CHARLES UNIVERSITY

FACULTY OF SOCIAL SCIENCES

Institute of Economic Studies

Bachelor thesis

2020 **Tereza Michálková**

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Determinants of Induced Abortion in Selected European Countries

Bachelor thesis

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Abstract

The thesis scrutinizes potential impacts of various socio-economic determinants on the legally induced abortions in Europe by examining a sample of 15 European countries for the 2007-2017 period. For the panel data regression, fixed effects estimation and random effects estimation, both with the Newey-West robust standard errors, are applied and compared with the Hausman test. The significant results generally correspond to the previous studies. Specifically, both crude divorce rate and female unemployment propose a positive impact on abortions and crude birth rate influences abortions negatively. The only exception opposing the previous studies is the female tertiary education that signals substantial negative impact on abortions in the context of European countries. In addition, the thesis introduces new economic variables to the topic of abortions (social benefits, GDP growth rate, GDP per capita and political stability index). Nonetheless, except for the positive effect of GDP per capita on abortions, the other economic variables did not appear to be significant in the preferred models.

Keywords

Abortion ratio, legally induced abortions, socio-economic determinants, fixed effects, random effects, European countries.

Abstrakt

Práce zkoumá potenciální vlivy různých socioekonomických determinantů na legálně indukované potraty v Evropě za použití údajů o 15 evropských zemích z let 2007-2017. Pro regresi panelových dat byly aplikovány modely fixních a náhodných efektů, oba s Newey-West robustními standardními chybami, a následně byly metody porovnány pomocí Hausmanova testu. Signifikantní výsledky v preferovaných modelech všeobecně korespondují s výsledky předchozích studií. Konkrétně výsledky ukázaly, že hrubá míra rozvodovosti i míra nezaměstnanosti žen mají pozitivní vliv na vývoj potratů, zatímco míra porodnosti ovlivňuje potraty negativně. Jedinou výjimkou, která nesouhlasí s výsledky předchozích studií, je procento žen s vysokoškolským vzděláním, které ukázalo značně negativní korelaci s potraty v kontextu evropských zemí. Nové ekonomické proměnné, které práce vnáší do tohoto tématu, jsou sociální podpora, míra růstu HDP, HDP na obyvatele a index politické stability. Ovšem, kromě mírného pozitivního efektu HDP na obyvatele na potraty, ostatní ekonomické indikátory neprojevily významnost v preferovaných modelech.

Klíčová slova

Index indukované potratovosti, legálně indukované potraty, socioekonomické determinanty, model fixních efektů, model náhodných efektů, evropské země.

Declaration of Authorship

I hereby proclaim that I wrote my bachelor thesis on my own under the leadership of my supervisor and that the references include all resources and literature I have used.

I grant a permission to reproduce and to distribute copies of this thesis document in whole or in part.

Prague, 5 May 2020

Signature

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Bachelor's Thesis Proposal

Institute of Economic Studies
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Author's name and surname: Tereza Michálková

Supervisor's name: doc. PhDr. Julie Chytilová Ph. D.

Proposed Topic:

Determinants of induced abortion in selected European countries

Preliminary scope of work:

Research question and motivation
The aim of the bachelor thesis is to examine the impact of various determinants of induced abortion.

Family economics has been studied by experts since 1960. From that time on it has gained in its importance. Gary S. Becker, one of the first economists that thoroughly explored this field, states in his paper *An Economic Analysis of The Family* (1986): "The economic approach contributes in an important way to understanding fertility by its attention to the "quality" of children. … The relative cost of a child depends on the amount spent on the child; that is, it depends on a determinant of the quality of the child.". This decision making about number and "quality" of children is an important issue influencing not only the child's future life and wealth of the family but also the whole economy by labour supply and employment, GDP per capita or policymaking (Blau & Robins 1988).

Closely related to the decision to have a child is the decision to abort, which is not that broadly covered. According to the Guttmacher Institute, there is an estimate of 56 million abortions between 2010 and 2014 globally. In Georgia, for instance, the number of registered induced abortions reached 24,9 thousand in 2017, while the number of births was 53 239 (National Statistics Office of Georgia 2019). This indicates that almost one third of pregnant women chose not to have a child. Nevertheless, after my thorough research, unlike fertility there are only a few research and studies concerned with abortions, that would broadly study determinants of induced abortion in European countries and compare them.

Therefore, in the theoretical part of the thesis, I would like to describe the current state of legislation regarding induced abortions across European countries and possible impacts of legalized abortion on the economy. For example, according to the study *Abortion and crime: Cross-country evidence from Europe*, abortion legalization seems to cause a significant drop in crime, on the other hand, in countries where abortions were restricted, legalization led to a reduction in births (Levine 2004) Then I will focus on the development of abortion rate in the Czech Republic and compare it with interesting statistics from other countries. Thereafter I will elaborate on various determinants that may influence abortion, for example, age, education and nationality of mother, wage, price of an abortion, religion, availability of contraceptives or addictions.

For the practical part of my thesis, I chose six countries representing different socioeconomic and demographic backgrounds and from different geographic regions of Europe. The countries are Finland representing Scandinavian states, Germany representing Western Europe, Czech Republic and Hungary representing former Eastern Bloc and nowadays Central Europe, Italy representing Southern Europe and Georgia representing Eastern Europe. In these countries, there is enough data to carry out complex research regarding the determinants of induced abortion over the past 15 years.

Contribution
Since there is no complete analysis of comparing selected European countries regarding induced abortion, my thesis should result in a contribution to this analysis and comparison of the selected countries in a careful and clear way. I would also like

to observe potential trends over the past 15 years and confirm (or disprove) expected coefficients of determinants proposed in the theoretical part.

Methodology
I will use datasets, that provide advanced information about abortion rates and abortion ratios in the above selected six countries. The aggregate data from component countries are available on Eurostat (European Statistical Office) and National Statistical Institutes. The same institutions supply furthermore statistics about the population, for instance, age, education, gross wage or GDP per capita. The demographic data collections contain both mandatory and voluntary data (annually collected), which ensure coherence and comparability of countries over time.

Based on collected data I will create a comprehensive econometric model describing the impact of various determinants on induced abortion. Consequently, I will compare the results with the theoretical part of the thesis and conclude the findings.

Outline
1. Introduction
2. Theoretical Background
3. Data and Methodology
4. Results
5. Conclusion

List of academic literature:

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Acronyms

CV Coefficient of Variation

FE Fixed Effects

GDP Gross Domestic Product

GLS Generalized Least Squares

ISCED International Standard Classification of Education

OLS Ordinary Least Squares

PCSE Panel Corrected Standard Errors

RE Random Effects

UNECE United Nations Economic Commission for Europe

US United States

VIF Variance Inflation Factor

Contents

1 Introduction

Since 1950, decisions about marriage, divorce or timing a birth have significantly gained on their importance. Gary S. Becker (1993) was the first one who described family choices as an attempt to maximize welfare by comparing advantages and disadvantages. Nonetheless, the economics of family varies across countries as their economies and laws differ as well. Accessibility of education, an opportunity for employment development, wage rate, social benefits or even access to abortion may influence family decision-making.

