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# Does family support decrease suicide rates? A panel data analysis of contemporary Europe

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**Abstract:** This thesis examines the suicide rates of 11 European countries from 2001 and 2017 to investigate a potential relationship between the level of family support and suicide rates. Age-group and gender-specific suicide rates are employed. In order to account for the level of family support, an index is created using Principal Component Analysis which includes different proxy variables for the level of family support in society. A significant relationship is found for middle-aged males and females, in the age groups of 35-54 and 45-54 respectively. The most significant effect is for males aged 45 to 54 years, where one standard deviation increase in the level of family support decreases the suicide rate with 12.55 (measured as the number of suicides per 100 000 males). Unemployment rates are only significant for women aged 35-44 and men aged 55-64. Our data tells us that family support is more important for people in child-bearing ages, perhaps because of fewer possibilities to social contact for this age group, thereby increasing the importance of strong family ties. Future research could investigate more into the role of family support, by enhancing our measure and employing more countries and over a longer timespan to see whether the effect still holds.

**Keywords:** Suicide, Social Support, Fixed Effects

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# Contents

# 1 Introduction

In ancient Rome, committing suicide was initially a legal act – until slaves began to practice it, leading to a devastating economic cost to the Roman state, ultimately leading to the criminalization of suicide (Leming and Dickinson, 2010, p. 290). Although slavery is now abolished, and committing suicide is no longer illegal in Europe, suicide still represents a substantial economic cost to the state, and therefore its citizens.

The number of suicides in the European Union (EU) equaled roughly 56 000 in 2015, circa 1% of all deaths reported in the EU (Eurostat, 2018d). Suicides represent the 4$^{th}$ leading cause of death for people under the age of 65 (Eurostat, 2009, p. 25). For certain countries, suicide represents an even more significant loss of life and resources. In Finland, suicide is the leading cause of death for males up until 45 years of age (Official Statistics of Finland [OSF], 2014). In its neighboring country Sweden, the total cost for all committed and attempted suicides was estimated at 5.5 billion SEK in 2004 (Räddningsverket and NCO, 2004, p. 3). These facts demonstrate an opportunity to increase savings, both in human and economic terms. Significant differences exist in suicide rates among European countries, where Hungary, Estonia, and Austria all exhibit more than twice the suicide rates of Spain and Italy (Eurostat, 2018d). A puzzling thought is why some southern European countries, hit hard by the financial crisis of 2008 and forward, continue to exhibit consistently lower suicide rates than many other European countries (see appendix A1-A6).

Previous research has mainly focused on finding which economic factors could drive the level of suicide rates. Most studies have investigated the relationship between unemployment rates and suicide, hypothesizing that lowered expectations on future income and economic distress could increase the likelihood of individuals committing suicide. However, multiple studies fail to establish a clear relationship or even argue that economic downturns could *lower* suicide rates by reducing the stigma of being unemployed as it is relative to the social and economic context.

Literature on the effect of different social factors on suicide rates demonstrate ambiguous results as well. Statistics from Europe show no clear pattern that can easily explain the causes of suicide and why some countries in Europe exhibit consistently lower and higher suicide rates (see appendix A1-A6). We argue that such a widespread phenomenon as suicide cannot be studied as a product of either the state of the economy or specific social characteristics, which is also motivated by several authors such as Hamermesh and Soss (1974) and Yang (1992).

We test in this thesis whether strong Family Support Systems, (FSS), mitigate suicide rates both for males and females by examining data differentiated by gender and age from 11 different European Union countries from 2001 to 2017.

**Family Support Systems:** contacts and or social interactions with family and the emotional support of these relationships.

In order to account for the level of FSS, an index is created using Principal Component Analysis which includes different proxy variables for factors, we believe, determine the level of support one can get from family when experiencing distress. We contribute to previous literature by combining both social and economic factors in a fixed effects model that could yield better results as to measuring the effect that social ties exert on the level of suicide rates. This could, in turn, help us obtain a better understanding of the differences in suicide rates which exist between European countries.

The thesis discovers a significant relationship between our measure of family support and suicide rates for middle-aged men and women, but not for other age groups. We do not find a general relationship between unemployment and suicide rates, nor the level of GDP per capita or unemployment expenditure.

The paper is structured in the following manner: A background overview is presented regarding costs, statistics and trends, followed by a literature review, where earlier studies are presented regarding suicide rates' relationship to different factors. We later present the aim and research question of our study, the academic contribution, and our hypothesizes. We then describe our statistical method, the variables employed and our dataset. Penultimately, we present the results and their interpretations. Lastly, we discuss the results, the limitations of our method and suggestions for future research.

# 2 Background

This thesis takes its standpoint in the current suicide statistics of Europe, with significant differences in suicide rates among countries in Europe. Generally, higher suicide rates occur in northern and eastern Europe such as in Finland, Sweden, and Estonia, compared to lower suicide rates in countries such as Spain, Portugal, and Italy (see table ). One could intuitively expect that higher unemployment rates in southern Europe would lead to higher suicide rates in these countries. However, data shows substantially lower suicide rates in south Europe, despite factors which at first glance would suggest otherwise such as lower income, higher unemployment rates and more. Furthermore, many countries' suicide rates do not exhibit large fluctuations over time (see 5.4 Summary Statistics).

## 2.1 Suicide's cost to society

A limited number of countries have collected official estimations of the costs of suicide for the state. Sweden is one country which has gathered official estimations. A single suicide has an estimated direct and indirect economic cost of 1.8 million SEK, and a total cost of 19 million SEK (Räddningsverket and NCO, 2004, p. 3). The cost of each suicide attempt is estimated at circa 0.5 million SEK (Räddningsverket and NCO, 2004, p. 26). In 2014, the total cost of committed and attempted suicides was estimated at 5,5 billion SEK, or 0,2 % of Swedish GDP (Räddningsverket and NCO, 2004, p. 24; Folkhälsomyndigheten, 2019).

**TABLE 1. SUICIDE COST ESTIMATIONS BY RÄDDNINGSVERKET (2004)**

| Costs in Sweden (2004) | Numbers in SEK (2004) |
|---|---|
| The economic cost of suicide | 1.8 mn |
| The total cost of suicide | 19 mn |
| The cost of suicide attempts | 0.5 mn |
| The total economic costs of committed and attempted suicides in 2004 | 5 500 mn |

| **DEFINITIONS** | |
|---|---|
| **Economic cost** | Economic cost of suicide is defined as services used in cases of suicide and attempted suicides as well as lost production from exit or absence from the workforce (Räddningsverket, 2004, p. 24; O'Dea and Tucker, 2005, p. 1) |
| **Total cost** | Total cost of suicide is only applicable to committed suicides, and includes intangible values such as grief and lost potential of lives lost (Räddningsverket, 2004, p. 25; O'Dea and Tucker, 2005, p. 1). |

Similar official cost calculations exist in New Zealand, with an estimated economic cost of suicide at 448 250 New Zealand Dollars (NZD), a rough estimate of 2.5 million SEK in 2019 values, and a total cost of circa 2 483 000 NZD, or circa 14 million SEK (O'Dea and Tucker, 2005). Official

estimations of the cost of suicide are difficult to find, but these numbers demonstrate the general economics of suicide and its significant cost to the state. It is important to also note the economic cost of the attempts, and not only the committed suicides. In Sweden, there are indications that for every committed suicide there may be between 8 to 25 suicide attempts (Räddningsverket and NCO, 2004, p. 3)**.**

Due to the high ratio of suicide attempts to committed suicides, attempts inflict a more significant cost on society than committed suicides in Sweden. Attempts represent 61 % of all costs and committed suicides the remaining 39 % (Räddningsverket and NCO, 2004, p. 24). Data availability on suicide attempts is scarce, and therefore studies focus on suicide rates since the driving force of the two phenomena could be expected to be the same.

Further understanding of what affects suicide rates could potentially save both lives and society's resources, and spare significant trauma for relatives, friends, and acquaintances. On an EU-average, suicide kills more people than road accident fatalities (Eurostat, 2018f, 2018a). Road-accident fatalities have a similar estimated cost as suicides in Sweden, where a road accident fatality has an estimated total cost of roughly 17.5 million SEK in 2004 values (Räddningsverket and NCO, 2004, p. 25). While resources in many countries are directed at preventing road fatalities, suicide prevention programs often lack (World Health Organization [WHO], 2014) – despite their similar cost structures and the higher prevalence of suicide. This motivates more research on what can be done to reduce this unnecessary loss of life and to reduce suicides' economic cost to society. The suicide rates of a country could potentially also be seen as a health indicator of the country in terms of mental health, which further motivates an investigation. Mental health being a vague area, suicide remains something concrete and measurable, although suffering from underreporting and other data collection problems such as misclassification of death causes.

## 2.2 Who commits suicide?

There are substantial differences in suicide rates: between different geographic regions, age groups, and gender. In a European context, Finland and Sweden exhibited suicide rates in 2016 of 13.8 and 11.7 per 100 000 inhabitants (WHO, 2018b). Spain and Italy, however, showed lower suicide rates, 6.1 and 5.5 respectively the same year (WHO, 2018b). In Finland and Sweden, suicide remains the leading and second leading cause of death among males from 15 to 44 years old (Åkerman et al., 2006, p. 35; Official Statistics of Finland [OSF], 2014). Generally, suicide rates are higher among older age groups, in all countries (see appendix A1-A6). Regarding the difference between men and women, the global male to female ratio of age-standardized suicide rates is 1.8, but in areas of eastern Europe such as Latvia, more than five males per woman commit suicide (WHO, 2018b). In all parts of the world, more men commit suicide than women, apart from China which has a ratio of 0.8 males per woman (WHO, 2018a).

In Sweden the government institution in charge of investigating public health, shows data from 2017 where the highest suicide rates exist in the age group of 85 and up, and substantially increasing suicide rates from 55 years and older (Folkhälsomyndigheten, 2019). The lowest suicide

rates are found in the age group of 15-29 and 30-44 year-olds (Folkhälsomyndigheten, 2019). The highest suicide rates are found in the oldest age groups in most countries and a sharp increase in suicide rates from the ages of 50 and older (see appendix A4-A6). Data demonstrates that about two-thirds of all suicides are male, partially because men use more lethal methods and thereby are more likely to die by their suicide attempts than females (Folkhälsomyndigheten, 2019). Educational attainment varies with suicide rates, where suicide rates are lower among higher educated individuals, which data from Sweden demonstrates (Socialstyrelsen, 2014). The reason behind that is dubious, however.

The trend for suicide rates in Europe over the last 25 years shows declining rates in eastern European countries, whereas for most countries the rates are more or less stable over the years, even across the financial crisis of 2008 and onwards (see Summary statistics). Finland, Estonia, Hungary, Austria and Denmark are countries which depict a significant negative trend between 1994 and circa 2004. From 2004 and onwards, Finland and Hungary continue to exhibit diminishing suicide rates, whereas generally across Europe the trend is stabilized, and there are small fluctuations between the years.

Suicide data differentiated by income, education, residential area and more are scarce. Thereby it is difficult to find statistics of which groups of people are the ones who are most prone to commit suicide. A consequence of this is that the vast majority of studies focus on examining suicides on an aggregated level, such as on a regional or country-level, which has its positive and negative effects which are discussed more in the literature review.

# 3 Literature Review

To support our research, we make a summary of the current knowledge that encompasses the relationship between suicide, social and economic variables. The purpose of the literature review is to place our study in relation to previous research by providing the reader with relevant information on the topic investigated and present methods used as well as conclusions reached in previous studies.

The literature review consists of 4 different sections. The first section includes results on the effect of unemployment and income on suicide rates. The second section incorporates findings on the effects of different social variables on suicide, as well as the effect of economic variables when controlling for the social context. The third section discusses in particular studies examining the effect of household composition variables on suicide rates, as these variables play an essential role in the creation of our measure of Family Support Systems. Lastly, we describe research within the topic of public expenditure on health and unemployment, and their effect on suicide rates.

