹ Folozind modelul CAPM am obținut rezultate similare.

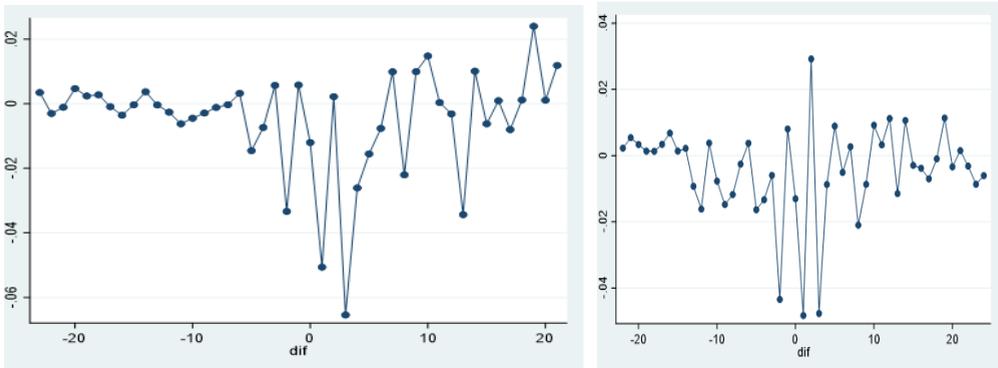
	CAAR (-1,1)	CAAR (-3,3)	CAAR (-5,5)	CAAR (0,0)	CAAR (1,1)	CAAR (1,5)
	0.0000	0.0000	0.0000	0.0074	0.0000	0.0000
Differences (high activity restriction – low activity restriction)	-0.0036	-0.0274	-0.0610**	0.0010	-0.0024	-0.0889***
	0.8112	0.2542	0.0358	0.8800	0.8176	0.0002
Supervisory power index						
Low supervisory power	-0.0454***	-0.1674***	-0.2152***	-0.0117**	-0.0529***	-0.1417***
	0.0001	0.0000	0.0000	0.0410	0.0000	0.0000
High supervisory power	-0.0472***	-0.1245***	-0.1784***	-0.0221***	-0.0370***	-0.1009***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Differences (high supervisory power – low supervisory power)	-0.0037	-0.0617***	-0.0522*	-0.0077	-0.0142	-0.0535**
	0.8027	0.0082	0.0673	0.2328	0.1522	0.0250
Overall capital stringency						
Low capital stringency	-0.0539***	-0.1619***	-0.2036***	-0.0181***	-0.0508***	-0.1220***
	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
High capital stringency	0.0901**	0.0014	-0.2330***	0.0205	0.0153	-0.2461***
	0.0226	0.9835	0.0042	0.2849	0.5633	0.0000
Differences (high capital stringency – low capital stringency)	-0.1478***	-0.1342*	0.0633	-0.0338	-0.0658**	0.1519*
	0.0026	0.0901	0.5118	0.1182	0.0487	0.0595

Table 8 depicts that regarding the overall activity restriction there are statistically significant differences only on [-5; 5] and [1; 5] windows, showing a slower reaction of the investors to hearing the announcement. The CAARs indicate an enhanced negative reaction for the banks with a lower activity restriction index. Thus, the investors have a weaker reaction for the banks from countries with a higher activity restriction index. A possible explanation is that the investors perceive the banks from these jurisdictions to be more stable and less affected from the unexpected events. Concerning the supervisory power, we notice an enhanced negative reaction for banks with a lower supervisory power index. Hence, in jurisdictions where the supervisory power is lower, the investors' reaction is stronger, a behaviour that we associate with a reduction in the banking sector's stability and an increased probability of default. We notice statistically significant differences on [-3; 3] [-5; 5] and [1; 5] event windows. Regarding the overall capital stringency index, there are statistically significant differences on the following intervals [-1; 1], [-3; 3], [1; 1] and [1; 5]. We observe that on the last interval, [1; 5], investors' reaction on the markets where the capital regulations are

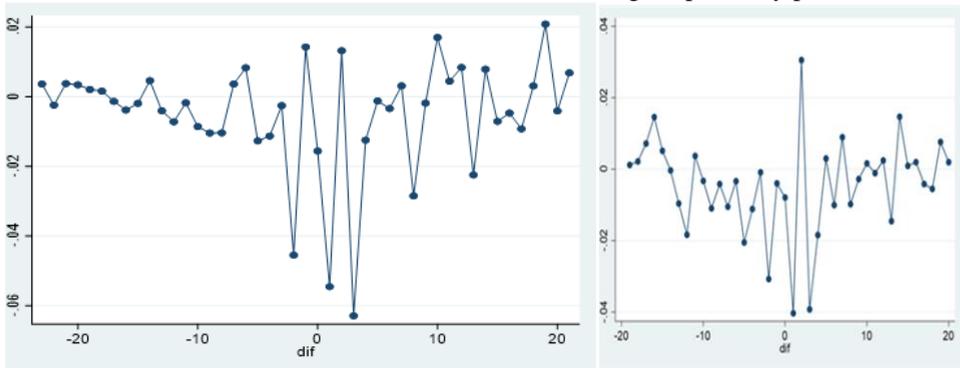
tighter is much stronger than of those that invest on a market with a lower capital stringency, although the immediate reaction where the capital regulations are tighter is a positive one. Weighting the costs on a longer period of time, the investors expect a tightening of capital requirements in these countries involving higher costs regarding the capital adequacy and therefore, a lower profitability.

From figure 3, we notice that AARs are negative but stronger for banks from countries with lower activity restrictions, which emerges from the interpretation of the graphs as well. Concerning the supervisory power we can observe a similar reaction, the AARs are negative, but stronger for the banks from countries with a lower supervisory power. As for the capital stringency, we notice that the reaction on the markets with tighter capital regulations is more negative compared to markets with tighter capital regulations, although the immediate reaction is positive for those who invest on markets with higher capital stringency.

Panel A. AARs in countries with low versus high activity restrictions



Panel B. AARs in countries with low versus high supervisory power



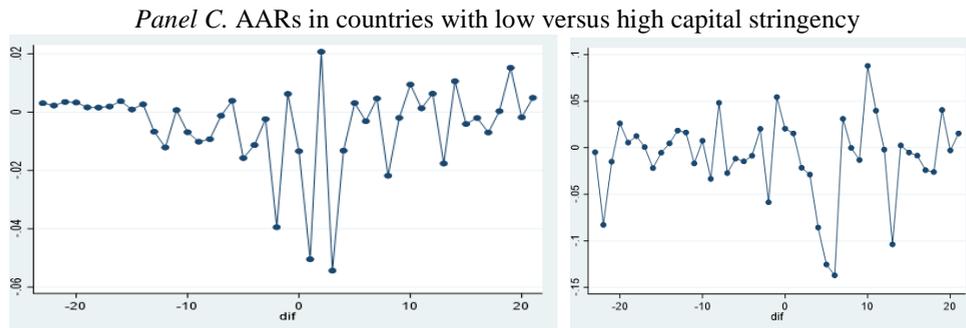


Figure 3 Average abnormal returns by regulation and supervisory indices

The figure presents the AARs evolution on a $[-20; 20]$ time frame with day 0 being the official announcement day of the pandemic. The upper graphs show the AARs for countries with low and high activity restriction. In the middle part, the graphs present the AARs for countries with low and high supervisory power index. The last two graphs report the AARs for countries with low and high capital stringency index respectively. The abnormal returns are computed using the market model.

5. CONCLUSIONS

In this study, we examine empirically the investors' reaction from the EU banking sector after the official announcement of coronavirus pandemic. We address a topic of current interest regarding the debates on the consequences of the pandemic on world's economy. Applying the event study methodology by computing abnormal returns using two methods for a dataset containing 141 banks from 21 countries, we find that the pandemic has a negative impact concerning the investors' reaction on the stock market from the banking sector. This is associated with a negative impact on the wealth of the banking industry as a result of banks' market value decrease. The results are consistent for all 21 countries involved in the study and for different sub-samples.

However, we notice statistically significant differences between the investors' reaction on markets divided by world-systems theory, tax regimes and regulatory and supervisory indices. Investors of banks from non-eurozone countries have an enhanced negative reaction than those of banks from eurozone countries. Investors on periphery and semi-periphery markets have stronger negative reaction than those from core countries. From a regulatory perspective, the investors from markets with a lower activity restriction and markets with a lower supervisory power have an enhanced negative reaction, and investors from markets with higher

capital stringency have a slightly delayed enhanced negative reaction. The main results, according to which the announcement of the pandemic has a negative impact on the banking sector, are consistent throughout our study, regardless of using the hybrid CAPM or the market model.

The results of this study contribute on the debate of the coronavirus pandemic effects on the economy. Meanwhile the overall consequences are obvious and easily observed at a macroeconomic level, we find evidence for the impact of the pandemic on the banking sector with respect for the differences resulted from tax regimes (eurozone membership and world-systems theory classification) and regulatory and supervisory measures.

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THE DETERMINANTS OF MEDICINE USE IN ROMANIA

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Abstract *For Romania's population, the highest share of total health services use corresponds to the use of pharmaceutical services, for which the state covers less than 60% of health expenditure. This leads people to use their financial resources to cover their health needs, which creates further disparities in the use of medicines. Therefore, the aim of this paper is to study the impact of socio-economic, health and health behaviour factors on the use of prescribed and self-prescribed medicines using probit models. This analysis is based on data from the European Health Interview Survey 2014 (EHIS 2014) and is explored at the whole population level and separately for two age groups (less than 65 years, 65 years and over). Overall, the empirical findings highlight that the determinants of pharmaceutical consumption differ by type of medicines and age group.*

Keywords: *Romanian public health system, medicines use, EHIS 2014, recursive bivariate probit model.*

JEL Classification: *I12, I18, C25, C26*

1. INTRODUCTION

The use of medicines is a major issue involving both policy decisions and the management of health systems, as well as important manufacturing and distribution industries. European policy-makers agree with the common objectives that health systems should ensure accessibility, quality and equity of medicines. But different countries have different approaches and therefore take divergent and sometimes contradictory measures. The diversity of health systems leads to the question of what is the best solution for different groups of people, especially those who are vulnerable and exposed to frequent changes in the system. Today, many

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governments face a pressing problem caused by the growing demand for healthcare services, which is higher than the share of health gross domestic product and higher than healthcare budgets. Governments therefore need to ensure that resources are used efficiently and avoid wastage by targeting the vulnerable in the right way.

The complex phenomenon of medicines use is little studied in Romania. This contrasts with changes in the behaviour and needs of the population in terms of use of health services, on the one hand, and changes in the public health system, on the other. Over the last 30 years, public health in Romania has faced a decrease in financial support and a shift from a strongly centralized system to one in which health services are partly covered by the state. Even though the health insurance system provides a full package of services, around 11% of the population remains uninsured and is entitled to only a minimum package of services (European Commission, 2019). Moreover, due to public insufficient funding, patient spending accounts for about one-fifth of current health expenditure in Romania (20.5% in 2017, compared to 15.8% in the EU), and most of this expenditure is for the purchase of medicines outside hospitals. Co-payments for these prescription medicines in outpatient care range from 10% of the consumer price of generic medicines to 80% for new prescription medicines. Thus, lack of government support leads people to use their own resources to afford needed medicines, which could create disparities in the use of this healthcare service.

In addition to the specificities of the health system, the demand for and consumption of pharmaceuticals is strongly correlated with the health status of the population, as well as a number of socio-economic and demographic determinants. The behaviour of the population with regard to the use of medicines requires constant research to identify these factors and also to analyze the existence of possible inequalities in access to the use of health services for a given population. To our knowledge, there is a lack of studies analyzing the consumption of medicines among the Romanian population. Only one study, conducted on eight Central and Eastern European countries, has investigated the impact of socio-economic determinants on the consumption of prescribed and non-prescribed medicines. This research outlines for Romania a positive relationship between a higher socioeconomic status and an increasing trend in prescription drug consumption (Vogler *et al.*, 2015). Other studies refer either to the consumption of illicit medicines (Elekes and Kovacs, 2002) or to the study of specific categories of people or medicines (Manole *et al.*, 2017; Tarcuic *et al.*, 2020).

This research addresses this gap in the literature on the need to study the use of medicines in Romania. After a long period of transition in the health system and

after important changes in the health and behaviour of the population, identifying the determinants of medicines use can serve policy makers and contribute to a deeper understanding of the use of this health service in Romania. The novelty of our work is therefore threefold. First, it provides an overall analysis of medicine use in relation to a set of determinants at national level. To our knowledge, no such studies have been conducted using the same data provided by EHIS 2014. Thus, it provides valuable information for policy makers on how to improve solutions or implement policies to ensure access for the whole population to both prescription and non-prescription medicines. Second, the empirical approach used allows us to address the endogeneity problem caused by the possible reverse causality of medication use in relation to health status. Third, regression analysis is employed for both the whole population and two major age categories to better highlight the specificity of medication use in a nationally representative sample.

The rest of this paper is organized as follows. Section 2 reviews a number of findings from empirical studies examining the determinants of prescription and non-prescription drug use. Section 3 presents the data and methodology used. Section 4 presents and discusses the main empirical results. The study ends with a series of concluding remarks and references.

2. LITERATURE REVIEW

A large body of the literature emphasizes a significant impact of socio-economic, demographic, cultural, and health factors on the use of medicines in any adult population. The role of these determinants has been analyzed for the two types of medicines: prescription medicines and non-prescription medicines. According to existing literature, the frequency of medication use, as well as the amount of medication consumed, is strongly influenced by the health status of the population. People reporting various physical or mental health problems or those who report being less healthy tend to consume more medication than healthy people (Johnson and Pope,1983; Vogler *et al.*,2015).

Of the demographic factors, the literature recommends analyzing the impact of age and gender on medicine use. In terms of gender, women tend to use more medicines than men. Findings from the literature show that this is generally true for both the use of non-prescription medicines (Johnson and Pope,1983; Carrasco-Garrido *et al.*,2014; Vogler *et al.*,2015) and the use of prescription medicines (Furu *et al.*,1997; Vogler *et al.*,2015). This is explained by the transformations women go through in their reproductive lives and the fact that

women with a diagnosis tend to use medication more than men in the same situation (Eggen,1997; Daban *et al.*,2010). It should also be noted that both men and women use more prescription drugs than non-prescription drugs (Mayer and Österle,2015). The age of the individuals also has a significant impact on medication. Most studies show that older people are more likely to use non-prescription medicines than younger people and adults, and this is also true for prescription medicines (Vogler *et al.*,2015). The risk of medication use increases with age in both sexes. However, in a study conducted on the Barcelona population, Daban *et al.* (2010) pointed out that prescription drugs increase with age, while over-the-counter drugs decrease with age.

Studies on representative samples show that socio-economic position is a category of factors with a significant impact on the use of medicines. Socio-economic position is usually measured by education, occupational position and income (Nielsen *et al.*,2003). Empirical evidence has been found supporting that more educated individuals are inclined to use non-prescription medications more often (Johnson and Pope,1983; Carrasco-Garrido *et al.*,2014; Vogler *et al.*,2015). On the other hand, arguments have been found supporting a negative relationship between education level and prescription drug use (Nielsen *et al.*,2003; Mayer and Österle,2015). Regarding income level, the results for non-prescription medicines are not decisive. There are studies showing that income has a significant impact on medication use (Carrasco-Garrido *et al.*,2014), while others found no support for a significant relationship between variables (Vogler *et al.*,2015). In terms of prescription drug consumption, it is thought that higher income individuals have greater access to medicines and then tend to consume more than lower income individuals (Daban *et al.*,2010; Vogler *et al.*,2015). Labour market participation is also a significant factor in people's medicine consumption behaviour. Those who do not work tend to use prescription medicines more often (Mayer and Österle,2015).

The importance of cultural factors on drug use has been studied to highlight differences among countries. A study of 27 European countries shows strong evidence of the impact of cultural dimensions on prescription and non-prescription antibiotic use (Deschepper *et al.*,2008). Another example is a study of the Israel population, which shows that cultural group is a determinant of drug use (Lerner-Geva *et al.*,2017). According to existing literature, ethnicity also plays a determinant role for prescription drug use (Nielsen *et al.*,2003; Vie *et al.*,2017).

3. DATA AND METHODOLOGY

3.1. Data used

The individualized secondary data retrieved from the second wave of EHIS 2014 for Romania were used to conduct our study on the determinants of medicines use. The EHIS 2014 is composed of three health modules, *i.e.* health status, healthcare utilization, health determinants, and a module that includes background variables on demographics and socio-economic status of the population living in non-institutional households residing in the country. After excluding observations without complete information, our final sample consists of 16411 observations.

The variables used in the present analysis have been shown to be important in public health studies and are consistent with the purpose of this study. Therefore, dependent variables are assessed based on questions on individual health care utilization. Of this group of indicators, those of interest are related to prescription medication use and self-medication (use *vs.* non-use) in the last two weeks.

The independent variables are divided into three major topics, such as individual characteristics, health status and variables describing different health behaviours. Individual characteristics correspond to demographic and socio-economic determinants such as age, gender, education level, marital status, occupational status, and income level. To measure health status, individuals were asked how their health status was in general, with the optional responses: very good, good, average, poor and very poor. According to previous research (Molarius *et al.*,2007; Rocca *et al.*,2015; Jemna and David,2020), in regression analyses, the last two categories, very poor and poor, collapsed to poor. The third class of independent variables comprises individual and environmental determinants describing four different health behaviours, *i.e.* body mass index, tobacco and alcohol consumption, and a nutrition index based on fruit and vegetable consumption.

3.2. Empirical strategy

According to the existing literature and the nature of our outcome variables, we employed a probit regression model. Nevertheless, the potential reverse causality between health status and medicine use may lead to endogeneity and, implicitly, to biased estimates. The impact of health status on the use of medicine is quite obvious, but the reverse causality between the two variables is based on the idea that medicine use may determine the health status of individuals due to the side effects of the consumption of medical drugs. To tackle the potential endogeneity issue of health status, we employed a recursive bivariate probit model

that involves the use of instrumental variables estimation (Maddala,1983; Ancelot *et al.*,2018). Instruments are explanatory variables that have an impact on health status but do not directly explain the probability of using medication, meaning that the effect of instrumental variables on medicines use is captured indirectly *via* health status. One instrumental variable was considered, namely the degree of concern shown by other people in what the person is doing as a proxy for people's social environment (Ancelot *et al.*,2020). We will therefore, in a second set of models, simultaneously estimate the discretized health status index and the probability of using medications.

Next, different robustness checks are performed to test the two estimation approaches (probit and recursive bivariate probit). In a recursive bivariate probit model, the likelihood ratio (LR) test is used to test for exogeneity and the overidentification test is used to check the validity of the instrumental variable. In addition, the association between medication use and its determinants was explored both for the whole population (classifying all respondents as a homogeneous group) and separately for two age groups (15-64 years and 65 years and over). Stratification of the sample allowed to account for variations in health between age groups that may affect the use of both prescription and non-prescription medicines.

4. RESULTS AND DISCUSSIONS

4.1. Descriptive statistics

Table 1 provides summary statistics for the outcome variables and Tables A1-A2 (in the Appendix) for the characteristics of individuals, both overall and stratified by the two age groups. Descriptive analysis of the data showed that in all three samples, the majority of respondents reported not using any type of medication. The only exception can be seen in the case of the age group 65 years and over, who reported using more prescription drugs. In addition, regardless of both age group and type of medication, the descriptive statistics presented in Tables A1-A2 suggest that medication use is more common among women than men.

Table 1 Medicine use, both for the entire population and stratified by age group

Medicine use		Total (%)	< 65 Years Age ≥ 65 Years Age	
			Group (%)	Group (%)
Non-prescribed medicines	No	84.03	85.64	79.69
	Yes	15.97	14.36	20.31
Prescribed medicines	No	73.03	85.17	40.25
	Yes	26.97	14.83	59.75

Source: Authors' computation

Descriptive results on the characteristics of respondents who used prescription drugs are presented in Table A1. Overall, the majority of users are married, female and older. More than two thirds of the population reported that the last level of education attained was secondary. It is important to note that the age groups of consumers are not balanced, with only 0.87% of respondents in the 15-24 age group. In terms of household income level, respondents are fairly evenly distributed, but self-reported employment status is, for more than 80% of them, unemployed. More than half of them reported a moderate good general health. In terms of factors related to individuals' health behaviour, although it is difficult to distinguish between users and non-users of prescription drugs in relation to BMI, the majority of individuals reported being non-users, regardless of their smoking, drinking and eating habits. In the 15-64 age group, more than half of consumers are married women. The vast majority in this group have at most a secondary education obtained (>84%), however, about two-thirds reported being unemployed (60.79%). In terms of income level, more than 66% of them stated that their income is at least in the range between the second and third quintile. The health status for about 30% of adult consumers is good and very good and only 19.97% reported poor health. This is also reflected in the very high percentages related to each of the determinants describing individuals' health behaviour, given that the vast majority of them said that they do not use prescription medications. Older consumers of prescription drugs are mostly women, mostly married and with a secondary education. In contrast to adult consumers, 68% of elderly reported that their household income level was at most in the second and third quintile range, and over 30% reported poor or very poor health. As for the health behaviour indicators, it is observed that for this category of individuals the use of prescription drugs is in a higher percentage attributed to those who have weight problems and bad smoking, drinking, and eating habits.

Table A2 is dedicated to presenting the characteristics of respondents who use non-prescription medicines. More than 63% of them are women, married, adults, and with secondary education level. Again, respondents were almost evenly split in each household income category and more than 57% of them reported being unemployed. In terms of health status, more than half of the respondents reported good or very good overall health, an observation that is supported by the health behaviour of the respondents, given that the majority reported not using non-prescription medication, regardless of BMI or other health habits. Most adult users of over-the-counter drugs are female, married, and 80% of them reported having a secondary education degree. The most frequent reported household income levels

are at the upper bound (>51%, respectively), with the majority of respondents being employed. At the same time, over 72% of consumers rated their health as good or very good, which again could also be related to their smoking, drinking and eating habits. In the case of older consumers of non-prescription medicines, the same characteristics of the majority were found, namely female, married and with a secondary education. Although most of them reported having health problems, their use of non-prescription medicines is very low related to their behaviour towards health.

4.2. Main results

In this study, empirical results are presented for only one specification of the regression models, depending on the significance of endogeneity and overidentification tests (Tables 2-3). In other words, if the test result indicates the presence of endogeneity, then the results of the recursive bivariate probit models are discussed. Otherwise, the results of multiple probit regressions are considered. In this sense, the results of the overidentification test reveal that the coefficients corresponding to the instrumental variable, *i.e.* the degree of concern shown by other people about what the person does, are jointly zero in the equations on medicine use. These results show that the chosen instrumental variables do not have a direct impact on the outcome variables and can therefore be used in recursive bivariate probit estimation. However, the LR statistics show that reverse causality is not confirmed for the use of non-prescription medicines at the population level and among the adult group (Table 3). Therefore, for the two cases, the results presented and discussed correspond to probit regression model.

Table 2 presents the empirical results on the relationship between prescription drug use and individual characteristics, both for the whole population (Column 1) and for each age group, adults (Column 3) and the elderly (Column 4).

Table 2 The association between prescribed medicine use and its determinants, in total population and stratified by age group

Variables	< 65 Years Age		≥ 65 Years Age
	Total	Group	Group
	Recursive Bivariate Probit Model	Recursive Bivariate Probit Model	Recursive Bivariate Probit Model
Intercept	0.6806 ***	0.8197 ***	0.4634 **
Age (15-24)	-0.6528 ***	-0.3863 ***	-
Age (25-44)	-0.7839 ***	-0.5549 ***	-
Age (45-64)	-0.2138 ***	-	-
Age (65-74)	-0.1344 **	-	-0.1764 ***
Age (75-79)	0.0434 .	-	0.0261 .

Variables	< 65 Years Age		≥ 65 Years Age
	Total	Group	Group
	Recursive Bivariate Probit Model	Recursive Bivariate Probit Model	Recursive Bivariate Probit Model
Gender (Male)	-0.0745 ***	-0.0746 *	0.0231 .
Education (Secondary)	0.0221 .	0.0146 .	-0.0364 .
Education (Tertiary)	0.1131 *	0.2617 **	-0.0860 .
Marital_Status (Divorced)	0.0651 .	0.0605 .	0.0880 .
Marital_Status (Married)	0.1576 **	0.1350 *	0.2476 .
Marital_Status (Widowed)	0.2048 ***	0.2759 ***	0.2590 *
Employment (Employed)	-0.2610 ***	-0.2236 ***	-
Employment (Self-employed)	-0.1650 ***	-0.2031 ***	-0.0584 .
Income (Q1-Q2)	0.1893 ***	0.1197 ***	0.2285 ***
Income (Q2-Q3)	0.3553 ***	0.3537 ***	0.3268 ***
Income (Q3-Q4)	0.3985 ***	0.3795 ***	0.3970 ***
Income (Q4-Q5)	0.4101 ***	0.3802 ***	0.4546 ***
BMI_Status (Normal_weight)	-0.2730 ***	-0.3482 ***	-0.1616 **
BMI_Status (Overweight)	-0.2279 **	-0.2825 ***	-0.1448 **
Smoking (Never)	0.0026 .	0.0307 .	-0.0855 .
Smoking (Occasional)	-0.1088 .	-0.0885 .	-0.2063 .
Drinking (Never)	-0.2720 ***	-0.2144 **	0.3446 ***
Drinking (Low_risk)	-0.1283 ***	-0.1130 ***	0.1448 ***
Nutrition (Moderate)	0.0483 .	0.0202 .	0.0836 .
Nutrition (Sufficient)	0.1944 ***	0.1669 ***	0.2156 ***
Health_Status (Good health)	-1.6318 ***	-1.3185 ***	-1.9090 ***
Health_Status (Moderate health)	-1.1286 ***	-1.0346 ***	-1.2304 ***
Health_Status (Poor health)	-0.3545 ***	-0.3247 ***	-0.4515 ***
<i>Test of exogeneity (LR statistics)</i>	7.89 ***	8.22 ***	5.31 **
<i>Test of overidentification</i>	2.26 .	2.85 .	0.62 .
<i>Number of observations</i>	16411	11969	4442

Notes: (1) The reference categories for each independent variables are: 80 years and older (age group for the whole population); 45-64 years (age group for those younger than 65 years old); 80 years and older (age group for those of 65 years and older); female (sex of respondent); primary education level (education); unmarried (legal marital status); unemployed (employment status); less than 1st quintile (income level); obese (BMI status); daily (smoking); high-risk (alcohol consumption risk profile); insufficient (nutrition – fruits and vegetables consumption); very good health (health status). (2) *** indicate the rejection of null hypothesis for 1%; ** indicate the rejection of null hypothesis for 5%; * indicate the rejection of null hypothesis for 10%.

Source: Authors' computation

For the whole population, with the exception of respondents' smoking habits, both socio-economic characteristics and health behaviour were consistently associated with prescription drug use. However, age group and health status prevailed. On the one hand, people in better health were less likely to use prescription drugs compared to those in poorer health. On the other hand, looking at the impact of age, the results show that people were more likely to use

prescribed medication at older ages. Therefore, the considerable heterogeneity within population subgroups justifies further analysis by age group. It is also noteworthy that higher income levels are related to a higher likelihood of using prescription medicines.

As far as the adult group is concerned, the same conclusions can be drawn. Except for the strong impact of health status, age, and income on the use of prescription drugs, our results also indicate that women are slightly higher users than men, as well as those respondents with tertiary education compared to those with primary education. Finally, the significant impact of some health behavior factors indicates that adopting a healthier lifestyle could lead to less use of prescription drugs.

Similar to the previous cases, that of the whole population and that of the adult group, in the case of the 65+ age group, the most substantial impact on the outcome variable is related to health status and income level. Therefore, lower use of prescription drugs is significantly associated with better health status and lower income respectively. Within this particular group, other significant differences are found between people aged 65-74 and those aged 80 and over, as well as in relation to some behavioural determinants.

The modelling findings on the association between the use of non-prescribed medicines and the socio-economic, health status and health behavioural factors are provided in Table 3 in Column (2) for the whole population, Column (3) for adults group, and Column (4) for the elderly group.

Table 3 The association between non-prescribed medicine use and its determinants, in total population and stratified by age group

Variables	< 65 Years Age Group		≥ 65 Years Age Group
	Total	Probit Model	recursive Bivariate Probit Model
Intercept	-0.3643	-0.3815	-0.7442
Age (15-24)	-0.1237	0.1485	-
Age (25-44)	-0.1615	0.0374	-
Age (45-64)	-0.1409	-	-
Age (65-74)	-0.1499	-	-0.2280
Age (75-79)	-0.0564	-	-0.1254
Gender (Male)	-0.4008	-0.5007	-0.1629
Education (Secondary)	0.0393	0.0570	-0.0388
Education (Tertiary)	0.1525	0.0589	-0.0171
Marital_Status (Divorced)	0.1364	0.1103	0.1524
Marital_Status (Married)	0.1545	0.1387	0.1282
Marital_Status (Widowed)	0.0848	0.0680	0.1277
Employment (Employed)	-0.0321	-0.0410	-

Employment (Self-employed)	0.1470	0.1593	0.1357
Income (Q1-Q2)	0.0650	0.0680	0.0823
Income (Q2-Q3)	0.0973	0.1001	0.0458
Income (Q3-Q4)	0.2106	0.2361	0.1408
Income (Q4-Q5)	0.2672	0.3021	0.1717
BMI_Status (Normal_weight)	-0.1543	-0.0685	-0.1581
BMI_Status (Overweight)	-0.1047	-0.0279	-0.1058
Smoking (Never)	-0.0483	-0.0430	-0.1826
Smoking (Occasional)	0.1546	0.1963	-0.3574
Drinking (Never)	-0.3082	-0.4002	-0.1054
Drinking (Low_risk)	-0.0883	-0.1288	-0.0115
Nutrition (Moderate)	0.0560	0.0838	0.0028
Nutrition (Sufficient)	0.0697	0.0968	0.0200
Health_Status (Good health)	-0.8439	-0.7503	-1.6729
Health_Status (Moderate health)	-0.5842	-0.5011	-0.6308
Health_Status (Fair health)	-0.3051	-0.2190	-0.3377
<i>Test of exogeneity (LR statistics)</i>	<i>2.45</i>	<i>0.37</i>	<i>4.52</i>
<i>Test of overidentification</i>	<i>2.13</i>	<i>1.77</i>	<i>1.72</i>
<i>Number of observations</i>	<i>16411</i>	<i>11969</i>	<i>4399</i>

Notes: (1) The reference categories for each independent variables are: *80 years and older* (age group for the whole population); *45-64 years* (age group for those younger than 65 years old); *80 years and older* (age group for those of 65 years and older); *female* (sex of respondent); *primary education level* (education); *unmarried* (legal marital status); *unemployed* (employment status); *less than 1st quintile* (income level); *obese* (BMI status); *daily* (smoking); *high-risk* (alcohol consumption risk profile); *insufficient* (nutrition – fruits and vegetables consumption); *very good health* (health status). (2) *** indicate the rejection of null hypothesis for 1%; ** indicate the rejection of null hypothesis for 5%; * indicate the rejection of null hypothesis for 10%.

Source: Authors' computation

The modelling results on non-prescribed medicine use that pertain to the whole population show that lower use of non-prescribed medicines was associated with young and adult age groups, with male respondents, with lower levels of education, unmarried individuals, lower levels of income, healthier life style (with normal weights, no risky drinking habits, and with a healthy diet), and with a better health status.

Among respondents under 65 years, the use of over-the-counter medicines is generally explained by the same factors. The only exception is education level, body mass index status, dietary habits, which do not have a significant impact on the use of non-prescription medicines. Furthermore, taking into account age group and marital status, the only significant differences in the use of non-prescription medicines are observed between the youngest age group and the group of individuals aged 45-64 years on the one hand, and between married and unmarried respondents on the other.

Within the older adult group, the results suggest fewer significant associations between the use of non-prescription drugs and various respondents' characteristics. Significant and strong differences are found in relation to age groups, higher income levels, smoking habits, and especially health status. Although gender remains a significant determinant, the difference between male and female respondents is smaller in magnitude for the older population.

Analyzing in the context of the existing literature, we can conclude that our findings are generally in line with other studies conducted on the identification of determinants of drug use. In this respect, a lower consumption of prescribed and non-prescribed medicines is highly associated to better health status of individuals (Vogler *et al.*,2015). Results on the impact of age on medication use also reveal that older individuals are higher users of medications than their counterparts, but they consume more prescription than non-prescription medications (Vogler *et al.*,2015). Regardless of age group, our findings are in compliance with other studies revealing that women consume more medicines than men (Daban *et al.*,2010; Carrasco-Garrido *et al.*,2014; Vogler *et al.*,2015). However, among the elderly population, this difference regarding the consumption of prescribed medication does not remain significant, which contrasts with the existing results in the literature, but which may support the hypothesis of this study that stratifying the population by age group allows to better highlight the specificity of medication use in relation to its determinants. Regarding the level of education, our results are not consistent with the literature which claims that it is more likely for those with a lower levels of education to consume prescribed medications (Nielsen *et al.*,2003; Mayer and Österle,2015), while more educated people are more inclined to consume non-prescription drugs (Carrasco-Garrido *et al.*,2014; Vogler *et al.*,2015). In the case of Romania, the results of our study show significant differences between people with tertiary level of education and those with primary level, but the former tend to be higher consumers for both types of drugs. This perspective can be supported to some extent by the impact of income level, which indicates a higher consumption of both prescription and non-prescription medicines as income increases. These results are in agreement with Daban *et al.* (2010) and Vogler *et al.* (2015) regarding the consumption of prescription drugs, but in contradiction for the use of non-prescription drugs which is not significantly related to income level according to Vogler *et al.* (2015). Furthermore, the findings on the impact of employment status also align with the existing literature, suggesting that those who do not work tend to consume more prescription drugs (Mayer and Österle,2015). For non-prescription medication, differences between categories defined by

employment status are only evident among the self-employed compared to the unemployed. Finally, based on the results obtained on the impact of health behavioural factors, we could conclude that the adoption of a healthier lifestyle could lead to a significant decrease in the use of prescribed medicines, regardless of age group, as well as in the consumption of non-prescription drugs, but especially for the adult population.