Although between 1995 and 2008 the number of induced abortions in Europe has been reduced by more than 43 % from 7.7 million to 4.2 million (Llorente-Marrón *et al.* 2016, pg. 2), abortion remains a controversial global topic. A substantial role in this change played the drop of abortion rates in former states of the Soviet Union while the numbers for Central Europe remained steady. Even though the European numbers of abortions are slowly dwindling and the use of contraceptive methods is rising, abortion ratios in Eastern Europe are considered to be the ones of the world's highest abortion ratios. (Llorente-Marrón *et al.* 2016, pg. 2) For instance, in 2017 in Georgia, almost a third of pregnant women chose to abort. (Eurostat 2019)

Despite the high numbers of abortions, after thorough research, only a few studies describe socio-economic determinants of legally induced abortion. Marshall H. Medoff (1988) explored this field by examining possible impacts on abortion demand. According to Medoff (1988), both higher female labour force participation and being single positively impact the number of abortions. His findings were confirmed and extended by Donna S. Rothstein (1992) who demonstrated a positive effect of both household budget constraint and crude divorce rate on the abortion demand and proposed a negative effect of abortion price. Furthermore, Rothstein (1992), as well as Blank *et al.* (1996), studied the influence of the unemployment rate, however, their outcomes conflict with one another. Gil Lacruz *et al.* (2011) scrutinizing Spanish regions described how abortion rate decreases with the rise in the childcare subsidies as well as with the growth of the male employment and how the rate increases with the higher female employment. Llorte-Marrón *et al.* (2016) focused more on welfare-state variables. Besides confirmation of the previous outcomes on the crude divorce rate, the study concludes that both higher public investment in health and higher national income have a negative relationship with the number of abortions. (Llorte-Marrón *et al.* 2016)

Although the empirical studies cover to a certain extent possible effects of various socio-economic indicators on the number of abortions, the analyses were conducted only for particular regions or for a specific time frame. For instance, the United States in 1985 (Rothstein 1992) or the 1974-1988 period (Blank *et al.* 1996), or Spain from 1999 to 2004 (Gil Lacruz *et al.* 2011). Only Llorte-Marrón *et al.* (2016) used 22 European countries as a sample, however, the study scrutinizes only the 2001-2009 period and is rather concentrating on welfare-state variables. To conclude, there exists no study that would broadly describe what have influenced induced abortions in European countries since 2010 from the socio-economic point of view.

Therefore, the thesis aims to examine relationships between various socio-economic determinants and induced abortions in selected European countries. To be more specific, an econometric panel-data analysis on 15 European countries for the 2007-2017 period is conducted using the fixed effects (FE) and the random effects (RE) models with the Newey-West robust standard errors.

The succeeding sections are constructed as follows. First, the abortion legalization in European countries is briefly delineated together with its possible impacts on the state's economy. Furthermore, in the literature review section, the topic of the economics of family as well as empirical studies scrutinizing the impacts of various socio-economic factors on induced abortions are described. Second, the data set is characterized by using summary statistics on the dependent variables and by conducting a simple statistical analysis to determine the final independent variables. Subsequently, the theory on the fixed effects and random effects estimations is introduced followed by the description of the tests performed to reveal potential issues including the Newey-West method for their treatment. After that, the testing for assumptions as well as the results of the regressions are presented followed by their discussion. The last section provides a conclusion that closes the thesis.

2 Literature Review

2.1 Legalization of Abortion

Since 1960 the access to legal abortions in Western Europe has been developing significantly. Between 1970 and 1990, the majority of European countries changed their abortion legislation. (Guillaume & Rossier 2018) The laws have been liberalised from abortion prohibition to allowing abortions on request during a certain number of weeks of pregnancy in most Western European countries (Levels *et al.* 2014, pg. 95). Results of a study conducted by Medoff (2002, pg. 490) show that abortion policy of a state depends on political forces and interest advocacy groups, for instance, with a greater percentage of female state legislators, the abortions laws are less strict. Another force may be the Catholic Church that according to Levels *et al.* (2014, pg. 100) is "*an active actor advocating strict abortion laws*".

In 2020 the only exceptions in Europe are Andorra, Malta and San Marino countries in which the abortion is banned under any circumstances. In Liechtenstein, Monaco, Northern Ireland and Poland, abortion is allowed only for health reasons when the embryo is a threat to the life of the pregnant women. Most of the other Western European countries permit early abortion for socio-economic reasons, but abortion policy may insist on performing abortions only in specialized facilities. (Levels *et al.* 2014)

2.1.1 Impacts of Abortion Legislation

Empirical studies conducted in the past demonstrate how abortion legislation may impact the state's economy and society. In countries where abortions are legal, the information on the number of abortions is regularly collected, reasonably exact and in most cases accessible, but in countries with prohibited abortions, the information on illegal abortions is unavailable or substantially misleading. (Basu 2003, pg. 23) Despite the state's abortion restriction, women's decision to abort is not affected by abortion constraints, in other words, she opts to abort illegally (Medoff 2002, pg. 491). Therefore, movements for women's rights argue that there is a need for legalization since the safe setting is crucial for female reproductive health. (Levels *et al.* 2014, pg. 103)

Another example of abortion legislation effect is the 1970 New York Abortion Reform. The legalization caused abortion rates to grow which led to an increase in a wage of low-income, African American and Hispanic workers as well as to a rise in the cost of crime. (Rotz 2012, pg. 21-22) Rotz hereby supported the study by Donohue & Levitt (2001) on the negative relationship between abortion and crime.

Compelling approach when determining the consequences of abortion legalization in all U.S. states in 1973 demonstrated Gruber *et al.* (1997). The research describes the possible impact of a marginal child who was not born because of abortion legalization. The marginal child is 70 % more likely to be born to a single woman, 50 % more likely to receive government support and 40 % more likely to live under minimum living standards. (Gruber *et al.* 1999)

2.2 Economics of Family

Gary Becker introduced a unique economic approach to the family as he does not analyze family with a focus on material aspects but he rather applies a choice-theoretic framework. (Becker 1998) In other words, he proposes an assumption that all family decisions made by women and men are based on an attempt to maximize their welfare by comparing benefits and costs. (Becker 1993, pg. 395) For example, one of his empirical studies describes how richer families tend to end marriages less than poorer families. (Becker *et al.* 1977)

Another field of economics of family that Becker dealt with was fertility by using economic models on behaviour. (Becker 1993, pg. 396) According to Becker (1998, pg. 135), wealthy families in the nineteenth century have had more children in comparison to modern families since the recently growing value of time and rising female wage rate increase the cost of children and consequently, the demand for large family declines. Becker's opinion is that diminishing demand for children resulted in the growing demand for birth control methods. Therefore, he believes that available birth control does not necessarily decrease fertility. (Becker 1998, pg. 143)

In the twentieth century, access to legal abortion has become an inseparable part of the economics of family planning. Together with growing birth control possibilities, the abortion legalization in the United States in 1973 caused a significant drop in birth rates. (Guldi 2008) Generally, the negative relationship between abortion legalization and birth rates is being described across studies, for instance by Sklar & Berkov (1973) or by Levine & Staiger (2004).