## 3.1 Previous research

### *3.1.1 Unemployment and suicide*

Various studies have focused on the relationship between unemployment and suicide, and the results are mixed. Intuitively, one can imagine that higher unemployment rates cause financial strain for those becoming unemployed as well as increased pressure on those still employed as it creates a higher risk of losing one's job. Hamermesh and Soss (1974) performed an extensive and since then frequently cited research on the linkage between unemployment rates, income, and suicide. They created an economic theory of lifetime utility by looking at unemployment, income, and age. Using time series regression against earlier periods of real income growth they created a measure for expected real income growth.

The theory of Hamermesh and Soss states that the individual will commit suicide when the discounted expected lifetime utility reaches zero, which could happen in the case of becoming unemployed for example (Hamermesh and Soss, 1974, p. 88). Unemployment periods are likely to increase with age as it is more difficult for older people to find a new job, and therefore the discounted expected lifetime utility will be more severely affected by unemployment. This could explain why older people exhibit higher suicide rates. Their results demonstrated a relationship between unemployment and lower income with higher suicide rates, and that suicide rates are generally lower among high-income groups "contrary to widely held beliefs" (Hamermesh and Soss, 1974, p. 97). Other studies have also seen a positive correlation between unemployment and suicide rates, such as Yang and Lester (1995) and Ruhm (2000).

Using a different method, Gerdtham and Johannesson (2003) have also found that unemployment significantly increases the risk of suicide in Sweden. Their method consisted of the usage of individual data of circa 30 000 people aged 20-64, from a survey conducted in Sweden. The individuals' health status was followed up during 10-17 years. After controlling for initial health status at the time of the survey and other exogenous factors, the results demonstrated that being

unemployed at the time the survey was conducted, increased the risk of having committed suicide the following year. This study by Gerdtham and Johannesson differs from most studies by examining individual data. Primarily, studies use aggregated data and measure the broader societal movements on suicide rates. The drawback of aggregated data is that it does not capture the effects on an individual level. The upside consists of obtaining the societal changes on a grander scale; for example, job loss could be expected to affect not only the individual becoming unemployed but also influence others in the same household by for example lowered household income expectations.

Neumayer (2004) demonstrates results contradicting earlier mentioned correlations – the study shows a negative relationship between unemployment and suicide rates using panel data from German regions. Furthermore, Neumayer found divorce rates to be among the most significant predictors of suicide rates. Similar studies employing panel data methods include Andrés (2005), who created a fixed effect estimation model of 15 European countries from 1970-1998. After including country-specific time trends, the effect of unemployment on suicide rates becomes insignificant for all age-groups except males aged 45-65. His results which denote correlations only for certain age groups highlight the importance of evaluating suicide to age-specific intervals. A lack of positive correlation between unemployment and suicide rates has also been demonstrated by Yang and Lester (1994), Williams (2002), Sommers (2018) among others.

### *3.1.2 Integrating social and economic variables*

Yang (1992) hypothesized that suicide rates in the USA were a result of the interplay between economic and social variables. A single equation regression was applied to 4 different social groups differentiated by race. Economic variables included GDP per capita and unemployment rates. Sociological variables included divorce rate, female labor force participation and proportion of the population belonging to the Catholic church. Results showed no clear relationship between suicide rates and economic booms and recessions, and unemployment had a significant effect only on white males. Divorce rates and religious affiliation were however correlated with suicide rates to a larger extent, and a higher level of female labor force participation led to lower suicide rates for women. Ying and Chang (2009) employed a panel data method of the G7 countries and also found an effect of female labor force participation. They found that a higher level of female labor force participation rates increased suicide rates for men, which was attributed to higher psychological pressure on males.

Chuang and Huang (1997) built on the works of Hamermesh and Soss (1974) and Yang (1992) and examined variations in the pooled suicide rates of 23 different regions in Taiwan between 1983 and 1993. The method involved a cross-sectionally heteroscedastic and time-wise autoregressive technique. Chuang and Huang complemented the lifetime utility theory by Hamermesh and Soss with the proportion of the population below the poverty line in need of public assistance (thereby including unemployment, income, age, and population below the poverty line in need of public assistance). Regarding control variables, they complemented Yang's (1992) variables with migration, as mobility could be expected to lead to a loss of contact with relatives

and friends. A dummy variable was also added for the existence or not of a regional office of a suicide prevention center.

Contrary to Yang (1992), Chuang and Huang's results showed that "on the whole, economic variables appeared to have a greater impact on regional suicide rates rather than sociological correlates. In particular the level of income per capita in a region stood out as the most important predictor of suicide rates" (Chuang and Huang, 1997, p. 288). The existence of a regional suicide prevention center also appeared to affect, as well as fertility, although the effect was small. Yang and Lester (1994) also found fertility to be a significant factor. Andrés (2005) found similar results regarding fertility but, contrary to Chuang and Huang, did not find that suicide rates were sensitive to income. Suicide rates were not sensitive to female labor force participation rates either.

Cook (2019) complemented the model by Hamermesh and Soss with years of education and found that years of education significantly raises the risk of suicide in the USA. Noh (2009) also followed a similar model to Hamermesh and Soss (1974) and to Chuang and Huang (1997). Noh included in the lifetime utility theory GDP per capita rather than income level and controlled for female labor force participation, urbanization and fertility rates as they were expected to represent the strength of family ties and "family help". Furthermore, the author included unemployment expenditure, alcohol consumption, average public happiness proxied by CO2 emissions as it was expected to be a proxy for industrialization, and the number of dependents to the working-age population, as he expected a greater dependency to induce more stress. The results showed that the effect of unemployment on suicide rates is only positive in high-income countries and that a negative relationship exists in low-income countries.

Kuroki (2010) states that the relationship between more unemployment and fewer suicides may be due to a lower stigma of poverty and being unemployed in countries or regions with higher unemployment. The sense of failure of being unemployed is argued to be relative to the social, cultural and economic context. Kuroki highlights the importance of placing suicide in relation to the economy and its specific social context. Evidence from Finland in the recession of 1991-1993 when suicide rates drastically dropped after a long period of increasing suicide rates is one example of where this pattern could be identified (Frantz and Rundt, 2016; Statistikcentralen, 2019).

### *3.1.3 Studies including household composition variables*

Several studies focus on the linkage between different household composition variables and suicide rates. Peter Sainsbury (1955) conducted a study on suicide rates in various London boroughs and found variations according to the social character of a neighborhood and between professions (Sainsbury, 1955, p. 20). Sainsbury found that professional groups such as miners and railway workers exhibited low suicide rates which he attributed to the strong community sense within mentioned professions. Differences in suicide rates between poor and rich boroughs, where the latter displayed about 30 % higher suicide rates, were attributed to the mobility and isolation or cohesion of the community (Sainsbury, 1955, p. 19).

In a study in England in the 1980s, the most significant increases in suicide rates took place in areas with the most substantial increases in the proportion of people living alone (Guohua, 1995, cited by Maskill et al., 2005, p. 50). Another study found suicide rates to exhibit a stronger correlation with variables such as single-person households, unmarried people and mobility, rather than economic variables (Whitley et al., 1999, cited by Maskill et al., 2005, p. 65). Neumayer (2003) however found household size to be an insignificant variable when examining suicide rates using a panel data method of 68 countries. A study from Italy focused on the relationship between suicide rates and socioeconomic factors (Bussu, Detotto, and Sterzi, 2013). They used a spatial panel data method on Italian regions for nine years to control for serial and spatial autocorrelation. Their study concluded the primary role of family, alcohol consumption, and population density in explaining suicide rates, whereas income per capita and economic growth did not appear to have any effects.

A study from 2013 conducted in Belgium, which used cross-sectional data from a national survey, also found a significant correlation between household composition and suicide rates, before and after controlling for socioeconomic status and income (Gisle and Van Oyen, 2013). By using multivariate logistic regression, they analyzed a sample representing the Belgian population to understand whether people living in different household types had a different propensity to engage in suicidal behavior. They controlled for gender, age, income level and unemployment status. Among other conclusions, the study discovered that people living alone were more than twice as likely to attempt or commit suicide compared to people living together with others.

### *3.1.4 Welfare spending and suicide rates*

Literature exists on the connection between suicide rates and public expenditure on health and unemployment compensation. Two studies conducted in the USA found a linkage between state welfare expenditures in different states and decreased suicide rates, after controlling for divorce rates, unemployment, sex, age, and population density as well as racial composition (Zimmerman, 2002; Flavin and Radcliff, 2009; cited by Ross, Yakovlev and Carson, 2012, p. 409). Ross, Yakovlev, and Carson (2012) built further on these works and studied the effect of public spending on mental health in the USA. They studied suicide rates from 1997 to 2005, using a panel data method where they complemented previous methods by also controlling for the number of sunny days in each state, and measuring mental health expenditure with the same Purchasing Power Parity over time and between states. Their results show a small and insignificant effect on suicide rates by the amount of public spending on mental health. Mattei and Pistoresi (2018) found a link between lower suicide rates and a more robust public expenditure on unemployment compensation. The study employed cointegration techniques, and they hypothesize that public spending on unemployment benefits compensates for the reduced social integration among unemployed, thereby reducing suicide rates. They also note a lack of studies examining the effects of different public spending on suicide rates.

### *3.1.5 Summary*

Previous literature presents ambiguous effects of unemployment on suicide rates, and several authors present an idea that suicide is the result of an interplay between social and economic factors, such as Yang (1992). Authors find an effect of different social variables, including single person households, fertility, female labor force participation and more. According to Noh (2009), female labor force participation can be seen as an indicator of "family help and social bonds" together with fertility and urbanization (Noh, 2009, p. 577). Neumayer (2003) describes that males are challenged in their role as breadwinners when females work to a larger extent, and have less emotional support when their female partners work since they are often the male's main source of "emotional comfort" (Neumayer, 2003, p. 312). These authors also suggest the importance of the social context, and so does Hamermesh and Soss (1974) among others. Authors have also studied the effect of public spending schemes including unemployment expenditure, finding strong to insignificant results.

We note the ambiguity of the results from previous authors which demonstrates the difficulties in examining suicide rates and their driving forces. We further note a lack of authors creating a concrete measure for the social context, although the usage of different social control variables is frequently employed.

# 4 Specification of research focus

## 4.1 Aim

The purpose of this research is to investigate the relationship between suicide rates and Family Support Systems (defined as contacts and or social interactions with family and the emotional support of these relationships). Ultimately, the aim is to obtaina better understanding on the relationship between family support and suicide rates, which could potentially give indications as to how a country might be able to diminish suicide's substantial economic cost to society.

## 4.2 Research question

Previous findings suggest that unemployment and income correlate with suicide, although the results are ambiguous and state both positive, negative and non-significant relationships. Solely examining statistics, data demonstrates that high-income European countries often exhibit a higher level of suicide per capita than their lower-income European counterparts, although they often exhibit lower unemployment rates and more unemployment benefits (see 5.4 Summary Statistics). Various authors present the idea that suicide is part of a broader economic and social context, such as Hamermesh and Soss (1974, p. 97), Kuroki (2010), etc. Due to the inconclusive results on the effect of unemployment on suicide, and a consistent difference in suicide rates between European countries, we strive to examine whether different social structures and family support in Europe has a relationship with the different suicide rates. Thereby, we establish the main research question:

*Is there a relationship between Family Support Systems and suicide rates in Europe?*

**Family Support Systems:** contacts and or social interactions with family and the emotional support of these relationships.

## 4.3 Hypotheses

Considering previous research and the aim of this study, the main hypothesis is established. We expect that more social support and contact with family will provide individuals with greater protection against committing suicide, thereby leading to lower suicide rates in countries with a higher level of FSS, ceteris paribus. When regressing suicide rates on FSS, we are also interested in testing two secondary hypotheses.

**Main hypothesis**
H1: Family Support Systems exhibit a negative relationship with suicide rates both for males and females in all age groups.

**Secondary hypotheses**
H2.a: Unemployment has a positive relationship with suicide rates when controlling for FSS for all working age groups.

H2.b:Unemployment expenditure per capita unemployed has a negative relationship with suicide rates.