5. CONCLUDING REMARKS

The fundamental aim of this study was to examine the relationship between medicine use and several socio-economic, health behaviour and health related factors in a nationally representative sample of people aged 15 years and over. The contribution of the paper to the existing literature is mainly highlighted by relating the objective of identifying the main determinants of medication use to the context of the Romanian public health system. From this point of view, it is emphasized the need to develop and implement projects, campaigns or public policies targeting in particular vulnerable groups of the population in order to ensure their access to health services, implicitly to the use of prescribed and non-prescribed medicines.

In this context, our empirical findings underline that the determinants of medicine use in the Romanian population depend on the type of drug and especially on the age group. Moreover, the results related to income, education, health behaviour or preventive health measures could play an important role in the development and implementation of such public health policies. However, these recommendations should be addressed separately according to the specificities and determinants most relevant for each type of medicine use and for each age group.

This study is not without limitations. In this regard, noteworthy is the self-reported nature of the data, particularly related to health status and non-prescribed medications, leading to the possibility of response bias due to inaccurate recall or social desirability. In addition, the cross-sectional nature of the data limits the exploitation of reverse causality. In this case, controlling for potential endogeneity of health status would be a difficult task as it involves the use of instrumental variable estimation. Therefore, another limitation of our study is actually related to the choice of these variables, which again depends on the survey data used.

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APPENDIX

Table A1 Distribution of individuals according to their characteristics and the use of prescribed medicines, in total population and stratified by age group

Variables	Total		< 65 Years Age Group		≥ 65 Years Age Group	
	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)
Age (15-24)	13.68	0.87	16.07	2.17	-	-
Age (25-44)	36.40	4.60	42.76	11.46	-	-
Age (45-64)	35.04	34.68	41.16	86.37	-	-
Age (65-74)	9.16	28.92	-	-	61.55	48.32
Age (75-80)	4.92	25.75	-	-	33.07	43.02
Age (80+)	0.80	5.18	-	-	5.37	8.66
Sex (Female)	49.76	60.14	49.21	60.79	52.96	59.70
Sex (Male)	50.24	39.86	50.79	39.21	47.04	40.30
Education (Primary)	7.44	23.22	3.10	5.62	32.24	35.04
Education (Secondary)	79.87	69.18	82.85	84.20	62.83	59.10
Education (Tertiary)	12.69	7.59	14.05	10.18	4.93	5.86
Marital_Status (Unmarried)	8.53	30.42	3.41	11.07	37.78	43.40
Marital_Status (Divorced)	26.63	4.53	30.86	8.73	2.49	1.72
Marital_Status (Married)	58.99	60.79	59.48	73.03	56.18	52.57
Marital_Status (Widower)	5.85	4.27	6.25	7.17	3.55	2.31
Employment (Unemployed)	41.77	80.91	33.20	60.79	90.75	94.40
Employment (Employed)	42.48	12.17	49.79	29.42	0.72	0.60
Employment (Self-Employed)	15.75	6.92	17.01	9.79	8.53	5.00
Income (<1st quintile)	19.72	17.89	18.34	13.96	27.59	20.52
Income (1st – 2nd quintile)	18.98	23.25	17.29	17.96	28.64	26.79
Income (2nd – 3rd quintile)	19.69	21.97	19.60	21.69	20.22	22.16
Income (3rd – 4th quintile)	19.74	19.85	20.86	23.47	13.35	17.43
Income (4th – 5th quintile)	21.87	17.04	23.91	22.91	10.19	13.10
BMI_Status (Normal_weight)	47.05	34.14	90.01	9.99	38.62	61.38
BMI_Status (Overweight)	46.02	49.31	83.78	16.22	43.08	56.92
BMI_Status (Obese)	53.13	46.87	65.01	34.99	33.45	66.55
Smoking (Never)	68.93	31.07	83.19	16.81	39.34	60.66
Smoking (Occasional)	88.25	11.75	91.71	8.29	55.95	44.05
Smoking (Daily)	85.63	14.37	89.32	10.68	50.86	49.14
Drinking (Never)	64.26	35.74	81.25	18.75	32.75	67.25
Drinking (Low_risk)	78.28	21.72	86.71	13.29	46.90	53.10
Drinking (High_risk)	82.10	17.90	89.19	10.81	55.61	44.39
Nutrition (Insufficient)	72.44	27.56	85.62	14.38	46.79	53.21
Nutrition (Moderate)	72.92	27.08	86.51	13.49	41.36	58.64
Nutrition (Sufficient)	73.93	26.07	84.17	15.83	37.20	62.80
Health_status (Bad)	1.60	27.29	0.69	19.97	6.81	32.02
Health_status (Moderate)	13.42	54.76	7.28	50.39	48.59	57.69
Health_status (Good)	48.19	17.22	49.39	28.03	41.33	9.96
Health_status (Very good)	36.79	0.74	42.65	1.61	3.27	0.15

Source: Authors' computation

Table A2 Distribution of individuals according to their characteristics and the use of non-prescribed medicines, in total population and stratified by age group

Variables	Total		< 65 Years Age Group		≥ 65 Years Age Group	
	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)
Age (15-24)	11.0	6.0	14.82	9.19	-	-
Age (25-44)	29.0	21.6	38.98	32.97	-	-
Age (45-64)	34.4	38.0	46.20	57.84	-	-
Age (65-74)	13.9	17.4	-	-	54.42	50.60
Age (75-84)	9.8	14.3	-	-	38.36	41.60
Age (85+)	1.8	2.7	-	-	7.22	7.79
Sex (Female)	50.4	63.8	48.52	65.25	55.96	61.03
Sex (Male)	49.6	36.2	51.48	34.75	44.04	38.97
Education (Primary)	11.3	14.0	3.44	3.68	34.00	33.59
Education (Secondary)	77.6	73.8	83.41	80.93	60.72	60.15
Education (Tertiary)	11.1	12.3	13.15	15.39	5.29	6.26
Marital_Status (Unmarried)	13.7	18.1	4.37	5.57	40.91	42.04
Marital_Status (Divorced)	22.2	12.7	29.09	18.55	2.18	1.43
Marital_Status (Married)	58.7	63.7	60.22	69.10	54.17	53.46
Marital_Status (Widower)	5.4	5.5	6.32	6.78	2.74	3.07
Employment (Unemployed)	51.4	57.3	37.00	39.06	93.12	92.21
Employment (Employed)	35.3	29.3	47.21	44.11	0.59	0.88
Employment (Self-Employed)	13.4	13.4	15.79	16.83	6.30	6.92
Income (<1 st quintile)	19.6	17.3	18.14	14.99	23.81	21.62
Income (1 st – 2 nd quintile)	20.1	20.4	17.53	16.60	27.50	27.66
Income (2 nd – 3 rd quintile)	20.7	18.1	20.38	17.12	21.71	20.09
Income (3 rd – 4 th quintile)	19.5	21.2	20.94	23.09	15.36	17.45
Income (4 th – 5 th quintile)	20.1	23.0	23.02	28.20	11.61	13.17
BMI_Status (Normal_weight)	85.54	14.46	86.85	13.15	80.82	19.18
BMI_Status (Overweight)	83.35	16.65	85.04	14.96	79.36	20.64
BMI_Status (Obese)	80.46	19.54	81.95	18.05	77.98	22.02
Smoking (Never)	83.58	16.42	85.52	14.48	79.56	20.44
Smoking (Occasional)	82.49	17.51	82.14	17.86	85.71	14.29
Smoking (Daily)	86.23	13.77	87.06	12.94	78.35	21.65
Drinking (Never)	84.91	15.09	87.94	12.06	79.30	20.70
Drinking (Low_risk)	82.95	17.05	83.85	16.15	79.61	20.39
Drinking (High_risk)	84.15	15.85	85.11	14.89	80.57	19.43
Nutrition (Insufficient)	85.75	14.25	88.33	11.67	80.45	19.55
Nutrition (Moderate)	84.12	15.88	85.78	14.22	79.84	20.16
Nutrition (Sufficient)	83.52	16.48	84.92	15.08	79.32	20.68
Health_status (Bad)	7.4	14.7	3.15	5.91	19.56	31.50
Health_status (Moderate)	23.1	32.4	12.37	21.42	54.17	53.46
Health_status (Good)	40.3	37.3	45.75	49.05	24.54	14.93
Health_status (Very good)	29.3	15.5	38.73	23.61	1.73	0.11

Source: Authors' computation



BURNOUT SYNDROME AMONG ROMANIAN TEACHERS DURING PANDEMIC

SIMINA-NICOLETA BOHÂLȚEANUⁱ

Abstract: *The emergence of the global pandemic context has led to rapid and important changes in education systems, from school closures and the transition to online classroom learning, to forcing teachers and students to adapt quickly to this new type of learning. The pandemic context thus determined the emergence of new challenges in the activity of teachers with an impact on their state of exhaustion. The purpose of this research is to identify the level of exhaustion experienced at work by teachers in Romania during the pandemic. Data were collected from 47 Romanian teachers through a google form. The data were analyzed using the SPSS Statistics program, using descriptive analyzes and group comparison tests. The results of the study show that responding teachers experience a moderate level of emotional exhaustion, a low level of depersonalization and a high level of personal achievement.*

Keywords: *Burnout syndrom, exhaustion, teachers, pandemic context*

1. INTRODUCTION

Burnout syndrome is one of the major challenges of today's modern society, given the dynamics of jobs and implicitly their increasingly diverse requirements, as well as the ever-evolving technology. The pressure felt by employees in various fields of activity and industries causes them to suffer from work stress, fatigue and even exhaustion.

Exhaustion at work is considered a professional hazard, especially for those professions that are people-oriented (for example in education, health care, etc.). In this regard, the teaching profession has been identified as one of the most stressful

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occupations, with specific activities affecting physical and psychological well-being, as well as job satisfaction (Johnson, et al., 2005).

Burnout syndrome is understood by specialists as a result of long-term occupational stress, whose symptoms and effects are experienced differently by employees and although the reasons for its occurrence may be different, all are exposed to a certain level of stress at work, including teachers (Jennett, et al., 2003).

Exhaustion at work can be considered a professional risk, in view of the existing consequences, but also a phenomenon that is induced by suffering (Beheshtifar and Omidvar, 2013), characterized by three specific dimensions: emotional exhaustion, depersonalization and reduced feeling of realization (Maslach and Leiter, 2016).

The teaching profession involves many satisfactions and challenges, but mismanaged by teachers or managers can contribute to their exposure to prolonged stress, which will lead to decreased job satisfaction, and the occurrence of chronic burnout in the form of burnout syndrome. The implications of this syndrome are found both at the level of individuals (teachers may feel disturbed physically, mentally and professionally) and at the level of school (absenteeism, inefficient teachers, overworked work environment that affects the well-being of colleagues, unprepared students - poor quality of the educational act).

The emergence of the pandemic context has led to restructuring in terms of how to carry out work activities in almost all areas of activity. Thus, working from home during the pandemic made the line between professional and personal life difficult to delimit, given the numerous activities to be performed at the same time (work tasks combined with household tasks, changes in social interactions, etc.).

The emergence of the global pandemic context has led to rapid and important changes in education systems, from school closures and the transition to online classroom learning, to forcing teachers and students to adapt quickly to this new type of learning. Or, this essential change in the life of teachers has made homework a significant challenge for some of them, especially in terms of management, as with a lack of control over how to perform new tasks, stress and exhaustion intensified.

Although the signs of exhaustion among teachers may go unnoticed by managers and even unrecognized by teachers, it is essential to identify early the symptoms they experience, so as to implement the most effective and effective intervention plans to maintain or even the increase of their well-being, implicitly of the qualitative level of education.

The need to know the level of exhaustion at work is all the more important as its effects can be felt in the long term in other aspects of the individual's life, and ignoring the symptoms of exhaustion by managers and employees can lead to worsening physical and mental health, as well as affecting organizational performance.

2. LITERATURE REVIEW

a. Burnout syndrome - concept

In the foreign literature there is an increased interest in studying this burnout syndrome due to its importance in the social life (increasing interest in mental health) of individuals, which has contributed to various opinions about its significance.

The results of the research conducted by Heinemann and Heinemann (2017) on the typology of research on the phenomenon of burnout show that there are six such categories: studies that considered the causes and factors associated with burnout (identified as personality factors, factors organizational, social factors); studies aimed at the prevalence of this syndrome in certain occupational groups; studies aimed at developing and testing methods to prevent or reduce burnout; studies that focused on identifying the psychological symptoms of burnout; psychometric studies; studies that looked at the physiological processes underlying burnout syndrome.

According to APA Dictionary of Psychology (2020) the meaning of the concept of burnout is that of "physical, emotional or mental exhaustion accompanied by low motivation, poor performance and negative attitudes towards self and others", being present among professionals such as: social workers, teachers, therapists, athletes, etc. Herbert Freudenberger first defined this concept in 1975 to describe a certain experience and mental state at work.

Schaufeli, Marek and Maslach (1993) argue that burnout can be described in terms of three elements:

- Emotional exhaustion understood by the individual as a lack of energy and consumption of emotional resources.
- Depersonalization that implies the existence of a feeling of distance of the employee from the work done.
- Low personal achievement - seen from a negative perspective (negative evaluation trend).

According to the definition given by the World Health Organization (2019), burnout is a syndrome caused by the individual's exposure to chronic stress at work, characterized by three dimensions: the existence of a feeling of exhaustion, a

feeling of detachment from the place work (or a negative feeling towards the workplace), a feeling of inefficiency and lack of achievement. According to the code assigned in the International Classification of Diseases and Related Problems (ICD-11), exhaustion is seen as a phenomenon in the occupational context, which refers to mental well-being at work.

Exhaustion at work is defined as a psychological syndrome caused by the action of chronic interpersonal stressors at work (Maslach and Leiter, 2016), more specifically it is a consequence of a perceived disparity between the employee's requirements and resources (material and emotional) that he has at his disposal (Beheshtifar and Omidvar, 2013).

The significance of the concept of burnout at work differs from the significance of similar terms, such as stress at work and depression in that burnout implies an attitude of cynicism and a feeling of inefficiency towards workplace stress (Cordes and Dougherty, 1993; Schaufeli and van Dierendonck, 1993), and that depression (which occurs in a free context, covering all areas of life) is related to the occupational context (Warr, 2007).

Psychology Today defines exhaustion as a state of emotional, mental and sometimes even physical exhaustion, caused by prolonged exposure to stress, and most often caused by problems at work.

b. Teacher exhaustion - causes, symptoms and effects

Education is a pillar of a strong modern society, being represented by teachers - the main promoters and guarantors of quality in education. The teaching profession in the 21st century involves a number of significant challenges for those working in the field of education, which can bring both satisfaction and exhaustion. Among the specific challenges of the educational career we can mention: adapting the contents of the curricula to the diversity of students' learning styles, managing the students' class (with everything that means leadership, motivation, problem solving, mentoring, evaluation, etc.), identifying the most appropriate ways to assimilate changes in education, so that students do not suffer, solving administrative tasks, concern for continuous professional development, etc.

Causes

Research in the field shows that many teachers experience burnout at work in terms of how to approach the daily challenges specific to work, and are then exposed to prolonged emotional stress. Thus, Ajayi (2016), McAllister (2018) consider that the evaluation of students by complying with certain standardized

tests leads to stressful situations among them, but also among teachers. In addition, Ávalos (2011) points out that there are many concerns and concerns among novice teachers, and that educational requirements in relation to professional development programs create pressures. Fernet, Guay, Senecal and Austin (2012) show in their study that teachers' perceptions of classroom overload and disruptive behavior of students are in a negative relationship with motivation, which ultimately influences teachers' level of exhaustion. In other words, teachers who are not motivated will consider that they do not have enough time to complete homework, which will make them feel inefficient and exhausted.

The results of Skaalvik and Skaalvik's (2010) study show that teachers' emotional exhaustion is strongly correlated with time pressure (given the feeling of having difficult work tasks, long time- evening, weekend- preparation for teaching, little time for rest and recovery), and the feeling of depersonalization is closely related to the relationship between teachers and parents.

The School of Education (2021) highlights some of the causes that lead to teacher burnout in the workplace:

- poor funding for the purchase of materials, technology to support the teaching-learning act carried out by the teacher (in this sense, teachers feel demotivated).
- high emotional demands: teachers feel the pressure of having on their shoulders the responsibility for future generations, teachers are the ones who also have the role of counselor (come into contact with tragic situations in the lives of students).
- inadequate teacher training in certain disciplinary areas (unsatisfied learning needs of students lead to feelings of dissatisfaction among teachers).
- challenging teaching situations: with e-learning, teachers have had to deal with various situations such as the challenging behavior of students and parents and thus feel more pressure to find a balance between personal and professional life.

Other factors that may contribute to teachers experiencing exhaustion at work may be: failure to manage a class of students (Reeves, 2012); low level of empowerment (Dierking and Fox, 2013); negative work environment (Norhisham, et al., 2021), lack of organizational support (Smetackova, et al., 2019).

The results of the study by Pyhältö, et al. (2021) indicate that there are a number of individual factors that influence the occurrence of teacher exhaustion in the workplace, such as: level of education, gender (female teachers are more likely to experience stress in unjustifiably, and male teachers are more likely to experience feelings of cynicism), years of experience.

The pandemic context determined the appearance of more accentuated causes in the activity of teachers with impact on their state of exhaustion, such as: more time needed to complete tasks, the need for training in order to easily adapt to new teaching-learning methods, lack of interaction direct with students and co-workers, the need to find the most appropriate methods of motivating and supporting students in such a context (Mogonea & Mogonea, 2021).

Symptoms

Drummond (2016) considers that burnout syndrome has its origin in the energy metabolism of individuals, which once disturbed can lead to the following symptoms, considered to be internal energy accounts: decreased levels of emotional and physical energy, decreased levels of compassion and so on. accentuating the feeling of cynicism, accentuating the states of concern about how well the work is done - lack of efficiency.

Burnout syndrome can be manifested by various symptoms (physical, emotional, behavioral) specific to the 12 stages identified by psychologist Herbert Freudenberger and listed by Kaschka, Korczak, and Broich (2011) in their study. Thus, these phases are:

- 1) excessive ambition - especially for people who are facing something new and who want to prove that they are capable - a new job, a new task
- 2) more work done
- 3) neglect of one's own needs (needs for sleep, food, etc.)
- 4) displacement of the conflict (it is not the employee's fault)
- 5) less time to complete tasks (even less time spent with loved ones)
- 6) denying the existence of a problem (not taking responsibility for one's own actions and behaviors)
- 7) withdrawal (individuals perceive a lack of direction)
- 8) behavioral changes (individuals become more aggressive)
- 9) depersonalization (self-removal, individuals feel detached from their own lives and needs)
- 10) anxiety (individuals look for certain activities to help them cope with these emotions - most often they are negative and addictive)
- 11) depression (individuals lose their meaning in life)
- 12) physical exhaustion that may endanger the lives of individuals.

Lowenstein (1991) points out some of the signs that may show that teachers suffer from burnout at work, such as: exhaustion, detachment, boredom, cynicism, impatience, irritability, feelings of being incompetent and unappreciated, paranoia and disorientation, complaints and depression.

The grade net work (2019) summarizes some of the symptoms identified in several specialized studies, such as: feelings of failure and overwhelm in terms of many specific activities (grading, assessment, preparation), feelings of frustration (teachers consider that they do not have the ability to change the system), stress from managing classroom problems, lack of support, physical problems associated with stress and overwork.

Effects

Regarding the consequences of this syndrome among employees, Salvagioni, and others (2017) conducted a qualitative analysis of a number of 36 articles on this topic, resulting in the following:

- the state of exhaustion at work affects the physical health of individuals; they are more prone to the following diseases: cholesterol, type 2 diabetes, cardiovascular disease, musculoskeletal disorders, gastrointestinal and respiratory problems, etc.
- the state of exhaustion at work affects the mental health of individuals: they are more prone to insomnia, depressive symptoms, mental disorders.
- the state of exhaustion at work has professional consequences: employees are more prone to experience dissatisfaction at work, absenteeism, the emergence of new pensions for mental illness, presence at work while not feeling well.

Jacobson (2016) concludes in his paper that teacher exhaustion can lead to wear and tear if the influencing factors are not managed effectively, but also to negative results among students due to the low level of teacher commitment (felt in situations of experiencing exhaustion). In addition, it highlights other effects of teacher exhaustion, in terms of studying the literature, such as: exhausted teachers are more prone to experience acts of violence and lose patience, to be absent and thus affect the quality of education, but also well-being colleagues. A similar opinion is shared by Shen and others (2015), who believe that the state of exhaustion at work among teachers affects students' motivation to learn. On the other hand, Leung & Lee (2006) show that teachers' emotional exhaustion underlies their intentions to leave the profession.

c. Exhaustion of teachers in the pandemic

The pandemic context has challenged the teaching profession to new challenges, with the transition of learning in the digital environment. At the same time, they were more pronounced with the return to class and the need to address

new ways of training (such as hybrid learning). Thus, in a new context (of digitalization of learning) teachers have faced new job requirements (complementary or additional to existing ones), with new expectations from education actors (educational bodies, principals, students, parents).

Bohâlțeanu (2021) identifies a series of features of the teacher that have been accentuated in a pandemic context, which has determined that the work done by him becomes much more challenging (and in this sense, maybe even more exhausting). These include: creativity (derived from the need to keep students' attention and actively involved), the need for continuous training (derived from the use of digital educational platforms), the roles of motivator, guide and mentor (derived from the need to be closer of students in a different form, in order to support positive thinking among students); patience and communication.

The results of research aimed at studying the level of burnout among teachers in a pandemic context show that they experienced high levels of burnout at work, women being more affected than men, and those with more experience felt lower levels of exhaustion (Sánchez-Pujalte, et al., 2021), which led to the early leaving of the profession (Diliberti, 2021).

Sokal, Trudel and Babb (2020) studied the relationships between requirements, resources specific to the teaching profession and the state of exhaustion felt by teachers in a pandemic context. Thus, the results of their study indicate that time management, technical issues, the relationship with parents, the balance between personal and professional life are closely related to teacher exhaustion, while lack of resources is in a negative correlation. with the size of the realization.

Pressley (2021) notes that during the pandemic, teachers experienced a high level of exhaustion, with a positive correlation between this condition and anxiety about COVID-19, anxiety about teaching requirements and administrative support.

The results of the study by Weißenfels, Klopp and Perels (2021) indicate that the challenge posed by the pandemic context in teachers' work was not work overload, but rather lack of resources, which intensified feelings of depersonalization and lack of achievement among them.

3. RESEARCH METHODOLOGY

a. Purpose and objectives

The purpose of this research is to identify the level of exhaustion experienced at work during the pandemic by teachers in Romania.

In order to achieve the goal, the following objectives were set:

1. identifying the level of emotional exhaustion among teachers
2. identifying the level of depersonalization among teachers
3. identifying the level of achievement among teachers
4. identifying differences at group level in terms of level of exhaustion.

b. Research hypotheses

In order to achieve these objectives, the following hypotheses of the study were drawn:

- H1. In a pandemic context, teachers feel high levels of emotional exhaustion.
- H2. In a pandemic context, teachers feel high levels of depersonalization.
- H3. In a pandemic context, teachers feel low levels of achievement.

c. Research design

In order to identify the average general level of exhaustion felt by teachers during the pandemic, we opted for a quantitative approach, more specifically to the research method called investigation. The working tool used was the online questionnaire, in the form of a google form, in order to collect as much information as possible from the respondents. Statistical data processing was performed using the SPSS Statistics program, version 22, running descriptive analyzes, independent samples t-test.

d. Target population and working tool

The target population was represented by the entire teaching staff of Romanian education, and the sampling was random.

The questionnaire was structured in two parts, aiming at gathering information on the exhaustion syndrome and the socio-demographic characteristics of the respondents.

In order to identify the level of exhaustion among teachers, it was decided to translate into Romanian the Maslach Burnout Inventory-Educator Survey (MBI-ES) scale (taken from Gaitan, 2009), composed of 22 items structured on the three specific dimensions: emotional exhaustion (items 1, 2, 3, 6, 8, 13, 14, 16, 20), depersonalization (items 5, 10, 11, 15, 22) and achievement (items 4, 7, 9, 12, 17, 18, 19, 21). The measurement scale is composed of 7 response variants that indicate the frequency of occurrence of the respective state, as follows: 0 = never; 1 = at least several times a year; 2 = at least once a month; 3 = several times a month; 4 = once a week; 5 = several times a week; 6 = every day. In

order to interpret the results obtained, the figures are cumulated by item categories, and the scores obtained indicate:

- For emotional exhaustion: between 0-16 low level, between 17-26 moderate level, over 27 high level.
- For depersonalization: between 0-6 low level, between 7-12 moderate level, over 13 high level.
- For personal achievement the scale is reversed: over 37 low level, between 31-36 moderate level, 0-30 high level.

Examples of questions specific to the three dimensions of exhaustion syndrome are: (1) I feel emotionally exhausted because of the work I do; (2) I feel exhausted at the end of the working day.; (7) I deal effectively with the problems of my students; (12) I feel full of energy .; (13) I feel frustrated by the work I do.; (15) I'm not very interested in what happens to many of my colleagues.; (18) I feel motivated when I work closely with my students.; (22) I feel that the students blame me for some of their problems.

The socio-demographic characteristics targeted among the respondents are: gender, position held (substitute teacher, tenured teacher, master teacher, principal, other position), level of education (primary, secondary, high school, vocational, post-secondary, higher), type of education (public, private), age (18-24, 25-40, 41-56, ≥ 57 years), disciplinary area, educational degree, experience in education (1-10 years, 11-20 years, ≥ 21 years), county.

4. RESULTS AND DISCUSSIONS

Following the application of the online questionnaire, information was collected from 47 respondents whose socio-demographic characteristics are the following:

- Gender: 15 males and 32 females
- Position held: all respondents hold teaching positions, most of them full-time teachers (33 of the respondents)
- Level and type of education: most respondents (31) work in state high school education (46 respondents)
- Age: 29 respondents are teachers of generation X (41-56 years), and 12 respondents are teachers of generation Y (25-40 years), and the rest are aged between 18-24 years (1) and ≥ 57 years (5)
- Disciplinary area: most of the respondents are part of the department of technologies (15), followed by those of the departments of mathematics and sciences (10) and language and communication (9)

- Educational degree: 24 respondents have a 1st degree, and 11 have a final degree.
- Experience in education: 14 respondents are between 1-10 years old, 15 respondents are between 11-20 years old, and 18 respondents are ≥ 21 years old).
- County: 31 respondents are from Iași county, and the rest from other counties, such as: Dolj, Neamț, Bistrița-Năsăud, etc.

As the original scale was translated into Romanian in order to collect information from Romanian respondents, in order to test the reliability of the working tool, an internal consistency analysis was run, by calculating the Cronbach alfa coefficient. According to table no. 1, the value of this coefficient of 0.890 indicates that there is a strong consistency of the items in terms of the measured construct.

Table 1 Test reliability

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.890	.891	22

Regarding the identification of the levels of exhaustion (on the three specific dimensions) and anxiety towards COVID-19 of the respondents, it was decided to compute the items by dimensions, and then to calculate the averages per group. In this sense, the results from table no. 1 indicates the following:

- Responding teachers experience a moderate level of emotional exhaustion (with a score of 19 rated on a scale of 17-26)
- Responding teachers experience a low level of depersonalization (with a score of about 6 rated on a scale of 0-6)
- Responding teachers feel a high level of personal achievement (with a score of 30 rated on a scale of 0-30).

Table 2 Descriptive analysis of the specific dimensions of burnout syndrome

	N	Minimum	Maximum	Mean	Std. Deviation
Emotional exhaustion	47	.00	48.00	19.1915	12.12371
Depersonalization	47	.00	28.00	5.7872	5.90481
Personal achievement	47	7.00	48.00	30.6383	11.64778
Valid N (listwise)	47				

In order to identify differences at the level of groups in terms of the level of emotional exhaustion, it was decided to run a test to compare the averages by groups of respondents by gender, age, educational level, years of experience. The

results of the independent samples t test indicated that there were no differences in the perceived level of emotional exhaustion among the respondents in the analyzed groups, the sig values being higher than 0.05.

These results may indicate that teachers have now adapted to the new challenges posed by the pandemic context and have managed not to disconnect from what the teaching profession means and thus diminish the feeling of cynicism. Another explanation for these results may be that teachers now feel that they are effective because they have so far managed to learn and learn to work in class with digital tools so as to better manage specific activities compared to the beginning period. However, the results indicate that teachers still feel a moderate level of emotional exhaustion, which, however, cannot necessarily be attributed to the pandemic context, but to the nature of the work itself (the teaching profession). Thus, according to the identified results we can say that the working hypotheses H1, H2, H3 are rejected.

5. CONCLUSIONS

The results of this study objectively reflect the overall picture of burnout syndrome among teachers, by highlighting its main causes, symptoms and effects on their personal and professional lives. In addition, it highlights the main manifestations of burnout at work among teachers in a pandemic context.

Due to the increasing frequency of this symptom in several professions, but especially in the teaching profession and starting from the analysis of the literature, this study sought to identify the level of burnout at work felt by teachers in Romania.

In this regard, an online questionnaire on this construct was applied, and the results obtained show that teachers generally do not experience burnout at work in this pandemic context. Of the three dimensions specific to this syndrome, emotional exhaustion is more felt by teachers than the other two (depersonalization and personal achievement), but all at a moderate level. The results of this study are not similar to those of other studies (Pyhältö, et al., 2021; Sánchez-Pujalte, Mateu, Etchezahar and Gómez, 2021), which show that in a pandemic context teachers experience high levels of exhaustion and felt differ depending on certain socio-demographic characteristics.

Knowing these levels of emotional exhaustion, cynicism, achievement, experienced by teachers contributes to the objective assessment of reality and thus to making the most appropriate decisions by people skilled and interested in these issues.

This study contributes at a theoretical level to a structuring of information on the exhaustion syndrome at work among teachers, as well as to a highlight of how teachers experience it in a pandemic context. At a practical level, the study contributes to the validation of a working tool, by translating items into Romanian and certifying the reliability of items, as well as to outlining a reality that would be the basis for decisions by directors regarding methods to prevent exhaustion. or proactive strategies to reduce burnout.

6. LIMITS OF THE RESEARCH AND FUTURE RESEARCH

The limitations of this study may be related to the small size of the sample, which determines that the results not be generalized, its running in the online environment which led to a low participation rate of respondents, failure to take into account other influencing factors.

However, this study is a solid basis for the development of future studies, targeting other variables such as: job satisfaction, employee empowerment, organizational support, work environment, time management. Future research may also take into account a qualitative part of the research design, in order to identify more developed answers from the respondents, respectively to run a comparative analysis on different professional occupations. Also, future research may continue to explore the impact of the pandemic context on educational requirements and implicitly on the exhaustion syndrome experienced by teachers.

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ONLINE EDUCATION: EVALUATION OF STUDENTS PERCEPTION DURING THE COVID-19 PANDEMIC

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Abstract: *The pandemic of COVID-19 caused a dramatic shift in education and the educational process. This has had a significant impact on e-learning and m-learning instructional activities via digital platforms, which are now widely used by learners and instructors. The acceptance and use of these platforms is a topic of interest among researchers, and this study seeks to assess users' perceptions of online education during the COVID-19 outbreak. The Unified Theory of Acceptance and Use of Technology (UTAUT) structural model was used to capture behavioral intention and use behavior. The results obtained showed that performance expectancy has the greatest influence on behavioral intention, which has the greatest influence on use behavior. Furthermore, use behavior is largely influenced by behavioral intention, followed by the facilitating conditions, and performance expectancy. In contrast, the results showed that effort expectancy has no effect on behavioral intention. Furthermore, the clear majority of students believe that online education and the usage of e-learning/m-learning technologies are useful, simple to use, and contribute to the more efficient completion of work duties during the learning process. In addition, they aim to continue using online platforms and education in future learning activities.*

Keywords: *online education, m-learning, user perception, technology acceptance, use of technology, behavioral intention, UTAUT*

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1. INTRODUCTION

1.1 Why is the Current Essay undertaken?

Online education has become very popular in recent years, due to the context caused by the COVID-19 pandemic. Under the influence of the COVID-19 pandemic, schools were forced to suspend face-to-face meetings, which affected teaching progress. To minimize the impact of the pandemic on education and control the spread of the pandemic, online teaching has become a necessary strategy during this special period (Chen *et al.*, 2020). Thus, the educational process has moved online, leading to the increase of e-learning and m-learning activities, and teaching has occurred remotely through various digital platforms such as Moodle, Zoom, Google Meet, Microsoft Teams, etc. Online educational platforms allow teachers to provide students with a range of resources and materials in a text or multimedia format. They also allow students to submit assignments online and teachers to keep track of student progress and give grades (Chakraborty *et al.*, 2020). World-renowned faculty have begun to obtain online training certifications to teach their students online, but switching to online has raised many questions about the quality of education (Shahzad *et al.*, 2020).

In the online environment, the methods of learning and teaching are very different from those in the offline environment practiced in the past, and technological advances have led to a number of changes. Thus, in the online environment, the recent educational approach considers that the emphasis should change from teacher to student, making learning and education a personal activity. As a result, it will be more effective when learning conditions are more appropriate, reliable, and attractive (Chavoshi and Hamidi, 2019). Although it brings a number of advantages such as ease of use, flexibility in learning, and a controllable environment, there are quite a few limitations of e-learning, such as social isolation, lack of face-to-face interaction between teacher and student, connectivity, etc. Although e-learning was not formally adopted as a form of education before this pandemic, now, at the time of the pandemic crisis, most educational institutions are exploring and approaching e-learning to make it easier for students to work at a normal level (Khan *et al.*, 2020).