2.3 Socio-economic Determinants

In 1988 Marshall H. Medoff has explored the demand for abortions. It was revealed that abortions are "*a normal good with an income elasticity of demand equal to 0.79*". According to Medoff (1988), higher demand for abortions is determined by higher female labour force participation and by being single, while religion or women's education does not impact the demand.

The socio-economic factors of the demand for abortion have been studied as well by Donna S. Rothstein in 50 American states in 1992. Besides confirming Medoff's claim about the positive effect of being single, the study demonstrates the substantial positive impact of the household budget constraint on the abortion demand and negative effect of the abortion price significant at 10 % level. Furthermore, according to Rothstein (1992), if a divorce rate increases, the abortion rate will rise as well, whereas, when there is a rise in the unemployment rate, the demand for abortion declines. Distinct outcomes introduced Rebecca M. Blank *et al.* in 1996 in a study examining the effect of policies, demographics and economy on the state abortion rates. The most significant result of the two-stage least squares regression declares that the unemployment rate is positively correlated with the abortion rate (Blank *et al.* 1996), which is in the contradiction with the Rothstein's findings.

The empirical study from 2011 by Gil-Lacruz *et al.* resulted in evidence that *"socio-economic conditions, lifestyles, and regional characteristics determine regional abortion rates"*, using data on Spanish regions between 1999 and 2005 and the ordinary least squares (OLS) method. According to this study, the abortion rate declines with growing male employment rates and rises when the female employment rate increases. In Spanish regions in which the childcare subsidies are more distributed, the abortion rate tends to be lower. Other characteristics that might influence the decision to abort are nationality, age or marital status. (Gil-Lacruz *et al.* 2011) In terms of age, abortion ratios generally show two patterns: a U-shape curve and monotonic increase with rising age. (Bankole *et al.* 1999)

Panel data analysis by Llorente-Marrón *et al.* from 2016 has focused more on welfare-state variables (public investment in health and income measured by GDP) and added socio-demographic variables crude divorce rate and adolescent fertility rate. The panel corrected standard errors (PCSE) method showed that both higher public investment in health and higher national income decrease the abortion rate as well as higher adolescent fertility rate. Regarding the crude divorce rate, the study states that in the case of unwanted pregnancy, most induced abortions occur to unmarried women. (Llorente-Marrón *et al.* 2016) The reason for abortion that the woman does not want to be a single mother was also in 48 % of cases affirmed in the paper by Finer *et al.* (2005) together with finding that 73 % of the women do not have sufficient resources to raise a child. A. M. Basu (2003, pg. 15) ascribes this to the impossibility to work with another child, reluctance to interrupt education or unstable relationship.

3 Data Description

In the chapter, various sources that were used to form the final data set are presented and the process of the countries selection is interpreted. Then, the dependent variables are described followed by their summary statistics. The chapter ends with the analysis that led to the selection of the final independent variables, concluded by the definitions of the final regressors.

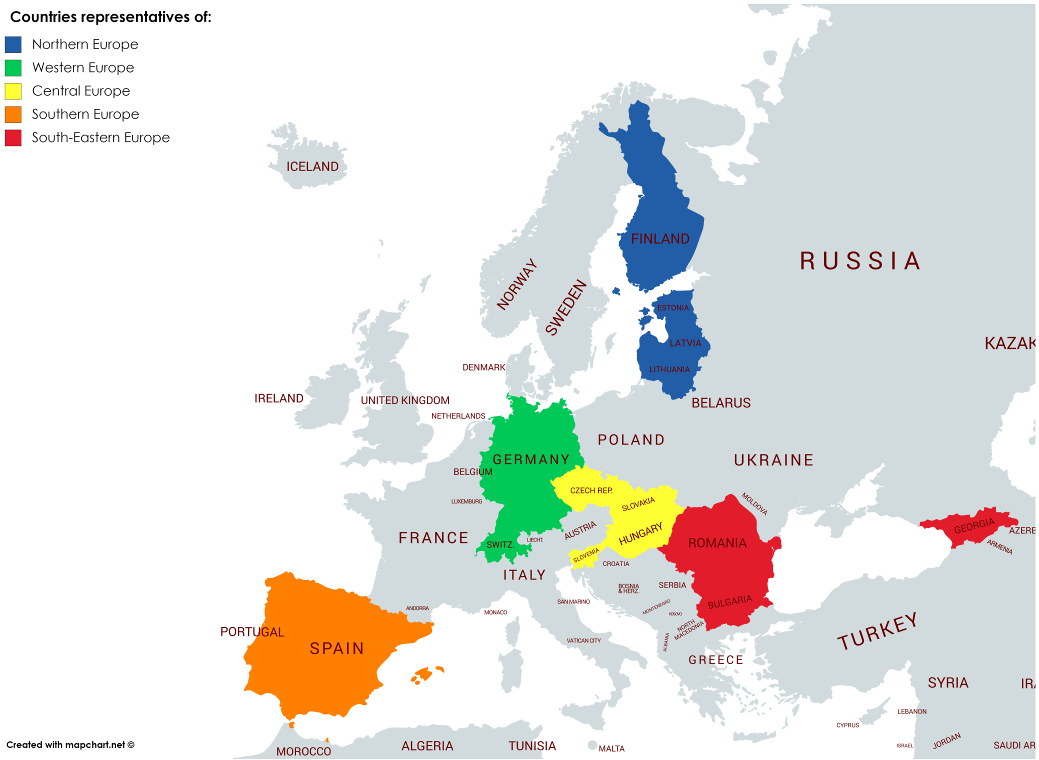
The final data set consists of information on various socio-economic indicators between 2007 and 2017 in 15 countries (see Table 3.1). Majority of aggregate data was provided by Eurostat, the two other main sources were the United Nations Economic Commission for Europe (UNECE) and Word Bank.

Table 3.1: List of Countries

Bulgaria	Finland	Hungary	Portugal	Slovenia
Czechia	Georgia	Latvia	Romania	Spain
Estonia	Germany	Lithuania	Slovakia	Switzerland

The initial intention, as written in the Thesis Proposal, was to use data for six diverse countries that would represent various socioeconomic and demographic backgrounds and different geographic regions of Europe to assure satisfactory variation in variables. Nevertheless, since the sample was too small, the outcomes would be problematic to interpret. Therefore, all the countries for which data was available and complete were included in the final data set. However, not deliberately, the primal intent was accomplished as the countries in the final data set are nearly evenly distributed for each geographical part of Europe as can be seen in Figure 3.1. Eventually, Finland, Estonia, Latvia and Lithuania represent countries of Northern Europe, both Germany and Switzerland are served as representatives of Western European countries, Portugal and Spain represent Southern Europe and Czechia, Slovakia, Hungary and Slovenia illustrate countries of Central Europe. Romania and Bulgaria are representatives of South-Eastern European countries together with Georgia that is located at the boundary of Eastern Europe and Western Asia.