## 4.4 Academic contribution

This work contributes to the literature by investigating the relationship between family support and suicide rates. We study the possible relationship between suicide rates and a more traditional family-centered society that provides closer support to the individual relative to more individualistic societies prevalent in higher income countries. This will be achieved by creating an index that betters mirrors the effect that factors such as fertility, divorce, household composition and leaving-home-age can have on society's ability to cope with distress and pressure exerted by drastic changes in life such as losing one's job. We hope that our measure for family support can capture and isolate the variation from the factors before mentioned to indicate the role of family support in diminishing suicide rates. We further expect to observe a more consistent effect of economic variables once family support is accounted for.

This work also contributes to the literature by examining the effect of unemployment protection expenditure on suicide rates, after controlling for social differences between countries, as demonstrated valuable by for example Yang (1992), Yang and Lester (1994), Andrés (2005). As noted, there is a lack of extensive literature examining different public expenditure programs and their effect on suicide rates, and also literature taking a broader approach by including both economic, social and welfare variables. Many authors note specifically the importance of examining more than only economic or social variables, including Hamermesh and Soss (1974), Mattei and Pistoresi (2018). We include factors on public health and unemployment expenditure because of the cost of these policies in themselves, as well as the possible cost-savings resulting from diminished suicide rates if these policies function well. This study should be viewed as an attempt to find general national differences in suicide explained by the different cultures of social support and their effect on the individuals' well-being. The aspiration is to contribute with findings on the potential effects of different factors on suicide, to enable better policy implementation which can reduce suicide rates and their costly implications.

# 5 Method

This section of the thesis aims to explain to the reader how the analytical process will be performed. First, the statistical method is presented, followed by a description of variables, including data collection and justification of the inclusion of each variable. The dataset is then presented with some graphical overview of the data.

## 5.1 Statistical method

We choose data analysis methods and relevant variables after examining the results from previous research. We follow similar statistical procedures of previous research to ensure comparability of results.

Panel data estimation is used to examine suicide rates through a specific period, 2001-2017. This allows us to control for unobserved factors specific to the geographical location or the age of the individuals that otherwise would bias our results when only applying Ordinary Least Squares (OLS) regression methods. We will make use of fixed effects in order to eliminate the effect of this time-invariant unobserved factor in order to ensure consistency in the results obtained from the analysis. We create a measure accounting for the strength of family ties and support by applying principal component analysis. This yields an index of our measure for Family Support Systems, FSS.

### 5.1.1 *Time fixed effects*

Including dummy variables accounting for each year specified in the panel allows for changes that are entirely time variant. One could argue that cyclical changes in the macroeconomy affecting the level of unemployment rates could bias our estimation giving us a misleading effect of unemployment on suicide rates. The financial crisis of 2008/2009 which is a part of the period analyzed is another disruptor. Another factor whose variation is only time dependent could be changing trends in family stereotypes that are not country-specific and increased wealth development and median income levels across nations. One could argue that these factors provide individuals with a higher degree of independence, probably decreasing the number of households constituted by more than one individual.

### *5.1.2 Ordinary Least Squares (OLS) model specification*

We want to compare the results from our final fixed effects model to a model including all variation in our data set. We first study the relationship between suicide rates and FSS with an OLS regression that is specified as follows:

$$Suicide_{rate_{it}} = \beta_0 + \beta_1 FSS_{it} + \beta_2 \boldsymbol{X_{it}} + \boldsymbol{\delta_t} + u_{it}$$

$\boldsymbol{\delta_t}$ denotes Time fixed effects which are included by dummy variables accounting for each year studied in our regression. $\boldsymbol{X_{it}}$ denotes all control variables included in our regression which are listed as follows: Unemployment rate (gender- and age-specific, unemployment expenditure, Health expenditure, Higher educational attainment and GDP.

### *5.1.3 Panel data estimation, fixed effects*

In order to estimate a possible relationship between our measure of family support systems and suicide rates, a panel or also called longitudinal data estimation method is used. A panel data method consists of a specific time series for each cross-sectional member in the data set. The time series will be constructed by a time interval of 17 years between the period of 2001 and 2017. The cross-sectional members are constituted by statistics on suicide rates differentiated by gender and age in 11 different countries of the European union. Our choice of age-intervals implies a total of 6 panels for all age groups, per gender.

The main benefit provided by panel data methods is the fact that having several observations on the same unit over time allows for the control of unobserved country-specific characteristics which might facilitate the simulation of a ceteris paribus experiment to investigate the presence of a possible relationship (Wooldridge, 2016, p. 435). The explanation is that using panel data will increase the level of variation in the data set studied, making it easier to establish statistical inference. Using a regular cross-sectional method such as OLS pooling might make it more difficult to control for unobserved factors that are specific to the units measured (males and females differentiated by age and country) and that are constant over time (Wooldridge, 2016, p. 436). The presence of these factors might affect our ability to infer a possible relationship between suicide rate and our measure of FSS. Implementing OLS statistical methods could lead to a significantly higher problem with omitted variable bias due to omission of this time-constant fixed effect.

The presence of heterogeneity bias would decrease our ability to establish whether our measure of FSS might have a significant effect on the number of suicides per country and suicides differentiated by gender and age. Since the central assumption for the consistency of an OLS estimation method is that the covariance of the idiosyncratic term and the explanatory variables is zero, we would fail to obtain consistent estimates given that a correlation between our measure of FSS and the idiosyncratic error will arise. This is because the previously mentioned fixed effect present in the idiosyncratic error would correlate with our explanatory variable. This would make our estimation on the effect of FSS on suicide rates biased and inconsistent.

The usage of panel data methods will allow isolating these time-constant factors otherwise present in the idiosyncratic error and facilitate the application of the fixed effects estimator in order to eliminate them. Time-invariant factors specific to each country's culture might be related to the expectation of family support provided to the individual that is linked to the country's culture and tradition. Another factor affecting our results could be expectations directly related to the age of the individual. One example could be to which extent individuals count on their families when encountering drastic life changes given a certain age. Even if the mentioned factors cannot be expected to be permanently time-invariant, since both cultures and expectations change, one could assume that changes in cultural attitude among individuals are at least prevalent under a period of 10 years making the age group division for the units observed reasonable for the control of these factors.

Other factors that are roughly time-invariant could be those related to demographic features of each country's population (age distribution, education level, attitude towards unemployment and future income loss). This could provide us with a degree of heterogeneity among the level of suicide rates across countries that does not vary over time and is specific to the country's culture and development, and that cannot be controlled for without the use of panel data methods. Another factor essential to mention is the presence of different reporting methods that might be specific to the country studied. This would imply a correlation of the reporting method used with our proxy variable or measure of FSS.

The panel unobserved fixed effect will be dealt with by performing the estimation with the help of a fixed effects model. Since it is reasonable in this case to expect the fixed effect to be correlated with our measure of FSS, the use of panel data is more suitable since it allows for correlation without compromising the consistency of estimators.

Neumayer (2003) refers to a study by Krupinski (1980) which observes that countries with very similar social structures have large differences in suicide rates (Krupinski 1980, cited by Neumayer, 2003, p. 309). Neumayer goes on to explain that the large differences cannot be explained with social and economic characteristics alone. He therefore uses a fixed effects estimation as it offers a much more "elegant way of controlling for a fixed national culture of suicide" (Neumayer, 2003, p. 309).

### *5.1.4 Fixed effects estimator*

In order to eliminate the effect that the unobserved heterogeneity factor or fixed effect has on our regression, which OLS fails to account for, we will be implementing a fixed effects estimation. By taking the average over time of each variable we will be able to eliminate all time-invariant bias in our model. The model is specified as follows:

$$Suicide_{rate_{it}} = \beta_0 + \beta_1 FSS + \beta_2 \boldsymbol{X_{it}} + \boldsymbol{\delta_t} + \boldsymbol{\alpha_i} + u_{it}$$

$\boldsymbol{\delta_t}$ denotes Time fixed effects which are included by dummy variables accounting for each year studied in our regression. $\boldsymbol{\alpha_i}$ denotes Country fixed effects controlling for all country specific variation in our data set that does not vary over time and that we believe disturbs the possible relationship between FSS and suicide rates. $\boldsymbol{X_{it}}$ denotes all control variables included in our regression which are listed as follows: Unemployment rate (gender- and age-specific, unemployment expenditure, Health expenditure, Higher educational attainment and GDP.

## 5.2 Choice of variables, data collection, and justification

This thesis investigates suicide rates by using the variables listed below. The data collection methods of each variable are first described followed by a justification of why we include the variable in our analysis.

### *5.2.1 Suicide rates*

Suicide rates are collected from Eurostat, more specifically from a data bank on all causes of death reported by each member state once a year (Eurostat, 2018a). In the case of suicide, a non-natural cause of death, the cause of death is determined by forensic physicians or legal professionals (Eurostat, 2018b). The death certification is coded according to WHO's International Statistical Classification of Diseases and Related Health Problems (ICD). According to Eurostat, all countries generally follow standards and rules specified in the ICD and the overall data collection procedures are relatively homogeneous (Eurostat, 2018a). However national differences in interpretation of ICD codes are present, making comparability issues remain. Data from 2011 and onwards are not always comparable with data from 2010 and before, because of changes in reporting methods and data collection. However, we do not observe any substantial differences between 2010 and 2011 in our data for suicide rates and therefore disregard any differences, but it is important to be aware of this issue. Suicide rates are presented as per 100 000 inhabitants. Data on suicide rates for specific age spans did not exist, only the crude death rate. Therefore we created the measure ourselves – we collected the crude number of suicides in each country every year per age group and put it relative to the number of people in that specific age group that year.

### *5.2.2 Creation of FSS index, Principal Component Analysis (PCA)*

In order to gain a better understanding of how our social variables measuring family support are related to suicide rates in Europe, we create an index with the help of Principal Component Analysis (PCA). PCA is used to reduce the dimensionality of large data sets into a set with fewer dimensions that is both easier to understand and to draw conclusions from, which however comes at the cost of somewhat reduced accuracy. PCA looks for the shared correlation and structures in the data set in order to understand where the most substantial amount of variation is generated.

The principal components generated by PCA are a set of new variables created as linear combinations or mixtures of our original proxy variables measuring family support. These new variables are uncorrelated to the original variables in our data set. Most of the explaining variation or information is squeezed into the first component making it the most useful to explain the underlying variation in the data that is due to the shared correlation in our variables (see appendix A7).

The principal components are less interpretable and are only a linear combination of our original variables but represent the direction of the data that explains the maximum amount of variation, which makes differences across observations more visible.

Since PCA is sensitive to measurement scales, all variables used to create the index were standardized before performing the calculation. FSS is created by using the variation present in the following variables (which are explain in detail in sections 5.2.3 until 5.2.8):

- Percentage of population living in single person households
- Percentage of population living in households with three adults or more
- Average age of leaving paternal households

- Gender gap in employment rates (measured as the difference between the labor force participation percentage of men and women)
- Fertility rate
- Divorce rates

We included and tested for other proxy variables for family support – share of young adults aged 18-34 living at home. However, this variable did not explain any significant additional amount of variation in our dataset. Preferably we would have included some measure for migration or urbanization in our list of variables, but due to a lack of useful data on migration and difficulties in measuring the level of urbanization for the population on an aggregated level for our 11 countries, it was decided not to include these variables.

It is crucial to ensure that a high value in all variables employed all bear the same meaning, a high level of FSS in this case. Therefore, we reversed divorce rates and single person household, so that a higher value will signify more people *not* living alone, and *fewer* divorces, indicating a higher level of FSS. A higher gender gap in employment rates (explained in detail in section 6.2.8) we motivate to signify a *higher* level of FSS, as according to Noh (2009), female labor force participation can be seen as an indicator of "family help and social bonds" together with fertility and urbanization (Noh, 2009, p. 577). This could be a double-edged sword for females though, since it signifies less participation in activities outside the home, and a higher level of female labor force participation has been shown by Yang (1992) to lower suicide rates for women. The inclusion of gender gap in employment rates is justified and explained further in section 5.2.8.