Although the field of online education is not new and has been studied intensively in recent decades, it has again attracted attention recently, being intensively studied in (Chakraborty *et al.*, 2020; Chavoshi and Hamidi, 2019; Chen *et al.*, 2020; Khan *et al.*, 2020; Kurilovas and Kubilinskiene, 2020; Shahzad *et al.*, 2020; Sitar-Taut and Mican, 2021) due to the fact that pupils and students have been

forced to participate to the educational process in online format, due to the imposition of social distance restrictions. According to (Chakraborty *et al.*, 2020), there is a lack of studies on how effectively students can interact with teachers and fellow students through various online tools and how effective online assessment techniques are. Only a few researchers have recently covered these issues (Chakraborty *et al.*, 2020; Chen *et al.*, 2020; Khan *et al.*, 2020; Shahzad *et al.*, 2020).

Due to the current context, this paper aims to provide an overview of students' perceptions of the use of mobile technology in online education. The aim of this paper is to contribute to the knowledge in the field, especially to see if online education is considered by students as a suitable solution to their learning needs and requirements. As a result, to achieve the research objectives, we chose to use the well-known Unified Theory of Technology Acceptance and Use (UTAUT) model (Ali and Arshad, 2016; Handoko, 2019; Hoi, 2020; Hussein Mohammad Jawad and Bin Hassan, 2013; Kuciapski, 2016; Nikou and Economides, 2017; Salloum and Shaalan, 2019; Thongsri *et al.*, 2018).

This article is organized as follows: introduction, theoretical aspects, and literature review, research methodology, results, and discussions, respectively, the conclusion. The first part of this paper offers an introduction regarding the field of study, the importance of the current research related to the field of knowledge, and the purpose and objectives. The second part examines the main studies conducted in the field of online education and how the COVID-19 pandemic has influenced major changes around the world. The next section details the research methodology, the results obtained, and discussions on how they influence the daily lives of students. The last section considers conclusions.

2. THEORETICAL BACKGROUND AND LITERATURE REVIEW

To study how users interact and accept technology, the Theory of Reasoned Action (TRA) and the Technology Acceptance Model (TAM) were used, but newer research uses models such as the Unified Theory of Acceptance and Use of Technology (UTAUT) (Hussein Mohammad Jawad and Bin Hassan, 2013). UTAUT is one of the most comprehensive models for accepting technology, and the advantage of the UTAUT model is its comprehensiveness, which means that the conceptual and empirical similarities of eight models are included in its design (Chavoshi and Hamidi, 2019). The UTAUT model (Ali and Arshad, 2016; Handoko, 2019; Hoi, 2020; Hussein Mohammad Jawad and Bin Hassan, 2013; Nikou and Economides, 2017; Salloum and Shaalan, 2019) considers that the

following factors influence the behavioral intention (BI) and use behavior (UB) to accept and use online education, that is: performance expectancy (PE), effort expectancy (EE), social influence (SI) and facilitating conditions (FC). Determining a student's desire to accept and use online education is done with the help of the behavioral intention (BI) and use behavior (UB) constructors (Salloum and Shaalan, 2019). Performance expectancy (perceived usefulness) (PE) is described as the degree to which an individual believes that using the new technology will help achieve benefits in job performance (Ali and Arshad, 2016). Effort expectancy (EE) is defined as the degree of ease with which a new system or technology can be used (Hoi, 2020). Social influence (SI) is considered the degree to which the intention of individuals to use a new system or technology is influenced by others (Hoi, 2020). Facilitating conditions (FC) are described as the extent to which an individual believes that an organizational and technical infrastructure will sustain the use of new technology (Ali and Arshad, 2016).

The paper published by (Kurilovas and Kubilinskiene, 2020) presented the application of a methodology to assess the adequacy, acceptance, and use of information technology tools for students, as well as a case study to evaluate two widely used IT tools when studying the design of human-computer interaction (HCI) in Lithuanian universities. The evaluation methodology of IT tools presented in the paper is based on well-known principles of multiple criteria decision analysis for identifying quality evaluation criteria and the Educational Technology Acceptance & Satisfaction Model (ETAS-M) based on the well-known Unified Theory on Acceptance and Use of Technology (UTAUT) model. The authors (Chavoshi and Hamidi, 2019) explored a number of factors, such as technological, pedagogical, social and individual, that affect the acceptance of m-learning in Iran on both a macro- and micro-scale. The results show that the selection of mobile devices as an educational strategy depends on the combination of pedagogical, technological, social and individual factors, and perceived utility is the most effective factor in accepting m-learning in Iran.

The study by (Chen *et al.*, 2020) aimed to analyze the impact of the pandemic on the user experience by obtaining reviews of seven major online education platforms before and after the outbreak of COVID-19. Furthermore, it seeks to learn about changing users' concerns about online education platforms in terms of access speed, reliability, timely information transmission technology, course management, communication and interaction, learning, and technical support. In research published by (Chakraborty *et al.*, 2020), a study was conducted on students' opinions on various aspects of online education during the pandemic.

The results showed that students felt that they learn better in physical classrooms (65.9%) considering that online education is stressful and has affected their health and social life. The study conducted by (Shahzad *et al.*, 2020) proposes a theoretical framework and a model to determine the success of e-learning portals. The objective of the study was to verify whether there are differences between women and men in terms of accessibility, quality of services, quality of the system, quality of information, user satisfaction, use of the system, and the success of e-learning portals. The results of the study reveal that men and women have a different level in terms of the use of e-learning portals in universities in Malaysia.

The study of (Nikou and Economides, 2017) provides empirical evidence on the acceptance of mobile-based assessment (MBA) and the proposed model, the Mobile-Based Assessment Acceptance Model (MBAAM) describes and predicts around 47% of the variance of behavioral intention to use mobile-based assessment. The purpose of the study conducted by (Thongsri *et al.*, 2018) employed UTAUT to investigate the factors that influence the intention of learners to use m-learning in developing countries such as Thailand. The results revealed that performance expectancy, cognitive need, affective need and social need had a significant effect on the intention to use m-learning. The study of (Kuciapski, 2016), based on UTAUT, investigated how students from Poland perceive the use of mobile technologies during the study process and used structural equation modelling to analyze data collected from 370 students from two universities.

3. RESEARCH METHODOLOGY, RESULTS, AND DISCUSSION

In this empirical study, the applied research methodology is based on the construction of a questionnaire in which the variables were derived following the review of the literature. The questionnaire contains on the one hand demographic profiles and on the other hand questions regarding experience with online learning platforms and the factors that affect the intention to continue using m-learning platforms, namely, the UTAUT model (Ali and Arshad, 2016; Handoko, 2019; Hoi, 2020; Hussein Mohammad Jawad and Bin Hassan, 2013; Kuciapski, 2016; Nikou and Economides, 2017; Salloum and Shaalan, 2019; Thongsri *et al.*, 2018). Five-point Likert scales established in the literature were used to measure the constructors, ranging from ‘strongly disagree’ (1) to ‘strongly agree’ (5). Therefore, for perceived utility (PE), questions such as (e.g., “I think m-learning systems are useful for me and allow me to perform tasks faster and more efficiently in the learning process”) were used, and for behavioral intention (BI) questions

such as (e.g., “I intend to continue using m-learning in my learning activity”). Thus, taking into account the specialized literature and the UTAUT model, the following hypotheses were issued:

H1. PE has a positive significant effect on BI of online education.

H2. EE has a positive significant effect on BI of online education.

H3. SI has a positive significant effect on BI of online education.

H4. BI has a positive significant effect on UB of online education.

H5. FC has a positive significant effect on UB of online education.

Samples were collected from university students during the COVID-19 pandemic using a Google survey. A total of 311 subjects participated in this study, all familiar with online education and currently using m-learning platforms. Of the total of respondents, 63.34% were women and 36.66% men. Of these, the vast majority, 89.07% are between 18 and 24 years old. In addition, 42.77% have up to two years of experience with online educational platforms (e.g., Moodle), and 41.16% have between 3 and 4 years of experience. In Table 1 we can see in detail the demographic characteristics of the study participants.

Table 1 Sample demographics (n = 311)

Respondent's demographic	Category	Total	%
Gender	Female	197	63.34%
	Male	114	36.66%
Age	18-24	277	89.07%
	25-34	34	10.93%
Experience with m-Learning products (years)	< 2 years	133	42.77%
	3-4 years	128	41.16%
	5-6 years	32	10.29%
	> 7 years	18	5.79%

To analyze the data collected, SmartPLS (Ringle, Christian M., Wende, Sven & Becker, 2015) was used, which uses PLS-SEM. PLS-SEM and SmartPLS modeling are used successfully in multiple research in the field of education (Nikou and Economides, 2017; Salloum and Shaalan, 2019; Shahzad *et al.*, 2020), e-commerce (Dan-Andrei *et al.*, 2020; Mican, Sitar-Tăut and Moisesescu, 2020), or social networks (Mican, Sitar-Tăut and Mișuț, 2020). The graphical representation of the structural model with the obtained values of path coefficients, p values and R^2 can be observed in Fig. 2. The model measurements' assessment in terms of

their reliability, convergent validity, collinearity issues and model fit was made and all values are in the recommended intervals (Hair *et al.*, 2016).

Table 2 Descriptive statistics

Items	Minimum	Maximum	Mean	Standard Deviation
Performance expectancy (PE)	1	5	4.287	0.756
Effort expectancy (EE)	1	5	4.328	0.781
Social influence (SI)	1	5	3.638	1.000
Facilitating conditions (FC)	1	5	4.473	0.750
Behavioral intention (BI)	1	5	4.301	0.794
Use behavior (UB)	1	5	4.103	0.822

The results of the preliminary analysis of the questionnaire can be seen in Table 2 and Figure 2. The results for the mean values and standard deviation are presented in Table 2. The mean value for almost all constructs (PE, EE, FC, and BI) is higher than 4.2, which leads us to conclude that the respondents strongly agree with these variables, and for SI and UB it is higher than 3.4, which leads us to conclude that they agree with these variables. The standard deviation ranges from 0.750 to 1.000, which is a very narrow range around the mean.

The percentage of participants' responses for each factor, based on Likert's 5-point scale, is shown in Figure 1. Thus, the majority of students (83.20%) believe that the use of new technologies, such as m-learning, are useful and will help to obtain benefits in terms of performing faster and more efficiently of work tasks in the learning process. A high percentage of students (86.28%) consider that m-learning systems (e.g., Moodle) are easy to use, that the discovery of various facilities is obvious in such systems, and how to interact with m-learning platforms it is easy and intuitive. Just over half of the students (53.70%) believe that the intention to use online education and online learning technologies is influenced by others. Most of the students (89.39%) consider that in general, the university / faculty and the environment in which they prefer to learn offer them the optimal conditions to be able to benefit from online education. Regarding the intention to accept and continue to use online education in future learning activities, the majority of students (83.82%) expressed their agreement to continue using the platforms that facilitate online education.

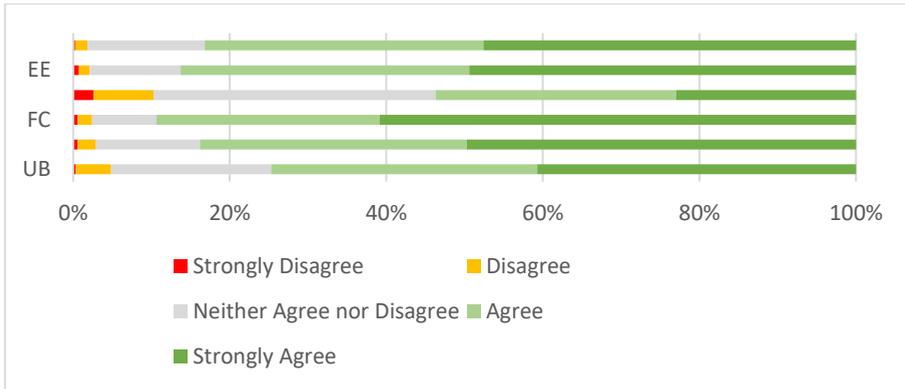


Figure 1 Distribution of responses

The structural model identifies the path relationships between the constructs in the research model and the bootstrap method was used to investigate the hypotheses in PLS-SEM. As Figure 2 reveals, performance expectancy (PE) has the most influence on behavioral intention (BI), which has the most influence on use behavior (UB). In addition, regarding the path coefficients of total effects, the final dependent variable use behavior (UB) is mostly influenced by behavioral intention (BI), then by facilitating conditions (FC), performance expectancy (PE), and social influence (SI). Effort expectancy (EE) does not have an effect on behavior intention (BI). As a result, H1, H3, H4, and H5 were supported and H2 was rejected.

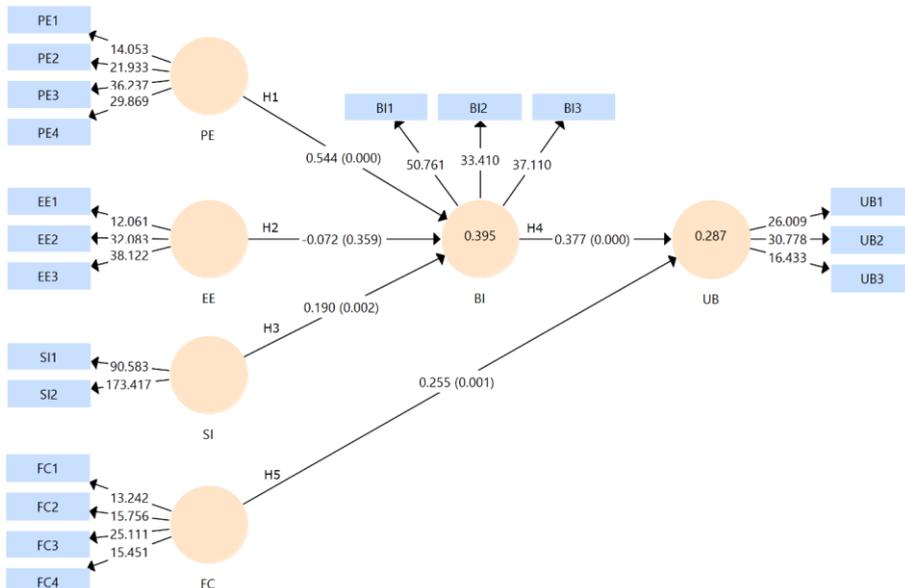


Figure 2 Structural model with the obtained values, of path coefficients, p values and R²

The results of our study have shown that performance expectancy (PE) has a positive significant effect on the behavioral intention (BI) of online education; therefore, the H1 hypothesis was confirmed. Similar conclusions were drawn by (Hoi, 2020; Hussein Mohammad Jawad and Bin Hassan, 2013; Salloum and Shaalan, 2019; Thongsri *et al.*, 2018) and (Hoi, 2020) also found that performance expectancy is the most powerful predictor of attitude towards the use. The better the performance expectancy (PE) is considered by the students, the higher the behavioral intention (BI), respectively, the use behavior (UB), and the behavioral intention (BI) mediates the relationship between the two variables. Regarding the H2 hypothesis, the hope of effort (EE) has no effect on the behavioral intention (BI) of online education, as a result, this hypothesis was rejected. These findings confirm those of previous studies, such as those published by (Hoi, 2020; Thongsri *et al.*, 2018), but in contrast to earlier findings of (Hussein Mohammad Jawad and Bin Hassan, 2013; Salloum and Shaalan, 2019).

Social influence (SI) was found to have a positive and significant effect on behavioral intention (BI) of online education, therefore, the H3 hypothesis is confirmed. These results are in line with those obtained by (Hoi, 2020; Hussein Mohammad Jawad and Bin Hassan, 2013; Salloum and Shaalan, 2019), but the results do not confirm previous research by (Thongsri *et al.*, 2018), which have found no significant effect. The results show that behavior intention (BI) has a positive and significant effect on use behavior (UB) of online education; as a result, the H4 hypothesis is confirmed. The last hypothesis, H5, is also confirmed, stating that facilitating conditions (FC) has a positive and significant effect on use behavior (UB) of online education. The last two hypotheses are consistent with the research of (Hoi, 2020; Hussein Mohammad Jawad and Bin Hassan, 2013; Salloum and Shaalan, 2019).

4. CONCLUSIONS

The COVID-19 pandemic has had a major impact on education, and with this sudden shift from offline to online, the question remains whether the adoption of online learning will continue to persist after the pandemic. This study aimed to identify the factors that affect students' acceptance of the use of mobile devices in online education. Using the data collected, about the user experience on online education platforms during the COVID-19 pandemic, both descriptive statistical

analyzes and modeling using structural equations were performed. Thus, out of the five hypotheses issued, four of them were confirmed, and one was rejected.

The study found that the behavioral intention to adopt online education on mobile devices depends on a multitude of factors related to performance, effort, social influence, etc. Specifically, based on the structural model, it was found that the use behavior of mobile devices in online education is mostly influenced by behavioral intention, which in turn is mostly influenced by performance expectancy. In addition, taking into account the total effects of the path coefficients, use behavior is mostly influenced by behavioral intention, then by facilitating conditions, performance expectancy, and finally by social influence. Instead, our study showed that effort expectancy does not have an effect on behavior intention. In addition, 83.20% of students believe that online education and the use of new m-learning technologies are useful and contribute to the benefits in terms of more efficient fulfillment of work tasks in the learning process. Moreover, 86.28% believe that the technologies are simple to use and that interacting with m-learning platforms is simple and intuitive. In terms of their intention to embrace and continue to use online education in future learning activities, 83.82% wish to use online platforms and education in the future.

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DETERMINANTS OF SUBJECTIVE WELL-BEING AMONG ROMANIAN OLDER ADULTS

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Abstract: *Due to population ageing, the analysis of the subjective well-being among older adults has received particular attention worldwide. In Romania this area of research is not very well studied and further investigation is needed. The purpose of this study is to analyze the determinants of subjective well-being of the Romanian older adults. Our empirical analysis is based on data from the Survey of Health, Ageing and Retirement in Europe. Using this we estimate ordinal logistic models to identify the main factors that explain subjective well-being.*

Our empirical results show that higher levels of income, education and a good health have a significant positive effect on subjective well-being. Also, we show that being alone and not involved in a partnership negatively affects the well-being of older adults.

Keywords: *subjective well-being, older adults, SHARE, life satisfaction, ordinal logit model.*

1. INTRODUCTION

Population ageing is a worldwide phenomenon of concern, not limited to developed countries with high national income per capita, but also to middle-income countries. Romania is no exception. Due to the unprecedented demographic change, it is facing a deep socio-economic transformation. In the last decade, the demographic structure of the population shows an increase in the number of older people; this is caused by a higher level of life expectancy and decreasing fertility rate; these changes are the results of higher levels of education, economic control, and advanced technology.

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The population ageing crisis signaled to policy makers that measures for ensuring a higher level of well-being among the elderly are needed, as the pursuit of high well-being or happiness is ultimately an important goal of every human being and a target of high importance for every society (Hayo and Seifert, 2003; Diener and Seligman, 2004). In the context of higher life expectancy, by promoting and maintaining the well-being of older adults, the society is primarily the main beneficiary; as example some of them will still be active, work and contribute to the society and the cost associated with their healthcare will be reduced. In this manner the older adults will be able to support the society through their contributions and not the society will support them.

Subjective well-being, besides being a measure that can be used in the context of policy creation, can also be a determinant of public support for democratic regimes and market economies. Starting from all these, knowing and understanding the determinants of subjective well-being is a widely debated and researched topic. The literature presents various factors such as income, employment status, health status, age group, living arrangements, social ties, and religiosity as important determinants of subjective well-being (Fleche et al., 2011; Diener et al., 2013).

There is a quite low number of studies that have been conducted to identify the micro-level determinants of subjective well-being among older adults. Most of the studies on these determinants are carried out in developed countries; these countries have the financial resources to carry out such research, as opposed to developing countries like Romania. Another widely debated issue regarding the identification of determinants of well-being is that terms like happiness and life satisfaction are used interchangeably to assess a person's subjective well-being (Howell and Howell, 2008). Thus, to make a distinction between the two concepts, the OECD (2013) developed a guideline on measuring subjective well-being, suggesting that all aspects should be measured separately to allow a better understanding of the determinants.

Among the few studies on the subjective well-being of older adults in Romania is the one conducted by Precupetu (2016) which analyses the subjective well-being of two socio-structural groups (the poor and the precarious prosperous) in comparison with the group living in secure prosperity, using a sample aged between 18 and 65 years or more.

Given the lack of a comprehensive analysis in Romania on the determinants of subjective well-being among older adults and the limitations of existing research, this article aims to provide a more comprehensive picture of the

determinants at micro level, using data from the Survey of Ageing, Retirement and Employment in Europe, a cross-national panel study of individuals aged 50 or over.

Based on the literature review, we would like to investigate several hypotheses, as follows:

H1: People with higher income show higher level of subjective wellbeing.

H2: People with poor health tend to have a lower level of subjective well-being.

H3: There is a non-linear relationship between age and life satisfaction.

H4: People who are single are more likely to have lower life satisfaction.

H5: Older adults involved in work activities record higher levels of subjective well-being.

H6: Older adults who are living alone are more likely to be less satisfied with their lives.

H7: People with higher education level are more satisfied with their lives.

Regarding the structure of the article, the following two sections review the literature on subjective well-being and its determinants; after this, we provide a brief overview of the research design, focusing on data and methodology. Then, the results of data analysis are presented and discussed, and some conclusions about the determinants of subjective well-being of the Romanian's older adults are drawn.

2. LITERATURE REVIEW

2.1. Defining and measuring subjective well-being

A first aspect that needs to be addressed concerns what subjective well-being entails. Often it is used in relation to physical health, usually as a concept for psychological health. Secondly, it is seen as a subjective equivalent of objective indicators on quality of life, implying an individual judgement. From another point of view, defining subjective well-being is that, like its counterparts, madness, and illness, it is at least partly a social construct (Vanhoutte, 2012). Thus, what subjective well-being entails depends not only on a person's psychological perspective on life, but also on their position in society and the society in which they live. Therefore, any research on the nature of well-being must balance philosophical theory and empirical measurement (Sumner, 1999).

Regarding the definition of subjective well-being, OECD (2013) proposes a broad definition: "Good mental states, including all of the various evaluations, positive and negative, that people make of their lives and the affective reactions of people to their experiences". This definition primarily encompasses measures of

how people live and evaluate their lives, namely that these evaluations are subjective because they are internally tested and not estimates of some external phenomenon. It also comprises three elements: life satisfaction in general, affect and eudaimonia. However, this paper examines only the first element which is a measurement of subjective well-being from the perspective of life satisfaction.

In terms of measuring life satisfaction in general, the OECD presents two approaches. The first one is the Cantril self-anchoring working scale, used, for example, in Gallup World Poll (Bjørnskov, 2010): “Please imagine a ladder with steps numbered from 0 at the bottom to 10 at the top. The top of the ladder represents the best possible life for you and the bottom of the ladder represents the worst possible life for you. If the upper step is 10 and the lower one is 0, on which step of the ladder would you say you personally feel you stand at this time?”. The second approach is the one used by World Values Survey (Bjørnskov, 2010) which involves asking a direct question about life satisfaction: „Taking all things together, how satisfied are you with your life these days? Using this card, where 1 means << completely dissatisfied >> and 10 means << fully satisfied >>, where would you place your life satisfaction as a whole?”

2.2. The determinants of subjective well-being

After examining the literature on potential determinants of subjective well-being, we find that there are two main streams of research. The macro-level analysis focuses on understanding how variables such as national income, unemployment or inflation influence subjective well-being; in many cases the analysis focuses on the relationship between GDP and subjective well-being or on the Esterlin paradox (Degutis et al., 2010). The second type of analysis focuses on micro-level variables influencing subjective well-being such as income, education level, health status, etc (Bjornskov et al., 2008; Dolan et al., 2008; Peiro, 2006; Baird et al., 2010; Helliwell, 2003; Hudson, 2006; Busseri et al., 2009). In the present study, the focus will be on micro-level determinants.

Following the literature review, micro level determinants of subjective well-being among older adults can be grouped into several broad groups:

1. Demographic characteristics, such as age, gender, number of children, living area;
2. Socio-economic characteristics, such as income, education level, marital status, health status, employment status;
3. Social networks, such as caring for others, community involvement, seeing friends and relatives;

4. Attitudes like trust in other people, religiousness.

Regarding the potential determinants of well-being, the literature reveals that there is a strong relationship between subjective well-being and the income level. Diener et al. (1999) conclude that there is a correlation between income and well-being in low-income countries and for the developed countries the situation is distinct. For these countries, once income reaches a threshold, further growth doesn't help in increasing the well-being (Clark et al., 2008).

Comparing the level of well-being among three groups of people (high, middle and low income), Cummins (2000) finds that "money buys happiness", especially for those who have low-income level. Likewise, Gildner et al. (2016) argues that income appears to influence well-being among older people; however, there is evidence that income is not a major determinant of subjective well-being among older adults (Wyshak, 2016).

A response to the influence of older adults' employment status on their well-being is not very clear stated, with some studies mentioning that self-employed respondents experience higher levels of happiness (Blanchflower and Oswald, 1998). On the other hand, the effect of unemployment on subjective well-being is clearly negative (Winkelmann, 2009). The impact of education varies from study to study, with some authors showing that there is no effect, while others show that subjective well-being is associated differently depending on the level of education (Clark and Oswald, 1994; Oswald, 1997; Blanchflower and Oswald, 2004). It is also mentioned that the level of education is correlated with income and health, so the latter should be controlled to fully capture the effect of education level (Bukanya et al., 2003).

Another interesting socio-economic determinant of subjective well-being is the role of health. Dolan et al. (2008) highlight that health status is strongly associated with subjective well-being. Haller and Hadler (2006) state that both good psychological and physical health have a strong and positive effect on subjective well-being, while chronic diseases negatively affect it (Easterlin, 2003).

Demographic variables can influence levels of well-being, age and gender being pertinent examples (Gerdtham and Johannesson, 1997). In general, women and men have similar levels of well-being, but this changes with age (Inglehart, 2002). A U-shaped distribution of well-being by age is described in the literature, with younger and older adults showing better levels of well-being than middle-aged adults (Blanchflower and Oswald 2008; Ferrer-i Carbonell and Gowdy, 2007).

Additional important factors that can also influence the level of subjective well-being of a person are marital status and living arrangements. The literature

highlights that being alone has a negative effect on a person's well-being, as opposed to being in a partnership (Dolan et al., 2008; Stutzer and Frey, 2004). It has also been found that unlike less stable partnerships, stable partnerships are most often associated with similar levels of well-being for married people (Kahneman and Deaton, 2010). Living arrangements and family structure have been found to influence well-being among the elderly (Agrawal, 2012; Andrade and De Vos, 2016). Thus, older people living alone would record a lower level of well-being; it is also mentioned that they are more likely to have symptoms of depression than those who are living with a child.

Social participation is considered a very important factor in the well-being of older adults (Ashida and Heaney, 2008; Haslam et al., 2008). As people get older, their social relationships may diminish as friends or even partners may die and these changes have negative effects on well-being (Charles and Carstensen, 2010). On the other hand, Cornwell et al. (2008) find that as age increases, so do social relationships, volunteering and religious participation.

The impact of residence environment on well-being has not received much attention; we can assume that because the urban areas are more populated, they can provide goods and services that rural areas cannot provide efficiently, which could plausibly increase well-being. Gerdtham and Johannesson (1997) argue that the direct effect of urbanization on well-being is significantly negative. According to Brereton et al. (2011), even if rural areas present more limited accessibility to local services, the quieter and more peaceful environment leads to higher levels of life satisfaction.

3. DATA AND METHODOLOGY

The present study is done using data from the survey conducted by SHARE-ERIC - Survey of Health, Ageing and Retirement in Europe – European Research Infrastructure Consortium (Borch-Supan et al., 2013). SHARE consists of a longitudinal survey, collected every 2 years which includes data on socio-economic, lifestyle and health-related information for people aged 50 and over from more than 25 European Union countries plus Israel. So far 8 waves have been collected, the first started in 2004 and the last started in 2020 but ended quickly due to the COVID-19 pandemic. The dataset used in this study focuses on respondents aged 50 years and over who have the residence in Romania, from wave 8 of the survey.

We will measure the subjective well-being by the respondents' life satisfaction score: "On a scale of 0 to 10, where 0 means total dissatisfaction and 10 means total satisfaction, how satisfied are you with your life?". Based on the literature review, we will try to explain this by socio-demographic characteristics

like gender, living area, age, the number of children, marital status, level of education and living arrangements, level of income, the employment status at the moment of the interview, disability, self-assessment of health. Our sample consists 1157 Romanian older adults that have been questioned about several aspects of their life in 2020, just before the starting of the Corona virus pandemic.

Due to the ordinal nature of the dependent variable, we consider that the most appropriate way of conducting our analysis is by using the ordered logit model (McCullagh, 1980).

The ordinal logistic regression model can be defined as

$$\text{logit}(P(Y \leq j)) = \beta_{j0} + \beta_{j1}x_1 + \dots + \beta_{jp}x_p, \quad (1)$$

Where $\beta_{j0}, \beta_{j1}, \dots, \beta_{jp}$ are the parameters (i.e., intercepts and slopes) of the predictors. The ordinal logit model can be used only for data which holds the proportional odds assumption. This assumes that the slopes are the same for all the categories. If the assumption is violated, the ordinal logit should be replaced by Generalized Ordinal Logistic Regression (Gujarati and Porter, 2009). An evaluation of this hypothesis is necessary as it is designed to assess whether the model is adequate.

4. RESULTS

After the data validation, we employ a descriptive statistics analysis. As mentioned before, in order to assess whether the model is adequate an evaluation of proportional odds hypothesis is necessary. Therefore, after testing this hypothesis was fulfilled ($\chi^2_{LP}=98.17, p = 0.261$), the odds for two outcomes were statistically similar, confirming the effectiveness of ordinal logistic regression in identifying subjective well-being determinants.

The estimated values for the dependent and control variables may be found in the Annex in Table 1. Our empirical results of the ordinal logistic regression presented in Table 2 show that subjective well-being of Romanian's older adults is significantly associated with marital status, level of education, income and self-assessment of health. According to the effect of marital status, the older adults who divorce or separate from partners are less likely to have higher scores on subjective well-being ($p < 0.002$), this result confirming our fourth hypothesis (H4) which states that the people who are single are more likely to have lower life satisfaction.

Table 2 Ordinal Logistic Regression Estimates of the Determinants of Life Satisfaction

Variables	β	SE	p-value
Age	0.001402	0.008262	0.865
Marital status (<i>ref. Married/ Cohabiting</i>)			
Widowed	-0.2927471	0.178728	0.101
Separated/ Divorced	-0.766524	0.2498072	0.002***
Living arrangements (<i>ref. Living alone</i>)			
Living with a family member	0.1832468	0.1964996	0.351
Level of education (<i>ref. Elementary school or less</i>)			
Middle school or unfinished high school	0.2283911	0.1733975	0.188
Completed high school or post-secondary	0.0710285	0.2016112	0.725
University studies	0.6315563	0.3062284	0.039**
Employment status (<i>ref. Retired</i>)			
Employed	0.1680222	0.1846814	0.363
Other inactive	0.0205058	0.1702458	0.904
Income	0.1896416	0.0704167	0.007***
Living area (<i>ref. Rural</i>)			
Urban	-0.1754703	0.1247868	0.160
No. of children	0.0514734	0.0395662	0.193
Disability (<i>ref. No</i>)			
Yes	-0.1666269	0.124071	0.179
Self-assessment of health (<i>ref. Poor</i>)			
Fair	0.6750929	0.1648297	0.000***
Good	1.15116	0.1698887	0.000***
Very good	1.967318	0.2400641	0.000***
Excellent	2.617782	0.4641625	0.000***
Observations	1157		
LR chi2	197.14		0.000***

***p<0.001; **p<0.05

Co-residence with family members is positively associated with subjective well-being measured by life satisfaction. Respondents who live with family members were more likely to report having a good or a very good life satisfaction, but this is not a significant predictor for Romanian's well-being which doesn't confirm our sixth the hypothesis.

The level of education and income have a positive and significant impact on Romanian older adults' life satisfaction. It can be noticed that the log-ratio in favor of higher level over a lower level of life satisfaction is, on average, 0,626 higher for

respondents who have graduated university studies. Regarding the income, we found that it influences life satisfaction in old age, in contrast to the conventional wisdom according to which “money can’t buy happiness”. For every one-point increase on income there is a predicted increase of 0,192 in the log odds of a respondent being in a higher category on life satisfaction. This finding confirms our first and seventh hypothesis; we do not have empirical evidence that the Easterlin paradox exists in Romania, and income is still a strong factor that affects the respondents’ subjective well-being.

Not all health variables indicate a significant impact on subjective well-being. There was no significant difference in the probability distribution of life satisfaction between respondents who don’t have a disability and those who have. Even so, those who were less independent in their daily life activities were less likely to have higher scores on well-being. In contrast to this, in terms of self-rated health, respondents that have a very good health are more likely to record a much higher level of satisfaction than the ones with poor health. This is also the case for those with fair health, for whom the odds ratio in favor of higher level over a lower level of life satisfaction increase by 2,61 as opposed to those with poor health. All these results confirm our expectations expressed by hypothesis H2.

Among all categories (i.e., employed, other inactive), there are no significant differences in the probability distribution of life satisfaction between employment’s categories; this doesn’t confirm our hypothesis regarding that older adults’ involvement in work activities increases their satisfaction with life.

Regarding the third hypothesis, we can say that age has not been found to be a predictor of subjective well-being among Romanian’s elderly. We can’t conclude if the relationship between Romanian older adults’ subjective well-being and age is U-shaped as it is presented in the literature (Easterlin, 2006).

Conclusions

This study aims to examine the main determinates of subjective well-being of older adults. Our study contributes to empirical literature by dealing with the determinants of subjective well-being considering the Romanian older adults. We use micro-data to measure subjective well-being and we estimate an ordinal logit model to identify the main determinants of Romanian older adults’ well-being.

Our empirical analysis shows that people who are divorced or separated perceived a lower subjective well-being level. This finding confirms the results obtained by Dolan et al. (2008) and Stutzer and Frey (2004), which have noticed

that negative effects of being alone are more pronounced than those of living with a partner.