Figure 3.1: Map of Selected Countries



3.1 Dependent Variables

The chosen dependent variables are abortion ratio and the total number of legal abortions both obtained from Eurostat (2019) and Johnston's Archive (2020). Eurostat defined the indicators as follows:

- **Total Number of Legally Induced Abortions**. Legally induced abortion is *"an induced expulsion of the foetus during the first part of a pregnancy, permitted by law for health or other reasons"*. (Eurostat 2019) For better interpretation, the variable is used in its logarithmic form.

- **Abortion Ratio** is *"the number of abortions per 1 000 live births in a given year"*. (Eurostat 2019)

Although both dependent variables are based on the same measure, the number of induced abortions, both are included in the thesis as their interpretation differs. To give an example, in Czechia in 2017, there were 19 415 legally induced abortions and the abortion ratio was equal to 167.7. Since the abortion ratio is computed as the number of abortions per 1 000 live births in a given year (Eurostat 2019), the ratio indicates that in 2017 there were nearly 170 Czech women who decided to abort per 1 000 Czech women who gave birth. Consequently, when omitting the infant mortality rate (2.7 in 2017), generalized interpretation may be presented as *in 2017 almost one in seven Czech pregnant women chose to abort*.

By contrast, the total number of legal abortions in its logarithmic form is included to generally assess the volume of abortions. Subsequently, it can be easily compared with other socioeconomic and demographic indicators, for example, with the total female population in reproductive age (15-49). To give another illustration of Czechia in 2017, when comparing it with Georgia, there were 19 415 legally induced abortions per 2.39 million Czech women of reproductive age while in Georgia, there were 24 937 legally induced abortions per 859 000 Georgian women of reproductive age. (Eurostat 2019) Consequently, the interpretation may be useful for further research, for instance, for an evaluation of the level of access to healthcare services or the level of contraceptive methods in the country.

Nonetheless, from this discussion follows the intuitive conclusion that although the dependent variables are interpreted differently, in the end, results on one predicted variable are likely to confirm the outcomes on the other predictive variable and vice versa. In other words, the relationships with individual regressors and their significance are expected to be similar for both measured variables.

3.1.1 Summary Statistics

The summary statistics on both dependent variables described in this section is derived from Table 3.2 and Table 3.3. For each country, there are values for 2007 and 2017 given as well as for minimum, mean, maximum and standard deviation.

In all countries, there is an overall trend of slowly dwindling abortion ratios with sample mean equal to 283.9 and median 220.8 as can be seen in Table 3.2. For abortion ratio plots of individual countries, see Figure A.1 in the Appendix.

Table 3.2: Summary Statistics on Abortion Ratio by Country

Country		**2007**	**2017**	**Min**	**Mean**	**Max**	**SD**
Northern Europe	Estonia	704.9	290.0	290.0	461.9	704.9	140.2
	Finland	180.1	184.5	168.4	174.8	184.5	5.0
	Latvia	511.5	188.1	188.1	321.8	511.5	107.2
	Lithuania	296.7	149.6	147.0	194.7	296.7	47.3
Western Europe	Germany	170.6	128.9	124.6	151.7	170.6	16.9
	Switzerland	141.4	112.9	112.9	126.4	141.6	10.4
Central Europe	Czechia	221.7	169.7	169.7	203.4	221.7	17.8
	Hungary	621.1	301.1	301.1	408.8	621.1	88.7
	Slovakia	246.7	156.7	156.7	199.7	246.7	27.1
	Slovenia	261.2	174.3	174.3	199.5	261.2	25.3
Southern Europe	Portugal	70.4	179.8	70.4	186.7	220.8	41.0
	Spain	227.7	240.6	222.5	234.9	256.1	12.2
South-Eastern Europe	Bulgaria	498.9	379.8	379.8	432.1	498.9	32.5
	Georgia	418.9	467.9	383.6	508.2	687.8	104.6
	Romania	639.1	278.2	278.2	453.9	639.1	110.0
Overall Summary				**70.4**	**283.9**	**704.9**	**143.6**

The lowest abortion ratio from the data set is 70.4 in Portugal in 2007, although one year later the Portuguese ratio was 177.9. The most probable explanation is that in 2007, Portugal was one of the last European countries where the abortion on demand was illegal, primarily because of the strict Roman Catholic church. However, in April 2007, there was a national referendum that ratified law about legal abortions that consequently caused a rise in the abortion ratios in the next years. (Manuel & Tollefsen 2008) In general, Switzerland has constantly the lowest ratios of abortion in Europe. Between 2007 and 2017, Swiss ratio has been slowly decreasing from 141.4 to 112.9. (Johnston's Archive 2020) Together with Germany, Switzerland is a representative of Western Europe that evinces the lowest ratios in the data set.

The country with the highest ratio is Estonia that amounted to 704.9 in 2007. However, the Estonian ratio has been decreasing since then and fell to 290.0 in 2017. (Johnston's Archive 2020) Altogether, South-Eastern European countries present the ones of the highest mean ratios in the sample. The leading representative of the region is Georgia whose mean ratio is equal to 508.25.

Table 3.3: Summary Statistics on Number of Legal Abortions by Country

(For comparison, the mean of the female population of reproductive age (15-49) between 2007 and 2017 in thousands is included.)

Country		**2007**	**2017**	**Min**	**Mean**	**Max**	**SD**	**FPop** (thous.)
Northern Europe	Estonia	8 883	3 997	3 997	6 265	8 883	1 601	307.9
	Finland	10 533	9 332	9 332	10 022	10 533	463	1 162.5
	Latvia	11 814	3 917	3 917	6 892	11 814	2 556	489.5
	Lithuania	9 596	4 294	4 294	6 363	9 596	1 832	730.9
Western Europe	Germany	116 871	101 209	98 721	106 350	116 871	6 409	18 164.1
	Switzerland	10 035	9 863	9 863	10 226	10 694	281	1 897.7
Central Europe	Czechia	25 414	19 415	19 415	22 884	25 760	2 138	2 472.6
	Hungary	43 870	28 496	28 496	36 710	44 089	5 675	2 344.3
	Slovakia	13 424	9 082	9 082	11 442	13 424	1 581	1 366.8
	Slovenia	5 176	3 529	3 529	4 226	5 176	522	470
Southern Europe	Portugal	4 325	15 492	4 325	16 882	20 480	4 505	2 476.1
	Spain	112 138	94 123	93 131	106 195	118 359	9 928	11 198
South-Eastern Europe	Bulgaria	37 594	24 287	24 287	30 664	37 594	4 119	1 654.8
	Georgia	20 644	24 937	20 644	29 314	39 225	6 304	985.4
	Romania	137 226	56 238	56 238	93 643	137 226	26 229	4 778.6
Overall Summary				**3 529**	**33 205**	**137 226**	**36 739**	

Regarding the development of the total numbers of abortions in individual countries, Northern European countries experienced an overall significant decline except for Finland whose development proved to be stable. Similar progress is observable by all Central European countries as well as in Western Europe (see Table 3.3). The largest number of legally induced abortions in the sample had Romania in 2007. However, as can be seen from the standard deviation, Romania experienced one of the largest drops in the numbers between 2007 and 2017. Despite this fact, South-Eastern European countries generally keep having the highest "number of abortions - female population" ratios in the sample.