PCA produces one component per variable used in the method, meaning that we obtain six components accounting for the entire variation of our data set. The most significant amount of the variation that is correlated across variables is compressed into the first component (see appendix A7) which explains 70% of the variation of our data set. This makes component number 1 the most relevant measure of variation shared across our original variables. The maximum remaining amount of variation uncorrelated to the first component is then compressed into component number 2. The process is then continued until 100% of the variation of the set is accounted for in the number of components that is equal to the number of original variables in the data set.

The first component from the process of PCA will onward be used as our measure of family support systems which we hope will allow inferring a possible relationship between family support and suicide rates.

### *5.2.3 GDP per capita*

GDP per capita is not measured in a single currency but measured in the same Purchasing Power Standard (PPS), to create a purchasing power adjusted GDP per capita measure. This means that the same PPS in two countries will buy the same value of goods and services. Using this standard allows us to better compare the wealth level of the different countries. The data is gathered from Eurostat (Eurostat, 2018e).

Authors such as Yang (1992) and Noh (2009) used GDP per capita as control variables. We also use GDP per capita, but adjust for purchasing power standard, since we believe this will better represent the wealth level of the different countries and the resources available to the people in each society. Results by Noh (2009) demonstrated higher suicide rates in high-income countries, by using GDP per capita as his measure. The effect of other variables on suicide rates was also shown depending on the level of GDP per capita – unemployment had a different effect on suicide rates depending on whether it was a high or low-income country. This motivated an inclusion of GDP per capita in our study.

#### *5.2.4 Household composition variables, EU-SILC Survey*

Data on household composition is collected using the Statistics on Income and Living Conditions (EU-SILC) Survey (Eurostat, 2014). The survey is executed each year in the member states. Household is defined as "a person living alone or a group of people who live together in the same private dwelling and share expenditures''. The classification of the type of household is constructed by reference to numbers of adults, age, gender and number of dependent children in the household. Children are otherwise counted as adults if above the age of 18. The data is collected using 4 different interview methods: telephone interviews, paper or computer-assisted personal interviews and self-administrated questionnaires where each country gets the opportunity to choose the method of their preference (Eurostat, 2018c). Interviews do not exceed one hour on average, and the data is to be collected using a nationally representative sample.

Variables measured with the EU-SILC survey include:

- Percentage of the population living in a single-person household.
- Percentage of the population living in households with three or more adults.
- Share of young adults aged 18-34 living at home, with either parent or both. Data is differentiated by sex (Eurostat, 2014, p. 287).

Neumayer (2003) describes that lower household size could potentially lead to greater feelings of loneliness and a lack of integration. A study conducted in Belgium in 2013 found a significant correlation between household composition and suicide rates, even after controlling for socioeconomic status and income (Gisle and Van Oyen, 2013). This propels an interest to investigate if the same results can be found using panel data from different European countries. Is it possible to observe an effect of single person household rates and households with three or more adults on suicide rates on a cross-country level? The variables can also be seen as a proxy for close support from family and relatives, which we assume to be less stable in countries where there is a tendency to live in single households, and where the possibility and culture expects one to leave the comfort of the family home at an earlier age and be more independent.

#### *5.2.5 Unemployment expenditure*

Our measure of unemployment expenditure stems from Eurostat's data on social protection expenditure (Eurostat, 2019c) and Eurostat's data on unemployment numbers in the union

(Eurostat, 2019b). The unemployment expenditure is measured in the same Purchasing Power Standards (PPS). Furthermore, we measure the expenditure on unemployment in relation to the number of unemployed people in the country to obtain unemployment expenditure in PPS per unemployed citizen. This method is recommended by Eurostat to ensure better comparability between different countries' unemployment protection schemes (Eurostat, 2017). Unemployment expenditure here includes all expenditure on unemployment, and is defined as "Income maintenance and support in cash or kind in connection with unemployment" (Eurostat, 2016, p. 36).

Authors including Zimmerman (2002), Flavin and Radcliff (2009), Ross, Yakovlev, and Carson (2012) as well as Mattei and Pistoresi (2018), have all included expenditure on health and unemployment in their research, with mixed results. Mattei and Pistoresi (2018) describe a lack of literature on the link between unemployment expenditure and suicide rates. The authors found significant correlations in their recent study, which motivated the inclusion of this variable in our study to evaluate potential effects. As national governments spend a considerable amount of resources on unemployment benefits, it motivates research on whether there are any additional benefits from this expenditure, such as diminishing suicide rates.

#### *5.2.6 Fertility and divorce*

Fertility is measured as the number of live births per woman in each country (Eurostat, 2019a). Divorce rates are measured in our dataset as the number of divorces per 100 marriages during one year, also gathered from Eurostat (Eurostat, 2015).

Yang (1992), Yang and Lester (1994), Chuang and Huang (1997), Neumayer (2004), Noh (2009) and several others as described in the literature review have included fertility and divorce rates when examining suicide and found significant relationships. Chuang and Huang (1997) described that the presence of children would promote family and social ties, and would increase social integration. Divorce, on the other hand, represents a disruption of family and social ties. Neumayer (2003) and Noh (2009) explained that fertility and divorce could be used as a measure for the strength of family ties and "family help," and we have thereby chosen to include these variables in our index of FSS to control for strength of family relationships.

#### *5.2.7 Educational attainment*

Educational attainment is measured as a percentage of the population possessing a higher education, signifying a tertiary education provided by university or higher institution (Eurostat, 2018g). Formally, the data is measured as a percentage of the population possessing an education of level 5-8 in the International standard classification of education (ISCED).

As Eurostat describes it, educational attainment generally increases economic development, growth as well as overall well-being (Eurostat, 2018g). Data demonstrating a generally lower suicide rate by higher educated people in Sweden encouraged us to control for the proportion of the population with higher education (Socialstyrelsen, 2014). Apart from Cook (2019), which found that more years of education *increased* the risk of suicide, few authors have explicitly

studied higher education as it is expected to also vary with GDP, as motivated by Yang (1992). However, the substantial difference between the suicide rates of groups with different levels of educational attainment, as well as the significant effect of education in the study by Cook (2019), motivated an inclusion of the variable.

#### *5.2.8 Employment variables, EU Labor Force Survey (LFS)*

The data is collected using interviews with a representative sample from all member states, but different interview methods are used in different countries depending on national legislation (Eurostat, 2019b, p. 7). Population census or list of addresses are the basis for the sample selection. On average less than 1% of the population is interviewed, and data is collected using personal visits, telephone interviews, web interviews and self-administered questionnaires, where each country can select their method of choice (Eurostat, 2019b, p. 9). A shared definition of unemployment is used, and 12 guiding principles for the development of the surveys and questionnaires ensure comparability between countries (Eurostat, 2019b, p. 26).

Variables measured with the EU-LFS survey include:

- Unemployment rates differentiated by sex and age. Divergences in the concept of unemployment do exist between member states of the EU, however not between any of the selected countries for this thesis using the selected unemployment measure where we have chosen the percentage of unemployed of the active population (Eurostat, 2019b).
- Gender gap measured as the difference between the percentage of female and male labor force participation rates.

Unemployment has been employed in several studies to measure its effect on suicide rates, with mixed results as previously mentioned. It represents a cost to the individual and to society in itself, but to understand the real cost of unemployment one would also need to investigate the effects unemployment has on another costly occurrence in society, suicide rates. Important to note is that *not* using unemployment when investigating suicide rates would mean to disregard the effect that a loss of income and job has on an individual. Unemployment leads not only to a loss of income but also possibly to reduced social contact and a loss of structure in life as well as a sense of losing one's place in society. Noh (2009) states further on that controlling for unemployment also includes controlling for general economic shocks and fluctuations in society, which is another compelling reason to include unemployment (Noh, 2009, p. 577).

Studying the gender gap we motivate is important by examining studies by Chuang and Huang (1997), Neumayer (2003), Ying and Chang (2009), Noh (2009), whom all use female labor force participation and find a significant correlation with suicide rates. As stated by Chang (2009), a higher female labor force participation can strike men specifically in terms of psychological pressure, and thereby increase suicide rates. According to Noh (2009), female labor force participation can be seen as an indicator of "family help and social bonds" together with fertility and urbanization (Noh, 2009, p. 577). Neumayer (2003) describes that males are challenged in

their role as breadwinners when females work to a larger extent, and have less emotional support when their female partners work since they are often their main source of "emotional comfort" (Neumayer, 2003, p. 312). We do not examine female labor force participation rates but employ the *gender gap* in labor force participation. This is because the female labor force participation rate in each society is also dependent on the general level of unemployment. Using the difference between men and women, in each country, we believe to be a better measure. We argue that the gender gap in labor force participation can be used as a proxy variable for how traditional a society is in terms of family structures and values. Therefore, the variable is used to measure the social structure of society and its gender roles. We believe that a smaller gender gap (meaning women work to almost the same extent as men) will signify a lack of family support for men in line with the arguments proposed by previous literature, and indicate a less traditional society where family ties and support are less strong.

## 5.3 Dataset

In order to study the effects of our measure of FSS on suicide rates in Europe, we use data on suicide rates differentiated by gender and age. Unemployment rates are also differentiated by gender and age. Statistics demonstrate differences in suicide rates between gender and age groups, and previous literature has shown differentiated effects of variables on different age groups, for example Andrés (2005). We decide to follow the same pattern and study the relationship between our measure of FSS to each specific age group and gender.

Effects specific to age will be studied by dividing the entire working life span into age groups with intervals of 10 years starting at the age of 15 and ending at the age of 64. This is important since suicides committed by people of working age represent a significant cost in terms of lost future tax payments for governments as explained by Räddningsverket (2004), and O'Dea and Tucker (2005). The age groups are constructed in the following way: 15-24, 25-34, 35-44, 45-54, 55-64. Narrower age spans are available which means that for example 5 years intervals groups could have been defined but with the cost of limited data access and a lower amount of observations. Furthermore, we look at the age span of people above 65 and try to determine the importance of social factors and the economy for those that have left the labor force. The suicide rates for each age group are studied by constructing a panel data set with a time interval of 17 years extending throughout 2001 and 2017. Due to the variables we employ, examining a more extended period was problematic since data for single person households, for example, did not exist for many countries before 2001.

To match the time interval and divided age groups, we will be looking at suicide rates among 11 countries in the European Union. We have chosen to study suicide rates on a cross-country level given the fact that suicide is a relatively scarce phenomenon, meaning that investigating smaller regions will give specific suicides a greater impact than reasonable. We use aggregate data which measures the effect of larger movements and differences between our measure of FSS, unemployment, unemployment expenditure and suicide. One problem faced when using aggregate

data is a higher difficulty to differentiate and isolate mechanisms at the individual level affecting attempted and committed suicides.

The thesis examines data from eleven countries; Austria, Czech Republic, Denmark, Estonia, Finland, Hungary, The Netherlands, Italy, Spain, Sweden, and Portugal. The countries were chosen to represent different areas of Europe: east, south, north and west. Preferably more countries would have been included. However, a lack of data for certain countries limited the choice of countries, and we decided to limit ourselves to countries within the European Union as some statistical measures were harmonized within the union, creating fewer comparability issues. Furthermore, after examining the World Health Organization's mapping of the reliability of different countries' suicide statistics (WHO, 2014, p. 19), we excluded countries with suicide statistics deemed unreliable such as Greece and Poland, which led to the final 11 countries included in our analysis.

## 5.4 Summary statistics

In this section, we explore the dataset through a set of tables and graphs to provide an overview of the variables used in our analysis. Panel descriptive statistics are first presented, including unemployment and suicide rates specific to each age group and gender. We also include descriptive statistics on the control variables and the variables included in our measure of FSS. We then present graphs of the suicide rates for the countries studied from 1994-2015 to provide an overview of trends and statistics. We lastly present our countries in order of their mean level of our measure for Family Support Systems.

The summary statistics begin on the next page.