We also found that the factors that can increase the probability of life satisfaction for Romanian older adults are higher education, better health, and higher income. Having a good financial situation shows that, for the Romanians, the phrase "money buys happiness" applies. Consistent with previous studies, absolute and relative income play an important role in levels of life satisfaction (Easterlin, 2005; Ng and Diener, 2014).

We did not find any evidence to confirm the existence of a non-linear relationship between age and life satisfaction in the case of our sample; by analyzing this relationship we can say that the Romanian population is not experiencing an inevitable decline in life satisfaction simply because of increasing age. Analyzing the results, we can say that if older adults have a high level of income and good health, age has no effect on the overall level of subjective well-being. Also, hypotheses 5 and 6 are not confirmed.

One limitation of this study was the use of one single item for measurement of subjective well-being, thus for future development of the research we propose to measure subjective well-being using more than one dimension. Another next step would be to investigate if the relations found in Romania's case would hold true in other Eastern European countries.

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Table 1 Descriptive statistics for the variables in the model

Variable	Total
	Mean
Life satisfaction	7.7830
Age	67.4866
Income	270,7301
No. of children	2,2402
	Proportion
Marital status	
<i>Married/ Cohabiting</i>	71,48
Widowed	21,95
Separated/ Divorced	6,57
Living arrangements	
<i>Living alone</i>	16,77
Living with a family member	83,23
Level of education	
<i>Elementary school or less</i>	14,87
Middle school or unfinished high school	56,87
Completed high school or post-secondary	23,77
University studies	4,49
Employment status	
<i>Retired</i>	70,18
Employed	13,48
Other inactive	16,34
Living area	
<i>Rural</i>	72,95
Urban	27,05
Disability	
<i>No</i>	43,22
Yes	56,78
Self-assessment of health	
<i>Poor</i>	21,18
Fair	25,41
Good	41,66
Very good	9,77
Excellent	1,99



UTILITY AND OPTIMIZATION'S DEPENDENCE ON DECISION-MAKERS' UNDERLYING VALUE-BELIEF SYSTEMS

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Abstract *This paper investigates how a consumer's utility and consequent optimization are determined by his/her natural endowments – self-awareness, imagination, conscience and free will. It focuses on such general utility that is a function in the dollar value of consumption, the number of hours spent on waged work and a particular value-belief system. For the third variable, we examine that it encourages the consumption of commodities and devalues waged job; it reinforces minimal commodity consumption; and it demands a non-standard optimization. While uncovering how an individual's marginal utility from commodity consumption or waged work varies respectively with different variables, such as non-waged incomes, etc., this paper demonstrates that when an individual decides on how much commodity is to be consumed and how much labor output is to be supplied to waged work by maximizing the corresponding utility, the person's utility and his/her method of optimization are exclusively defined by his/her value-belief system.*

Keywords: *commodity consumption; holistic thinking; mod function; values and beliefs; wage rate*

JEL Classification: *B41, D90*

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1. INTRODUCTION

In studies of economic and social behaviors, a commonly employed approach is to first introduce an objective function, such as a utility function, a production function, a profit function, etc., and then based on some kind cost-and-benefit analysis of the underlying economic agent, this objective function is optimized (e.g., Friedman, 1953; Gilboa, 2010; Gul and Pesendorfer, 2008). However, such an approach does not capture real-life scenarios, although it has been repeatedly confirmed with falsified empirical evidence, as so criticized by behavioral economists (e.g., Mullainathan and Thaler, 2000; Kahneman, 2011). Hence, the following question arises naturally at the most fundamental level underneath all investigations of economic and social behaviors, if one focuses only on the micro-level of individuals: Does an economic man really go through such a general procedure when he/she decides on what to do in terms of making a consumption decision?

The importance of this question is well witnessed by the vast amount of related literature in the name of rationality, where the aforementioned, commonly employed approach in studies of economic and social behaviors is widely known as the assumption of rationality. Although such rationality has been criticized only in recent decades by behavioral economists, some degrees of an inherent uncertainty this assumption implicitly embodies has been broadly felt and explored by a good number of leading scholars (Hudik, 2019), including, among numerous others, Gary Becker (1962), Frank Lovett (2006), Fritz Machlup (1946), Ariel Rubinstein (1998), Paul Samuelson (1948), Herbert Simon (1986), LL Thurstone (1931), Max Weber (1949) and Glen Weyl (2019). In summary, after using this approach for so many decades, scholars are still debating on what the assumption of rationality really means (Hudik, 2019). This end indirectly explains the reason why a compelling need for a meaningful reconstruction of economic theory has been called for by recent events, in particular, the 2008 financial crisis. For example, considering the inability for existing economic theories to describe, to predict and to explain in a timely manner in the front of the recent financial turmoil, Paul Krugman commented as follows in *New York Times* (2009-09-02),

The economic profession went astray because economists, as a group, mistook beauty, clad in impressive-looking mathematics, for truth... As memories of the Depression faded, economists fell back in love with the old, idealized vision of an economy in which rational individuals interact in perfect markets... Unfortunately, this romanticized and sanitized vision of the economy led most economists to ignore... things that can go wrong. They turned a blind eye to the limitations of human rationality that often leads to bubbles and burst; to the

problem of institutions that run amok; to the imperfection of markets... that can cause the economy... to undergo sudden, unpredictable crashes; and to the dangers created when regulators don't believe in regulation.

while Paul De Grauwe wrote the following in *Financial Times* (2009-07-21):

Mainstream (economic) models take the view that economic agents are superbly informed and understand the deep complexities of the world ... they have "rational expectations"... they all understand the same "truth", they all act the same way. Thus modelling the behavior of just one agent (the "representative" consumer and the "representative" producer) is all one has to do to fully describe the intricacies of the world. Rarely has such a ludicrous idea been taken so seriously by so many academics.

This paper aims at addressing the aforementioned question of fundamental importance by basing our reasoning and analysis on the four natural endowments of human beings: self-awareness, imagination, conscience and free will. To do this, we focus on the study of such general utility of an individual as an explicit function in the dollar value of total consumption, the number of hours spent on waged work and the person's particular system of values and beliefs. More specifically, the third variable is categorical and mostly not known to others and maybe in many cases even not known to the person him/herself involved. We examine the following values of this variable individually one by one:

- (1) The system positively values the consumption of commodities while treating waged job negatively;
- (2) The system believes in minimal commodity consumption, under which the following two subcases are detailed: (i) the individual maximally enjoys providing his labor on the waged work, and (ii) the person likes to supply as little labor as possible to his waged work; and
- (3) The system demands for a non-standard method of optimization of the established utility function.

By basing our reasoning and analysis on the novel ground of natural human endowments, this paper establishes 11 formal propositions, some of which, among others, reveal how an individual's marginal utility of commodity consumption and that of working on waged work vary respectively with (i) the income from non-waged sources, (ii) the number of hours spent on waged work, (iii) hourly wage rate, (iv) additional savings, (v) unit commodity price, and (vi) expense on leisure. By comparing these results with each other, it can be readily seen that within different systems of values and beliefs, the identified utility function behaves differently. Most importantly, such comparison and several constructed examples

collectively demonstrate that when an individual decides on how much commodity is to be consumed and how much labor output is to be supplied to his/her waged work by maximizing the corresponding utility subject to existing constraints, the individual's utility and his/her method of optimization are exclusively defined by his/her value-belief system. In other words, this paper contributes to the literature through supporting Simon's (1986) claim that the widely adopted rationality is about the decision behaviors of individuals and Rubinstein's (1998) belief that the selected option is most preferred among available alternatives, where preference is defined by the individual's natural endowments. This end differs majorly from the well-adopted definition of rationality – maximize an individual's advantage based on cost-and-benefit analysis (e.g., Friedman, 1953).

The rest of this paper is organized as follows. Section 2 examines how and why each individual has his/her own unique system of values and beliefs regarding how the world functions, what are considered either right or wrong and to what degree, and where the person is positioned in the myriad of things in the world. Section 3 looks at such a situation that a person's value-belief system positively values the consumption of commodities while seeing waged job negatively. Section 4 considers the scenario that an individual's value-belief system believes in minimal commodity consumption. Section 5 investigates scenarios involving non-standard optimizations of utilities that lead to the conclusion that both utility and method of optimization are exclusively determined by the value-belief system of the individual involved. Section 6 concludes this paper while pointing to potential future problems for research.

2. THE EXISTENCE OF VALUE-BELIEF SYSTEMS THAT VARY FROM ONE PERSON TO ANOTHER

This section, which is mainly based on Forrest and Liu (2021) and Lin and Forrest (2012), prepares the background knowledge necessary in order for the logical reasoning of the rest of the paper to go through smoothly. It provides reasons for why each person has his/her own unique system of values and beliefs regarding how the world operates, what are considered morally right or wrong and to what degree, and where his/her being is positioned in the myriad of things in the world and in nature. Different from similar studies in social science (e.g., Carden et al., 2021; Churchland, 2019; Ekstrom, 2000; Gamsakhurdia, 2019), where data- or anecdote-based observations and conjectures are treated as confirmed conclusions, although only statistically for most cases (Forrest, 2018, p. 12-16), discussions in

this section are based on the methodology and the holistic thinking of systems science (Forrest et al., 2013).

For the current purpose, let us imaginarily reason by starting from the moment when a person is born in this physical world. For a period of time, this person lives within the boundaries of many constraints and has to passively submit to the caretaker and the restricted environment. The newborn baby, as an input-out system (Forrest, 2018), develops its simple beliefs, basic values, and fundamental philosophical assumptions from exchanges with people and limited exposure to the environment. For instance, the baby swiftly discovers that “everybody around must take care of me; otherwise he/she will have to bear with the consequence – my crying, really loud crying.” In other words, the nature of being an input-output system, which exchanges with other entities, makes the baby aware that he/she exists as an individual and an entity that is different and separate from other people and objects, which is the person’s endowment of self-awareness (Cooke, 1974; Lin and Forrest, 2012). So, the conclusion below follows:

The endowment of self-awareness helps a person examine either consciously or unconsciously his/her thoughts and how to respond adequately to circumstances.

By employing developed beliefs, values and assumptions, the child orders the caretaker and directs the surrounding environment to meet its various needs and desires. As the child grows older, he/she gradually uses his/her forever expanding collection of beliefs, values and assumptions to elucidate whatever unfathomable, develop tactics to overcome difficulties, and fashion ways to manage his/her own dealings and concerns.

Over time, the person’s mental capacity increases in maturity so that he/she gains an increasing amount of control over his/her self-awareness. That strengthening mental capacity assists the person to acquire and master efficient tools and advanced knowledge from differentiated sources in the environment of a broadening scale and range. Therefore, the reservoir of experience and knowledge of the person’s imagination (Egan, 1992; Lin and Forrest, 2012; Norman, 2000) concurrently grows with new elements continuously added either consciously or unconsciously, while the elements of the reservoir are associated with each other at rising levels to form intellectual understandings of things, events, thoughts and situations. These associations of experiences and knowledge grow more fortified within the person’s self-consciousness. As soon as the strength of these associations goes beyond some threshold value, Bjerknæs’s (1898) Circulation Theorem guarantees that certain abstract, multi-dimensional eddy motions will appear within the self-awareness and the reservoir of that person’s imagination. It is these abstract, multi-dimensional

input-output movements of the experiences and knowledge that the person's imagination helps the person form his/her view of life, belief on how the world operates and philosophical system of values within the mind.

This holistic analysis in the previous paragraphs points to the following realization:

A person forms his/her unique view of life, belief of how the world operates, and philosophical values by closely associating experiences and knowledge that exist in the reservoir of his/her imagination.

Because there is not any such an environment into which more than one person is born, people's exchanges with their caretakers and environments are different from one person to another. These differences, which, for example, exist in family compositions, environmental structures, and interactions between and among entities in the environment, help people formulate their correspondingly different philosophical systems of values and beliefs. That is, we have the following conclusion:

Different people hold their individually varied views of life, beliefs of how the world operates and systems of values.

A person's conscience stands for such an ability that the person can use to know the principles by which his/her behaviors are judged as acceptable and to what degree his/her thoughts and actions are in accord with the principles (*Buss, 2004; Pfaff, 2007; Tinbergen, 1951*). It is through these principles that a person is able to separate what's wrong from what's right, what is moral from what is not, making him/her feel remorse, morality or truthfulness accordingly. Regarding conscience, Forrest and Liu (2021, Proposition 10.9) establish the following systemic result

Each person is genetically endowed with a capability of conscience; and some of the elements in the reservoir of a person's imagination are assigned with either a morality + value or a – value.

Jointly, the analysis and discussion above indicate that although a person's capacity for conscience is genetically determined, the person's conscience resides totally on top of his/her imagination. While his/her imagination develops on top of the person's self-awareness – an innate capability of the person, the exact contents of the person's conscience and the assigned morality values are learned throughout the entire life span.

As for free will, it stands for such a capability by mobilizing that a person makes promises to others or him/herself. The capability helps a person make estimates regarding what he/she can do and what's optimal that can be carried out

for resolving the issue at hand (Lin and Forrest, 2012). Implicitly, free will is an aptitude that helps people make decisions and pick choices among alternatives and correspondingly take consequent follow-through actions that materialize those choices and decisions.

The previous discussion indicates that as a person grows and matures over time, his/her reservoir of imagination enlarges continuously; and an increasing number of elements in the reservoir are assigned with morality values of either + or -. So, no matter whether or not the person is aware of his/her specific "self," there are three possibilities: (a) the "self" is assigned a + morality value; (b) the "self" is assigned a - morality value; or (3) the "self" is assigned with neither a + nor - morality value.

When possibility (a) holds true, the person makes promises based on estimates that are as accurate as possible so that what is promised can be mostly kept. If for a particular situation where a good estimate cannot be derived, the person will agree to do his/her best without providing any assurance of accomplishing the desired outcome. That is, for possibility (a), the person is able to keep what is promised. If possibility (b) turns out to be the case, then the person also determines as scrupulously as possible regarding the underlying potential so that he/she will most likely make promises that are opposite to what can be expectedly achieved. In other words, for possibility (b), promised is opposite to what will happen. And as for possibility (c), the person grew up without really knowing or caring whether his/her "self" means anything good or evil. Therefore, the person simply makes random promises (or noises) that are pleasant to the ear without considering to take correspondingly actions. No matter what happens next, it does not affect the person in any way conscientiously. Therefore, the following is concluded by Forrest and Liu (2021).

The endowment of free will assumes one of the following three possible scenarios: (i) promises are mostly kept; (ii) promised is most likely opposite to the actual outcome; and (iii) whatever is promised does not have anything to do with the outcome.

To further prepare, the rest of this paper looks at an individual who spends h hours working on a waged job or employment in the labor market. Assume that this individual's utility function U is real-valued and differentiable and is given as follows:

$$U = U(x, h, A), \quad (1)$$

where x stands for the individual's consumption of aggregate commodity, and A his/her personal system of values and beliefs. As in real life, A is a

categorical variable and is not definitively known to other people. To show that values of A really make difference, this paper considers such A -value as

- A positively values the consumption of commodities, while seeing waged job negatively.
- A believes minimal commodity consumption. And
- A determines how uniquely the utility function of concern is optimized according to the value-belief system of the individual involved.

If w represents the constant hourly wage and y the income independent of the waged work. Then the individual's total income is given below:

$$\text{total income} = wh + y. \quad (2)$$

That is, the individual faces the optimization problem of maximizing his/her utility function in equation (1) subject to the budget constraint in equation (2) by choosing $x > 0$ and $h \geq 0$.

3. WHEN CONSUMPTION IS PREFERRED WHILE WORK IS NOT DESIRABLE

This section looks at such a system A of values and beliefs that the consumption of commodities is valued positively so that the more commodities are consumed, the better, while working on a waged job is seen negatively such that the less time is spent on the waged job, the better. This scenario is the one typically considered in the literature (e.g., Pencavel, 1986; Prescott, 2004). To reflect this scenario, let us impose the following conditions on the individual's utility function in equation (1):

$$\frac{\partial U}{\partial x} > 0, \frac{\partial U}{\partial h} < 0, \frac{\partial^2 U}{\partial x^2} < 0, \frac{\partial^2 U}{\partial h^2} < 0, \quad (3)$$

where the conditions on the second-order partial derivatives are employed to guarantee the necessary concavity of the utility function.

3.1 The Evolution of Marginal Utility Function

In this case, let p represent the fixed unit price of the aggregate commodity. Then the individual maximizes his/her utility function subject to the following budget constraint, assuming that no decision on saving is involved.

$$px = wh + y. \quad (4)$$

Using the method of Lagrange multipliers, the first-order condition of this constrained optimization problem is

$$\begin{bmatrix} \frac{\partial U}{\partial x} \\ \frac{\partial U}{\partial h} \end{bmatrix} = \lambda \begin{bmatrix} p \\ -w \end{bmatrix}, \quad (5)$$

where λ is the Lagrange multiplier.

Proposition 1. This individual's Lagrange multiplier λ is a positive function of income y that is independent from the waged work, the commodity price p , wage rate w , the consumption x of aggregate commodity and the labor supply h , satisfying that

$$\frac{\partial \lambda}{\partial y} < 0, \frac{\partial \lambda}{\partial w} \leq 0, \frac{\partial \lambda}{\partial h} < 0 \text{ and } \frac{\partial \lambda}{\partial p} \leq 0. \quad (6)$$

Because λ is determined jointly by equations (2) and (5), it follows that λ is a function of all the variables mentioned in the proposition. And, from $\partial U/\partial x > 0$, as given in equation (3), and $\partial U/\partial x = \lambda p$, as indicated in equation (5), we know that λ takes positive values only. By solving equation (2) for x , we produce $x = (wh + y)/p$ and then the following:

$$\frac{\partial x}{\partial y} = \frac{1}{p} > 0, \frac{\partial x}{\partial w} = \frac{h}{p} \geq 0, \frac{\partial x}{\partial h} = \frac{w}{p} > 0, \frac{\partial x}{\partial p} = \frac{-(wh+y)}{p^2} < 0.$$

And by equating the first cells on both sides of equation (5), it follows that $\lambda = p^{-1} \cdot (\partial U/\partial x)$. So, from equation (1) we have

$$\frac{\partial \lambda}{\partial y} = \frac{1}{p} \cdot \frac{\partial^2 U}{\partial x^2} \cdot \frac{\partial x}{\partial y} = \frac{1}{p^2} \cdot \frac{\partial^2 U}{\partial x_t^2} < 0,$$

$$\frac{\partial \lambda}{\partial w} = \frac{1}{p} \cdot \frac{\partial^2 U}{\partial x^2} \cdot \frac{\partial x}{\partial w} = \frac{h}{p^2} \cdot \frac{\partial^2 U}{\partial x_t^2} \leq 0,$$

$$\frac{\partial \lambda}{\partial h} = \frac{1}{p} \cdot \frac{\partial^2 U}{\partial x^2} \cdot \frac{\partial x}{\partial h} = \frac{w}{p^2} \cdot \frac{\partial^2 U}{\partial x_t^2} < 0$$

and

$$\frac{\partial \lambda}{\partial p} = \frac{-1}{p^2} \cdot \frac{\partial U}{\partial x} + \frac{1}{p} \cdot \frac{\partial^2 U_t}{\partial x^2} \cdot \frac{\partial x}{\partial p} = \frac{-1}{p^2} \cdot \frac{\partial U}{\partial x} - \frac{wh+y}{p^3} \cdot \frac{\partial^2 U_t}{\partial x^2} \leq 0$$

Hence, all inequalities in equation (6) are shown.

Proposition 2. The following hold true in general:

- (i) The individual's marginal utility of commodity consumption decreases along with increasing income y that is independent from waged work; and
- (ii) The individual's marginal utility from working extra hours on the waged work increases with increasing income y .

To see the first part of this statement, let y_1 and y_2 be two different values of y such that $y_1 < y_2$. Then, equation (6) implies that $\lambda|_{y=y_1} > \lambda|_{y=y_2}$. So, equation (5) indicates the following inequality, which shows the first part of statement (1) above:

$$\left. \frac{\partial U}{\partial x} \right|_{y=y_1} = \lambda|_{y=y_1} p > \left. \frac{\partial U}{\partial x} \right|_{y=y_2} = \lambda|_{y=y_2} p.$$

To see the second part of this statement, let y_1 and y_2 be two distinct amounts of income that are independent from the waged work, satisfying $y_1 < y_2$. Then, equation (6) implies that $\lambda|_{y=y_1} > \lambda|_{y=y_2}$. So, equation (5) indicates the following, which confirms the second part of statement (1) above:

$$\left. \frac{\partial U}{\partial h} \right|_{y=y_1} = -\lambda|_{y=y_1} w < \left. \frac{\partial U}{\partial h} \right|_{y=y_2} = -\lambda|_{y=y_2} w.$$

Proposition 3. If the individual supplies a positive amount of labor on the waged work, then the following hold true:

- (i) The individual's marginal utility of commodity consumption drops along with increasing hourly rate of the waged work; and
- (ii) The individual's marginal utility from working extra hours on the waged work increases along with increasing hourly rate of the waged work.

The argument for this conclusion is similar to that of Proposition 2. All details are omitted.

3.2 Reservation Hourly Wage and Unit Commodity Price

Dividing the second equation in equation (5), as obtained by equating corresponding cells from both sides of equation (5), by the first one produces

$$\frac{w}{p} = \text{real wage} = -\frac{\partial U / \partial h}{\partial U / \partial x} = -m(x, h, A), \quad (7)$$

where $-m(x, h, A)$ is the marginal rate of substitution of the working hours for the consumption of commodities. By solving equations (2) and (7) jointly for x and h , we obtain the functions of the optimizing demand x for commodities and the optimizing work-hour supply h as follows, if $h > 0$:

$$\begin{cases} x^{max} = x^{max}(p, w, y, A) \\ h^{max} = h^{max}(p, w, y, A) \end{cases} \quad (8)$$

The special hourly wage rate w^* , satisfying $w^*/p = -m(x, 0, A, \varepsilon)$, represents the implicit value of the individual's time at the given commodity price p , and the personal system A of values and beliefs. This wage rate w^* is known as the individual's reservation wage (Prescott, 2004) for the given p and A . That is, only when $-m(x, h, A) = w/p > -m(x, 0, A) = w^*/p$, the individual will participate in the labor market. Hence, we have

$$\forall w \in \mathbb{R}^+ \exists (w > w^* \rightarrow h > 0) \wedge (w \leq w^* \rightarrow h = 0), \quad (9)$$

where \mathbb{R}^+ stands for the set of all positive real numbers. In other words, the reservation hourly wage rate w^* determines whether or not the individual will be prepared to supply his labor to the market.

If by leisure we mean any activity that is not any part of the waged employment, then the previous analysis shows the following conclusion.

Proposition 4. Assume that an individual has an endowed block of available time that is split between either participating in waged work or enjoying leisure, and that he/she also receives income from at least one other source that is independent of his/her labor supply in the market, then the following hold true:

- (i) For any given unit price p of the aggregate commodity and personal system A of values and beliefs, there is a reservation hourly wage rate w^* so that when the market hourly wage rate w of a job is greater than w^* , the individual will participate in the labor market; otherwise, he/she will not enter the labor market; and
- (ii) For any chosen level of participation in the labor market and personal system A of values and beliefs, there is a reservation unit price p^* so that when the unit price p of the aggregate commodity is less than p^* , the individual's demand for the aggregate commodity is positive; otherwise, her demand will be non-existent.

Proposition 5. Let

$$V = U(x, h, A)|_{x=x^{max}, h=h^{max}} = V(p, w, y, A) \quad (10)$$

be the maximized utility of the individual. Then the maximum demand x^{max} for commodities and the maximum labor supply h^{max} are analytically given by the following formulas:

$$\begin{cases} x^{max}(p, w, y, A) = -\frac{\partial V/\partial p}{\partial V/\partial y} \\ h^{max}(p, w, y, A) = -\frac{\partial V/\partial w}{\partial V/\partial y} \end{cases} \quad (11)$$

In fact, applying the method of Lagrange multipliers to equation (10) and the budget constraint $xp = wh + y$ leads to

$$\begin{bmatrix} \frac{\partial V}{\partial p} \\ \frac{\partial V}{\partial w} \\ \frac{\partial V}{\partial y} \end{bmatrix} = \lambda \begin{bmatrix} -x \\ h \\ 1 \end{bmatrix},$$

where λ is the Lagrange multiplier, which, according to the third equation of above matrix expression, is equal to the marginal utility of the non-waged income y when the utility function is evaluated at its maximum. Through respectively dividing the first and the second equation by the third in the previous expression, we obtain equation (11).

Example 1. In this case, we use a specific utility function to confirm scenario (1) listed above. In particular, let the individual's utility function be:

$$U = 2x^{\frac{1}{2}} - \frac{1}{3}h^3. \quad (12)$$

Then, this utility function satisfies the inequalities in equation (3). Let $p = 1$, $w = 1$ and $y = 0$, equation (4) becomes $x = h$. So, the method of Lagrange multipliers implies $x^{-1/2} = h^2$. So, $x = h = 1$, and

$$U_{max} = \frac{5}{3} \approx 1.6667 \text{ and } \left. \frac{\partial U}{\partial x} \right|_{y=0} = 1. \quad (13)$$

Similarly, for $p = 1$, $w = 1$ and $y = 1$, equation (4) becomes $x = h + 1$. Equation $x^{-\frac{1}{2}} = h^2$ implies that $h^4(h + 1) = 1$ so that $h \approx 0.8566$ and $x \approx 1.8566$. Correspondingly, we have

$$U_{max} \approx 2.5156 \text{ and } \left. \frac{\partial U}{\partial x} \right|_{y=1} \approx 0.7339. \quad (14)$$

The marginal utility function values for $y = 0$ and $y = 1$ respectively in equations (13) and (14) confirm the conclusion in Proposition 2(i).

Similarly, for $p = w = 1$, we can obtain

$$\left. \frac{\partial U}{\partial h} \right|_{y=0} = -1, \left. \frac{\partial U}{\partial h} \right|_{y=1} \approx -0.7338,$$

where confirms the conclusion in Proposition 2(ii).

Let $p = w = 1$, $y = 0$, and respective, $p = 1$, $w = 2$, $y = 0$, we obtain

$$\left. \frac{\partial U}{\partial x} \right|_{w=1} = 1; \left. \frac{\partial U}{\partial x} \right|_{w=2} \approx 0.6600; \left. \frac{\partial U}{\partial h} \right|_{w=1} \approx -1.7411, \left. \frac{\partial U}{\partial h} \right|_{w=2} \approx -1.3195,$$

which confirm the conclusions in Proposition 3.

According to equation (7), the marginal rate of substitution of the working hours for the commodity consumption is given by

$$-m(x, h, A) = \frac{w}{p} = h^2 x^{-1/2}.$$

So, the reservation hourly wage $w^* = 0$ and the reservation unit commodity price $p^* = +\infty$. In other words, as indicated by Proposition 4, if the individual values commodity consumption and devalues labor output in the waged work, then

- (i) For any given unit-commodity price p , as long as the hourly wage rate is positive, the individual will participate in the labor market; and
- (ii) The individual's demand for commodity consumption is positive.

For the special case of $y = 0$, we produce:

$$\begin{cases} x^{max}(p, w, y, A) = \left(\frac{w}{p}\right)^{6/5} \\ h^{max}(p, w, y, A) = \left(\frac{w}{p}\right)^{1/5} \end{cases}$$

4. TWO SCENARIOS WHEN COMMODITY CONSUMPTION IS KEPT TO MINIMUM

This section looks at such an individual that as dictated by his/her value-belief system A the person keeps his/her commodity consumption to the minimum level of basic survival. Under this condition, we study two scenarios respectively:

- (1) The individual maximally enjoys providing his labor on the waged work.
And
- (2) The person also likes to supply as little labor as possible to his waged work.

4.1 Minimum Commodity Consumption with a Joyful Waged Work

To reflect Scenario (1), which describes the situation of a workaholic (van Beek et al., 2011), let us consider the following utility function along with the imposed conditions, where s stands for savings:

$$U = U(x, h, s, A), \text{ satisfying } \frac{\partial U}{\partial x} < 0, \frac{\partial U}{\partial h} > 0, \frac{\partial^2 U}{\partial x^2} < 0, \frac{\partial^2 U}{\partial h^2} < 0. \quad (15)$$

The reason why we include savings in this utility function is because when the individual enjoys working while is not motivated to spend extra on commodities, he/she has to have a place to park the additional earnings. And as before, the conditions on the second-order partial derivatives in equation (15) are employed to guarantee the needed concavity of the utility function. At the same time, the fact that no condition in equation (15) is imposed on the variable s reflects that earning additional money does not play a role on the person's utility.

In this case, the budget constraint can be rewritten as

$$px + s = wh + y. \quad (16)$$

And the first order condition of this optimization problem is

$$\begin{bmatrix} \frac{\partial U}{\partial x} \\ \frac{\partial U}{\partial h} \\ \frac{\partial U}{\partial s} \end{bmatrix} = \lambda \begin{bmatrix} p \\ -w \\ 1 \end{bmatrix}, \quad (17)$$

where λ is the Lagrange multiplier.

Proposition 6. The following hold true:

- (i) The individual's marginal utility of commodity consumption decreases along with increasing hourly wage rate w of the waged work;
- (ii) The individual's marginal utility from working extra hours on the waged work increases along with increasing hourly wage rate w of the waged work; and
- (iii) The individual's marginal utility from additional savings decreases along with increasing hourly wage rate w of the waged work.

To see the first part of this statement, the expression $\partial U / \partial x = \lambda p$ in equation (17) implies that $\lambda < 0$ due to equation (15). From equation (16), we have $\partial x / \partial w = hp^{-1} > 0$; and from equations (15), (16), (17), we obtain

$$\frac{\partial \lambda}{\partial w} = \frac{1}{p} \cdot \frac{\partial^2 u}{\partial x^2} \cdot \frac{\partial x}{\partial w} = \frac{h}{p^2} \cdot \frac{\partial^2 u}{\partial x^2} < 0.$$

That is, λ is a decreasing function in w . So, for $w_1, w_2 > 0$, condition $w_1 < w_2$ implies $\lambda|_{w=w_1} > \lambda|_{w=w_2}$. So, from equation (17), it follows that

$$\frac{\partial U}{\partial x}\bigg|_{w=w_1} = \lambda|_{w=w_1}p > \frac{\partial U}{\partial x}\bigg|_{w=w_2} = \lambda|_{w=w_2}p,$$

which shows the first part of this proposition.

To see the second part of this statement, the previous argument indicates that λ is a decreasing function in w . So, for $w_1, w_2 > 0$, satisfying $w_1 < w_2$, we have $\lambda|_{w=w_1} > \lambda|_{w=w_2}$. So, from equation (17), it follows that

$$\frac{\partial U}{\partial h}\bigg|_{w=w_1} = -\lambda|_{w=w_1}w < \frac{\partial U}{\partial h}\bigg|_{w=w_2} = -\lambda|_{w=w_2}w,$$

which shows the second part of this proposition.

To confirm the third part of this statement, the previous argument implies that λ is a decreasing function in w . So, for $w_1, w_2 > 0$, satisfying $w_1 < w_2$, we have $\lambda|_{w=w_1} > \lambda|_{w=w_2}$. So, from equation (17), it follows that

$$\frac{\partial U}{\partial s}\bigg|_{w=w_1} = \lambda|_{w=w_1} > \frac{\partial U}{\partial s}\bigg|_{w=w_2} = \lambda|_{w=w_2},$$

which shows the third part of this proposition.

Proposition 7. The following hold true:

- (i) The individual's marginal utility of commodity consumption drops along with increasing income y that is independent from the waged work;
- (ii) The individual's marginal utility from working extra hours on the waged work increases long with increasing income y ; and
- (iii) The individual's marginal utility from additional saving decreases long with increasing income y .

To see the first part of this statement, from equation (16), it follows that $\partial x/\partial y = p^{-1} > 0$. Equations (15), (16), (17) imply that

$$\frac{\partial \lambda}{\partial y} = \frac{1}{p} \cdot \frac{\partial^2 u}{\partial x^2} \cdot \frac{\partial x}{\partial y} = \frac{1}{p^2} \cdot \frac{\partial^2 u}{\partial x^2} < 0.$$

Hence, λ is a decreasing function in y . So, for $y_1, y_2 > 0$, satisfying $y_1 < y_2$, we have $\lambda|_{y=y_1} > \lambda|_{y=y_2}$. So, from equation (17), it follows that

$$\frac{\partial U}{\partial x}\bigg|_{y=y_1} = \lambda|_{y=y_1}p > \frac{\partial U}{\partial x}\bigg|_{y=y_2} = \lambda|_{y=y_2}p,$$

which confirms the first conclusion of this proposition.

To see the second part of this statement, let $y_1, y_2 > 0$, satisfying $y_1 < y_2$, we have $\lambda|_{y=y_1} > \lambda|_{y=y_2}$. So, from equation (17), it follows that

$$\frac{\partial U}{\partial h}\bigg|_{y=y_1} = -\lambda|_{y=y_1} w < \frac{\partial U}{\partial h}\bigg|_{y=y_2} = -\lambda|_{y=y_2} w,$$

which shows the second part of this proposition. The third part of this statement follows the same argument as the one in the argument of the previous proposition.

From equation (17), it follows that

$$\frac{\partial U}{\partial x} / \frac{\partial U}{\partial s} = p, \frac{\partial U}{\partial h} / \frac{\partial U}{\partial s} = -w. \quad (18)$$

Solving the system of equations (16) and (18) for x , y and s produces

$$\begin{cases} x^{opt} = x^{opt}(p, w, y, A) \\ h^{opt} = h^{opt}(p, w, y, A) \\ s^{opt} = s^{opt}(p, w, y, A) \end{cases} \quad (19)$$

Let $V^{opt} = U(x^{opt}, h^{opt}, s^{opt}, A) = V^{opt}(p, w, y, A)$ be the maximized utility of the individual. Then the method of Lagrange multipliers implies that

$$\begin{cases} \frac{\partial V^{opt}}{\partial p} \\ \frac{\partial V^{opt}}{\partial w} \\ \frac{\partial V^{opt}}{\partial y} \\ \frac{\partial V^{opt}}{\partial s} \end{cases} = \lambda \begin{bmatrix} x \\ -h \\ -1 \\ 1 \end{bmatrix}. \quad (20)$$

Dividing respectively the first equating cells by the third one and fourth one in equation (20), dividing the second equating cells by the third and the fourth one, and applying equation (16) lead to the following result.