3.2 Independent Variables

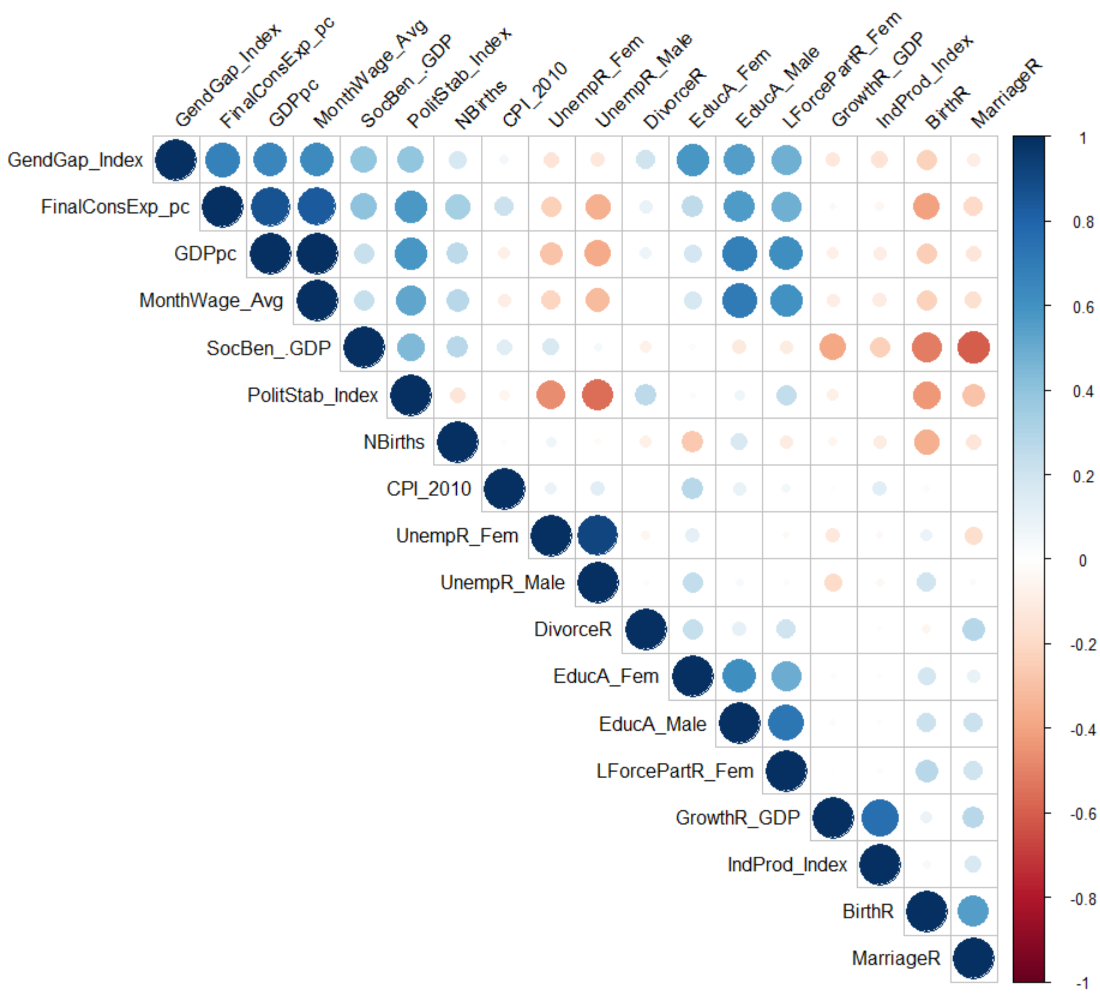
The process of collecting relevant independent variables followed the studies described in chapter 2.3 as well as the supervisor's advice. Nevertheless, data on some variables that were proved to be significant in the past were not available, for example, percentage of single-mother households (Medoff 1988), abortion prices (Rothstein 1992) or criminality rate (Donohue & Levitt 2001). Eventually, the final data set consists of 18 possible explanatory variables, see Table A.1 in Appendix for the full list. To determine which variables should be included in the final model, a simple statistical analysis was conducted.

At first, a correlation matrix was constructed to determine correlations between individual explanatory variables. The correlation coefficient measures linear association between two variables and always ranges from -1 to 1. The correlation coefficient of variable X_1 and variable X_2 is computed as follows:

$$Corr(X_1, X_2) = \frac{Cov(X_1, X_2)}{\sqrt{Var(X_1)Var(X_2)}}.$$

A problem in a regression model occurs when two independent variables are strongly correlated as difficulties with model interpretation arise due to multicollinearity. Therefore, to avoid multicollinearity in the final model, the pairs of variables of which the absolute value of correlation was higher than 0.7 were sought. Consequently, only one variable from each pair was added to the model. For instance, the correlation of *GDP per capita* and *average monthly wage* amounted to 0.99. Since there is another indicator *real GDP growth rate* that relates to the GDP and can be included in the model, the *GDP per capita* indicator was kept. For further correlation illustrations, see Figure 3.2.

Figure 3.2: Correlogram of Independent Variables



Second, the coefficient of variation (CV) was computed to characterize the variability of individual random variables. The advantage is that the coefficient can compare distributions of values when their units of measure are incomparable. In a single variable setting, the CV formula is written as follows:

$$Coefficient\,of\,Variation = \frac{Standard\,Deviation}{Mean}.$$

Values of the coefficient range from null to infinity and the higher the CV, the greater the variability. (UCLA 2020) If the variation in an independent variable is small, the slope coefficient of the estimated regression will be estimated imprecisely. Therefore, the aim was to determine variables with a nearly null coefficient (< 0.1). (See Table A.2 in Appendix)

As a result of the selection procedure, the following variables that initially seemed to be suitable were not included: female labour force participation (Medoff 1988), average monthly wage (Llorente-Marrón *et al.* 2016), global gender gap index, human development index.

The final model is comprised of the following independent variables:

- **Total Number of Live Births** is *"the number of births of children that showed any sign of life"*. (Eurostat 2020) The indicator is included only in the model with the *total number of legal abortions* as a dependent variable. For better interpretation, the variable is used in its logarithmic form.

- **Crude Birth Rate** is *"the ratio of the number of live births in a year to the average population in that year"*. The value is expressed per 1 000 persons. (Eurostat 2020) The variable is included only in the model with the *abortion ratio* as a dependent variable for better compatibility. The impact of birth rates on abortions has been examined across studies, for instance, by Sklar & Berkov (1973) or Levine & Staiger (2004), both demonstrating a negative relationship between abortion and birth rates.

- **Female Tertiary Education Attainment**. Education attainment is *"the highest International Standard Classification of Education (ISCED) level completed"*, being validated by a recognised qualification. Tertiary education attainment includes *"ISCED 2011 levels 5, 6, 7 and*

8 (short-cycle tertiary education, bachelor's or equivalent level, master's or equivalent level, doctoral or equivalent level), data up to 2013 refer to ISCED 1997 levels 5 and 6". (Eurostat 2020) The indicator is measured in percentage.