## TABLE 2. GENDER AND AGE-SPECIFIC VARIABLES

| | Variable | Obs. (N) | Mean | Std. Dev. | Min. | Max. |
|---|---|---|---|---|---|---|
| ***Variables specific to each panel*** | | | | | | |
| ***Panel 1*** | Suicide rates, males | 176 | 12.74 | 7.50 | 2.57 | 34.97 |
| | *Suicide rates, females* | 177 | 3.56 | 2.38 | 0.47 | 13.25 |
| ***(Age 15-24)*** | Unemployment, males | 187 | 19.20 | 9.98 | 4.40 | 55.50 |
| | *Unemployment, females* | 187 | 19.36 | 10.45 | 4.50 | 54.60 |
| ***Panel 2*** | Suicide rates, males | 176 | 18.47 | 9.21 | 7.05 | 54.08 |
| | *Suicide rates, females* | 177 | 4.49 | 2.27 | 0.99 | 12.12 |
| ***(Age 25-34)*** | Unemployment, males | 187 | 8.02 | 4.27 | 1.70 | 26.60 |
| | *Unemployment, females* | 181 | 9.72 | 5.11 | 1.95 | 29.10 |
| ***Panel 3*** | Suicide rates, males | 176 | 24.27 | 12.59 | 8.95 | 71.36 |
| | *Suicide rates, females* | 177 | 6.36 | 2.88 | 2.17 | 17.68 |
| ***(Age 35-44)*** | Unemployment, males | 186 | 6.35 | 3.60 | 1.90 | 22.50 |
| | *Unemployment, females* | 183 | 7.37 | 3.92 | 2.35 | 24.10 |
| ***Panel 4*** | Suicide rates, males | 176 | 31.42 | 16.74 | 9.26 | 82.46 |
| | *Suicide rates, females* | 177 | 9.38 | 4.55 | 1.06 | 23.47 |
| ***(Age 45-54)*** | Unemployment, males | 187 | 6.24 | 3.78 | 1.70 | 22.90 |
| | *Unemployment, females* | 183 | 6.37 | 3.75 | 2.05 | 22.85 |
| ***Panel 5*** | Suicide rates, males | 176 | 30.36 | 15.31 | 12.66 | 87.02 |
| | *Suicide rates, females* | 177 | 9.19 | 3.62 | 2.12 | 17.52 |
| ***(Age 55-64)*** | Unemployment, males | 187 | 6.22 | 3.38 | 1.50 | 20.60 |
| | *Unemployment, females* | 169 | 6.34 | 3.62 | 1.00 | 20.80 |
| ***Panel 6*** | Suicide rates, males | 162 | 42.47 | 20.15 | 16.20 | 107.50 |
| | *Suicide rates, females* | 162 | 10.81 | 5.25 | 3.72 | 30.40 |
| ***(Age above 65)*** | Unemployment, males | 187 | 8.23 | 3.98 | 2.90 | 26.10 |
| | *Unemployment, females* | 187 | 8.23 | 3.98 | 2.90 | 26.10 |

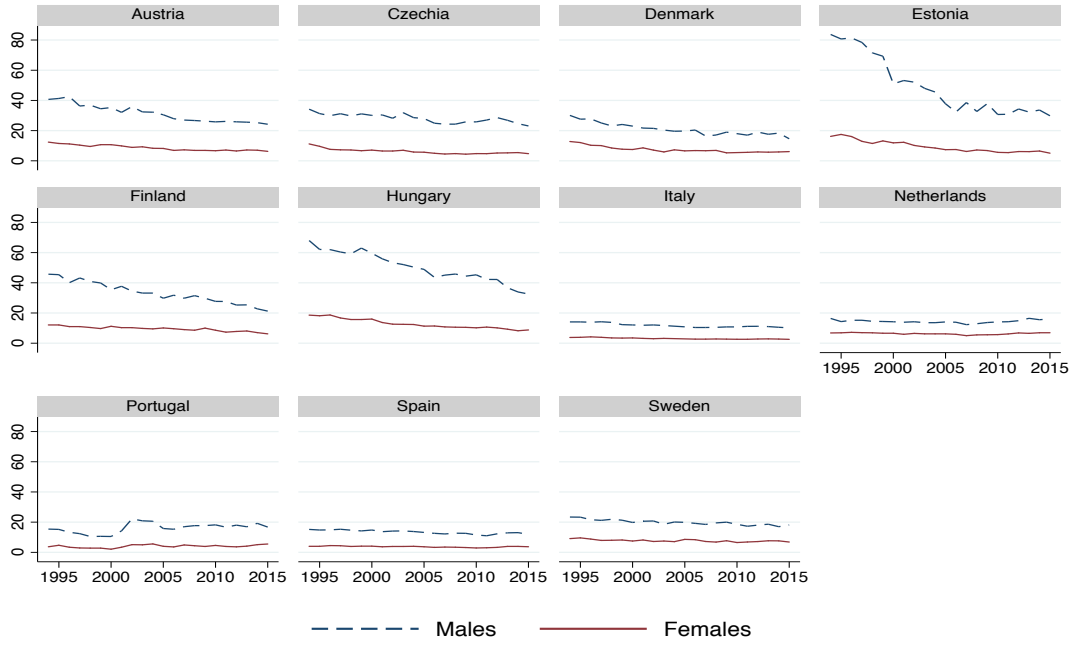
| ***FSS index*** | | | | | | |
|---|---|---|---|---|---|---|
| | Variable | Obs.(N) | Mean | Std.Dev. | Min. | Max. |
| ***All panels*** | Family Support Systems Index | 129 | 0 | 1 | -1.75 | 2.10 |

| ***Included in FSS index*** | | | | | | |
|---|---|---|---|---|---|---|
| ***All panels*** | Single | 153 | 14.63 | 4.77 | 5.90 | 23.50 |
| | Adults | 153 | 10.67 | 6.00 | 1.50 | 21.30 |
| | Leave home | 161 | 26.70 | 3.17 | 19.70 | 31.30 |
| | Gender gap | 186 | 12.04 | 6.71 | 1.90 | 31.50 |
| | Fertility rate | 187 | 1.56 | 0.43 | 1.15 | 1.98 |
| | Divorce rate | 176 | 50.04 | 13.45 | 15.20 | 79.30 |

| ***Control variables used in all panels*** | | | | | | |
|---|---|---|---|---|---|---|
| ***All panels*** | Unemployment expenditure | 176 | 10522.57 | 7451.75 | 260.91 | 39429.32 |
| | Health expenditure | 165 | 2044.24 | 521.41 | 800.00 | 3300.00 |
| | High educational attainment | 184 | 28.56 | 11.01 | 1.78 | 50.70 |
| | GDP | 187 | 25862.57 | 6957.71 | 8900.00 | 38400.00 |

A graph of the total, age-standardized suicide rates for the 11 countries is presented, together with a table distribution of our countries' mean level of FSS, from lowest to highest. We demonstrate here suicide rates from a different time span than the one employed in our analysis, to display the trends for a longer period. Note that the high suicide rates of Estonia and Hungary until circa 2005, distort the scale which makes the suicide rates of the remaining countries appear more similar than they in reality are. The suicide rates of Sweden are circa double those of Spain for example.

**FIGURE 1. AGE-STANDARDIZED SUICIDE RATES 1994-2015**




Note: Author's rendering based on data from Eurostat (Statistical office of the European Union).

We present a ranking of the countries studied according to their mean level of FSS to make a simple comparison with the suicide rates presented above. We also aim to provide a general display of what value of FSS each country is given using our measure.

**TABLE 3. COUNTRIES ARRANGED ACCORDING TO MEAN LEVEL OF FSS**

| Sweden | Denmark | Finland | Netherlands | Estonia | Austria | Czechia | Hungary | Portugal | Spain | Italy |
|---|---|---|---|---|---|---|---|---|---|---|
| -1.89 | -1.58 | -1.18 | -0.69 | -0.38 | 0 | 0.47 | 0.74 | 0.9 | 0.91 | 1.33 |

# 6 Results

In this section, the results of our analysis are presented and explained for the reader. The first section regards the possible relationship between our measure of FSS and suicide rates when implementing OLS multiple regression analysis. The second section concerns the results obtained when implementing panel data estimation and fixed effects to our data set in order to control for unobserved country fixed factors.

### *6.1.1 OLS regression*

We test our first hypothesis, that Family Support Systems exhibit a negative relationship with suicide rates for both males and females in all age groups, by using the entire variation in our data set. We perform an OLS regression to test whether there is a clear relationship from our measure of FSS with suicide rates. We construct models separated by gender, which then show the effect of FSS on all age groups employed in the analysis.

All variables used in the regression have been standardized to allow for easier comparison. Our main explanatory variable is our standardized index of Family Support Systems. Each regression includes the age- and gender-specific level of suicide and unemployment rate for each country studied. We control for age-specific unemployment, unemployment expenditure, health expenditure, higher educational attainment, and GDP per capita. Time fixed effects are included in the form of dummy variables controlling for factors that are time variant, not specific for each country and which might correlate with the effect of our measure of FSS. We adjust for clustered standard errors in order to control for the possibility that observations are related to each other at the country level due to country-specific factors.

As shown in Table 4, the estimate for our measure of Family Support Systems is significant at a 1% level for males aged 15-24 in column (1) and significant at 5% for remaining age groups except for those above the age of 65, for which no significance is established. This implies that the null hypothesis of no effect from FSS on the level of suicide rates in Europe can be rejected at some significance level for all age groups apart from pensioners, when implementing OLS regression. The results do not support our main hypothesis: that the level of FSS will have a *negative* relationship with suicide rates for both gender groups across all ages. All coefficients obtained in the regression have a positive correlation with suicide rates, implying that an increase of one standard deviation in the level of FSS would increase the level of suicide rates. We also regress the effect of our measure for FSS on suicide rates for females in all age groups. The results yield only statistical significance for the age group of 15-24 in column (1) at 10%, while no relationship could be established for the remaining age groups.

**TABLE 4. OLS REGRESSION, FSS ON SUICIDE RATES FOR MALES AND FEMALES IN ALL AGE GROUPS**

| | (1) (15-24) | | (2) (25-34) | | (3) (35-44) | | (4) (45-54) | | (5) (55-64) | | (6) (65+) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | Males | Females | Males | Females | Males | Females | Males | Females | Males | Females | Males | Females |
| FSS | 5.43*** | 1.24* | 5.04** | 0.51 | 6.55** | 0.86 | 10.23** | 1.46 | 8.99** | 0.81 | 0.89 | 1.15 |
| | (1.50) | (0.60) | (1.92) | (0.59) | (2.86) | (0.87) | (4.28) | (1.87) | (3.45) | (1.32) | (5.98) | (1.49) |
| Age specific | -1.86* | -0.06 | -2.88** | -0.82* | -1.17 | -0.38 | -0.90 | -0.67 | -1.41 | -0.68 | -4.25 | -0.67 |
| unemployment | (0.89) | (0.38) | (1.03) | (0.38) | (1.32) | (0.54) | (2.04) | (0.88) | (1.94) | (0.70) | (3.41) | (0.91) |
| Unemployment | 0.62 | -0.02 | 0.51 | -0.12 | -0.26 | -0.41 | -1.72 | -0.81 | -3.01 | -1.04 | -10.55** | -2.41** |
| expenditure | (1.51) | (0.34) | (1.40) | (0.23) | (1.97) | (0.47) | (2.97) | (0.93) | (2.95) | (0.76) | (4.21) | (1.02) |
| Health | 0.09 | 0.32 | 0.87 | 0.14 | 7.09** | 0.73 | 10.33* | 2.13 | 7.27 | 3.06* | 4.34 | 1.46 |
| expenditure | (2.65) | (1.10) | (2.66) | (0.86) | (2.48) | (0.95) | (4.70) | (1.79) | (4.29) | (1.50) | (4.87) | (1.44) |
| Higher | 2.58 | 1.10* | 3.54* | 1.28** | 2.25 | 0.91 | 1.97 | 1.20 | 0.73 | 1.47 | -0.83 | -0.13 |
| education | (1.44) | (0.60) | (1.73) | (0.55) | (2.25) | (0.54) | (3.28) | (1.12) | (3.59) | (0.96) | (4.65) | (1.48) |
| GDP | -5.77* | -0.59 | -7.99** | -0.41 | -15.63*** | -1.07 | -23.35** | -3.08 | -20.03*** | -3.56* | -15.23** | -3.85* |
| | (2.89) | (0.88) | (2.80) | (0.73) | (3.10) | (1.16) | (5.87) | (2.29) | (5.35) | (1.86) | (6.69) | (2.00) |
| YEAR FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| COUNTRY FE | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Constant | 18.93*** | 5.39*** | 17.29*** | 5.55*** | 20.44*** | 5.41*** | 26.72*** | 11.46*** | 31.23*** | 9.62*** | 41.69*** | 9.80*** |
| | (4.16) | (1.10) | (1.67) | (1.10) | (2.20) | (0.54) | (3.36) | (1.49) | (2.90) | (1.36) | (3.48) | (1.11) |
| Observations | 124 | 124 | 123 | 121 | 123 | 123 | 123 | 123 | 123 | 116 | 114 | 114 |
| R-squared | 0.63 | 0.58 | 0.66 | 0.58 | 0.63 | 0.42 | 0.62 | 0.36 | 0.65 | 0.45 | 0.71 | 0.60 |

The dependent variables are the gender and age-group specific suicide rates and the coefficients are estimated using OLS regression. The age intervals of the groups are found in parenthesis in each column title. Clustered standard errors for each coefficient are specified in parenthesis. ***,**,* denotes significance levels 1%, 5%, 10% respectively. A positive coefficient of FSS indicates that stronger family support systems lead to a higher rate of suicide.