Proposition 8. The optimal demand x^{opt} for commodities, the optimal labor supply h^{opt} and the optimal savings s^{opt} are analytically given by the following formulas:

$$\begin{cases} x^{opt}(p, w, y, A) = -\frac{\partial V^{opt}/\partial p}{\partial V^{opt}/\partial y} = \frac{\partial V^{opt}/\partial p}{\partial V^{opt}/\partial s} \\ h^{opt}(p, w, y, A) = -\frac{\partial V^{opt}/\partial w}{\partial V^{opt}/\partial s} = \frac{\partial V^{opt}/\partial w}{\partial V^{opt}/\partial y} \\ s^{opt}(p, w, y, A) = wh^{opt} + y - px^{opt} \end{cases}. \quad (21)$$

Example 2. For the second scenario considered in the previous sections, where commodity consumption is kept at the minimum for basic survival, while the waged work is enjoyable so that more labor is pleasantly supplied to the work, let us specify individual's utility function be:

$$U = 2h^{\frac{1}{2}} - \frac{1}{3}x^3 + s^2, \quad (22)$$

where the first two terms on the right-hand side are the same as those in equation (12) except that the places of the variables x and h are switched. It is straightforward to check that all the inequalities in equation (15) are satisfied.

The method of Lagrange multipliers implies that

$$\frac{\partial U}{\partial x} = -x^2 = \lambda p, \frac{\partial U}{\partial h} = h^{-1/2} = -\lambda w, \frac{\partial U}{\partial s} = 2s = \lambda, \quad (23)$$

where λ is the Lagrange multiplier. So, we have

$$\frac{x^2}{h^{-1/2}} = \frac{p}{w}. \quad (24)$$

To double check Proposition 6, we first let $p = w = 1$ and $y = 0$. Then the budget constraint in equation (16) becomes $x + s = h$. So, equation (24) can be rewritten as $x^2 = h^{-1/2} = (x + s)^{-1/2}$. Respectively, if we let $p = 1, w = 2$ and $y = 0$, then we have $x^2 = h^{-1/2} = [(x + s)/2]^{-1/2}$. Therefore, the following is readily obtained

$$\left. \frac{\partial U}{\partial x} \right|_{w=1} = \frac{-1}{\sqrt{x+2}} > \frac{-1}{\sqrt{(x+2)/2}} = \left. \frac{\partial U}{\partial x} \right|_{w=2}.$$

This end confirms the conclusion in Proposition 6(i). And, similarly, we obtain from equation (23)

$$\left. \frac{\partial U}{\partial h} \right|_{w=1} = \frac{1}{\sqrt{x+2}} < \frac{1}{\sqrt{(x+2)/2}} = \left. \frac{\partial U}{\partial h} \right|_{w=2},$$

which confirms the conclusion in Proposition 6(ii). Next, equation (23) implies that $\partial U / \partial s = -w^{-1} \partial U / \partial h$ and therefore

$$\left. \frac{\partial U}{\partial s} \right|_{w=1} = - \left. \frac{\partial U}{\partial h} \right|_{w=1} > - \left. \frac{\partial U}{\partial h} \right|_{w=2} > \frac{-1}{2} \left. \frac{\partial U}{\partial h} \right|_{w=2} = \left. \frac{\partial U}{\partial s} \right|_{w=2},$$

which confirms the conclusion in Proposition 6(iii). By letting $p = w = 1$, we obtain

$$\frac{\partial U}{\partial x} = -(h + y - s)^2, \frac{\partial U}{\partial h} = \frac{w}{p} (h + y - s)^2, \frac{\partial U}{\partial s} = \frac{-1}{p} (h + y - s)^2.$$

So, conclusions in Proposition 7 are confirmed.

4.2 Minimum Commodity Consumption with as Little Labor Supply as Possible

Regarding scenario (2), as listed at the beginning of this section, that the individual of concern does not enjoy the consumption of commodities and likes to supply as little labor as possible to any waged work. Additionally, assume that the person needs to maintain the minimum level of commodity consumption for basic survival. To this end, he/she also need to supply labor, although as little as possible, to a waged work in order to meet the minimum financial requirement to survive. What this scenario describes very well matches the phenomenon of hikikomori in Japan (Bowker et al., 2019). To study this current scenario, let us impose the following conditions on the individual's utility function in equation (1): There are $x_{min} > 0$ and $h_{min} \geq 0$ such that

$$\begin{aligned} \frac{\partial U}{\partial x} &\geq 0, \frac{\partial U}{\partial h} \geq 0, \text{ for } 0 \leq x \leq x_{min}, 0 \leq h \leq h_{min}, \\ \frac{\partial U}{\partial x} &< 0, \frac{\partial U}{\partial h} < 0, \text{ for } x > x_{min}, h > h_{min}, \\ \frac{\partial^2 U}{\partial x^2} &< 0, \frac{\partial^2 U}{\partial h^2} < 0. \end{aligned} \quad (25)$$

Such a scenario appears when the individual is addicted to one or several activities he participates in during his leisure time. Assume that the person spends q dollars on his leisure activities. Hence, the budget constraint for this individual is

$$px + q = wh + y. \quad (26)$$

Proposition 9. The following hold true:

- (i) The individual's marginal utility of commodity consumption is a non-increasing function in the hourly wage rate w of the waged work; and
- (ii) The individual's marginal utility from working extra hours on the waged work is a non-decreasing function in the hourly wage rate w of the waged work.

The proof is similar to those of parts (i) and (ii) in Proposition 6. All relevant details are omitted.

Proposition 10. The following hold true:

- (i) The individual's marginal utility of commodity consumption drops along with increasing income y that is independent from the waged work;
- (ii) The individual's marginal utility from working extra hours on the waged work increases long with increasing income y ;

- (iii) The individual's marginal utility of commodity consumption increases along with increasing unit commodity price p , for when the commodity consumption x is greater than the minimum x_{min} ;
- (iv) The individual's marginal utility from working extra hours on the waged work decreases with increasing p , for when the commodity consumption x is greater than the minimum x_{min} ;
- (v) The individual's marginal utility of commodity consumption increases along with increasing expense q on leisure; and
- (vi) The individual's marginal utility from working extra hours on the waged work decreases with increasing expense q .

The proof for (i) and (ii) is the same as that of Proposition 7. For (iii), the method of Lagrange multipliers implies that $\partial U/\partial x = \lambda p$; and from equation (26) it follows that $\partial x/\partial p = -(wh + y - q)/p^2 \leq 0$. Hence, we have the following for $x > x_{min}$

$$\frac{\partial \lambda}{\partial p} = \frac{\partial}{\partial p} \left(\frac{1}{p} \frac{\partial U}{\partial x} \right) = -\frac{1}{p^2} \frac{\partial U}{\partial x} + \frac{1}{p} \frac{\partial^2 U}{\partial x^2} \frac{\partial x}{\partial p} = -\frac{1}{p^2} \frac{\partial U}{\partial x} - \frac{(wh+y-q)}{p^3} \frac{\partial^2 U}{\partial x^2} > 0,$$

because equation (25) implies that $-p^{-2} \cdot \partial U/\partial x > 0$ for $x > x_{min}$, while $-(wh + y - q)p^{-3} \cdot \partial^2 U/\partial x^2 \geq 0$, assuming that the individual does not live on borrowed money. That is, for $x > x_{min}$, λ is an increasing function in p . So, for any p_1 and p_2 , satisfying $p_1 < p_2$, we have $\lambda|_{p=p_1} < \lambda|_{p=p_2}$ so that

$$\left. \frac{\partial U}{\partial x} \right|_{p=p_1} = \lambda|_{p=p_1} \cdot p_1 < \lambda|_{p=p_2} \cdot p_2 = \left. \frac{\partial U}{\partial x} \right|_{p=p_2}.$$

This end confirms the conclusion in (iii). The proof for (iv) follows from $\lambda|_{p=p_1} < \lambda|_{p=p_2}$ and $\partial U/\partial h = -\lambda w$. All details can be filled in as above and are omitted. Similarly, parts (v) and (vi) can be shown.

Example 3. For the third scenario considered in the previous paragraphs, where the commodity consumption is kept at the minimum for basic survival, and as little labor as possible is supplied to the waged work, let us specify individual's utility function as follows:

$$U = -(x - 2)^2 - (h - 3)^2, \quad (27)$$

so that the inequalities in equation (25) are satisfied with $x_{min} = 2$ and $h_{min} = 3$. This negative utility function means that the individual wants to minimize the adverse impact of labored work and commodity consumption.

By using the method of Lagrange multipliers and budget constraint in equation (2), we can produce

$$\frac{\partial U}{\partial x} = \frac{2p}{w} \left(\frac{px+q-y}{w} - 3 \right) \text{ and } \frac{\partial U}{\partial h} = -2 \left(\frac{px+q-y}{w} - 3 \right). \quad (28)$$

So, the conclusions in Propositions 9 and 10 are confirmed.

5. WHEN MAXIMIZATION TAKES ON A DIFFERENT MEANING

The previous two sections consider three scenarios where the value-belief system A of the individual of concern specifies respectively: (1) more commodity consumption is better, while less labor supply to the waged work is more desirable; (2) commodity consumption is kept at the minimum for basic survival, while the waged work is enjoyable so that more labor is pleasantly supplied to the work; and (3) commodity consumption is kept at the minimum for basic survival, and as little labor as possible is supplied to the waged work. And for each of these cases, the specified scenario can be adequately described as a standard optimization problem with correspondingly varied constraints. Different from the previous discussions, this section looks at such a particular value-belief system A that the output values of the objective function are not ordered as how real numbers are ordered ordinarily.

In particular, let \mathbb{R} be the set of all real numbers and a a positive real number. We define a linear order relation $<_{mod(a)}$ on \mathbb{R} as follows: For any x and $y \in \mathbb{R}$,

$$x <_{mod(a)} y \text{ if and only if } x \bmod(a) < y \bmod(a), \quad (29)$$

where the ordering $<$ is the conventional one defined on \mathbb{R} , $x \bmod(a)$ is the remainder of $x \div a$ and $y \bmod(a)$ the remainder of $y \div a$, such that $|x \bmod(a)| < a$ and $|y \bmod(a)| < a$. When all the involved numbers a , x and y are integers, this order relation $<_{mod(a)}$ degenerate into the one widely studied in number theory (Burton, 2012).

Geometrically, this mod function transforms the real number line \mathbb{R} into a “spring” of infinite length, Figure 1, so that for any positive $r \in \mathbb{R}$, satisfying $0 \leq r < a$, the following set of real numbers are classified into one equivalence class:

$$\{x \in \mathbb{R}: \exists q \in \mathbb{Z}(x = aq + r)\}, \quad (30)$$

where \mathbb{Z} stands for the set of all whole numbers, that is, $\mathbb{Z} = \{\dots, -3, -2, -1, 0, +1, +2, +3, \dots\}$. The arrows in Figure 1 signal the positive direction with the opposite being the negative direction. All such numbers as 0,

$\pm a, \pm 2a, \pm 3a, \dots$, are identified as equivalent with 0 serving as the representative of the equivalence class. By doing so in general, the class given in equation (30) can be represented by $r \in [0, a)$. For example, when $a = 2$, because $2.1 = 1 \cdot 2 + 0.1$ and $-2.1 = (-3) \cdot 2 + 0.9$, 2.1 is equivalent to and is represented by 0.1, while -2.1 is equivalent to and is represented by 0.9.

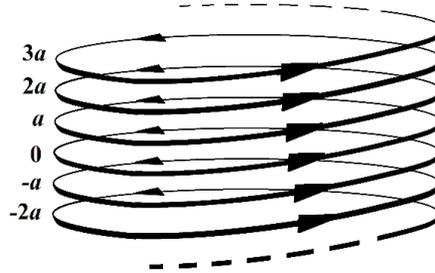


Figure 1 How the mod function turns the real number line into a “spring”

With the geometry of the mod function explained, the linear order relation $<_{\text{mod}(a)}$, as defined in equation (29), means the following: for any x and $y \in \mathbb{R}$, $x <_{\text{mod}(a)} y$, if and only if $r_x < r_y$, where r_x and $r_y \in [0, a)$ are respectively the representatives of x and y . Next, we look at how this order relation $<_{\text{mod}(a)}$ makes a difference for the case studied in Example 1 above.

Example 4. First, the maximization problem in Example 1, where the budget constraint is specified as $x = h$, provides the following outcomes:

$$\max_{x,h} U = \frac{5}{3} \approx 1.667, x_{\max} = h_{\max} = 1. \quad (31)$$

If we consider this maximization problem by respectively introducing $\text{mod}(2)$, $\text{mod}(1.5)$ and $\text{mod}(1)$, then the case of $\text{mod}(2)$ provides the same solution as that in equation (31). However, for the case of $\text{mod}(1.5)$, the maximization problem can be rewritten as follows:

$$\max_{x,h} (U \text{ mod}(1.5)) = \left(2x^{1/2} - \frac{1}{3}h^3 \right) \text{ mod}(1.5), \text{ subject to } x = h,$$

then the solution becomes

$$\max_{x,h} (U \text{ mod}(1.5)) = 1.5, x_{\max} = h_{\max} \approx 0.62527,$$

where for $x = y = 1$, $U \text{ mod}(1.5) = \frac{5}{3} \text{ mod}(1.5) \approx 0.167$. That is, equation (31) is no longer the desired the solution.

As for the case of $\text{mod}(1)$, the maximization problem becomes

$$\max_{x,h}(U \text{ mod}(1)) = \left(2x^{1/2} - \frac{1}{3}h^3\right) \text{ mod}(1), \text{ subject to } x = h.$$

So, the solution to this optimization problem is

$$\max_{x,h}(U \text{ mod}(1)) = \left(\frac{5}{3}\right)^- \text{ mod}(1) \approx 0.667, x_{\max} = h_{\max} = 1^-.$$

where for any real number x , the symbol x^- stands for $\lim_{z \rightarrow x^-} z$. That is, equation (31) is no longer the desired the solution.

One take-away we can learn from Example 4 is that when the set of all possible values of the objective function is ordered in a specific way, the method employed to optimize the objective function must be accordingly adjusted. By combining the conclusions established above, we have

Proposition 11. If an individual's decision about the amount of commodity consumption and labor output into a waged work is made by optimizing his/her corresponding utility subject to the underlying constraints, then both the utility and method of optimization are exclusively defined by the individual's value-belief system.

6. CONCLUSION

By setting foot on the four natural human endowments – self-awareness, imagination, conscience and free will (Forrest and Liu, 2021; Lin and Forrest, 2012), this paper innovatively shows how an individual's utility and his/her method of optimization are fundamentally determined by the person's natural endowments. Therefore, our answer to the question, as posed in the beginning of this paper, of whether or not an economic man really relies on rationality to make consumption decisions is both yes and no. The yes answer comes from that the endowment of conscience, together with that of imagination, determines what is considered satisfactory (beyond what is morally right or wrong) (Section 2). And, the no answer stems from the conclusion implicitly established in this paper that each utility function is subjectively introduced by the decision maker, while the consequent optimization of the utility is dictated by criteria formulated within the person's system of values and beliefs. In particular, the literature (Hudik, 2019) tends to have the researcher, whoever he/she is, define utility functions and determine which method of optimization to use under the implicit assumption that

he/she knows the decision maker well although in real life a person's value-belief system is not known anybody, including possibly the person him/herself. That is, the researcher represents the authority who decides which variables to include in a utility function and which specific method of optimization to use, although he/she has no idea about the underlying value-belief system of the decision maker. In the contrary, results developed in this paper clearly demonstrate that both a utility function and consequent method of optimization are determined either consciously or unconsciously by the specific individual involved in a decision situation. That is, when facing a decision situation, different people rely on different utility functions to choose their individually varied courses of actions. That explains in real life why the optimal course of action (or selection) in one person's eyes generally does not seem like optimal at all in another person's eyes.

Beyond the discussion in the previous paragraph, another major contribution this paper makes to the existent literature is that it relies on pure logical, systemic and analytical reasonings to derive conclusions without employing any empirically confirmed hypothesis as the basis and starting point of reasoning. Because of this reason, our developed conclusions are more theoretically sound than most of those that are data- or anecdote-based in the literature (Forrest and Liu, 2021).

For possible future research, one can investigate properties of marginal utilities under different circumstances of value-belief systems beyond the ones considered in this paper. Similarly, additional methods of optimization should be carefully introduced and studied. Another important scenario for future research is the question of what happens when an individual's decision is not derived on the optimization of any underlying objective function. Our expectation is that the same as what has been obtained in this paper – the person's utility and his/her method of optimization are exclusively defined by his/her value-belief system – will still be the result.

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FISCAL IMPULSE AND SECTORAL OUTPUT – EVIDENCE FROM INDIAN STATES

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Abstract: *The study covering the states of India for the period 2005 up to 2020 examines the growth effect of fiscal impulse on sectoral output. Gross value added of sectors is taken as the dependent variable while fiscal impulse as a ratio of the state domestic product has been taken as the explanatory variable. Four control variables are additional included. The study employs the generalized method of moments (GMM) for estimation. For industry and the services sector, growth effect of fiscal impulse is found to be positive and significant while for agriculture sector the effect is not significant. A sample split of states reveal developed states to be benefitting more from the growth effect of fiscal impulse as compared to the lesser developed states. The study contributes to the literature on fiscal policy and growth among the states of India.*

Keywords: *fiscal impulse, output, growth, GMM.*

JEL Classification: *E620*

1. INTRODUCTION

Globally, fiscal and the monetary policy are the principal policy measures adopted by economies for inducing growth (Arestis, 2012; Boskin, 2012a; Czaronis et al., 2020; Day & Yang, 2010a). As regards the monetary policy, there is a broad consensus on the impact of money supply and interest rates on stimulating credit growth and achieving the monetary policy objective of price stabilization (Goryunov & Trunin, 2016; Johnson et al., 2000; Svensson, 1999; Wen, 2009). However, the economic view of the growth effect of fiscal policy has varied with time and among economists based on theory and empirical findings. The Keynesian approach which was effective in reviving the economic growth during the great depression of 1929

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advocates increased government spending or an expansionary fiscal policy to spur consumption demand. This theory is based on the premise that the fiscal deficit primarily accounted for by government spending and especially in the infrastructure sector facilitates private investment and due to the “crowding in” effect it fosters growth (Amiri, 2013; Marimuthu et al., 2021a). A few empirical studies supporting the Keynesian thought of increased capital accumulation due to increase in fiscal deficit include Auerbach (2012), Fazzari (1994), Fontana (2009) and Musgrave (1987). The neo classical approach believes that an increase in fiscal deficit increases consumption levels but reduces savings thereby increasing interest rates (Canova & Pappa, 2011, Kumar. R & Soumya, 2010; McCallum, 2005). This results in suppressing economic activity. This thought is based on the premise that the fiscal deficits driven by government expenditure have a “crowding out” effect on private investment. It implies higher productive capital replaced by relatively lesser efficient government investment. The third view referred to as the “Ricardian approach” argues the impact of fiscal deficit to be neutral. But, based on empirical findings, this theory has received little or insignificant support from economists and policy makers (Doi, 2018; Mankiw, 2010). Thus, the Keynesian and the neo classical approaches can be viewed as two competing theories in the context of the relationship between fiscal deficit and growth.

The fiscal policy primarily revolves around government expenditure, taxes, and investment (Spilimbergo et al., 2009; Tanzi, 1993). The taxes form sources of revenue while the government expenditure and investment contribute to the expenses. The difference between the revenues and expenses can be surplus or deficit. A large deficit is generally met by drawings from the foreign exchange reserves or borrowings from the domestic or foreign markets. The excess foreign exchange drawings lead to balance of payments difficulties, the foreign borrowings lead to increased future debt obligations while the domestic borrowings tend to push the interest rates higher (Kumar S, 2012; Singh & Srinivasan, 2004). There is consensus that controlling fiscal deficit will enable economies to develop in the long run (Kleis, 2016; Marimuthu et al., 2021a; Petrovic & Brcerevic, 2014; Sen & Kaya, 2017). It has also been argued that the effectiveness of the fiscal policy including policy multiplier may vary with respect to economic conditions (Day & Yang, 2010b). Fiscal policy may be more effective in recessions (Goolsbee, 1998).

For developing economies government expenditure in social and infrastructure related projects may often lead to large fiscal deficits. For these economies it is important to balance their government finances with investments in the social and capital-intensive sectors (Koreh & Béland, 2017; Sinfield, 2020).

There are numerous studies available examining the relationship between fiscal policy and growth especially in the developed and advanced economies including Dekel (1994), Jaramillo & Cottarelli (2012) and Pasichnyi (2017). Although literature seems to suggest that the growth effect of fiscal deficit has mixed results depending on stage of economic development and expenditure composition, fiscal consolidation continues to be one of the major macroeconomic policy areas for all economies.

Literature on growth effect of fiscal policy at sector level are scarce. A few studies on growth effect of fiscal policy at country level include Isiaq (2013) for Nigeria, Tagkalakis (2013) for Greece, Gavin & Perotti (1997) for Latin America and Hussain & Haque (2017) for Bangladesh.

In the context of India, Raja Chelliah was one of the chief architects of India's public finance policies. He proposed increased compulsory savings through taxation coupled with high public and private investment as conducive for economic growth (Prest & Chelliah, 1960). This view over the years has been supported by many researchers including the recent studies of Medhi (2014), Mishra & Mohanty (2021) and Sharma & Sharma (2014). For India, to the author's best knowledge, studies on the sectoral impact on output of fiscal policy at country and state level are at best scarce. The present study attempts to fill this gap. The remaining part of the paper is organized as follows- section 2 covers prior work on the nexus between fiscal policy and growth, section 3 details the data and methodology used, section 4 discusses and reports the empirical findings of the study while conclusion is presented in section 5.

2. LITERATURE REVIEW

Literature related to fiscal policy differentiates between fiscal expansion and fiscal adjustment (Perrotti,1998). While the former is achieved through increased expenditure the latter relies on tax increases. Broadly, the studies on fiscal policy can be segmented as those examining (i) growth effects of fiscal policy at country/region level; (ii) growth effects of select fiscal policy variables; or (iii) the impact of fiscal policy on development indicators.

2.1 Country/region level studies

Most studies on the growth effect of fiscal policy are focused on developed and advanced economies including recent studies by Iorio & Fachin (2021), Leeper & Walker (2011) and Ubide (2016). One of the earliest studies covering underdeveloped countries was by Prest & Chelliah (1960). Other prominent works

include Perotti (2004) based on OECD countries, Ridzuan & Abd Rahman (2021) and Tang et al (2013) on ASEAN countries. In their study on developing economies Adam & Bevan (2005) estimate that the long-term growth dividend of cutting the deficit disappears or reverses below a threshold of around 1½ percent of GDP. An emerging market economies study by Fetai (2017) finds the effective role of fiscal policy in shortening the duration of financial crises.

The procyclical nature of the fiscal policy has also been examined in a few studies. The fiscal policy is procyclical in advanced/resource rich economies as observed by Aliyev (2012). The fiscal policy for developing economies is generally procyclical with spending increases (tax reductions) during boom and spending reductions (tax increases) during recessionary periods (Alesina A.F & Tabellini, 2005).

2.2 Growth effect of select fiscal policy variables

The common fiscal policy variables include public spending, taxation, and public debt. Most studies confirm public spending raises economic growth (Bayraktar & Moreno-Dodson, 2012; Greiner, 2015a). Different allocations of public resources lead to different growth rates (Paternostro et al., 2012). A recent study of 19 Asian countries by Gnangoin et al (2019) for the period 2002- 2017 finds public spending to have a positive impact on growth. In a study of developed economies Boris (2014) and Greiner (2015b) find public debt to hamper growth. In a recent study covering developing economies. Megersa & Cassimon (2015) find a significant negative relationship between public debt and growth. Cecchetti et al (2010a) in their study on industrialized economies with large aging population find the debt/GDP ratios to be unsustainable in the future. Gupta et al (2004) finds increasing efficiency of the tax system or enhanced spending on the infrastructure to push up the per capita growth. Further, broadening tax base supports growth for these economies. Alesina A.F. & Ardagna (2009) argue that fiscal consolidation based on tax increases is short lived fiscal consolidation based on cutting public employment and government wages is likely to have a long-term effect. Over a longer period, tax cuts as compared to increased government expenditure is likely to have a more favorable growth effect (Alesina A.F & Tabellini, 2005_b).

2.3 Fiscal policy and development indicators

Lustig (2016) in a study of 25 developing nations find fiscal policy to always reduce inequality but has mixed results on the poverty reduction. In a study of OECD countries covering the last four decades Salotti & Trecroci (2013) finds that

the increase in government debt and expenditure promote a less unequal distribution of income.

3. DATA AND METHODOLOGY

The study has two objectives. First is a state level examination of the growth effect of fiscal impulse on GVA of different sectors of the state economy. Second is to examine whether there is a variation in the growth effect if states are classified based on per capita income.

3.1 Measuring fiscal impulse

At a macro level and especially for developing economies, fiscal policy plays an important role in inducing domestic demand through enhanced government expenditure. Worldwide a variety of indicators are used to assess the fiscal policy stance of any government. Currently two of the important indicators estimated by IMF at a country level to assess the fiscal stance include cyclically adjusted balances (CAB) and structural balance (SB). The CAB adjusts for the cyclical nature of revenues and expenses while SB further adjusts for additional items not closely related to the business cycle.

In the Indian context, state level fiscal indicators estimated by the Reserve Bank of India (RBI) include gross fiscal deficit (GFD), primary deficit (PFD), revenue deficit (RD) and primary revenue deficit (PRD) as depicted in Table 1

Table 1 List of fiscal indicators reported by RBI

S. No.	Indicator	Description
1	Gross fiscal deficit	Aggregate expenditure – Revenue receipts and non-debt capital receipts
2	Primary deficit	GFD – interest payments
3	Revenue deficit	Revenue expenditure – revenue receipts
4	Primary revenue deficit	Revenue deficit- interest payments

Conceptually, fiscal stimulus or fiscal impulse is measured as the change in the government budget balance (Schinasi & Lutz, 1991). This could result from changes in the government expenditure or tax policies. One way of assessing the fiscal stance of the government is to look at the changes in one/more fiscal policy variables. The current study takes fiscal stimulus or fiscal impulse since it gives a composite view of the revenue and expenditure position of the government.

Thus, the study uses primary deficit and its increase/decrease over time to give an indication of the fiscal stance of the government. If PD_t and PD_{t-1} are the primary deficits at two time periods, then the difference between the two gives an indication of the fiscal impulse (FI) in the year. Thus, $FI = PD_t - PD_{t-1}$.

A positive FI would indicate an accommodative stance or the fiscal stance getting more expansionary while a negative FI would be an indication of contraction of the fiscal stimulus.

3.2 Selection of variables

The study attempts to examine the impact of fiscal impulse on different sectors of the economy. Three sectors namely Agriculture, Industry and Services are considered in the study and the gross value added (GVA) of each sector has been taken as the dependent variable. Fiscal impulse as a ratio of the SDP of the state has been taken as the explanatory variable. Other control variables included in the model are credit extended by scheduled commercial banks, gross fixed capital formation, state domestic product and number of workers. The description of the variables is given in Table 2.

Table 2 Description of the variables taken in the study

S. No.	Variables	Description
1	GVAAGR	Natural logarithm of gross value added of the agriculture sector
2	GVAIND	Natural logarithm of gross value added of the industry sector
3	GVASER	Natural logarithm of gross value added of the services sector
4	FI	Ratio of fiscal impulse and SDP of the state
5	BCRDT	Natural logarithm of credit extended by scheduled commercial banks
6	GFCF	Natural logarithm of gross fixed capital formation
7	SDP	Natural logarithm of state domestic product
8	WRKRS	Natural logarithm of number of workers

3.3 Data sources and sample selection

The state level data for the study is sourced from Reserve Bank of India (RBI) data base available on its website. The figures of GVA for all sectors has been taken at constant prices with base year 2004-05. The RBI website has data available from 2004-05 onwards and hence the study period is from 2004-05 up to 2019-20. The study covers 26 of the 29 states of India. Data for Telangana state is available from 2014-15 onwards and hence dropped. Similarly due to unavailability of complete data for Arunachal Pradesh and Mizoram, these two

have also been dropped from the sample. For the year 2019-20, these 3 states accounted for only 4.5 percent of the national gross domestic product and thus their omission from the study is unlikely to have any significant impact on the findings of the study.

3.4 Summary statistics

The summary statistics of the selected variables is presented in Table 3.

Table 3 Summary Statistics

Variables	No. of observations	Max	Min	Mean	STDEV
GVAAGR	390	122566	298	24249	23385
GVAIND	390	375135	561	56403	65913
GVASER	390	885374	1013	109209	132753
FI	390	42525	-44038	422.27	6129
BCRDT	390	2450000	300	159862	327031
GFCF	390	99649	0.21	10564	14987
SDP	390	1060000	1036	158070	185583
WRKRS	390	2234321	1734	369297	4331

(WRKRS is denoted in number of people while the unit of all other variables is in Rs. Cr)

Table 3 presents the summary statistics of the sample states in terms of output by economic activity (agriculture, industry, and services), state support through government expenditure (FI) and other economic and development indicators like bank credit, capital formation, SDP, and number of workers. The significant difference between the maximum and the minimum of the variables reflects the wide variations among the states in terms of population and stage of development. The mean of the fiscal impulse for the period is Rs.422.27 Cr indicating an overall expansionary stance of the fiscal policy adopted by states.

4. EMPIRICAL ANALYSIS, DISCUSSION AND FINDINGS

4.1 Estimation procedure

On the available panel data, it is possible to employ the ordinary least squares or the fixed effects model for estimation. The following equation 1 is used to examine the relationship between GVA of the sectors and fiscal impulse.

$$\ln GVA_{pit} = \alpha_0 + \beta_1 FI_{it} + \gamma Z_{it} + \epsilon_{it} \quad (1)$$

where $\ln GVA$ is the natural logarithm of gross value added, p represents output from agriculture, industry, and services. FI_{it} is the fiscal impulse of the i^{th} state in the t^{th} year. Z is the vector of the control variables that are believed to have an impact on GVA. The estimated result from eq. (1) is reported in table 4

Table 4 Estimation of relationship between output by economic activity and fiscal impulse

	Ordinary least squares (OLS)			Panel fixed effects (FE)		
	1	2	3	4	5	6
	GVAGR	GVAIND	GVASER	GVAAGR	GVAIND	GVASER
FI	0.034 (0.81)	0.005 (0.83)	-0.005 (0.81)	-0.0008 (0.93)	0.004 (0.54)	-0.006 (0.22)
BCRDT	0.37*** (0.000)	0.25*** (0.000)	0.57*** (0.000)	0.09** (0.06)	0.93*** (0.000)	0.09*** (0.000)
GFCF	0.08*** (0.0000)	0.08*** (0.000)	-0.07*** (0.000)	0.019** (0.08)	0.014** (0.04)	0.005 (0.38)
SDP	0.13*** (0.000)	0.17*** (0.000)	0.14*** (0.000)	0.22*** (0.000)	1.04*** (0.000)	0.107*** (0.000)
WRKRS	0.39*** (0.000)	0.29*** (0.000)	0.21*** (0.000)	0.08*** (0.000)	0.07*** (0.000)	0.004 (0.81)
R Square	0.79	0.96	0.96	0.99	0.98	0.99
N	390	390	390	390	390	390

Note: GVAGR, GVAIND and GVASER are the dependent variable in each of the specified models. Figures in parenthesis are the respective p values. ***, **, * denotes values significant at 1%, 5% and 10% confidence levels respectively.

It can be observed from table 4 that the impact of fiscal impulse on output is *insignificant* for all models. However, all other variables have a positive and significant impact on output irrespective of the model specification except for GFCF and WRKRS in model 6.

The panel data estimation using the fixed effects helps in eliminating the state specific *fixed* effects. However, two visible problems remain. One is the problem of endogeneity due to the existence of a simultaneous relationship between the dependent and the independent variables. Secondly, the finite sample size is a limitation. The dataset consists of a wide panel of 26 states as cross sections but a relatively shorter time of 13 years. To address these issues, estimation is done using the generalized methods of moments (GMM). Model specification of GMM is as per eq (2). This is a minor modification of eq (1) with one lagged value of the output being taken as an explanatory variable in the model. Other notations are the same as in eq (1)

$$\ln GVA_{pit} = \alpha_0 + \beta_0 \ln GVA_{pi,t-1} + \beta_1 FI_{it} + \gamma Z_{it} + \epsilon_{it} \quad (2)$$

The equation is estimated using one step GMM. The lagged values of the dependent and the independent variables are taken as instruments in the model. For testing the robustness of the model, two specification tests as proposed by Arellano & Bond (1991) are used. The validity of the instruments is checked by the Sargan test, and the error terms are tested for no serial correlation.

The results of eq (2) are presented in table 5

Table 5 Estimation of relationship between output by economic activity and fiscal impulse using one step generalized method of moments

	GVAAGR	GVAIND	GVASER
$GVAAGR_{t-1}$	0.079** (0.091)		
$GVAIND_{t-1}$		0.19185*** (0.000)	
$GVASER_{t-1}$			0.2309 (0.137)
FI	-0.0009 (0.651)	0.0045*** (0.0001)	-0.0032*** (0.000)
BCRDT	0.1012** (0.059)	0.3909 (0.1011)	0.2527 (0.1480)
GFCF	-0.0143*** (0.031)	0.0086*** (0.0221)	0.0041 (0.5551)
SDP	0.265*** (0.0282)	1.585*** (0.000)	0.2158*** (0.000)
WRKRS	0.044 (0.345)	0.0586*** (0.000)	0.0079 (0.681)
AR (1)	0.000	0.000	0.000
AR (2)	0.341	0.313	0.271

	GVAAGR	GVAIND	GVASER
Hansen test (p value)			
N	338	338	338

Note: GVAGR, GVAIND and GVASER are the dependent variable in each of the specified models. Figures in parenthesis are the respective p values. ***, **, * denotes values significant at 1%, 5% and 10% confidence levels respectively.