- **Female Unemployment Rate** is expressed in percentage terms as the female labour force that is unemployed. (Eurostat 2020) The variable was included based on the conflicting studies by Rothstein (1992) and by Blank *et al.* (1996). Rothstein proposes a negative impact of the unemployment rate on the abortion rate, whereas, Blank *et al.* suggest a positive effect.

- **Gross Domestic Product (GDP) per capita** at current market prices is *"the final result of the production activity of resident producer units"*, expressed in euro per capita. (UNECE 2019) Inclusion of the variable is inspired by Llorente-Marrón *et al.* (2016) stating that higher national income lowers the abortion rate.

- **Real GDP Growth Rate** is measured in chain-linked volumes and expressed as a percentage change in the previous period. To compute GDP growth rate, *"GDP at current prices are valued at the prices of the previous year and the thus computed volume changes are imposed on the level of a reference year"*. Consequently, price movements will not inflate the growth rate. (Eurostat 2020)

- **Social Benefits** paid by the general government are the transfers to households designed to help them from the financial burden of several risks or needs, expressed as a percentage of GDP. (Eurostat 2020) Inspiration to include the variable is taken from the Spanish study by Gil-Lacruz *et al.* (2011) demonstrating that the higher childcare subsidies distribution, the lower abortion rate.

- **Political Stability Index** is measured as *"the likelihood of political instability and/or politically-motivated violence, including terrorism"*.

Estimate gives the country's score on the aggregate indicator ranging from approximately -2.5 to 2.5. (World Bank 2019)

- **Crude Divorce Rate** is *"the ratio of the number of divorces during the year to the average population in that year"*, expressed per 1 000 persons. (Eurostat 2020) The effect of the crude divorce rate was already scrutinized in the studies by Rothstein (1992) and Llorente-Marrón *et al.* (2016) both concluding that there is a positive relationship between divorce rate and demand for abortions.

- **Crude Marriage Rate** is *"the ratio of the number of marriages during the year to the average population in that year"*, expressed per 1 000 persons. (Eurostat 2020) The inspiration to add crude marriage rate comes from a paper by Gil-Lacruz *et al.* (2011) describing a possible influence of marital status on the decision to abort.

4 Methodology

In this part, the theory behind the econometric models will be delineated as well as tests performed to determine whether the assumptions are fulfilled followed by the possible treatment of their non-fulfilment.

The data set in the thesis can be described as the panel (longitudinal) data set since it is collected as a time series for each cross-sectional member, in this case, for each geographical unit. In other words, panel data are multi-dimensional. (Wooldridge 2013, pg. 10)

The two approaches used in the thesis for the panel data regression are the methods including the unobserved effect a_i that is an "*unobserved variable in the error term that does not change over time*". (Wooldridge 2013, pg. 860) The main difference between the fixed effects (FE) estimation and the random effects (RE) estimation is the way how is the unobserved component a_i treated. In the RE approach, a_i is considered to be a random variable whereas, in the FE model, it is treated as a parameter to be estimated for each country i. (Wooldridge 2011, pg. 285-286) As a consequence, the fixed effects estimator allows the correlation between the time-constant unobserved effect a_i and independent variables (Wooldridge 2013, pg. 485) while RE method assumes that the correlation is zero. Although the correlation for our data set is rather expected, both methods will be described and examined.

4.1 Fixed Effects Estimation

In the fixed effects transformation, the unobserved effect a_i and the time-constant independent variables are removed before the estimation. The initial equation for both dependent variables can be written as follows (Wooldridge 2013, pg. 484):

$$\begin{gathered} y_{it} = \beta X_{it} + a_i + u_{it}, \\ i \in \{1, ..., 15\},\ t \in \{1, ..., 11\}, \end{gathered} \tag{1}$$

where y_{it} as dependent variable represents either *abortion ratio* or the *total* *number of legal abortions*, X is the vector of all regressors for each country i over time t (see part 3.2), a_i is the fixed effect, and u_{it} is the idiosyncratic error.

The time-demeaned data is consequently created by subtracting the following equation (2) from equation (1):

$$\bar{y}_i = \beta \bar{X}_i + a_i + \bar{u}_i \tag{2}$$

where

$$\bar{y}_i = \frac{\sum_{t=1}^{11} y_{it}}{11}\ ,\ \ \bar{X}_i = \frac{\sum_{t=1}^{11} X_{it}}{11}\ ,\ \ \bar{u}_i = \frac{\sum_{t=1}^{11} u_{it}}{11}\ ,$$

meaning that equation (2) is an average of the equation (1) for each country i over time. Since the fixed effect a_i is time-invariant ($\bar{a}_i = a_i$), after the time demeaning, a_i disappears:

$$\tilde{y}_{it} = \beta \tilde{X}_{it} + \tilde{u}_{it} \tag{3}$$

where $\tilde{y}_{it} = y_{it} - \bar{y}_i$, similarly $\tilde{X}_{it} = X_{it} - \bar{X}_i$ and $\tilde{u}_{it} = u_{it} - \bar{u}_i$. As the equation (3) is disposed of the unobserved component a_i, the pooled OLS can be used for its estimation. (Wooldridge 2013, pg. 485)

The main assumption of the fixed effects approach is the strict exogeneity of the independent variables $E(u_{it}|X_i, a_i) = 0$ for $t = 1, ..., 11$. Together with the existence of the unobserved effect a_i in the initial equation (1), random sampling and no perfect linear relationships among the regressors, the assumptions ensure that the FE estimator is unbiased. Other assumptions are the homoskedasticity of the errors u_{it} for $t = 1, ..., 11$, $Var(u_{it}|X_i, a_i) = \sigma_\mu^2$, and no serial correlation of the errors in all periods. From the previous assumptions follows the last assumption that the idiosyncratic errors u_{it} are i.i.d. extended by the assumption of their normal distribution. (Wooldridge 2013, pg. 509)

4.2 Random Effects Estimation

In contrast to the FE estimation, the most important assumption of the random effects estimation is that there is no correlation between the unobserved variable a_i and independent variables across time. When this assumption holds, the random effects model has the following form:

$$\begin{gathered} y_{it} = \alpha + \beta X_{it} + a_i + u_{it}, \\ i \in \{1, ..., 15\},\ t \in \{1, ..., 11\}. \end{gathered} \tag{4}$$

As the intercept α is added, it can be assumed that the unobserved component a_i has zero mean. (Wooldridge 2013, pg. 492) Other components of the equation have the same description as in equation (1).