We expect that factors specific to each country, which do not vary over time, bias our estimation and give us misleading results. This would result in heterogeneity bias meaning that our measure of FSS, at least when applying OLS regression, still correlates with the idiosyncratic error. Since we expect that our measure of FSS will have a negative relationship with suicide, we could argue that country fixed effects are biasing our estimate upward making FSS positive and misleading to draw conclusions on any possible relationship.

### *6.1.2 Panel data estimation, country fixed effects.*

Using the variation in our panel data set and applying fixed effects estimation could yield results that better mirror the effect our measure of FSS has on suicide rates. When applying fixed effects, we allow unobserved variables included in the idiosyncratic term to correlate with our measure of FSS. Fixed effects will partial out this effect of unobservable variables coming from each country but will not allow us to estimate the specific effect of these time-invariant and unobserved factors.

As in the previous section, we control for age-specific unemployment, unemployment expenditure, health expenditure, higher educational attainment, and GDP. Time fixed effects are also included in the regressions. We begin our analysis by presenting the results on the effect of our main explanatory variable FSS on suicide rates for males and females in each separate age group.

**TABLE 5. FIXED EFFECTS ESTIMATION, FSS ON SUICIDE RATES FOR MALES AND FEMALES IN ALL AGE GROUPS**

| | (1) (15-24) | | (2) (25-34) | | (3) (35-44) | | (4) (45-54) | | (5) (55-64) | | (6) (65+) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | Males | Females | Males | Females | Males | Females | Males | Females | Males | Females | Males | Females |
| FSS | -0.78 | -0.77 | -3.76 | -0.64 | -6.23** | 1.45 | -12.55*** | -3.81** | -4.14 | 0.51 | -5.60 | -0.62 |
| | (2.10) | (0.89) | (2.38) | (0.98) | (2.92) | (1.22) | (4.19) | (1.64) | (3.53) | (1.34) | (3.95) | (1.25) |
| Age specific unemployment | -0.43 | -0.02 | -0.26 | -0.19 | 0.11 | 0.92** | 1.58 | -0.25 | 2.07** | 0.36 | -0.29 | -0.26 |
| | (0.60) | (0.32) | (0.65) | (0.33) | (0.74) | (0.37) | (1.07) | (0.48) | (0.80) | (0.37) | (1.08) | (0.34) |
| Unemployment expenditure | -1.14 | 0.00 | 0.01 | -0.57 | -0.00 | -0.94* | -1.70 | -0.61 | -0.35 | 0.47 | -1.46 | 0.27 |
| | (0.96) | (0.41) | (1.07) | (0.45) | (1.29) | (0.55) | (1.90) | (0.74) | (1.61) | (0.63) | (1.78) | (0.56) |
| Health expenditure | -0.13 | 0.66 | -0.57 | -0.44 | -1.22 | -0.83 | -0.26 | -1.86** | -1.32 | 0.48 | -2.51 | -0.14 |
| | (1.09) | (0.47) | (1.22) | (0.51) | (1.47) | (0.63) | (2.17) | (0.86) | (1.84) | (0.72) | (2.10) | (0.67) |
| Higher education | 3.95** | 1.10 | 0.63 | 0.87 | 6.87*** | 1.55 | 10.25*** | 2.79** | 2.85 | 2.14* | 1.74 | 2.72** |
| | (1.82) | (0.78) | (2.02) | (0.83) | (2.48) | (1.03) | (3.64) | (1.40) | (3.11) | (1.17) | (3.75) | (1.19) |
| GDP | -3.85 | -1.20 | 0.02 | 0.60 | -6.36 | 3.46** | -6.52 | -1.79 | 2.81 | 1.15 | 4.09 | -2.82* |
| | (2.85) | (1.24) | (3.19) | (1.29) | (3.87) | (1.53) | (5.51) | (2.09) | (4.37) | (1.76) | (5.05) | (1.60) |
| YEAR FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| COUNTRY FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Constant | 9.15*** | 4.32*** | 16.45*** | 3.72*** | 18.30*** | 2.03*** | 24.87*** | 7.88*** | 24.49*** | 5.43*** | 37.11*** | 8.86*** |
| | (2.06) | (0.88) | (2.34) | (1.00) | (2.77) | (1.18) | (4.01) | (1.60) | (3.32) | (1.25) | (3.74) | (1.18) |
| Observations | 124 | 124 | 123 | 121 | 123 | 123 | 123 | 123 | 123 | 116 | 114 | 114 |
| R-squared | 0.31 | 0.25 | 0.23 | 0.14 | 0.49 | 0.24 | 0.47 | 0.36 | 0.32 | 0.15 | 0.33 | 0.37 |

The dependent variables are the gender and age-group specific suicide rates and the coefficients are estimated using fixed effects method. The age intervals of the groups are found in parenthesis in each column title. Clustered standard errors for each coefficient are specified in parenthesis. ***,**,* denotes significance levels 1%, 5%, 10% respectively. A positive coefficient of FSS indicates that stronger family support systems lead to a higher rate of suicide.

When studying our data set with country fixed effects, most coefficients on our measure for family support become negative – in line with our expectation that Family Support Systems exhibit a *negative* relationship for both genders in all age groups. However, the coefficients are not significant for all age groups, and actually positive for females aged 35-44 in column (3) and 55-64 in column (5).

Our main hypothesis, *Family Support Systems exhibit a negative relationship with suicide rates both for males and females in all age groups*, is not supported by the data in table 5. For certain age spans, however, a relationship could potentially be observed. For males we observe: the estimate for our primary variable of interest, FSS, is significant to 1% for males aged 45-54 in column (4). Ceteris paribus, an increase in one standard deviation of FSS would decrease male suicide rates in that age span by a number of 12.55 per 100 000 males. For males aged 35-44 in column (3) the same increase in FSS would decrease the suicide rates by 6.23 with a significance level of 5%. Continuing with females: we observe that our measure of FSS is statistically insignificant for all female age groups, except for females aged 45-54 in column (4), which is significant at 5%. The coefficient indicates a negative relationship, where a one standard deviation increase in FSS would decrease suicide rates by 3.81 per 100 000 females. To summarize, the data demonstrates no clear relationship between FSS and suicide rates, apart from males who are between 35 and 54 years old, and women aged 45-54.

Our first secondary hypothesis, *unemployment has a positive relationship with suicide rates when controlling for FSS for all working age groups*, appears to be false when analyzing the coefficients obtained for our control variable of age- and gender-specific unemployment rates. The level of unemployment is insignificant for both genders and all age groups except for males aged 55-64 in column (5) and females aged 35-44 in column (3), at a 5% significance level. These results imply that one standard deviation increase in the level of unemployment would increase suicide rates by 2.07 and 0.92 per 100 000 inhabitants for males aged 55-64, and females aged 35-44 respectively. The lack of significance is in line with the results of Andrés (2005), who concluded with his panel data analysis of 15 European countries, that suicide rates are not sensitive to unemployment.

Our last secondary hypothesis, *unemployment expenditure per capita unemployed has a negative relationship with suicide rates,* is not supported by the data. Although the coefficients on the variable show a negative relationship with the level of suicide, all of them are statistically insignificant for both genders across (almost) all age groups. It was only marginally significant (10%) for females aged 35-44.

Interesting to mention is the possible relationship between suicide rates and higher educational attainment that we observe for males aged 35-44 and 45-54. The results imply that one standard deviation increase in the level of education would increase suicide rates by 6.87 and 10.25 respectively, at a 5% significance level. We even observe a positive relationship between suicide rates and educational attainment for males aged 15-24. These results are in line with those of Cook (2019) which demonstrated a significant positive correlation between years of education and

suicide rates. The results are, however, contrary to what one might expect when examining statistics from Sweden, which demonstrated lower suicide rates for higher educated groups (Socialstyrelsen, 2014). Lastly we note that GDP per capita is significant only for females, aged 35-44 in column (3) and above 65 in column (6). Health expenditure also appears to lack a significant effect, as it is only significant for females aged 45-54 in column (4).

### *6.1.3 Summary of results*

When employing OLS regression, we find a *positive*, significant relationship between our measure of family support and suicide rates for males across all working-age groups. For females, the relationship only holds for women aged 15-24. These results are in direct contrast to the main hypothesis; *Family Support Systems exhibit a negative relationship with suicide rates both for males and females in all age groups*.

When employing fixed effects on our panel data set, data demonstrates a lack of an overall negative relationship between FSS and suicide rates, apart from three groups. We find a relationship for middle-aged males and females: males aged 35-54, and females aged 45-54.

We fail to find support for our first secondary hypothesis, that unemployment rates have a positive relationship with suicide rates: only males aged 55-64 and females aged 35-44 had significant positive coefficients. We do not find support for our last secondary hypothesis, that unemployment expenditure has a negative relationship with suicide rates.

# 7 Discussion

## 7.1 Discussion of results

We discuss the results obtained in our analysis and relate them to previous literature as well as our three hypotheses.

The goal of this research was to investigate and enhance the understanding of the impact of family support and ties on suicide rates. We argued, based on previous research, that our measure of FSS would exhibit a negative relationship with suicide rates, implying that greater family support could potentially reduce suicide rates at the country level. We also hypothesized that we would observe a positive relationship between unemployment and suicide rates when including our measure of FSS in the model. This would imply that high levels of unemployment could increase suicides rates, ceteris paribus. Furthermore, we expected to find a diminishing effect of unemployment expenditure on suicide rates meaning that an increase in unemployment benefits in one country would have a negative effect on the level of suicide rates, ceteris paribus.

It is important to take account of the fact that we perform a study based on aggregated data. This implies that our results cannot be analyzed as to the impact that our measure of FSS might exert on the individual, and how this affects one's likelihood of committing suicide. Instead, our study's goal is to investigate the possible effect of a more traditional family culture where the individual has easier access to family support and stronger family ties. We expected that a country's suicide rates would be lower if the people had access to greater family support systems, diminishing the effect of distress on suicide rates.

Our first hypothesis of a *general* negative relationship between suicides and FSS, for all age groups and all genders, is not supported by data. For males 35-54 and females 45-54, however, a relationship could potentially be observed. Our method and data set involve shortcomings which means the results should be interpreted cautiously. However, our data imply that our measure of FSS is particularly important for middle-aged individuals, who need close contact with family members. A close social atmosphere perhaps becomes more critical the older one gets. Family ties could be argued to be more important as one grows older: Decreased opportunities to establish new friendships later in life, and old friendships losing strength as family and children receive more attention (in one's own household and others). This might lead to countries with weaker family support to exhibit higher suicide rates. For young people, social interactions and ties to other individuals than the close family group might be more prevalent – from university acquaintances, friends from high school, from "beginning life" and finding new workplaces, new interests, and more. Thereby, they might be less dependent on family support. The lack of relationship between FSS and suicide rates for people above 65 is not in line with our expectation. This could be due to a methodological error, or because our measure of FSS does not capture factors relevant to this age group.