The impact of fiscal impulse on the output of industry and services is positive and statistically significant. Thus, an expansionary stance of the fiscal policy seems to have a positive influence on both these sectors. However, the results seem to suggest that any change in fiscal impulse does not have any impact on agriculture output at state level. Most probable reason could be that agriculture output in India is still largely influenced by monsoons and other support subsidies/incentives from both the state and central governments. Among the other explanatory variables, the SDP has a positive and statistically significant impact on the output of all sectors with industry output increasing the maximum for every unit increase in the fiscal impulse. The results indicate that at state level gross capital formation does not impact output of any of the sectors. Number of workers has a significant impact on the industry output.

4.2 Sample splits

The states in India vary widely in terms of size and economic development. The impact of fiscal impulse can vary across states depending on the efficiencies in the utilization of the factors of production. Advanced states are more developed generally because of their efficiencies in utilizing factors of production. The study classifies states into 3 categories based on their average per capita income from the year 2010 to 2020. Category A is the group of states with the highest average per capita income while Category C are the states with the lowest average per capita income. These states as categorized are as per table 6.

Table 6 Categorization of states on per capita income

Category	No. of states	States
A	10	Goa, Gujrat, Haryana, Himachal Pradesh, Karnataka, Kerela, Maharashtra, Sikkim, Tamil Nadu, Uttarakhand
B	8	Andhra Pradesh, Chhattisgarh, Nagaland, Odisha, Punjab, Rajasthan, Tripura, West Bengal
C	8	Assam, Bihar, Jammu and Kashmir, Jharkhand, Madhya Pradesh, Manipur, Meghalaya, Uttar Pradesh

The impact of the fiscal impulse on the output by economic activity for each of these categories is examined. Since the cross sections are now reduced with the time of study remaining the same, panel data model can be appropriately applied. The random effects model is first run on each of the models. Hausman test with the null hypothesis that the random effects model is appropriate for the data is used to determine the choice between the random effects or the fixed effects model for the data. Results are reported in table 7

Table 7 Panel data estimation results of sample splits

	Cat A			Cat B			Cat C		
	A*	I*	S*	A*	I*	S*	A*	I*	S*
	FE	FE	FE	FE	FE	FE	RE	FE	RE
FI	-0.54 0.13	0.16*** 0.042	-0.04 0.87	-0.02 0.75	0.001** 0.07	-0.009 0.114	0.003 0.98	-0.23 0.87	0.05*** 0.00
BCRDT	-0.13*** .00	0.26*** 0.00	0.29*** 0.00	3.69*** 0.00	0.004** 0.08	0.21*** 0.00	0.04 0.31	-0.15*** 0.004	0.39*** 0.00
GFCF	0.01 0.19	0.013*** 0.018	-0.01 0.18	2.58 0.01	0.012*** 0.023	0.021 0.26	0.02 0.127	0.05*** 0.003	-0.03*** 0.03
SDP	0.44*** 0.00	1.63*** 0.00	1.63*** 0.00	1.99*** 0.003	1.07*** 0.00	0.94*** 0.00	0.93*** 0.00	1.79*** 0.00	0.32*** 0.00
WRKRS	0.21*** 0.00	0.13*** 0.00	0.13*** 0.00	0.05 0.17	0.027** 0.042	0.03 0.34	0.06 0.19	-0.18** 0.05	0.24*** 0.00
N	150	150	150	120	120	120	120	120	120
Hausman test chi square p value	0.0065	0.00	0.02	0.00	0.00	0.00	0.00	0.334	0.96

Note: A*, I* and S* denote gross value added by agriculture, industry, and services respectively. FE and RE represent fixed effects and random effects model respectively. Figures in parenthesis are the respective p values. ***, **, * denotes values significant at 1%, 5% and 10% confidence levels respectively.

It can be observed from table 7 that the impact of fiscal impulse on output of industry is positive and statistically significant for both category A and B states. Similarly, the impact of gross capital formation and number of workers is also positive and significant on the industry output. Being amongst the more developed states of India, these states are relatively better in the utilization of their resources. These states are better able to exploit the increased expenditure of the government whether capital or revenue. Bank credit also has a positive and significant impact on output of each of the sectors. The impact of SDP across the states is positive on the output of each of the sectors. The results indicate that the more developed states better utilize the fiscal impulse advantage as compared to the lesser developed

states. However, the lesser developed states do well on exploiting the advantages from increase in gross capital formation.

5. SUMMARY AND CONCLUSIONS

Initial results of the OLS and FE model suggest that fiscal impulse has an insignificant impact on the output of different sectors. However, estimation based on the GMM method gives different findings. Given the nature of the dataset, findings based on this model are likely to be more reliable. The findings of the model indicate the growth effect of fiscal impulse to be positive and significant for the industry and services sector. Given the agriculture output to still be largely dependent on the vagaries of the monsoon, the growth effect of this sector to fiscal impulse is insignificant. Among the explanatory variables BCRDT, GFCF and WRKRS have a positive and significant impact on the GVAIND.

Amongst the more developed states, the impact of fiscal impulse is positive and significant for industry output. The findings suggest that stage of development of states influence their leveraging of fiscal impulse to enhance output. However, the less developed states better exploit the advantages from GFCF.

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AI ETHICS IN BUSINESS – A BIBLIOMETRIC APPROACH

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Abstract *Different businesses utilize Artificial intelligence (AI) to accelerate their digital transformation aiming to enhance specific outcomes while maximize productivity. Artificial Intelligence technologies have evolved rapidly and the interest to study this field has increased accordingly. In this context, the researchers were interested not only on the technical side of AI, but also on its impact on economy, or business. This study reviews, through bibliometric techniques, the key players, and the main discussed topics, that contribute to the research of ethics of AI solutions implemented in business. We analyzed the most cited 2000 articles extracted from Scopus databases, and we used VOSviewer to visualize the identified data. The insights provided through this paper are valuable for the researchers that are exploring the AI ethics, as well as for specific audiences from different domains such as social sciences, business decision making, IT management, government, and public policy decision-makers.*

Keywords: *Artificial Intelligence, AI ethics, business, digital transformation, bibliometric analysis.*

1. INTRODUCTION

Technology has always been a determining factor in the development process of societies or business organizations. Among the studies and research that were published on technology topics, there was always a particular interest related to the impact that the technology has on society. From a historical perspective, we can see that technology (generically speaking) faced an evolutive transformation, starting with the *Industrial Revolution*, Internet and computers

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networking development, continuing with the rapid growth of what we call today as *digitalization*.

Today the technology is transforming our daily lives, impacting routine tasks such as how we are thinking, shopping, communicating, learning, working, and one pandora's box in this regard is the artificial intelligence (AI). There are lots of examples of AI applications that are used intensively either by individuals or by businesses, such as surveillance and automation systems, medical healthcare, farming, banking, smart homes, remote working, and many others. On the other side, the business is also trying to benefit as much as possible from the AI systems investing in this direction to optimize and automate daily routines.

Within this context, the AI is showing an unlimited potential, that is be beneficial for lots of organizations and individuals, especially from an economic viewpoint. There is market research (PwC, 2017:1) that is estimating that the greatest economic gains from AI will be in China (26% boost to GDP in 2030) and North America (14.5% boost), equivalent to a total of \$10.7 trillion and accounting for approximately 70% of the global economic impact.

Note that due to the pandemic context, that began in 2019, we are witnessing a hyper-accelerated growth in the need for Artificial Intelligence systems in the business environment. McKinsey, in a recently published report (McKinsey Global Institute, 2021:3), shows that throughout history companies have controlled costs and mitigated insecurity in two ways: by adopting automation solutions and redefining work processes to simplify the daily routine of employees. Thus, this report presents the situation from July 2020, where approximately 65% of the companies had on their agenda the automation of business processes through AI, and simultaneously in China the production of robots had exceeded the norms reached a year before the pandemic.

Alternatively, organizations are still exploring the opportunities offered by AI and at the same time self-educating about the possible risks associated with it. Another recent PwC study (Global CEO Survey, 2021:2) shows that 75% of company leaders consider Artificial Intelligence useful to society, but a higher percentage, 84% of them believe that AI-based decisions need to be explained to be credible. For example, some of the top ethical issues on the research agenda today are related to unemployment and future of work, inequality and how wealth is created by machines and how these can affect human interactions. Other concerns are related to security, AI biases or privacy (Bossmann, 2016) and these are only some of them.

In this context, the study of AI ethics becomes increasingly relevant because it is essential to explore the opportunities of AI as well as the potential risks. There is research that is promoting the idea of AI for people enumerating principles as part of an AI framework that overcomes associated risks (Floridi et. al., 2018:689-707). It is obvious that there is a significant transformation of how different business environments become more productive and efficient due to digitization and through artificial intelligence solutions.

The main objective of this paper is to identify the current key players with interest in the research of the ethical concerns related to the AI ethics in business. To address it, we have integrated a bibliometric approach that will help explore the key topics and find the main contributors to the scientific literature. The scope of this scientific approach is to report on the potential opportunities for further research on the ethical debates surrounding the AI solutions implemented in business.

Therefore, this paper explores, what is the current landscape of the research articles that are addressing the topics of Artificial Intelligence ethics applied in business. Specifically, we will use bibliometric methods on data visualization to report on co-authorship and co-occurrence for the identified datasets, to retrieve what are the most cited articles, most influential institutions and journals, top countries researching this topic as well as the surfacing emerging topics. The datasets that will be chosen will be from Scopus, because it is the largest journal database that is currently available and it's offering also enriched capabilities to analyze the identified articles in results.

The next sections of the paper follow on the structure below: Section 2 focuses on the literature review of studies related to AI ethics in business; Section 3 will present the methodology used and the identified datasets used for the analyses; Section 4 will present the result of the bibliometric analyses and the key findings and finally Section 5 will offer the conclusions of this study as well as further research opportunities within the AI ethics field

2. EXPLORING ETHICS AND AI

To obtain the big picture on AI ethics in business, this paper will explore the related previous work done by other researchers interested on the AI ethics in business. In this section, we will review via a structured approach, 3 essential aspects of AI ethics: the current research related to the concepts of digital ethics in general (to understand the conceptual elements of ethics in technology), the AI impact on business (to explore how AI technologies is reshaping the business

landscape), and the current main AI ethics debates. We will further introduce the bibliometric methods that were used within this study for data visualization, to report on the co-occurrences and co-authorship analysis.

2.1 Analysis of the ethics concept from a digital perspective

The importance of ethics research becomes important in the context of the development and implementation of AI solutions toward digitalized business environments. This importance is given by the multidisciplinary complexity of AI and by its impact on society, economy, technology.

Defining the term *ethics* can be difficult and this approach would also involve explaining related, interdependent concepts that can be associated with what could be explained to be ethical or not.

According to the Encyclopedia Britannica (Singer, 2021) the term ethics may refer to the discipline that deals with the study of the concepts of good or bad, right, or wrong from a moral perspective. The term can be associated with any theory of values and moral principles. Finally, the subject of ethics must be seen and interpreted in terms of particularities that may be related to religion, culture, profession and which are associated with a group of individuals, communities, organizations, etc.

For this paper, we will not rely on the philosophical descriptions for ethics but it's important to make some distinctions between *metaethics*, *normative ethics*, *applied ethics* (Marturano, 2002) or *descriptive ethics* (Nijssingh and Duwell, 2009). Issues that address the foundation of moral values, that explore morality as culturally relevant, or that link ethics to empirical principles can be seen as relating to *metaethics*. It explores the connection between values, motives for action and human motivation, and that must be seen from the perspective of moral responsibility (Sayre-McCord, 2014). Descriptive ethics describes and understand moral values, its judgments, and good practices, representing the foundation for normative ethics, the latter seeking to justify different ethical positions depending on certain principles or virtues (Stahl et al., 2016). Normative ethics is based on the ethics of virtue and the abovementioned Kantian ethics.

From all above perspectives, for this paper we consider relevant the concept of applied ethics which is based on proposing prescriptions in specific situations. Examples for applied ethics could be those represented by biomedical ethics, technology ethics, military ethics, environmental ethics, or computer ethics (Stahl et al., 2016). Considering the purpose of this paper, it is necessary to explore the

evolution of computer ethics concept, which today is broadly called *digital ethics*. In large sense, the AI ethics could be seen as part of this broader theoretical concept.

With the advent of computer systems, ethics have aroused new interests and dilemmas in society. Terms such as "*computer ethics*" date back to the 1970s, but ethical dilemmas with reference to the technological environment appear with the development of the first technologies based on computer systems (Wiener 1954, Wiener 1959, Bynum 2001). Norbert Wiener, also considered the father of cybernetics and one of the main contributors to the development of digital computers, recognizes from the early stages of research that technology and digital computers will consistently change many aspects of life and have a crucial ethical importance, anticipating their impact on the labor market.

Today, computer ethics or, in general, digital ethics involves old problems that have acquired a new quality due to digital technology. Simultaneously, there are new dilemmas that did not exist at all, determined by automatic decision-making through Artificial Intelligence solutions and the potential risk associated with them (Muller, 2020). Of course, this rapid development of computers and computing in general has raised even more ethical

In a general sense, "digital ethics" has been approached as a need for the study since the first appearances of information and communication technologies. The issue of the need to propose a basis for research and the adoption of digital ethics arises, since the 1970s, where the debates were focused on the fact that "technological civilization" is a truly "new" civilization, in which information and communication technologies play a vital role, growth, hence the recourse to a "new ethics" based on responsibility (Jonas, 2014).

The emergence of new cloud computing technologies, the Internet of Things (IoT), Artificial Intelligence or social media facilitates rapid exposure of products or services to customers, as well as their access to an accessible and diverse market where only trust in the product or bidder can make a difference. Companies have felt the need to reach potential buyers with products much faster, and technology (social media for example) has made this possible.

2.2 Artificial intelligence and its impact on the business environment

Researchers refer to Artificial Intelligence as that software's, algorithms, systems, and machines that can demonstrate intelligence (Shankar, 2018). Another way to describe Artificial Intelligence is that this concept does not depend on the characteristic technologies, but rather on the purposes associated with the use and implementation of AI. In this sense, most of the time, business organizations will

use AI systems to streamline business processes or marketing strategies through easy access of data for more efficient interaction with customers or their own employees (Davenport and Ronanki, 2018). Finally, AI can be described by the ability of a machine or software to mimic human functions, such as reasoning, learning, planning, and creativity. Some AI technologies have been around for over 50 years, but increasing computing power, the availability of huge amounts of data, and new algorithms have led to major advances in AI in recent years. Artificial intelligence is already present in our lives and is considered a central element of the digital transformation of society becoming a priority for the European Union and is expected to bring huge changes to future applications. (European Parliament Resolution 2088-INI, 2019).

As this study explores the ethics of Artificial Intelligence implemented in different businesses, it is important to take a step back and look at what business means for technology in general and for AI. There are different perspectives on the concept of business with respect to business models that can be identified in the literature, most of them are gaining popularity in the 1990s, when companies were using different processes to communicate to investor groups the strategic development ideas for a short time (Zott and Amit, 2010). The scientific literature identifies three main perspectives of the business model concept (Aloini, Latronico and Pellegrini, 2021): *the strategic perspective*, the one based on *the object of activity of the business* and *the architectural one*.

For this paper we consider relevant the third perspective, as this is the most appropriate way for a company to propose a value-added business model (in a broad sense) with the possibility of creating, maintaining, and redistributing this value through digital technologies (in this case Artificial Intelligence). We are talking about a business model digitized by AI systems used to create added value.

Obviously, the relationship between technology and business, in a broad sense, depends on the market context, field of activity, customers and others. Under these circumstances, the main idea of our research is that technology can add value to a business or even create new business models, that focus on added value in all senses (profit, redistribution of it, investment, quality interactions with customers and partners, etc.).

Due to the different forms that AI can take, exploring the impact of these systems on the business environment is a complex process. A recent bibliometric analysis (Loureiro et. al., 2021) in the field of AI applied in business, was performed to obtain a classification of topics of scientific interest, identifying 4 areas of research.

- the impact of AI on society: this first area covers issues related to how AI influence society (specifically what is the impact of robots, what are the laws that control the effects of AI, how is AI used in marketing and social media to manipulate purchasing decisions)
- the impact of AI on organizations: this area captures the focus of current research on how AI impacts the way we work, factors of production and manufacturing in general, science management, business decisions, and risk management.
- AI methodologies: this topic is dedicated to research aimed at the methods used by AI systems to provide functionality such as prediction, data analysis, learning, neural networking, problem solving.
- AI systems: this area focuses on how AI systems are implemented in organizations such as those that create AI algorithms themselves or those that design products that can incorporate AI or those that only use AI to process information.

Another research topic that is captured from the literature is one related to the impact of AI in the business environment and we can find research that explores 3 different angles: the impact of AI on the labor market, automation of daily tasks (productivity efficiency) and finally the interaction between companies and customers. (Haenlein and Kaplan, 2020).

In the first category, different studies analyze how the changes introduced by AI influence the way human resources departments are organized (Tambe et. al., 2019) with reference to data storage, decision making, privacy and security and others. Other articles examine how AI systems can streamline business processes by automating daily activities.

Huang, Rust, and Maksimovic (2019) provide a broader view and analyze the relative importance of mechanical activities (e.g., repair and maintenance of equipment), human-thinking (e.g., processing, analysis, and interpreting information) and feeling activities (the *feeling tasks* such as, communicating with people) in different fields of activity. Analyzing from an empirical perspective, these authors show that, in the future, human employees will be increasingly busy with *feeling tasks because the thinking tasks* will be replaced by AI systems. They are continuing that hypothesis showing that a similar process happened when the most mechanical loads in the car manufacturing industry were replaced by robots.

Finally, there is the third category of studies focused on the interaction between business environments that use AI and customers (Kumar et. al., 2019). This category focuses on the marketing industry, proposing application models of

AI through which it can be performed. automating product selection, pricing, or displaying advertising content based on individual customer preferences.

It can be observed that the approach of literature is focused more on the relationship between AI and the business environment in terms of increasing employee productivity, streamlining distribution chains, optimizing costs, personifying services, without approaching also the potential associated risks of AI solutions.

2.3 Ethical Perspectives on Artificial Intelligence

Recent developments in the field of Artificial Intelligence are topics of public debate and attract media attention most of the time. Artificial Intelligence computer systems (whether we are talking about robots, chatbot virtual agents, facial recognition systems, etc.) are perceived as systems that transform from simple computer tools into systems that can make decisions autonomously. Therefore, the scientific community also pays more attention to both studying the development and to identifying the potential impact of these systems.

Nowadays, many companies are reinventing their business processes through digitalization or digital transformation. Referring to the systems of artificial intelligence, it is observed that a universally applicable definition for Artificial Intelligence cannot be found precisely due to the multidisciplinary aspect of the term. Some authors define Artificial Intelligence by the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with intellectual processes characteristic of people, such as the ability to reason, to discover meaning, to generalize or to learn from experience (Copeland, 2020).

Alternatively, some programs have reached the performance levels of human experts and professionals in performing certain specific tasks, so artificial intelligence in this limited sense is found in applications as diverse as medical diagnosis, computer search engines and recognition. voice or handwriting. Artificial Intelligence or in general sense, the theory of developing "computing" systems that can perform activities specific to human intelligence, is considered an ongoing revolution that transform societies and science (Harari, 2017).

While some forms of Artificial Intelligence (such as machine learning, deep learning, artificial neural networks) are changing the way data are stored, accessed, and processed other forms, such as autonomous and semi-autonomous systems are increasingly used by to different industries: medicine, transport, production. (Jordan, Mitchell, 2015). Of course, the benefits for optimizing work processes and

business productivity have been positively influenced, but on the other hand in the scientific environment there have been concerns that Artificial Intelligence would endanger jobs (Nature editorial, October 2017) or could be used as malicious tendencies (Brundage et al., 2018), or would exclude liability as there is a risk of inadvertently disseminating prejudices that may undermine the idea of fairness (Zou and Schiebinger, 2018). Other studies aimed to identify parameters to assess the ethics of Artificial Intelligence (Cath et. al., 2018, Greene et. al., 2019) or its association with some systemic risks (Crawford and Calo, 2016, Altman et al., 2018) which can generate negative consequences in society such as discrimination due to the prejudice of algorithms (Bolukbasi et al., 2016, Veale and Binns, 2017).

In the last decade, the private sector has made massive investments in innovation by developing robots and autonomous Artificial Intelligence systems that can interact with humans in various fields of activity. These innovations of recent years undoubtedly have benefits for society because they can save time, reduce human effort, costs or even save lives (Winfield and Jirotko, 2018).

For this paper, we considered essential to study the business perspective when talking about AI. Among others, there are also many signs from the business field indicating the Artificial Intelligence solutions are used to transform business processes to streamline productivity and reduce costs. First, to automate business processes, AI systems use programmed algorithms to perform well-defined tasks without the need for human intervention. Some examples of this could be related to automatic transfer of data from emails to centralized storage systems, automatic replacement of lost bank cards, automatic implementation of simple financial transactions or reading documents to be able to automatically extract keywords by language processing natural language processing.

Alternatively, AI systems can identify key information from large volumes of customer data, using not only available figures from their transactions but also from elements such as texts, messages, voice, facial recognition, and images. Using analytical features associated with Artificial Intelligence systems, companies can make predictions about customer preferences, detect real-time fraud, or implement digital advertising campaigns that target customers in real time (Davenport et al., 2020).

Different studies reveal that AI solutions improve process of decision-making, while boosting the human analytical skills and decision-making abilities, and improving human creativity (Wilson & Daugherty, 2018). However other researchers such as Miller (2018) advertise the need of a new human-machine symbiosis and calls for the rethink of “how humans and machines need to work symbiotically to augment and enhance each other's capabilities”. In this context,

ethical dilemmas concerns are on an increasing trend, and we are witnessing not only the research of scientific concepts but also the assessment of the impact in terms of ethics applied to artificial intelligence systems.

In recent years (after 2014), private companies, research institutions, as well as public sector organizations have formalized principles and guidelines for the ethics of Artificial Intelligence, but nevertheless there is still a strong debate about what Artificial Intelligence really means and what it is the requirements, technical standards and good practices that can ensure this ethic (Jobin et. al., 2019; Mittelstadt, 2019).

Also, national, and international organizations, both governmental and non-governmental, have responded to these social fears by developing new directives or ad-hoc committees with Artificial Intelligence experts which aims to design policies that represent legal bases for controlling AI systems ethically. The European Commission, the Organization for Economic Development and Cooperation (OECD), the Singapore Council for the Ethical Use of Artificial Intelligence and Data, or the UK Parliament's Artificial Intelligence Committees are just a few examples of international bodies whose role is to set rules to ensure AI ethics (Jobin et al., 2019). Added to this effort are some private companies that produce Artificial Intelligence solutions such as SAP, Google in 2018 or Microsoft that have publicly released codes of ethics, principles, and standards of Artificial Intelligence solutions (Microsoft, 2017, SAP, 2018, Google, 2017). Therefore, this paper will highlight the main topics and key players that are currently part of the AI ethics in business debate.

The scientific communities approach AI ethics from different perspectives, associating this with the ethics of other fields. Recently, there have been several comparisons and possible associations between Artificial Intelligence ethics initiatives and medical ethics. (Whittlestone et al., 2019). Studies have demonstrated that one starting point in the research of AI ethics could be to refer the ethical guidelines needed in AI with the classical principles applied in medical ethics. (Floridi, 2018).

The OECD and the European Commission have expressed their support in this regard (OECD 2019 and EU 2019) and have proposed four principles that will contribute to the development of "trustworthy" Artificial Intelligence solutions: respect for the autonomy of the individual, injury prevention, fairness, and explicability. This assimilation of AI ethics around the principles of medical ethics is probably the most pragmatic approach historically. This has emerged in the medical field and can be perceived as a theoretical moral framework.

These four essential principles need to be always contextualized, depending on different decision-making situations and different fields of activity (BeauChamp and Childress, 2009). AI needs a similar approach in terms of founding a common framework to ensure ethics guidelines, as in medical ethics, the principled approach provides a common language for identifying and conceptualizing ethical challenges by identifying concrete solutions for health policy making and clinical decision making (Bosk, 2010).

A similar principled approach in AI ethics seems to aim incorporating normative considerations in the design and governance of technology. (Mittelstadt, 2019). This type of approach, provide a useful framework for assessing the potential for Artificial Intelligence ethics to promote real change in the development and implementation of these solutions. Despite the initial credibility offered by the comparison with medical ethics, there are reasons to be concerned about the future impact of AI ethics because there are important differences between medicine (or other traditional professions (Filipovic et. al., 2018)) and AI development.

Note that in the scientific community we identify a consensus according to which Artificial Intelligence should be ethical, but nevertheless there are significant divergences when discussing the framework, principles, and control of AI ethics. Moreover, there is some uncertainty about how ethical principles and guidelines should be applied when developing or implementing AI solutions. Thus, contrary to the scientific consensus on the need for ethics, many challenges are related more to the implementation, control by political legislation and governance of AI technologies, there is an imperative need to harmonize and re-prioritize the AI agenda involving both business organizations as well as the governmental environment (Jobin et al., 2019).

But in this sense, the major challenge is that the development of a global agenda of AI ethics must also consider respect for cultural diversity and transnational moral pluralism. The ethics of Artificial Intelligence systems can be correlated with the degree of trust of the consumer public. Building such trust in AI requires different ethical approaches to target individual systems themselves and areas of applicability (Robinette, Wagner, Howard, 2013), but also to respect an institutional framework.

In this regard, Winfield and Jirotko (2018) argue that one of the necessary (but not sufficient) elements to build trust in AI systems is to ensure a framework of "ethical governance" (AI). The two define this concept as that set of processes, procedures, cultures and defining values to ensure the highest behavioral standards for Artificial Intelligence systems. It is therefore proposed to move from a

descriptive ethic in which AI solutions are evaluated to a normative, prescriptive ethic with a role in framing the principles of responsibility in research and technological innovation.

The goal of ethics is to address fundamental issues related to practical decision-making, and one of the major concerns may be the evaluation of standards by which human actions can be judged rightly or wrongly.

We explored on the different approaches of the AI ethics with applicability on business organizations, within the next sections of this paper we will focus on the bibliometric analyze to understand what the most relevant studies, authors and key topics are, as well as what will be the further research opportunities within this field. The specific interest for this paper was to use the bibliometric techniques to explore the field of AI ethics in business. Based on the above context, we aim to identify the further research opportunities on how business organizations are perceiving the AI ethics, while using it to digital transformation and business optimization.

3. DATASETS AND METHODOLOGY

In this section we will describe the strategy used on this paper that led us to the identification of the main datasets that served as input for the bibliometric analysis, and the bibliometric methods that were used in the analysis.

3.1 Data sets

Bibliometric analyses are popular today among scientific researchers and this is mainly because it represents a great instrument that allows to explore large volumes of scientific data, that could be assessed to identify emerging trends in literature, collaboration patterns or research components. (Donthu et. al., 2021). On the AI research topics, there are several others recent bibliometric analysis, but either covering general aspects of ethics and privacy (Zhang et. al., 2021), either focusing on general evolution of AI (Yuh-Shan and Ming-Huang, 2020; Yufei and Zhongbao, 2019) or niched on specific domains such as healthcare (Guo et al. 2020; Vinit and Saikat, 2020) or education (Song and Xiang, 2020; Baek and Doleck, 2020).

For this paper, we used Scopus as our primary datasets resource, because this is a well-known platform of bibliometric data sources and the largest database that provides scientific literature content, having a global presence and covering a variety of research fields.

In the first phase, our research explored the global landscape of AI Ethics in business, and hence we had the following strategy of exploring the relevant data that allowed us to #1) identify all relevant articles for the chosen topic so that we can analyze the overall results, and #2) have a niche approach by refining to identify only the documents that are article type and written in English and #3) filter on most cited 2000 articles that will use for the actual bibliometric analyze.

The search strategy used for the initial discovery of the chosen topic was the below one, and that was performed between 15th of May and 04th of June 2021 with below data sets results(#R)

Dataset	Results(#R)	Search String
#1 (relevant articles)	16822	ALL ("Artificial Intelligence" AND ethic* AND business)
#2 (refining)	8942	ALL ("Artificial Intelligence" AND ethic* AND business) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English"))
#3 (filter)	2000	On dataset #2 - filter on first 2000 most cited

Based on the above, there were 3 main datasets identified as following:

- **dataset #1)** which is initial raw dataset (16822 documents) obtained as per the above search string.
- **dataset #2)** which was used after refining the results because this paper focused only the articles as document type that were written in English.
- **dataset #3)** which was the working dataset for the bibliometric analysis obtained after filtering the second dataset on first 2000 most cited articles as per Scopus indexation.

Considering this search strategy, we can see in *Figure 1*, that the first identified article was published in 1972, focusing the need of theorizing societal *cybernetics* to have a proactive control on computer machines and Artificial Intelligence (Byrne, 1972). Between 1972 and 2016 we can see a low rate of studies and starting with 2019 we can observe an abrupt rise of published articles which indicates an urgent need for attention from the academia on our research topic.

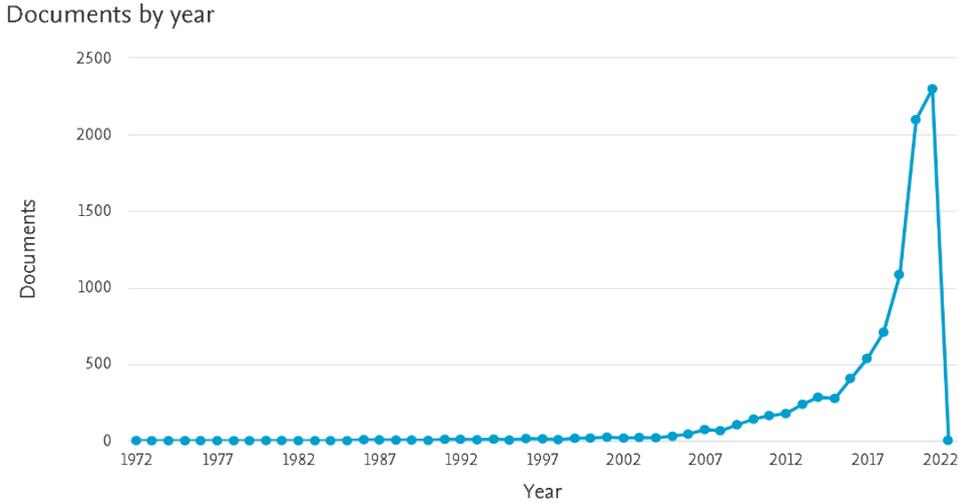
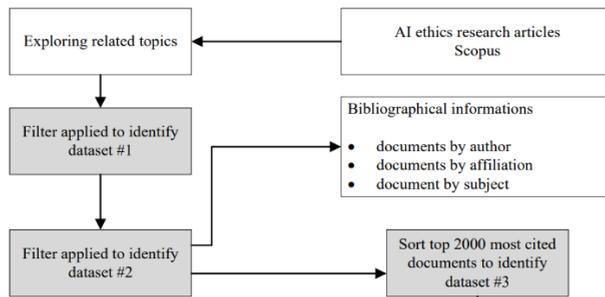


Figure 1 Trends in the annual number of records as per the search strategy using dataset #2

Based on the *Figure 1*, we can see that after year 2000 there was a particular interest from the academia on the AI ethics topics. That could be correlated with the fact that in same period the AI solution faced a boom and its evolution trough new developments such as machine learning, deep learning, neuronal networks but also the tremendous growth of the computer transistors. (Delipetrev et. al., 2020). The fact that within the last two decades we can see an increasing number of publications in journals, could be related to the fact that the AI does not anymore representing some ideations models, but offers specific solutions for an era which is data driven. Additionally, not only the academia is interested in these topics, but also the international organizations or the companies producing AI systems.

3.2 Methodology

The research approach for this paper is schematically described in *Figure 2* Essentially, we had two big phases that we used to explore the topic of AI ethics within the business context so that we can identify key concepts, current concerns and issues presented in previous research. In the *Phase 1* we focused on identifying the right datasets that can be used in our analyze, while in *Phase 2* we focused on the bibliometric techniques that can be used to have an analytic approach on the identified results.

Phase 1. Datasets processing


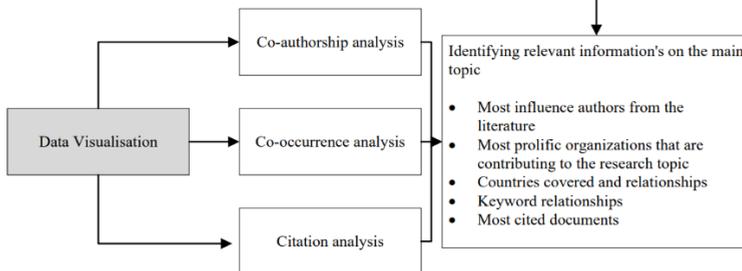
Phase 2. Bibliometric analysis


Figure 2. Research framework on understanding the AI ethics in business

3.2.1 Phase 1 data processing

In the first phase of our study, we focused on exploring the main articles related to AI ethics in business and therefore we applied the above-described search strings to identify the datasets #1 and #2. One important mention to make here is that, even though in dataset #2 we identified 8942 related articles, we only exported the first 2000 most cited documents. That was since currently in Scopus there is a hardcoded limitation that allows the full information export of only first 2000 identified articles. Having this limitation, we obtained a new dataset #3 that will be used for the bibliometric analysis. Because the study focuses on obtaining a high-level overview on all the identified articles for the chosen topic, we used both datasets #2 and #3 as per below:

- dataset #2 was used to explore the overall bibliographical information, analyzing all articles authors, affiliations and subject and,
- dataset #3 was used for the bibliometric analysis.