To estimate β, the composite error term is formed, written as $v_{it} = a_i + u_{it}$, that is considered to be positively serially correlated in all periods,

$$Corr(v_{it}, v_{is}) = \frac{Var(a_i)}{Var(a_i) + Var(u_{it})},\ \ t \neq s.$$

To eliminate the correlation, generalized least squares (GLS) method is applied as pooled OLS would not be efficient. The final equation results from subtracting a fraction of time averages:

$$y_{it} - \theta \bar{y}_i = \alpha(1 - \theta) + \beta(X_{it} - \theta \bar{X}_i) + (v_{it} - \theta \bar{v}_i), \tag{5}$$

where $\theta = 1 - \sqrt{\sigma_u^2/(\sigma_u^2 + T\sigma_a^2)}$, $\theta \in [0, 1]$ and the time averages are computed equally as in the equation (2). In other words, the subtracted fraction is contingent on $Var(u_{it})$ and $Var(a_i)$ and the total number of periods, $T = 11$. Therefore, the data in equation (5) can be called quasi-demeaned. By transforming the equation (4) into the equation (5), the serial correlation of the errors is eliminated and consequently, pooled OLS can be used to estimate the equation (5) as in the fixed effects estimation. (Wooldridge 2013, pg. 493)

To acquire the random effects estimator, the parameter θ needs to be estimated. Generally, the formula is written as

$$\hat{\theta} = 1 - \sqrt{\frac{1}{1 + T(\hat{\sigma}_a^2/\hat{\sigma}_u^2)}}$$

where $\hat{\sigma}_a^2, \hat{\sigma}_u^2$ are consistent estimators estimated by pooled OLS. (Wooldridge 2013, pg. 493-494) The assumptions for the RE estimator are similar to the assumptions for the FE estimator, however, as stated before, the key difference between them is that in the RE estimation both assumptions $E(a_i|X_i) = \alpha$ and $Var(a_i|X_i) = \sigma_a^2$ hold. As a consequence, together with fixed effect assumptions, the random effects estimator is consistent, asymptotically efficient and asymptotically normally distributed as N gets large for fixed T. (Wooldridge 2013, pg. 510)

4.3 Tests

The first test to be conducted is to determine whether random effect estimation or fixed effect estimation is better to use. Generally, the appropriate method is to estimate both equations, test the overall significance by F test and consequently apply Hausman test (1978) which examines statistically significant differences in the coefficients of the regressors that change across time. The null hypothesis is that the following equation holds:

$$H_0 : Cov(x_{itj}, a_i) = 0, \;\; t \in \{1, ..., 11\}, \; j \in \{1, ..., 9\}. \tag{6}$$

As the equation (6) is simultaneously the key assumption for the random effects estimator, the RE estimator is preferred until the H_0 is not rejected. Nevertheless, if the null H_0 is false and thus, the main random effects assumption does not hold, the fixed effects estimator will be solely consistent. (Wooldridge 2013, pg. 496)

Next issues to be tested are whether the assumptions of the estimators are fulfilled. The testing is mainly focused on the problem of serial correlation and heteroskedasticity, however, first, the concern about multicollinearity is briefly discussed.

The potential problem of multicollinearity was prevented before the estimation by excluding one from the pair of potential predictors from the final model with a correlation higher than 0.7 (see section 3.2). Nevertheless, the Variance Inflation Factor (*VIF*) method is used to confirm the non-existence of multicollinearity. Variance Inflation Factor is a term in the variance of an estimator influenced by multicollinearity in the model and is computed for each explanatory variable. The values of *VIF* range from 1, meaning no correlation, to infinity and generally, $VIF = 10$ is chosen to be the threshold for multicollinearity. (Wooldridge 2013, pg. 98)

To test whether there is a serial correlation of the errors over time, the Breusch-Godfrey test for higher-order autocorrelation is used. (Breusch 1978, Godfrey 1978) The null hypothesis H_0 of the test can be stated as: the idiosyncratic errors are uncorrelated across time. If the null is rejected at the p-value < 0.05, the estimators will remain unbiased and consistent but serial correlation will impact their efficiency. (Williams 2015) Therefore, there needs to be an inference made that is robust to breach of the serial correlation assumption. (Wooldridge 2013 pg. 511)

As for the serial correlation, the issue of heteroskedasticity does not affect unbiasedness or consistency of the estimators, however, the estimators are not efficient as their standard errors are biased. (Wooldridge 2013, pg. 435) Since the sample in the thesis is relatively small, the heteroskedasticity is expected. To test the presence of heteroskedasticity, Breusch-Pagan test is conducted with the null hypothesis H_0 of homoskedastic errors. (Breusch & Pagan 1979) When the null is rejected at the p-value < 0.05, meaning that the data are heteroskedastic, the heteroskedasticity-robust standard errors should be implemented. (Wooldridge 2013, pg. 436)

If the tests conducted are proven to be significant, the robust covariance matrix of parameters is estimated to treat the violations of the assumptions. Specifically, Newey-West non-parametric estimators are used in the thesis as they are consistent for serial correlation as well as for heteroskedasticity. (Newey & West 1987) Nevertheless, as the Newey-West method assumes no cross-sectional correlation, cross-sectional correlation is tested using Pesaran's test (2004) with the null hypothesis H_0 of no cross-sectional correlation. If the Pesaran's test appears not to be significant, Newey-West robust covariance matrix can be used for parameters estimation. As a result, the estimators will be both heteroskedasticity and serial-correlation consistent.

5 Results

The section is divided into two main parts according to the dependent variables: results on the *abortion ratio* and results on the *total number of legal abortions*. In both subsections, the outcomes of the tests demonstrated in section 4.3 are provided followed by the description of the results of the regression models. The shortcuts of the independent variables included in the models are explained in Table A.1 in the Appendix. At the end of the section, significant outcomes are discussed and assessed concerning the previous studies introduced in sections 2.2 and 2.3.

5.1 Results on Abortion Ratio

There are two models to be demonstrated with the *abortion ratio* as a dependent variable. The first one is a basic model including variables from the previous studies described in section 4.3 and the second, advanced, model was subsequently constructed based on the basic model by adding other explanatory variables to the regression. To observe the changes in coefficients of the regressors and the overall quality of the models, results for both models will be presented.

5.1.1 Basic Model

Independent variables included in the basic model are crude birth rate, crude divorce rate, female tertiary education attainment, female unemployment rate and social benefits as % of GDP. Inclusion of the variables was based on or inspired by the studies conducted by Levine & Staiger (2004), Llorente-Marrón *et al.* (2016), Medoff (1988), Blank *et al.* (1996) and Gil-Lacruz *et al.* (2011) respectively. As specified in section 4, to estimate the effect of independent variables, fixed effects estimation and random effects estimation methods are applied. Before their results demonstration, outcomes of the tests proposed in section 4.3 to verify assumptions will be briefly presented.

Results of Variance Inflation Factor (*VIF*) method confirm no multicollinearity among the explanatory variables as the highest VIF is 1.53 for the *crude birth rate* variable. Nevertheless, the null hypothesis of the Breusch-Godfrey test revealing the presence of serial correlation was rejected for both FE and RE methods with p-values almost equal to 0. The problem of serial correlation was expected as in our data set it is likely that the patterns among European countries are repeating. Similarly, the Breusch-Pagan test rejects the null with a p-value equal to 0.0028, meaning that the heteroskedasticity is present in the model. After checking the absence of cross-sectional correlation by Pesaran's test, both assumptions violations are fixed by the implementation of the Newey-West estimators. The results of regressions can be seen in Table 5.1.

Table 5.1: Regression on Abortion Ratio (basic model)

(Emphasized columns are the preferred models according to Hausman test.)