The protective effect of family support on the level of suicide rates for some age groups might indicate that suicide rates are caused by an interplay between social and economic variables. This

is also similar to the results demonstrated by Bussu, Detotto, and Sterzi (2013) who concluded that family was an essential factor in explaining suicide rates, whereas income per capita and economic growth did not appear to have any effects. At least for males in the age group of 45-54, we could argue that stronger family ties could decrease the likelihood of individuals committing suicide. Yang and Lester (1994), Andrés (2005) and Noh (2009) argued that fertility and divorce rates were relevant factors when studying suicide. Since we include these factors in our measure of FSS, we could argue that marriages and children exert a protective effect when individuals experience distress, decreasing, in turn, the number of suicides.

We found similar results to Andrés (2005) in terms of a small or insignificant effect of unemployment. Our data set could, on the other hand, fail to capture the real effect of unemployment on suicide rates since only 11 countries are studied under a period that could be considered too short to draw any conclusions. The absence of some other specific control variable could also imply the existence of bias in our control variable for unemployment making the results obtained misleading.

It appears more difficult to establish a relationship between our main variable FSS and female suicide rates than for males. The lack of a more significant effect on females could potentially be explained by the generally lower suicide rates of females, and thereby creating a smaller variation in our dataset, making it more difficult to infer any relationship between female suicide rates and FSS. Possibly, a lack of family support affects women differently than men. It could also be the case that women have stronger family support than men do, which our aggregated data cannot demonstrate.

Important to note is that our measure of FSS includes the variable *gender gap in employment rate*, where a greater difference between the percentage of men and women working was believed to constitute greater family support systems and more traditional family structures. For women, a higher gender gap in employment rates might not signify greater family support systems, but only that they are more restricted to the household, have less economic freedom and are more isolated. Yang (1992) showed that higher female labor force participation decreased suicide rates for women. Our way of employing gender gap in employment rates was seen from a male perspective, one could argue, as Ying and Chang (2009) found that higher female labor force participation rates increased suicide rates for males. Perhaps this explains the less significant results from FSS on females compared to males.

We reject our last secondary hypothesis since unemployment expenditure does not appear to mitigate suicide rates. These results are in line with the findings of Ross, Yakovlev, and Carson (2012) who found a small and insignificant effect of the level of unemployment expenditure on suicide. It could be the case that unemployment expenditure's effectiveness in preventing suicide is diminished by the amount of family support individuals have access to. More family support could imply less dependence on help from the state when the individual becomes unemployed making unemployment expenditure benefits less crucial for survival.

## 7.2 Limitations of method

There are limitations with our data set and method implemented that might lead to misleading results.

The limited amount of countries included and the relatively few years makes it difficult to isolate the specific mechanisms by which FSS might exert an effect on suicide rates. On the other hand, it could also lead to an increased risk of type 1 errors. This implies that we are more likely to find a relationship between our variables that does not exist. It also poses a problem considering that our variables have a high correlation between each other, leading to difficulties when trying to disentangle the effect of each variable on suicide. For example, a higher GDP per capita could be expected to correlate with a lower age of leaving one's parental household, or a higher percentage of the population living in single person households. This could in turn explain the low significance of the coefficients of our variable. A critique could also be that we have attempted to control for more variables than what is reasonable given the size of our dataset.

Important to bear in mind is the potential distortion of data between different European countries as suicide data is dependent on a multitude of factors and data might be biased depending on the social stigma of suicide. Suicide data has been criticized on the basis that socially integrated communities such as Catholic or Muslim groups may influence the recordings of suicides within their group to stay clear from social backlash (Douglas, 1967, cited by Maskill *et al.*, 2005). Therefore, suicide rates in Catholic and Muslim countries are expected to be lower leading to a problem of measurement error due to underreporting. According to Murphy (1992), if this underestimation is not correlated with our explanatory variable, the results obtained by using panel methods should be consistent, but this assumption might be difficult to justify in our data set. Collection methods used in different countries in Europe are still not fully standardized and difficulties to establish the cause of death of individuals might imply an underestimation of the actual number of suicides each year, worsening the problem further (Eurostat, 2018b).

Since we are only applying fixed effects to our panel data in order to isolate the effect that our measure of FSS has within countries, it is impossible for us to account for which factors actually play a role in each country when it comes to the prevalent levels of suicide rates. All these factors that are specific to each country which do not vary in the short-term (up to 10 years) are partialed out when implementing fixed effects. Even though it would be interesting to isolate the effect that these factors have on suicide rates, they still remain unobserved factors that are difficult to account for.

By using an index of FSS, we are not able to determine which variables are most important out of the variables included. We can only see the aggregated effect of our index, which creates difficulties in determining which factors are most relevant. For example it is not possible to infer whether the percentage of single person households or number of divorces affect our measure of FSS the most, it is only possible to examine the total effect of including the six variables employed.

We have not included several variables which earlier literature has included (see Yang, 1992; Neumayer, 2003; Noh, 2009) such as alcohol consumption, GDP growth or income growth, population density variables, migration or urbanization rates, amount of sunny days or different variables relating to climate. We do not possess a variable on mental health expenditure either, simply a general measure of health expenditure.

Noh (2009) also used CO2 emissions as a proxy for the amount of industrialization in a country, which was believed to be a proxy level for health and public level of happiness (Noh, 2009, p. 577). We believe that using CO2 emissions within a country as a measure for industrialization is a poor measure, however. Many emissions relating to the usage of resources within the country can take place *outside* of the country, and the amount of CO2-emissions also depends on factors such as a country's reliance on fossil fuels or not for heating and electricity, which are not direct measures of industrialization. According to his measure, a country with a greater reliance on coal or with more emission-producing industries could be falsely classified as a more industrialized country, than a country which uses more nuclear power and has more service production.

The omission of alcohol consumption and population density variables as well as migration and urbanization rates stemmed from a lack of data, as well as difficulties in using one measure for urbanization or population density, for an entire country. We believed this could provide erroneous results. The same applied to climate variables, as it was difficult creating one variable for climate or sunshine for entire countries. The omission of mental health expenditure stemmed from a lack of harmonized data amongst our countries. The level of overall health expenditure which we included would hopefully be a proxy variable for the resources available to mental healthcare as well.

# 8 Concluding remarks

Suicide represents a large cost to society, killing more people and costing more than road accidents within the European Union (Eurostat, 2009, 2018f, 2018a). Considering that suicide is partially preventable, the lack of clear knowledge regarding the underlying reasons is worrisome. From an economic perspective it is essential for society to continue evaluating which factors might increase or diminish the level of suicide rates, as one can intuitively imagine that suicide rates and its causes will change in the future as societies develop. In this study we aimed to explore whether family support exerts any protective effect on individuals, thereby reducing suicide rates. We did not find a clear relationship between family support and suicide rates in the European countries we studied. On the other hand, we observed a possible relationship between family support and suicide rates for men and women aged 35-54 and 45-54 respectively. Family ties could be argued to be more important as one grows older, due to decreased opportunities to establish new friendships and old friendships losing strength as family and children receive more attention (in one's own household and others). This could be important for public policy to take note of and perhaps enable better policy creation by taking account of this fact.

The lack of a stronger relationship between family support systems and suicide rates could be due to factors not taken into account in our study, or limitations caused by the size of our dataset which only allowed to find a significant relationship for some age groups. Our measure of family support could be argued to be misconstructed due to cultural differences between countries or because we lack variables which could have explained the level of family support better. We see a need for individual data studies as they could provide a better understanding regarding which factors are most important in determining suicide rates. As noted in the literature review, aggregate data methods do not seem able to find clear relationships between different variables and suicide rates. It might be more beneficial to find the individual reasons for why people commit suicide and investigate any possible trends from that data. Future research could enhance our measure of Family Support Systems and employ a larger dataset with more countries and over a longer period to explore the relationship once again. This could potentially provide more reliable results and a deeper understanding regarding the role family support plays in diminishing suicide rates on an aggregate level.

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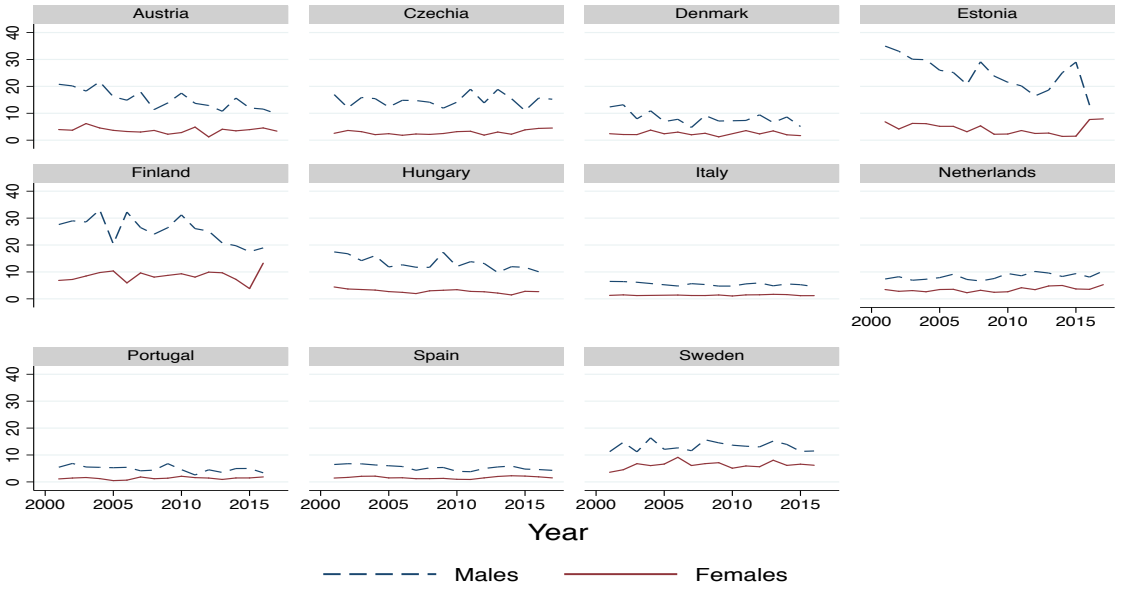
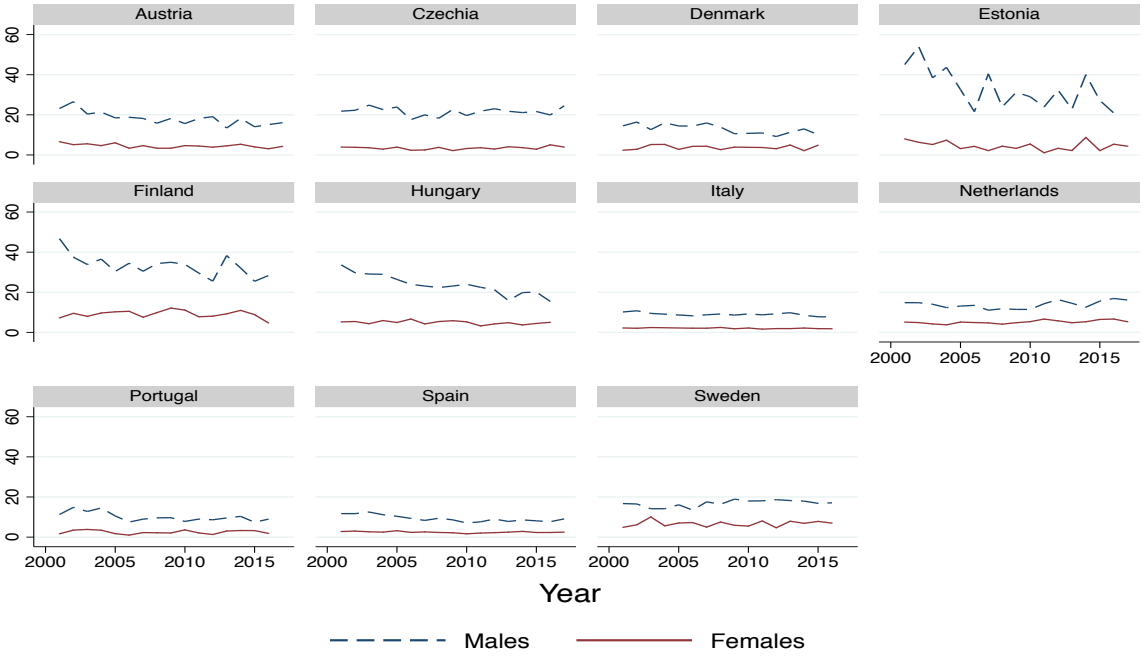
# Appendix