3.2.2 Bibliometric analysis techniques

Once identified the dataset #3, we used this one for the bibliometric analysis, focusing on data visualization. Specifically, we performed 3 types of analysis via VOSviewer. VOSviewer is a software tool for constructing and visualizing bibliometric networks. These networks may for instance include journals, researchers, or individual publications, and they can be constructed based on citation, bibliographic coupling, co-citation, or co-authorship relations. (VOSviewer, 2021). For this paper, VOSviewer was used for data visualization, focusing on three main analysis categories: *co-authorship* (to identify most relevant authors, organizations, and countries), *co-occurrence* (to identify most relevant key words), and *citation* (to have a look on most relevant documents). Based on this methodological approach, this paper offers a consistent view on the current issues and concerns related to AI ethics in business, which may provide a certain level of knowledge that can further help other researchers to shape their studies with respect to AI ethics and impact on business landscape.

4. RESULTS

We investigated the AI ethics in the business field, by exploring all the articles and indexed by Scopus *within* the last years (as detailed in our search strategy in Figure 1) so that we can identify who are the key players (e.g., research institutions and universities, countries, subjects) contributing to this research domain, but also to capture what is the overall interest of the academia in these issues and how this changed over time. From a result analyze perspective, this paper focus on mixing results from the bibliographical information and data visualization techniques so that will offer a consolidated view on the research topic, assuring the correlation between the different types of data analyzed (essentially between datasets #2 and #3).

4.1 Key contributors on the research field of AI ethics in business

For this research, we considered relevant to utilize the full bibliographical information (as per Scopus [definition](#)) applied on the dataset #2 results, with the scope of revealing who are the key players that are contributing to the research of AI *ethics* in business. Specifically, we focused on analyzing 1) what are the top 15 authors and how many articles they published, 2) what are the top 15 academical organizations that are considering the research of the chosen topic and 3) what are the main subject's areas of research where the topic of AI ethics is present. As side note it is important to mention that we always choose the first 15 authors and

organizations, because that is the maximum default value that can be displayed by Scopus within the search results analyze.

The below *Figure 3* lists the top 15 most productive authors as per our search strategy, with Maseleno Andino the biggest contributor with 27 articles, followed by Huda Mitchel with 26 articles identified, Dwivedi Y.K., Chatterjee Sheshadri, Floridi Luciano and other as per below. One important aspect to mention here is that Maseleno (the most prolific author identified) is not always the first author, and he is a *contributor* to AI related research focusing more on technical aspects (methods, code, and development techniques) with applicability on different industries, such as pharmacy (Irawan et. al, 2019), food industry (Hamid et. al, 2018) or education (Abadi et. al, 2018). On the other side, other authors have a multidisciplinary approach on AI ethics topics (e.g., Huda and Dwivedi), or they are referring to the impact of AI in business organizations (e.g., Chatterjee, Abadi, Connelly), or to the general need to regulate the AI by assuring its ethics via a strategical framework (e.g., Floridi, Taddeo).

According to this output, we can see that the researchers are covering a large spectrum of AI studies but with not much applicability on the AI ethics impact on business, and if there are studies on that, those are presenting a generic approach (Dwivedi, 2021). This may indicate a good opportunity of researching the AI ethics impact on business with applicability on why we need such studies, who are the key players that should trigger this and what could be the consequences in case of missing such research.

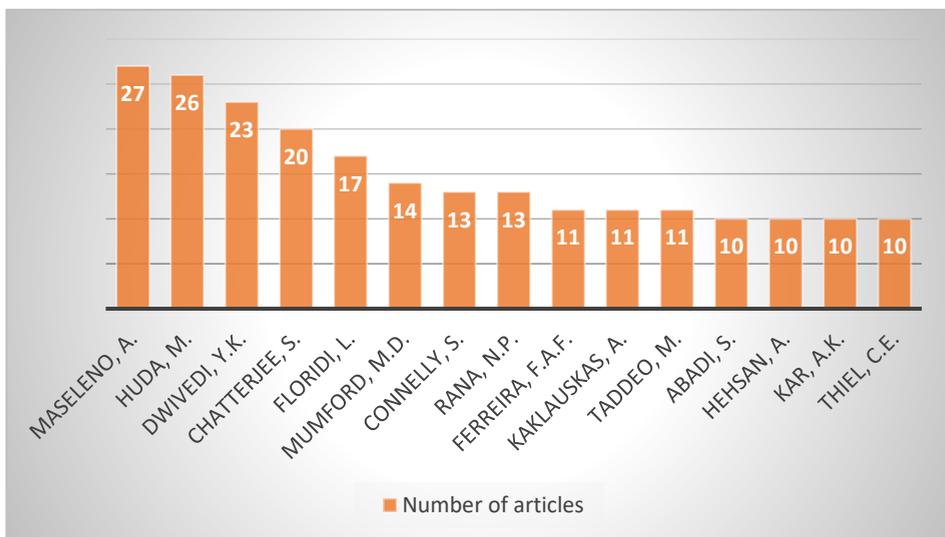


Figure 3 Top authors contributing to the research field as per dataset #2

On the other side on *Figure 4*, we can see a network map on co-authorship extracted with VOSviewer. Among the first captured aspects, we can see a big cluster formed around the authors Maseleno and Huda, which seem to be the most influential and prolific authors on this research topic, but their scientific approaches are rather generalized with respect to AI. Additionally, another important cluster seems to be the one formed around authors such as Mumford, Connelly, Thiel and Devenport, which are targeting case-based ethics (Bagdasarov et. al, 2013) within their articles. That could be an important aspect indicating that a further potential research opportunity around the AI ethics in business will consist of a case-based approach (like ethics in medicine or in journalism etc.). Furthermore, another important co-authorship cluster revealed by VOSviewer is around authors such as Dwivedi and Floridi. Note that all identified articles from Floridi, are in co-authorship with Taddeo, but their articles are tackling specifically the need for AI ethics in all domains (a generic approach).

One preliminary key conclusion on the authors and co-authorship analyses could be that it looks like there are two big categories of authors. In the first category, we have those authors that are researching the ethics of AI from a technical perspective, while targeting different industries that implemented specific AI solutions for optimizations of different processes. In the second one, we can retrieve researchers that are focused on the need of AI ethics in all domains, working on finding solutions/framework that could answer issues and concerns generated by AI. Hence, one future research direction could be to map the need of an AI ethics framework in business with respect to the impact that AI can generate for both business landscape and its consumers.

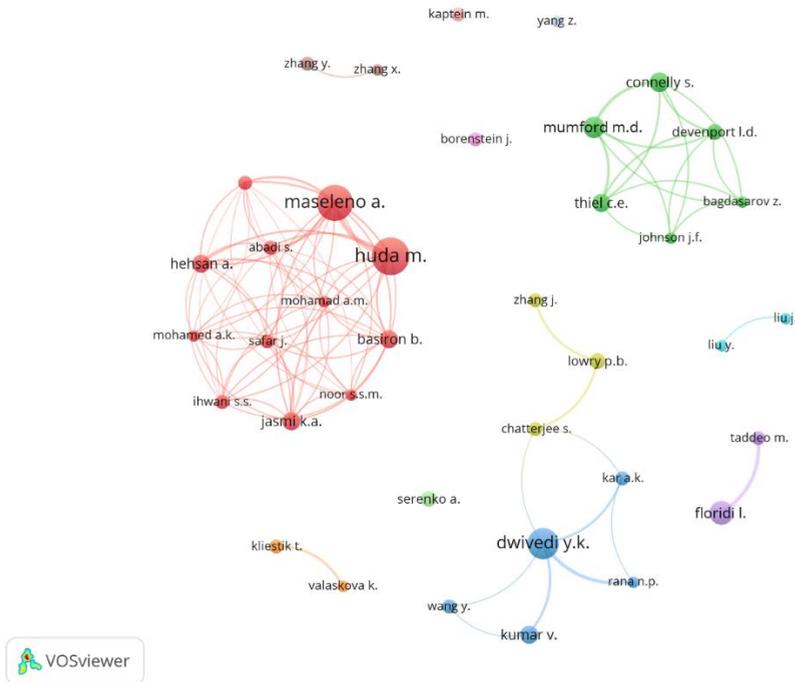


Figure 4 Co-authorship (author based) map extracted with VOSviewer based on dataset #3

Another interest on this study is to identify the most representative institutions that are contributing to the research of AI ethics in business topics. The *Figure5* list the first 15 documents affiliations as per our identified dataset # 2. That means, based on the bibliographical information obtained in dataset #2(8942 articles), University of Oxford and University of Delft seems to be the most prolific ones on the research topic of AI ethics and business. These are followed by University of Twente, University of Amsterdam, University of Malaysia, University of Queensland and others (each of them with a similar number of research). It is not a random result that the first two most influential institutions are leading the research contribution on this chart (based on the affiliation of the indexed articles in Scopus), since these organizations are incorporating digital ethics labs (see [Oxford Digital Ethics Lab](#), or [Digital Society Institute](#) at University of Twente).

One key element that can be observed based on this finding is that the organizations that have dedicated AI research departments are tempting to contribute more to the overall research on AI ethics and its associated impact in different domains of activity. Additionally, 13 of 15 of these universities are part of

the top 200 World Universities ranking for year 2021 (QS World University Rankings, 2021). In *Table 1*, we centralized the 13 of the 15 universities contributing to AI ethics in business research as per the result analysis on dataset #2. There are two exceptions here: one is *CNRS* in France which is not a university and the other one which is the *Queensland University of Technology* that is ranked on the position 217 on the above-mentioned ranking top.

An important aspect to be mentioned is that within the overall score obtained by each university in the above-mentioned ranking, there are 2 ratings out of 4 contributing the most: *the academic reputation (40%)* and *the citations per faculty (20%)*. *The academic reputation* is a score obtained after a survey that collates the expert opinions of 130.000 individuals in the higher education with regards to *teaching* and *research* quality in the universities. *The citations per faculty* is an indicator that is calculated based on the total number of citations received by all papers produces by an institution across a five-year period. In *Table 1* both ratings are listed for each university just to exemplify the reason why the intuitions that are contributing the most to the research of AI ethics in business are also part of the top 200 most valuable institutions.

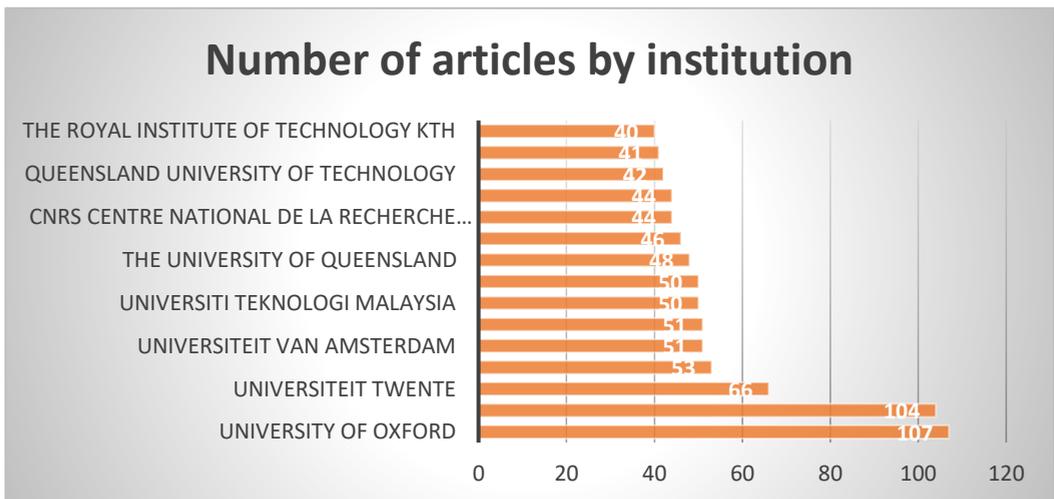


Figure 5 Top academical institutions contributing to the research field as per dataset #2

Table 1 Ranking in QS World University Top for the most representative institutions identified in dataset #2

Rank in QS World University	University	Academic Reputation rating	Citations per faculty rating
5	University of Oxford	100	99.4
197	University of Twente	96.1	86.5

Rank in QS World University	University	Academic Reputation rating	Citations per faculty rating
61	University of Amsterdam	84.5	61.6
57	Delft University of Technology	70.7	75.8
7	University of Cambridge	100	69.2
40	The university of Sydney	97.4	69.6
187	Universiti Teknologi Malaysia	39.4	51.6
10	University College London	99.4	65.4
46	The University of Queensland	89	79.6
25	University of Toronto	99.3	45.8
2	Stanford University	100	98.1
120	Eindhoven University of Technology	30	76.6
98	KTH Royal Institute of Technology	46.2	68

On the other side, on *Figure 6*, we can see a map extracted from VOSviewer using the dataset #3 (most cited 2000 articles), that is listing the co-authorship connections of the most influential organizations. To obtain this result we configured VOSviewer to display the organization with minimum 3 articles published on the selected research topic so that we can make it relevant. One important finding here is that the academical institutions with more prolific research (Oxford, Twente, Amsterdam) are not involved on co-authorship contributions. In other words, the researchers affiliated to these institutions published their results without collaborations with other institutions within EU or outside EU. Additionally, we can observe a big cluster of academic institutions that are researching this topic in a collaborative approach, formed around University of Malaysia, but this looks like a silo research Asia based.

One key observation related to the current published research is that these are not spanning a cross-cultural approach on AI ethics. There are silos of organizations whit affiliated researchers that are not necessarily have cross-collaborations. The key pattern on this matter seems to be a domestic collaboration. Essentially when ethics in general and AI ethics needs to be research it is mandatory to have as pre-requisites the cross-cultural differences because that could be an important corner stone in deciding how AI solutions could be ethically implemented to have ethics decision-making processes (Hagerty and Rubinov, 2019; Narayanan, 2021).

there is a strong interest in each of the displayed countries but the key pattern in terms of collaboration is the domestic one or maximum a regional one (looking at the EU or the Asian countries).

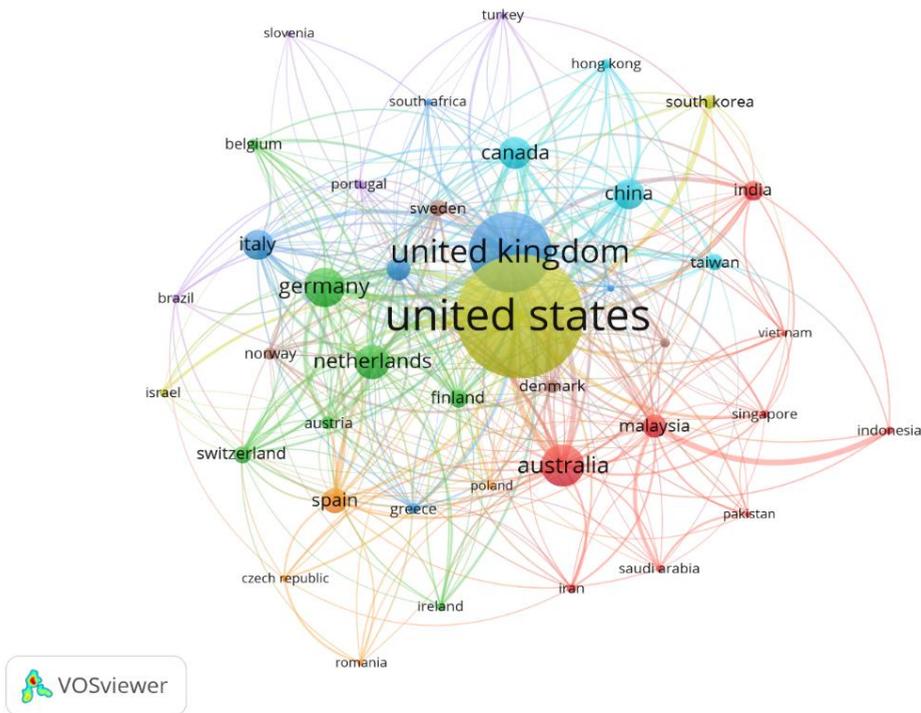


Figure 7 Co-authorship (country based) map extracted with VOSviewer based on dataset #3

As a preliminary conclusion, we identified the key players (e.g., academic institution, and most prolific authors and communities) which are significant contributors to the research undertaken in their countries on AI ethics in business. Also, one important finding was to understand the current cross-collaborations between these players so that we can understand the relationships between these research topics. Such information's could help us to design a clear landscape of the current state of the AI ethics in business research agenda, understanding who's having a strong interest within this area, how is that objectified, what are the current gaps and what further study opportunities may be developed.

4.2 AI ethics and the main subject areas of interest

The aim of this paper was to explore what's the current research agenda on the AI ethics applied to different business models, so that we can further develop studies on the impact of AI from an ethical perspective and how organizations can use frameworks with the scope of assuring the ethics of the decision-making of AI solutions. Hence on the results analysis, this paper captures also the main subject areas and the most important keyword that are currently mentioned on the identified articles.

In this section we moved our focus again on the dataset #2 to understand, from bibliographical information available in Scopus, what are the research subject's areas of the articles identified as per our initial search string. In the *Figure 8* we have listed all the subject areas that are incorporating the identified articles.

Documents by subject area

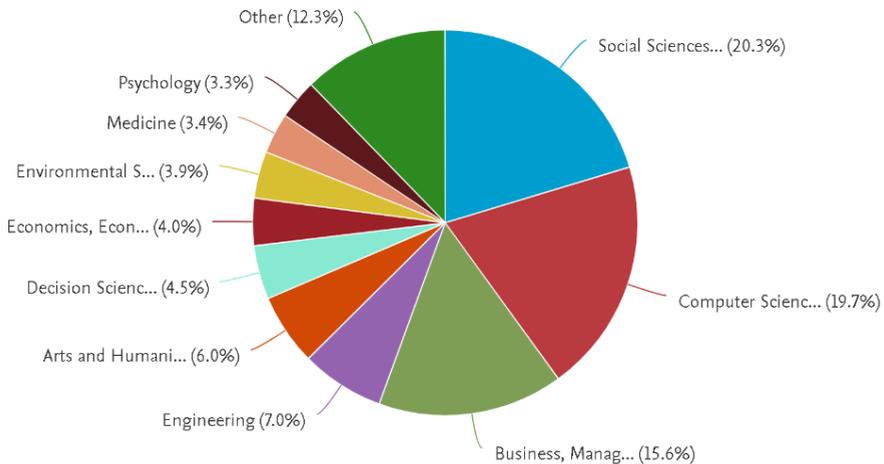


Figure 8 Documents classified by subject area extracted from Scopus using dataset #2

The following observations can be made: (1) most part of the articles are incorporated into the *Social Sciences* area – 3670 documents while 3551 documents are part of the *Computer Science* research area and 2807 are part of the *Business, Management and Accounting* area; (2) there is an strong research interest on AI ethics that is coming from the philosophical approach and that is explain the *Social Sciences* have most part of the listed documents and (3) engineering research area have only 1266 indexed documents which may indicate a lack of interest within the AI ethics at its design/development level.

It is essential to explore AI ethics not only from a philosophical and conceptual point of view, but it is equally important to do this also from an engineering perspective (to explore the ethics of the code and the algorithms that are the foundation of the AI solutions).

On *Figure 9* we have the keywords identified with VOSviewer by using a minimum of 25 occurrences per word so that we can keep this research relevant. In bibliometrics paper, the keyword analyses is considered as a crucial element that can help identifying the core concepts by revealing the structure of the research domains (Su&Lee, 2010). This approach was also used on this paper so that we can understand what the most important topics of discussion are: main issues and concerns surrounding the AI ethics topics and business. Unexpectedly, the first observation is that the keyword *business* is not present at all within the identified key words. From the below map we can distinguish 4 main clusters that are distributed as following:

#Cluster 1 formed around the keyword *Artificial Intelligence* in strong relationship with other words (a smaller occurrences), such as: *machine learning, algorithms, sustainability, trust, economics, data privacy, big data, security*. This could indicate an interest from the researchers that are approaching the AI ethics topics from the perspective of security, data privacy and compliancy.

#Cluster 2 formed around the word *Decision Making* correlated with other relevant keywords, such as *Internet of Things, Blockchain, social media, commerce, information management, sustainable development*. This cluster may reveal the fact that there is a strong interest in re-defining the business decision-making processes trough the AI technologies.

#Cluster 3 formed around the word *Ethics*. This is a smaller cluster consisting of words such as *robotics, automation, philosophical aspects* and point out an interest of the research on ethical concerns around the new technological ways that can be used to automate routine tasks of human beings.

#Cluster 4 formed around the word *Human* and connected with other words such as *methodology, internet, research, algorithms* and with *privacy, security, and development*. This last cluster could indicate that the researchers are always put the individual in the center of everything. At the end, the technology should be made for the people and that could indicate a concern coming from the academia that there could be risks associated if AI is not designed for people assuring the needed ethics.

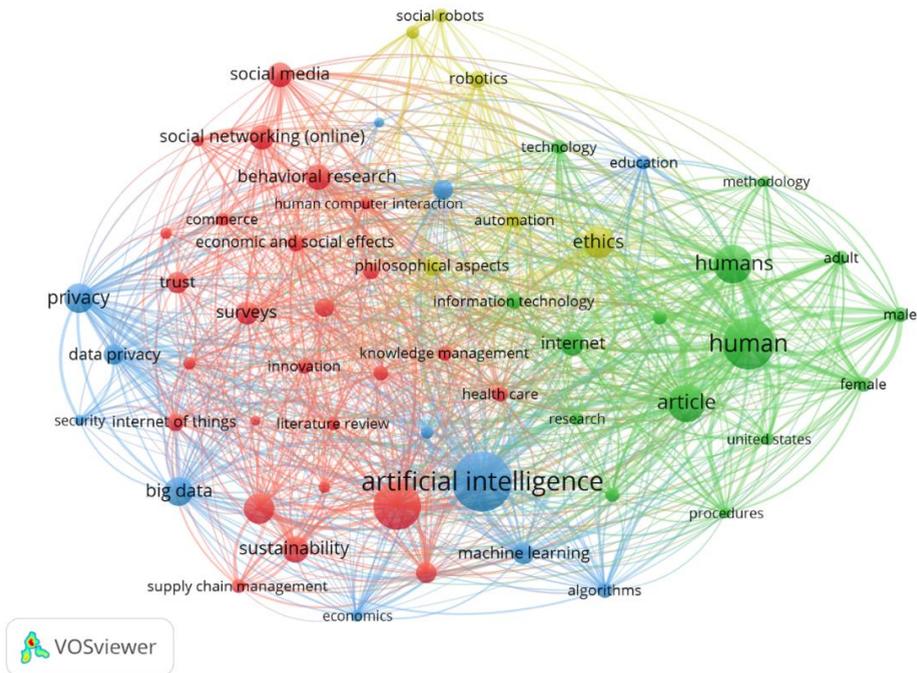


Figure 9 Co-occurrence analysis on keywords extracted from VOSviewer using dataset #3

Based on the above findings, it looks like the current emerging issues in AI ethics in business are related to topics such as data security and privacy, economic and social impact, automations and robots and human beings. There is a strong indication that topics such as technology and subsequently artificial intelligence, big data, and autonomous systems (i.e., robots, self-driving cars) are questioned from the perspective of their impact on humans, economy, and society. These debates are clearly reflecting the current dilemmas that are researched and questioned by the researchers.

As a conclusion, the above identified keywords as well as subject areas of research help us to understand that there is a strong need in continuing to explore the AI ethics in a general sense, but also to explore specific domains (i.e., business area and how we can assure the AI ethics for sustainable business decision-making). We can conclude that there seems to be a research opportunity on specific niches that need to address the AI ethics in business and the associated implications. In other words, some of the future research directions could be to understand how and with what purposes the business organizations are using the AI

solutions, how ready are they to work with these and what could be the associated ethical risks and the mitigation solutions available.

5. CONCLUSIONS

In this article we analyzed the most 2000 cited articles from Scopus database as per the described search strategy, using a series of co-authorship and co-occurrences bibliometric analysis, with the scope of investigating the current debates around the AI ethics in business. The motivation for such research was partially due to the fact we are seeing an accelerated development of AI systems used for business optimizations, and partially because we can see an increased interest and concern coming from the public but also from the academia. This paper's aim was to understand to which extent we need to research on AI ethics in business. The objectives were to identify the key players (authors and institutions) using co-authorship bibliometric analysis, as well as the main topics and current emerging issues. This paper referred on the most prolific authors and their affiliations, countries and research institutions which have the highest contribution to the research on AI ethics in business. Besides these, our research highlights the main topics and subject areas that are presented in the current debates. At the same time, this paper established further research opportunities that may arise. Such findings, revealing a quantitative picture of the current landscape of AI ethics in business research, could be relevant to scientific communities and to business decision makers, but also to other audiences, such as policy makers, IT representatives and government agencies.

5.1 Our key findings

Referring to the *key findings* of this paper, we can see that the *most prolific authors* (Maseleno Andino-27 articles, Huda Mitchel-26, Dwivedi Y.K. - 23, Floridi L - 17) are covering a broad range of research topics but from a conceptual point of view. These topics are mainly related to 1) technical implications of AI systems in different industries; 2) the need of having regulations and frameworks to be used to assure an AI ethical governance; 3) the multidisciplinary perspectives that can be associated with AI systems and the potential risks.

According to this output, we can see that the researchers are covering a large spectrum of AI studies but with not much applicability on the AI ethics impact on business. Furthermore, this research distinguished between two big categories of authors. In first category we have those authors that are researching the ethics of AI

from a technical point of view, while targeting different industries that implemented specific AI solutions for optimizations of different processes. In the second one, we can retrieve researchers that are rather focused on the need of an AI ethics in all domains, working on finding solutions/framework that could answer to issues and concerns generated by AI. Hence, one future research direction could be to map the need of an AI ethics framework in business with respect to the impact that AI can generate for both business landscape and its consumers.

Another interest on this paper was to identify *the most representative institutions* that are contributing to the research of AI ethics in business topics. One key finding here was that the first 2 most prolific institutions researching AI ethics in business have dedicated digital labs (see [Oxford Digital Ethics Lab](#), or [Digital Society Institute](#) at University of Twente). Also, 13 out of 15 most exponential institutions in this analysis are also part of the top 200 World Universities ranking for year 2021 (QS World University Rankings, 2021) and the criteria for these evaluations were mainly related to the quality of research and the number of citations. Obviously, that could be a good indicator showing that the research of AI ethics in business needs investments and budgets that could afford an end-to-end research strategy that brings together academia, the public sector, non-governmental organization as well as public administrations.

On the other side this paper identified that the key pattern in terms of collaboration, is the domestic one or maximum a regional one (looking at the EU or the Asian countries). The English-speaking countries have more research published on the AI ethics in business but without having cross-country collaborations. Other countries such as China and other Asian ones (Taiwan, India, Vietnam, South Korea, Malaysia) are well ranked as important contributors but among their advantages, the most important is that there is a strong collaboration between these in terms of co-authorship. Comparably, the European countries such as Germany, the Netherlands, Italy, Spain, and France produce a large volume of research together as a single entity.

Finally, this paper reported on *the main topics and current emerging issues* surrounding the AI ethics in business, and here we can clearly see a focus around four big clusters that were retrieved after analyzing the keywords obtained with co-occurrence analysis in VOSviewer. These clusters are mainly referring linked to *Data Security and Privacy* (associated with AI systems), *robotics and automations* (robots, autonomous cars, drones etc.), *humans* (i.e., the impact of AI on humans and the potential issue of workers losing jobs due to AI automation solutions) and *ethics* (with respect to AI impact on society, on business decision-making, healthcare etc.). Based on these findings, we can see that topic such as technology

and subsequently artificial intelligence, big data, and autonomous systems (i.e., robots, self-driving cars) are questioned from the perspective of their impact on humans, economy, and society.

5.2 Limitations and further research opportunities

We are expecting that further bibliometric research opportunities will overcome our current limitations. One of the main limitations was related to Scopus database itself because by default it is not allowed to export the full bibliographical information of more than 2000 articles. In this context, we had to filter the first 2000 most cited and that was our main work dataset. Additionally, another limitation was related to the data visualization tools. VOSviewer is a great data visualization tool, but it does not allow to perform a mapping of different results (i.e., creating matrix diagrams that maps authors, journals, and institutions). Since a bibliometric analysis is quantitative research than it will be beneficial to have even more documents and data sources. For instance, one of the next research directions could be to extend the search strategy in Scopus or other well-ranked database and to capture all related articles.

On the other side, a new research direction could be to use an extended search strategy that will focus only on business journals. This way we can capture the interest of business and management review in AI and how these technologies are perceived. Another further research direction can be related to how AI systems are used in the strategic decision-making processes and how performant these are based on specific business criteria. Based on these research directions, we can identify patterns regarding the need of AI ethics in business while capturing the associated impact on society, economy, education. In the end, the AI ethics in business research should not be about good or bad, but rather about efficiency, transparency and fairness and about having a framework to guide towards a successful AI systems implementation.

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COMMENTS



A BRIEF ASSESSMENT OF COMPLIANCE WITH THE “EUROPE 2020” STRATEGY CRITERIA OF MEMBER STATES OF THE EUROPEAN UNION

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Abstract *Eight indicators corresponding to the targets of “Europe 2020” Strategy were used to estimate the deviation of EU Member-States from their targets. The study showed that: i) the distance to the employment target of 75 % of people aged 20-64 years has narrowed, ii) the expenditure for R&D as a percentage of GDP are still below the target of 3%, iii) the reduction of greenhouse gas emissions in ESD sectors by 20 % compared to 1990 levels are still below the target, iv) the increase of the share of renewable energy in final consumption to 20 % remains just below the target, v) the move towards a 20% increase in energy efficiency shows a good prospect, vi) the reduction of school drop-out rates to less than 10 % is steadily approaching its target, vii) the share of population aged 30-34 having completed tertiary education to at least 40 % is steadily approaching its target, viii) the lifting at least 20 million people out of risk of poverty was not achieved.*

Keywords: *“Europe 2020” Strategy, smart growth, sustainable growth, inclusive growth.*

THE “EUROPE 2020” STRATEGY – SCOPE OF STUDY

The “Europe 2020” Strategy proposed by the Commission on 3 March 2010 and adopted by the European Council on 26 March 2010 set three priorities to promote growth: (a) smart, with more efficient investment in education, research and development and innovation, (b) sustainable, with transition to a low

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carbon economy, share of renewable energy and increase in energy efficiency, (c) inclusive, with a focus on job creation and poverty reduction (European Commission, 2010, 2012, 2014).

Five key EU-wide objectives have been agreed to assess the progress made in implementing the “*Europe 2020*” Strategy: (a) employment, (b) research and development, (c) climate change and energy sustainability, (d) education and (e) combating poverty and social exclusion. To reach the objectives, the EU has adopted eight ambitious targets at EU level. These targets are then converted into national targets for each Member State, reflecting the different situations, conditions and abilities in each Member State (Fischer et al., 2010, Hacker & Treek, 2010, Anastasiou & Pasiopoulou, 2020, Papailiou et al., 2018, Zavou et al., 2018, Lyroni et al., 2018).

For the employment target it is foreseen to increase employment in the age group 20-64 from 69% to at least 75%. For the R&D target, it is foreseen that 3% of EU GDP should be invested in R&D. For the target of climate change and energy sustainability it is foreseen to reduce greenhouse gas emissions by 20% (or even 30% if conditions allow) compared to 1990, to secure 20% of renewable energy and a 20% increase in energy efficiency (Aggelopoulos et al., 2018). For the target of education it is foreseen to reduce early school dropout rates from 15% to less than 10% and complete higher education in the age group of 30-34 from 31% to at least 40%. For the target of combating poverty and social exclusion it is foreseen to be reduced by at least 20%, i.e. by 20 million people who are or will be at risk of poverty and social exclusion. The following Table 4 illustrates the objectives and the targets of “*Europe 2020*” Strategy.

Table 1 Targets and Objectives of “Europe 2020” Strategy

Priorities	Objectives	Targets
Smart growth	Investing in R&D	<ul style="list-style-type: none"> Increasing combined public and private investment in R&D to 3 % of GDP
	Education	<ul style="list-style-type: none"> Reducing school drop-out rates to less than 10 % Increasing the share of the population aged 30-34 having completed tertiary education to at least 40 %

Priorities	Objectives	Targets
Sustainable Growth	Climate Change	<ul style="list-style-type: none"> • Reducing greenhouse gas emissions by at least 20 % compared to 1990 levels • Increasing the share of renewable energy in final energy consumption to 20 % • Moving towards a 20% increase in energy efficiency
Inclusive Growth	Employment	<ul style="list-style-type: none"> • Increasing the employment rate of the population aged 20-64 to at least 75 %
	Combating Poverty & Exclusion	<ul style="list-style-type: none"> • Lifting at least 20 million people out of the risk of poverty and social exclusion

Source: European Commission (2020), modified by the author

Member States are committed to achieving the objectives of the “*Europe 2020*” Strategy, which they have turned into national targets. However, the desired results for development can be achieved only with the coordination and proper targeting of efforts at national level. The Commission has introduced the “European Semester”, a cycle of economic policy coordination. The European Council of 17 June 2010 endorsed the idea of the “European Semester”. Each year, the Commission gives a detailed breakdown of the budgetary, macroeconomic and structural reforms programme for each Member State, and makes recommendations for the next 12-18 months.

The scope of this study is the estimation of the deviation of all Member-States from the targets set by each state during the years 2008 – 2018. Recent available data from Eurostat (2019) will be used to estimate the current deviation from targets for each Member-State and to rank all of them according to this deviation (Gros & Roth, 2012).

CALCULATION OF “EUROPE 2020” STRATEGY INDICATORS

Eight normalized indicators corresponding to the targets presented in Table 1 will be calculated. Data and targets for each Member-State have been extracted from Eurostat (2019) data bases. Data and targets for all states are presented in Appendix.