Figure A1. Suicide Rates Age 15-24



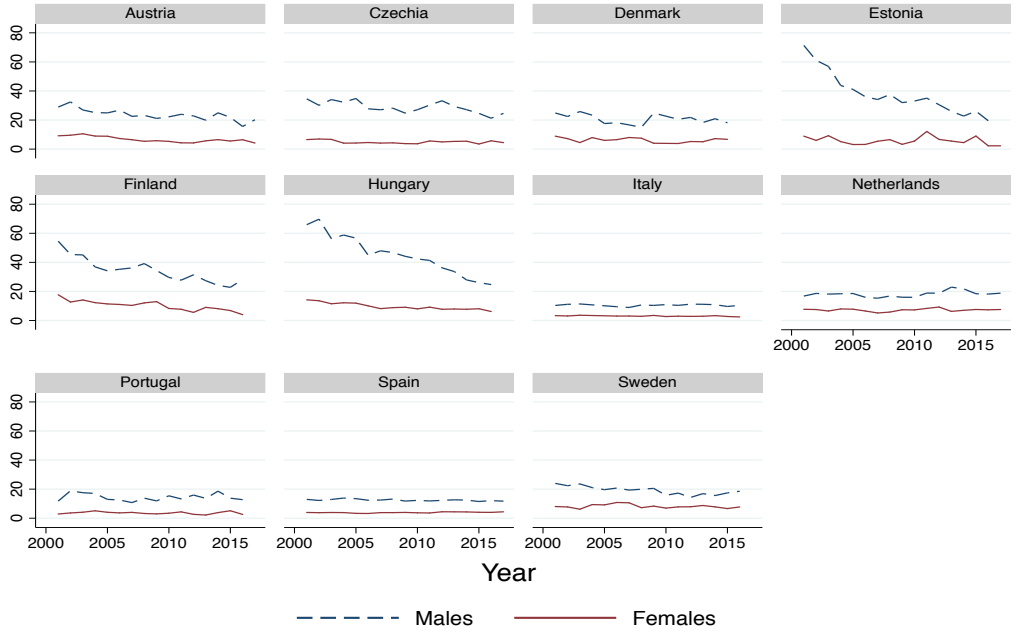

Note: Author's rendering based on data from Eurostat (Statistical office of the European Union).

Figure A2. Suicide Rates Age 25-34



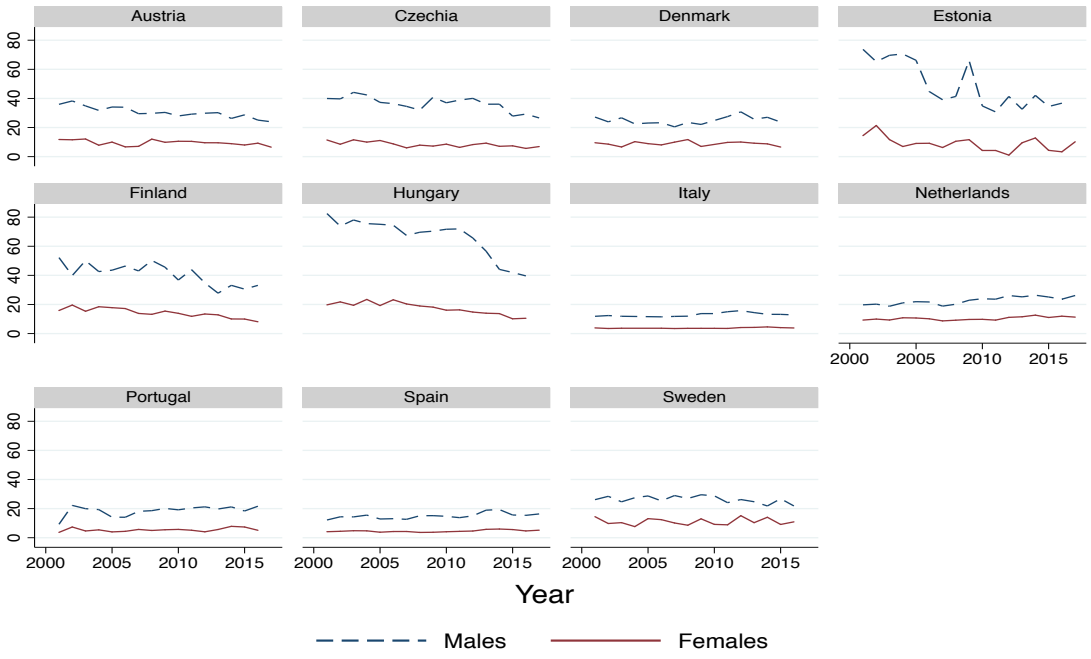

Note: Author's rendering based on data from Eurostat (Statistical office of the European Union).

## Figure A3. Suicide Rates Age 35-44



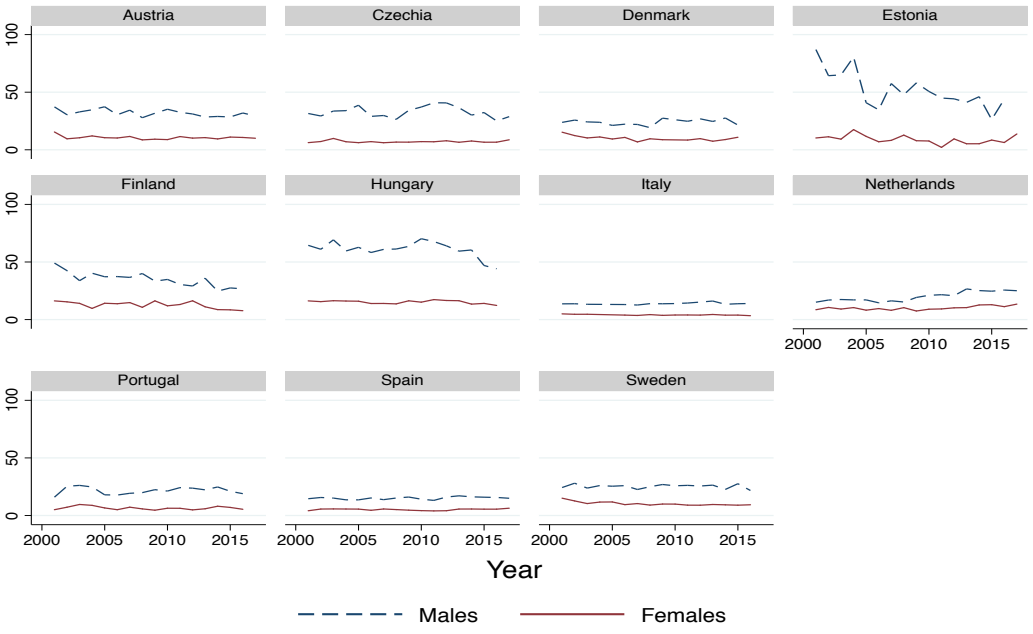

Note: Author's rendering based on data from Eurostat (Statistical office of the European Union).

## Figure A4. Suicide Rates Age 45-54



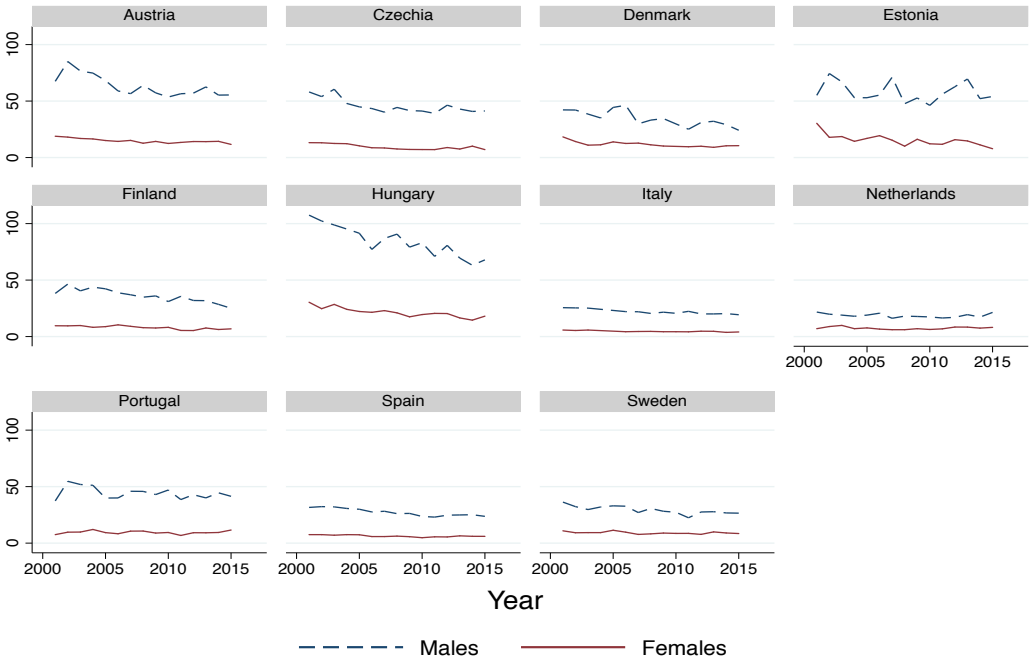

Note: Author's rendering based on data from Eurostat (Statistical office of the European Union).

## Figure A5. Suicide Rates Age 55-64



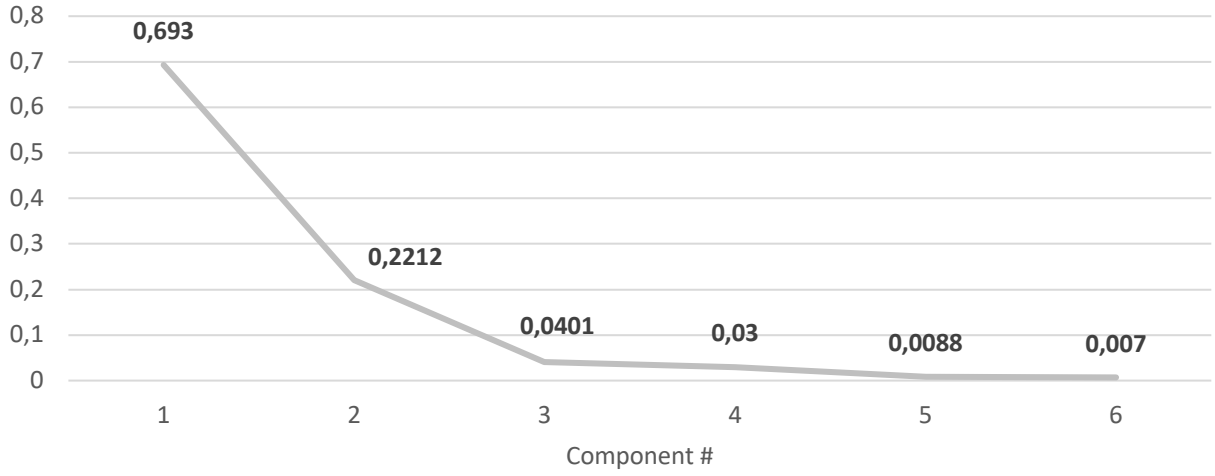

Note: Author's rendering based on data from Eurostat (Statistical office of the European Union).

## Figure A6. Suicide Rates Age 65 and above




Note: Author's rendering based on data from Eurostat (Statistical office of the European Union).

**Figure A7. Proportion of Variation captured by each component in PCA**




Note: Author's rendering based on data from Eurostat (Statistical office of the European Union).