Following the description of the objectives of “*Europe 2020*” Strategy, the following indicators will be calculated, using the corresponding data and targets:

1. Employment indicator:

$$EMP_{i,t} = \frac{emp_{i,t} - emp_{i,\tau}}{emp_{i,\tau}} \quad (1)$$

where:

EMP_{i,t} = is the normalized employment indicator of Member State i during year t

emp_{i,t} = is the employment rate of Member State i during year t as % of age group 20–64

emp_{i,τ} = is the employment rate target of Member State i as % of age group 20–64

2. Research and Development indicator:

$$R\&D_{i,t} = \frac{r\&d_{i,t} - r\&d_{i,\tau}}{r\&d_{i,\tau}} \quad (2)$$

where:

R&D_{i,t} = is the normalized research and development indicator of Member State i during year t

r&d_{i,t} = is the research and development expenditure of Member State i during year t as % of GDP_{i,t}

r&d_{i,τ} = is the research and development expenditure target of Member State i as % of GDP_{i,t}

3. Climate Change and Energy indicator A:

$$CEA_{i,t} = \frac{cea_{i,t} - cea_{i,\tau}}{cea_{i,\tau}} \quad (3)$$

where:

CEA_{i,t} = is the normalized climate change 1st indicator of Member State i during year t

cea_{i,t} = is the greenhouse gas emissions of Member State i during year t compared to 1990 levels

cea_{i,τ} = is the greenhouse gas emissions target of Member State i compared to 1990 levels

4. Climate Change and Energy indicator B:

$$CEB_{i,t} = \frac{ceb_{i,t} - ceb_{i,\tau}}{ceb_{i,\tau}} \quad (4)$$

where:

CEB_{i,t} = is the normalized climate change 2nd indicator of Member State i during year t

ceb_{i,t} = is the share of renewable energy of Member State i during year t in final consumption %

ceb_{i,τ} = is the share of renewable energy target of Member State i in final consumption %

5. Climate Change and Energy indicator C:

$$CEC_{i,t} = \frac{cec_{i,\tau} - cec_{i,t}}{cec_{i,\tau}} \quad (5)$$

where:

CEC_{i,t} = is the normalized climate change 3rd indicator of Member State i during year t

cec_{i,t} = is the final energy consumption of Member State i during year t in Mtoe

cec_{i,τ} = is the final energy consumption target of Member State i in Mtoe

6. Education indicator A:

$$EDA_{i,t} = \frac{eda_{i,\tau} - eda_{i,t}}{eda_{i,\tau}} \quad (6)$$

where:

EDA_{i,t} = is the normalized education 1st indicator of Member State i during year t

eda_{i,t} = is the early leavers from education and training of Member State i during year t as % of population aged 18–24

eda_{i,τ} = is the early leavers from education and training target of Member State i as % of population aged 18–24

7. Education indicator B:

$$EDB_{i,t} = \frac{edb_{i,t} - edb_{i,\tau}}{edb_{i,\tau}} \quad (7)$$

where:

EDB_{i,t} = is the normalized education 2nd indicator of Member State i during year t

edb_{i,t} = is the tertiary educational attainment of Member State i during year t as % of population aged 30–34

edb_{i,τ} = is the tertiary educational attainment target of Member State i as % of population aged 30–34

8. People at Risk of Poverty indicator:

$$POV_{i,t} = \frac{pov_{i,\tau} - pov_{i,t}}{pov_{i,\tau}} \quad (8)$$

where:

POV_{i,t} = is the normalized people at risk of poverty indicator of Member State i during year t

pov_{i,t} = is the people at risk of poverty or social exclusion of Member State i during year t in thousands

pov_{i,τ} = is the people at risk of poverty or social exclusion target of Member State i in thousands

Variables with capital letters refer to the final normalized indicators, while variables with lowercase letters refer to either target values (with index t) or values for a specific year (with index i). Obviously, if the value for a specific year equals to the target value, then the indicator value equals to 0 (zero). If the values of a specific year exceed the target values (ie if $emp_{i,t} > emp_{i,\tau}$, $r\&d_{i,t} > r\&d_{i,\tau}$, $cea_{i,t} > cea_{i,\tau}$, $ceb_{i,t} > ceb_{i,\tau}$, $cec_{i,t} > cec_{i,\tau}$, $eda_{i,t} > eda_{i,\tau}$, $edb_{i,t} > edb_{i,\tau}$, $pov_{i,t} > pov_{i,\tau}$), then the values of the final indicators are positive, while if this is not the case then the values of the final indicators are negative.

Total deviations from targets are calculated using only the negative values of the indicators, since zero and positive values mean that the targets have been reached.

RESULTS AND DISCUSSION

The obtained results for all Member-States and all targets of “Europe 2020” Strategy for years 2008 – 2018 are given in the following Figures 1 - 8 which illustrate graphically the change of all indicators for all EU28 Member-States. Also, Table 2 illustrates the starting and the recent deviations from targets for all indicators of Strategy “Europe 2020” and the total deviations for all Member States. It shows how far a Member-State is from its targets by comparing the national target (blue line), the country’s indicators in 2008 (yellow line) and the recent indicators (red line).

From the obtained results and for each of the eight indicators it is clear that:

1. Employment indicator (Increasing the employment rate of the population aged 20-64 to at least 75 %). EU15 Member States obviously have been affected widely by the recent global economic crisis, and as a result, the employment rate of age group 20–64 was reduced from year 2008 until year 2013 for most Member-States, with the exception of Germany and Sweden, where the employment rate have almost not been affected by the economic crisis. Recent data show that most of the Member-States of EU15 could not reach the figures of year 2008 yet, meaning that there is an increase in the deviation from final targets for most Member-States of EU15. On the other hand, EU13 Member-States, although they have been affected by the global economic crisis, they reacted more efficiently, and as a result, most of them have reached their targets, while the rest of them show a considerable decrease in their deviation from their target. But although the mean deviation of all EU Member-States is recently smaller than that

of year 2008, mainly due to the behaviour of the EU13 Member-States, more effort is required especially from the EU15 Member-States, in order the average target for EU Member-States to be reached within the next two years.

2. Research and Development indicator (Increasing combined public and private investment in R&D to 3 % of GDP). With the exception of Germany and Denmark, the rest of EU15 Member-States did not reach their target. Actually, their expenditures for research and development as % of GDP, did not increase considerably for years 2008-2018. For EU13 and with the exception of Czechia, for which the target includes public sector only and is set to 1% of GDP, Cyprus is the only Member-State reached the target. As a result, the mean deviation of all EU Member-States is recently (2018) smaller than that of year 2008, but there is a lot to be done in order the average target for EU Member-States to be reached, especially from the EU13 Member-States.

3. Climate Change and Energy indicator A (Reducing greenhouse gas emissions in ESD sectors by at least 20 % compared to 1990 levels). Almost all EU15 Member-States have decreased their deviations from their targets, with the exception of Ireland. Seven Member-States have reached their final targets, among them Greece and Portugal which had reached their targets since 2008. Most of EU13 Member-States had reached their targets from year 2008, but their positive distance from targets in 2018 was decreased, while Poland and Malta, although they had indicators values above the target during 2008, their indicators during 2018 are below the target. More effort is required from some EU15 and EU13 Member-States in order the average target for EU Member-States to be reached.

4. Climate Change and Energy indicator B (Increasing the share of renewable energy in final energy consumption to 20 %). All Member-States of EU15 are approaching significantly their final targets. Netherlands is the Member-State with the largest deviation from its target, while five Member-States have already reached their targets. From the EU13 Member-States, six states have already reached their targets, from which, Croatia had reached its target since 2008. The rest of them are approaching their targets significantly. As a result, the deviation from the average target for all EU Member-States was decreased significantly, showing a good prospect for this indicator.

5. Climate Change and Energy indicator C (Moving towards a 20% increase in energy efficiency). All Member-States of EU15 are approaching significantly their final targets, while five Member-States have already reached their targets, from which, Finland had reached its target since 2008. From the E13 Member-States, seven states have already reached their targets, from which, five states had reached their targets since 2008. The rest of them are approaching their targets significantly. As a result, the deviation from the average target for all EU Member-States was decreased significantly, showing a good prospect for this indicator. Note that the target for all EU Member-States was almost reached during 2014.

6. Education indicator A (Reducing school drop-out rates to less than 10 %). Almost all Member-States of EU15 showed a very good behaviour in approaching and reaching their targets and eight of them have already reached their targets. Four Member-States of EU13 have already reached their targets, among which Lithuania which had reached its target since 2008, while the rest of them are approaching their targets significantly, with the exception of Slovakia which although it had indicator value above the target during 2008, its indicator during 2018 is below the target. The deviation from the average target for all EU Member-States was decreased significantly, showing a good prospect for this indicator.

7. Education indicator B (Increasing the share of the population aged 30-34 having completed tertiary education to at least 40 %). Nine Member-States of EU15 have already reached their final targets, from which, Finland had reached its target since 2008. The other six Member-States are approaching their targets significantly. Also, eight Member-States of EU13 have already reached their final targets, from which, Cyprus had reached its target since 2008. The other five Member-States are approaching their targets significantly. The average target for all EU Member-States has already reached, showing a good prospect for this indicator.

8. People at Risk of Poverty indicator (Lifting at least 20 million people out of the risk of poverty and social exclusion). Only two Member-States of EU15 have already reached their final targets, while other Member-States like Greece, Spain, Ireland and Italy have been affected by the global economic crisis. Luxembourg increased its deviation from the final target due to the difficult target set by it.

Also, eight Member-States of EU13 have already reached their final targets, while from the rest Member-States Estonia and Cyprus increased their deviation from the final target, mainly due to the economic crisis. More effort is required from mainly EU15 and some EU13 Member-States in order the average target for EU Member-States to be reached.

CONCLUSIONS

Generally for all EU Member-States, i) the distance to the employment target of 75 % of people aged 20-64 years has narrowed but more effort is required especially from the EU15 Member-States, ii) the expenditure for R&D as a percentage of GDP are still below the target of 3%, which calls for increasing combined public and private R&D expenditure, iii) the reduction of greenhouse gas emissions in ESD sectors by at least 20 % compared to 1990 levels are still below the target and more effort is required from some Member-States, iv) the increase of the share of renewable energy in final energy consumption to 20 % remains just below the target, showing a good prospect from almost all Member-States, v) the move towards a 20% increase in energy efficiency was significant showing a good prospect from almost all Member-States, vi) the reduction of school drop-out rates to less than 10 % is steadily approaching its target, vii) the increase of the share of the population aged 30-34 having completed tertiary education to at least 40 % is also steadily approaching its target, viii) the lifting at least 20 million people out of the risk of poverty and social exclusion was not achieved and more effort is required from mainly EU15 and some EU13 Member-State.

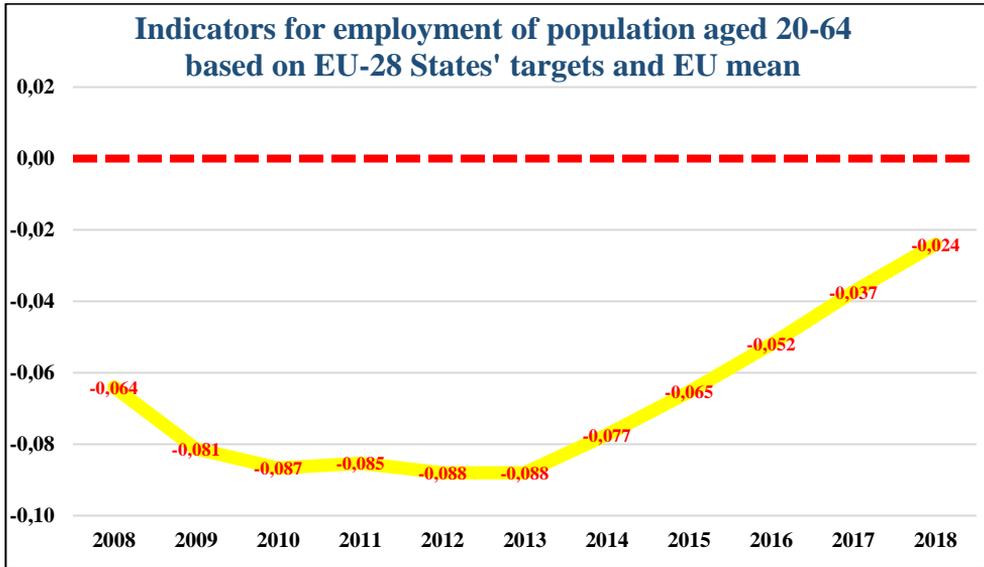


Figure 1 Indicators for employment of population aged 20-64
based on EU-28 States' targets and EU mean.

Source: Author's calculations

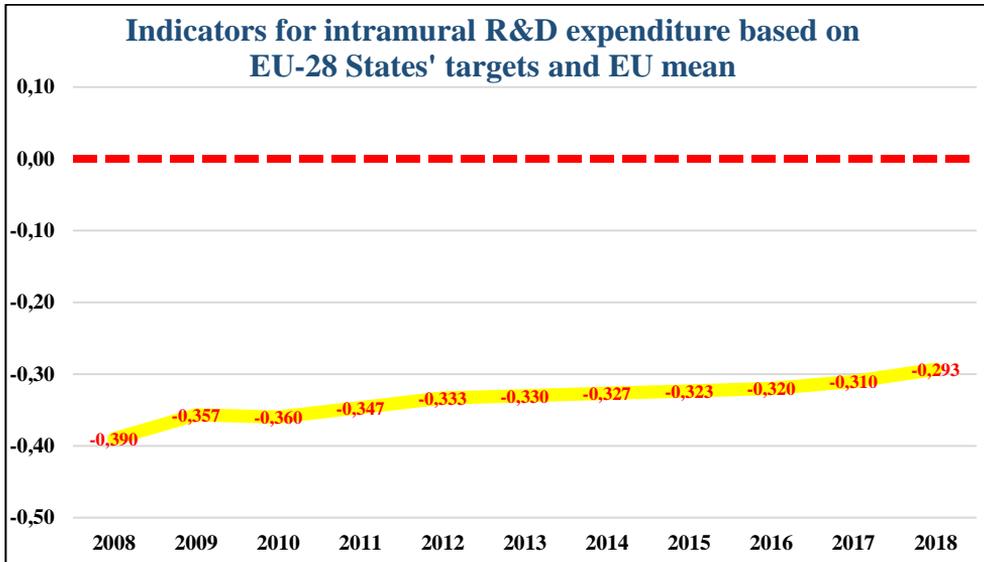


Figure 2 Indicators for intramural R&D expenditure
based on EU-28 States' targets and EU mean

Source: Author's calculations

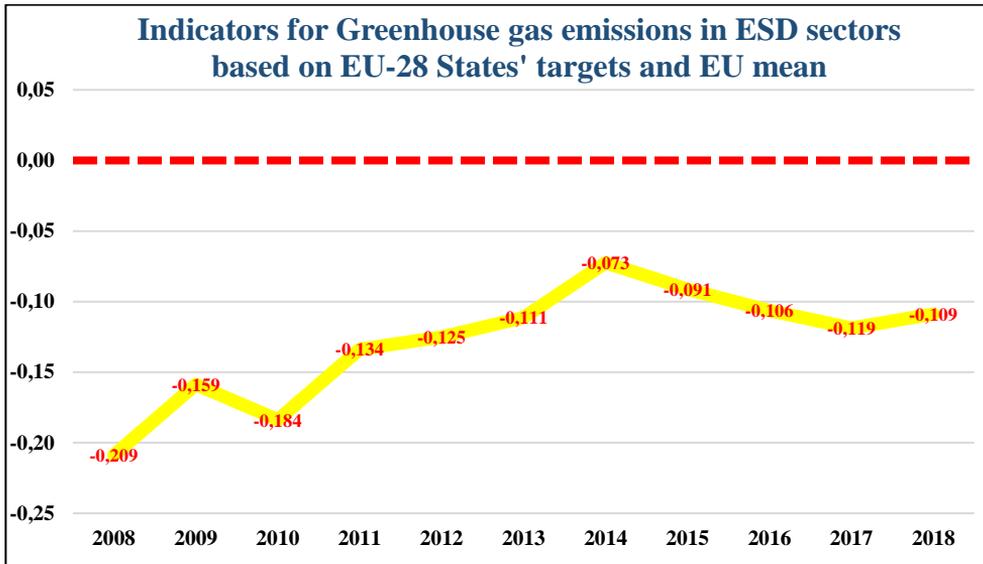


Figure 3 Indicators for Greenhouse gas emissions in ESD sectors based on EU-28 States' targets and EU mean.

Source: Author's calculations

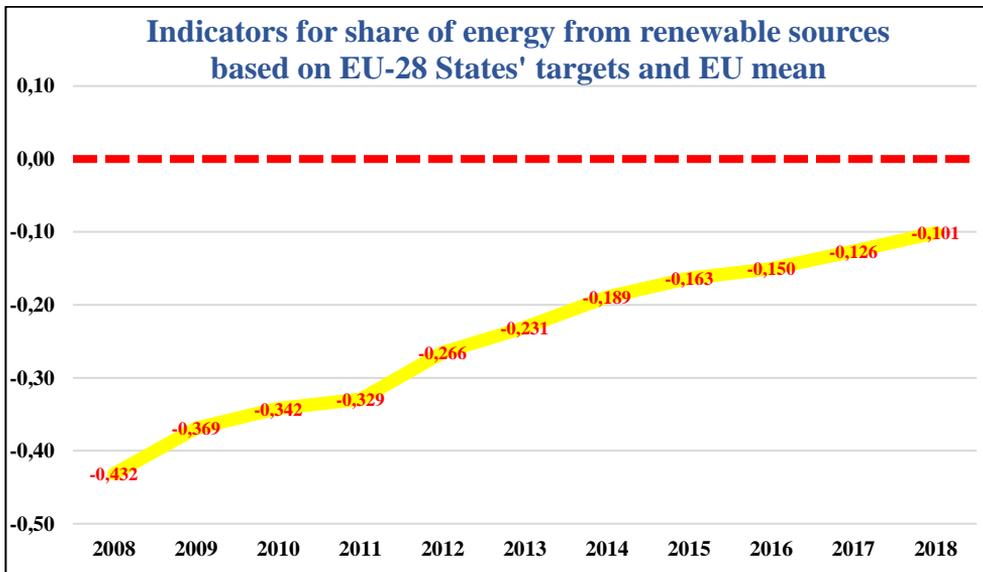


Figure 4 Indicators for share of energy from renewable sources based on EU-28 States' targets and EU mean.

Source: Author's calculations.

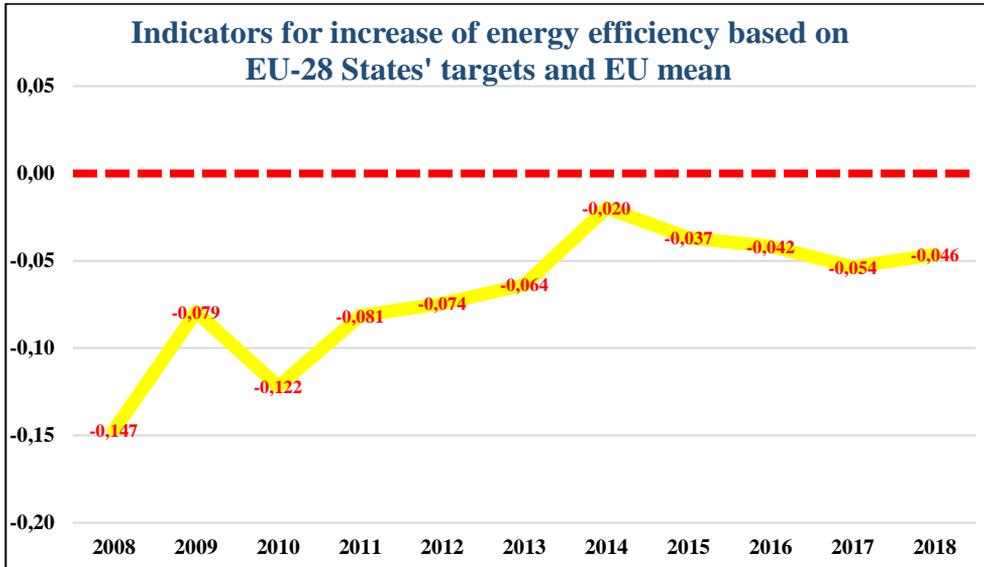


Figure 5 Indicators for increase of energy efficiency based on EU-28 States' targets and EU mean.

Source: Author's calculations

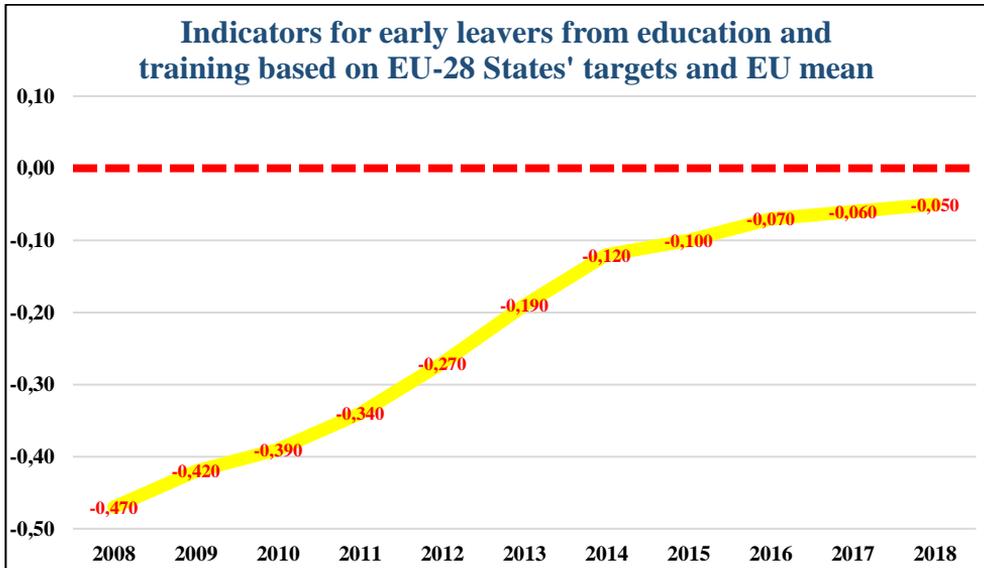


Figure 6 Indicators for early leavers from education and training based on EU-28 States' targets and EU mean.

Source Author's calculations.

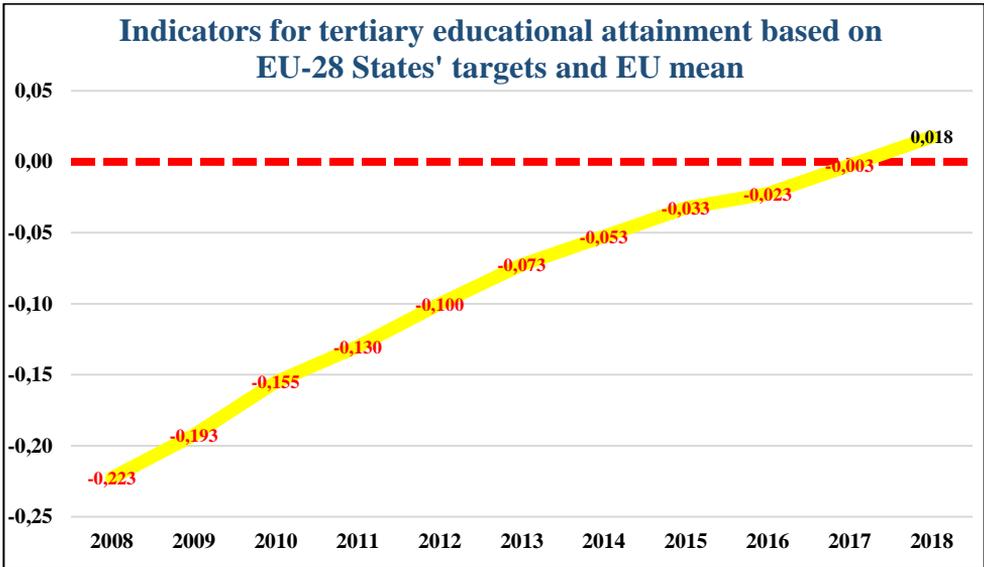


Figure 7 Indicators for tertiary educational attainment based on EU-28 States' targets and EU mean.

Source: Author’s calculations

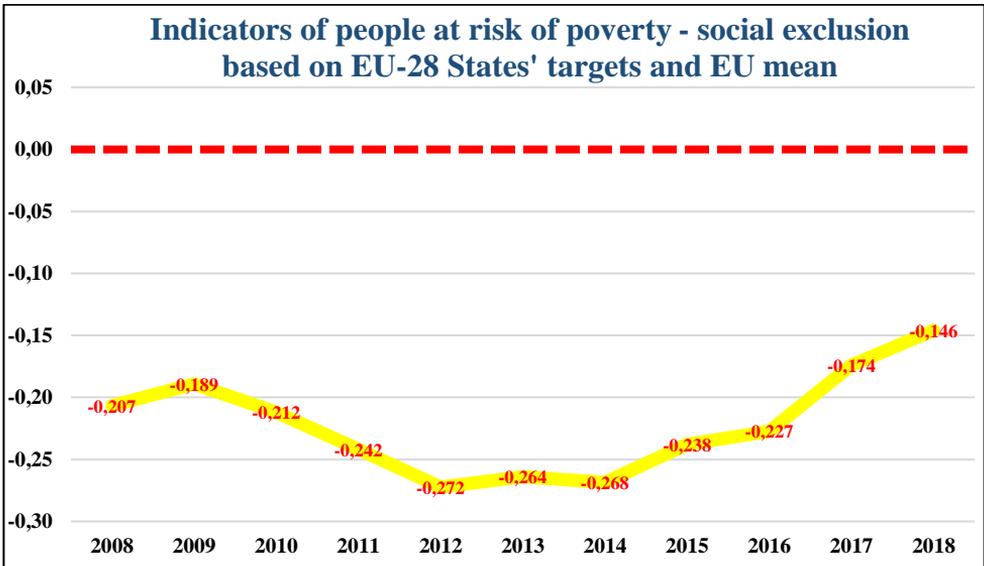


Figure 8 Indicators of people at risk of poverty - social exclusion based on EU-28 States' targets and EU mean.

Source: Author’s calculations.

Table 2 Starting and recent deviations from targets for all indicators of Strategy “Europe 2020”. Source: Author’s calculations

Country Name	Years	EMP	R&D	CLA	CLB	CLC	EDA	EDB	POV	Deviation
Austria	2008	-0,041558	-0,316489	-0,098810	-0,151294	-0,030794	-0,073684	-0,423684	-0,160519	-0,287212
	2018	-0,010390	-0,156915	-0,060714	-0,016882	-0,009524	0,231579	0,071053	-0,032787	Rank: 2
Belgium	2008	-0,071038	-0,353333	-0,162353	-0,723846	-0,170023	-0,263158	-0,087234	-0,209482	-0,759403
	2018	-0,047814	-0,080000	-0,045882	-0,275154	-0,071854	0,094737	0,012766	-0,238699	Rank: 16
Bulgaria	2008	-0,069737	-0,700000	-0,007500	-0,353438	-0,125444	-0,345455	-0,247222	-0,189504	-0,990993
	2018	-0,047368	-0,500000	-0,008333	0,283000	-0,086391	-0,154545	-0,063889	-0,130466	Rank: 21
Croatia	2013	-0,090620	-0,421429	0,217117	0,402000	0,282511	-0,125000	-0,268571	-0,041803	-0,332857
	2018	0,036566	-0,307143	0,109009	0,401200	0,266368	0,175000	-0,025714	0,173770	Rank: 3
Cyprus	2008	0,020000	-0,220000	-0,102105	-0,605077	-0,295455	-0,370000	0,023913	-0,175325	-0,564051
	2018	-0,014667	0,100000	-0,052632	0,067846	-0,159091	0,220000	0,241304	-0,337662	Rank: 11
Czechia	2008	-0,034667	0,240000	0,066055	-0,332769	-0,073232	-0,018182	-0,518750	-0,068213	-0,147222
	2018	0,065333	0,930000	0,045872	0,165385	-0,019949	-0,127273	0,053125	0,137790	Rank: 1
Denmark	2008	-0,016250	-0,076667	-0,217500	-0,381833	-0,144253	-0,270000	-0,027500	-0,067692	-0,526992
	2018	-0,031250	0,010000	-0,011250	0,190267	-0,032184	-0,040000	0,210000	-0,412308	Rank: 9
Estonia	2008	0,014474	-0,583333	-0,069369	-0,254280	0,173846	-0,473684	-0,140000	-0,300000	-1,235059
	2018	0,046053	-0,533333	-0,052252	0,199840	0,050769	-0,189474	0,180000	-0,460000	Rank: 23
Finland	2008	-0,028205	-0,115000	-0,152381	-0,174684	0,037047	-0,225000	0,088095	-0,181818	-0,586405
	2018	-0,021795	-0,312500	-0,053571	0,083211	0,081058	-0,037500	0,052381	-0,161039	Rank: 13
France	2008	-0,068000	-0,313333	-0,113953	-0,513609	-0,161392	-0,242105	-0,180000	-0,175912	-0,923015
	2018	-0,049333	-0,266667	-0,001163	-0,278565	-0,086448	0,063158	-0,076000	-0,164839	Rank: 19
Germany	2008	-0,038961	-0,126667	-0,136047	-0,439556	-0,159653	-0,180000	-0,340476	-0,245023	-0,411465
	2018	0,037662	0,043333	-0,073256	-0,084389	-0,054772	-0,030000	-0,169048	0,539816	Rank: 4
Greece	2008	-0,052857	-0,450000	0,015625	-0,545389	-0,228745	-0,440000	-0,196875	-0,173344	-0,456728
	2018	-0,150000	-0,016667	0,252083	0,000111	0,092308	0,530000	0,384375	-0,290062	Rank: 6
Hungary	2008	-0,180000	-0,455556	0,170909	-0,341231	-0,043983	-0,170000	-0,329412	-0,191980	-0,472314
	2018	-0,008000	-0,150000	0,180000	-0,039308	-0,016183	-0,250000	-0,008824	0,194966	Rank: 7
Ireland	2008	0,065217	-0,305000	-0,236250	-0,754438	-0,125899	-0,462500	-0,201667	-0,235294	-1,253456
	2018	0,073913	-0,425000	-0,205000	-0,308688	-0,046043	0,375000	-0,061667	-0,207059	Rank: 24
Italy	2008	-0,061194	-0,241830	-0,085057	-0,324000	-0,114684	-0,225000	-0,261538	-0,170781	-0,427482
	2018	-0,059701	-0,091503	0,056322	0,045588	0,068101	0,093750	0,069231	-0,276277	Rank: 5

Country Name	Years	EMP	R&D	CLA	CLB	CLC	EDA	EDB	POV	Deviation
Latvia	2008	0,032877	-0,613333	0,082051	-0,254725	0,151852	-0,550000	-0,226471	-0,195477	-0,573333
	2018	0,052055	-0,573333	0,081197	0,007300	0,131481	0,170000	0,255882	0,122779	Rank: 12
Lithuania	2008	-0,010989	-0,584211	0,148696	-0,225043	-0,270769	0,166667	-0,180698	-0,117936	-0,536842
	2018	0,068681	-0,536842	0,072174	0,062957	0,026154	0,488889	0,182752	0,024570	Rank: 10
Luxembourg	2008	-0,057534	-0,295652	-0,198750	-0,744091	-0,024444	-0,340000	-0,396970	-0,090909	-1,840272
	2018	-0,012329	-0,473913	-0,120000	-0,176455	0,008889	0,370000	-0,148485	-0,909091	Rank: 26
Malta	2008	-0,154286	-0,735000	0,046667	-0,980500	-0,371429	-1,720000	-0,363636	-0,088125	-2,290413
	2018	0,078571	-0,725000	-0,256190	-0,202200	-0,171429	-0,740000	0,051515	-0,195594	Rank: 27
Netherlands	2008	-0,038750	-0,352000	-0,135714	-0,743143	-0,151236	-0,425000	-0,050000	-0,104932	-0,810481
	2018	-0,010000	-0,136000	0,052381	-0,472500	-0,066063	0,087500	0,235000	-0,125918	Rank: 17
Poland	2008	-0,084507	-0,647059	0,078947	-0,485800	0,034336	-0,111111	-0,340000	-0,150135	-0,713256
	2018	0,016901	-0,288235	-0,062281	-0,247733	-0,048340	-0,066667	0,015556	0,301772	Rank: 15
Portugal	2008	-0,025333	-0,466667	0,064356	-0,259903	-0,048444	-2,490000	-0,460000	-0,078217	-0,870593
	2018	0,005333	-0,500000	0,169307	-0,021871	-0,006222	-0,180000	-0,162500	0,130622	Rank: 18
Romania	2008	-0,080000	-0,725000	0,147059	-0,158167	0,132093	-0,407080	-0,400749	-0,067955	-1,281616
	2018	-0,001429	-0,745000	0,173109	-0,005208	0,244651	-0,451327	-0,078652	0,254833	Rank: 25
Slovakia	2008	-0,044444	-0,616667	0,141593	-0,448357	-0,035366	0,000000	-0,605000	-0,197674	-0,941119
	2018	0,005556	-0,300000	0,154867	-0,150286	0,037195	-0,433333	-0,057500	0,052326	Rank: 20
Slovenia	2008	-0,026667	-0,456667	-0,044231	-0,400200	-0,026027	-0,020000	-0,227500	-0,124611	-0,519616
	2018	0,005333	-0,350000	0,107692	-0,154040	0,086301	0,160000	0,067500	-0,015576	Rank: 8
Spain	2008	-0,074324	-0,335000	-0,096667	-0,463150	-0,122204	-1,113333	-0,061364	-0,149158	-1,155466
	2018	-0,094595	-0,380000	0,045556	-0,127350	-0,040317	-0,193333	-0,036364	-0,283507	Rank: 22
Sweden	2008	0,005000	-0,127500	-0,107229	-0,088449	-0,094240	-0,128571	-0,066667	-0,192857	-0,607523
	2018	0,030000	-0,172500	0,093976	0,115204	-0,077880	-0,071429	0,151111	-0,285714	Rank: 14
United Kingdom	2008			-0,091667	-0,820467	-0,192568				Undefined
	2018			0,061905	-0,265533	0,007489				
EU evolutive	2008	-0,064000	-0,390000	-0,208750	-0,431600	-0,146952	-0,470000	-0,222500	-0,206549	-0,769601
	2018	-0,024000	-0,293333	-0,108750	-0,101150	-0,046473	-0,050000	0,017500	-0,145894	

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