	Dependent variable: Abortion Ratio (standard errors in the parenthesis)			
	FE	***Newey-West FE***	*RE*	*Newey-West RE*
BirthR	**−12.188**	**−12.188**	−0.247	−0.247
	(8.720)	(9.936)	(8.219)	(10.379)
EducA_Fem	**−8.624*****	**−8.624*****	−6.695***	−6.695***
	(1.455)	(1.712)	(1.330)	(1.688)
UnempR_Fem	**−0.172**	**−0.172**	3.334	3.334
	(2.748)	(2.635)	(2.495)	(2.694)
SocBen_%GDP	**6.529**	**6.529**	−0.699	−0.699
	(4.929)	(5.707)	(4.494)	(6.522)
DivorceR	**56.384*****	**56.384****	55.129***	55.129***
	(16.530)	(22.374)	(16.208)	(18.837)
Constant			343.923***	343.923**
			(121.455)	(156.958)
Observations	165		165	
R^2	0.305		0.238	
Adjusted R^2	0.214		0.214	
F Statistic	12.709*** (df = 5; 145)		49.557***	

Note: *p<0.1; **p<0.05; ***p<0.01

As can be observed from the first and third column, in both fixed effects and random effects estimations two independent variables appeared to be significant. Both approaches evince same adjusted R^2 equal to 0.214 and both are according to the F statistic overall significant signalling correct choice of regressors. Nevertheless, the Hausman test suggests that the fixed effects estimators are solely consistent (p-value $<$ 2.2e-16). The Newey-West method treats the standard errors to be robust and therefore, they tend to be larger than in the standard FE method. Nonetheless, the estimated coefficients remain unchanged as can be seen in Table 5.1. As a result, the significance of the coefficients may change as the t-statistic alters. Since the Newey-West estimators are suggested for the treatment, only the results of the second column (*Newey-West FE*) will be interpreted.

Female tertiary education attainment variable is statistically significant at 1 % level. As the variable is measured in percentage, a 1 percentage point increase in the female tertiary education attainment will decrease the abortion ratio by almost 9 abortions per 1 000 births. At the 5 % significance level, the *crude divorce rate* variable is considerably significant as well. The coefficient equal to 56.38 means that if the crude divorce rate rises by 1 divorce per 1 000 inhabitants, the number of abortions per 1 000 live births will grow by slightly more than 56 abortions. The positive relationship between abortion ratio and *social benefits* (p-value = 0.187) as well as the negative relationship between abortion ratio and *crude birth rate* (p-value = 0.164) appeared not to be significant. Variable with the most non-significant effect in the model is the *female unemployment rate* as its p-value is equal to 0.95.

5.1.2 Advanced Model

Besides the variables included in the basic model, the advanced model consists of the following regressors: GDP per capita, real GDP growth rate, political stability index and crude marriage rate. The tests conducted to examine the fulfilment of assumptions copy the outcomes of the tests computed for the basic model. The multicollinearity assumption holds with the highest VIF equal to 3.24 for *political stability index*. The Breusch-

Pagan test suggests the problem of heteroskedasticity in the model (p-value = 0.0019) and the Breusch-Godfrey test shows the presence of strong serial correlation. The Pesaran's test resulted in no sign of the cross-sectional correlation, hence, as in the basic model, Newey-West robust method is applied to the estimators of both models (see Table 5.2).

When comparing fixed effects (FE) and random effects (RE) estimations, in the FE model four independent variables appeared to be statistically significant whereas, there are only three significant variables in the RE model. The difference lies in the *crude birth rate* variable whose coefficient is nine times larger in the FE model that in the RE model, but standard errors are similar for both models. Nonetheless, according to the F statistic, both models are overall significant. Adjusted R^2 for the FE model is marginally larger than for the RE model and the Hausman test resulted in favour of the fixed effects estimators. As in the case of the basic model, only the outcomes of the preferred Newey-West FE method will be elaborated.

Both *female tertiary education attainment* and *crude divorce rate* basic variables proved their statistical significance at 1 % significance level. When comparing them with their performance in the basic model, the coefficients of both variables slightly changed. The coefficient of female tertiary education attainment declined to -9.73 meaning if the attainment rose by 1 percentage point, there would be nearly 10 abortions less per 1 000 births. By contrast, increased coefficient of crude divorce rate equal to 66.94 implies that growth of the rate by 1 divorce per 1 000 inhabitants would raise the number of abortions per 1 000 births by almost 67 abortions. The basic variable that became significant in the advanced model is the *crude birth rate* with a 10 % significance level. As birth rate is one of the most stable variables in the data set, the interpretation is as follows: increase in the rate by 0.1 unit would reduce the abortion ratio by slightly more than 2 abortions. The fourth significant variable in the model is *GDP per capita*. As the robust standard errors are larger than those in the FE model, the p-value was reduced from 0.103 to 0.075 and therefore, the variable is statistically

Table 5.2: Regression on Abortion Ratio (advanced model)

(Emphasized columns are the preferred models according to Hausman test.)

	Dependent variable: Abortion Ratio (standard errors in the parenthesis)			
	FE	***Newey-West FE***	*RE*	*Newey-West RE*
BirthR	**−21.747****	**−21.747***	−2.407	−2.407
	(9.715)	(12.143)	(9.167)	(11.851)
EducA_Fem	**−9.728*****	**−9.728*****	−4.028***	−4.028*
	(1.866)	(2.190)	(1.420)	(2.304)
UnempR_Fem	**1.366**	**1.366**	2.793	2.793
	(2.876)	(3.315)	(2.564)	(3.508)
GDPpc	**0.004**	**0.004***	−0.003**	−0.003*
	(0.002)	(0.002)	(0.001)	(0.002)
GrowthR_GDP	**−2.986***	**−2.986**	−2.739	−2.739
	(1.702)	(2.218)	(1.686)	(2.564)
PolitStab_Index	**29.859**	**29.859**	−27.771	−27.771
	(35.132)	(27.866)	(32.373)	(35.909)
SocBen_%GDP	**1.829**	**1.829**	−7.423	−7.423
	(6.583)	(7.634)	(5.668)	(8.333)
DivorceR	**66.942*****	**66.942*****	56.725***	56.725**
	(19.005)	(22.271)	(17.664)	(22.356)
MarriageR	**8.696**	**8.696**	0.448	0.448
	(10.393)	(19.678)	(10.380)	(26.535)
Constant			452.103***	452.103***
			(139.290)	(170.320)
Observations	165		165	
R^2	0.333		0.255	
Adjusted R^2	0.225		0.211	
F Statistic	7.839*** (df = 9; 141)		52.946***	

Note: *p<0.1; **p<0.05; ***p<0.01

significant at 10 %. Since GDP per capita annually amounts to thousands of euros, the coefficient equal to 0.004 can be interpreted as a rise in the GDP of 1 000 € per capita would cause a growth in the number of abortions per 1 000 births by 4 abortions.

The remaining five independent variables appeared not to be significant. *Real GDP growth rate* proposing negative relationship with abortion ratio lost its significance from the FE model due to the increase in t value from −1.75 to −1.35. Therefore, its final p-value is equal to 0.18. A compelling fact is that the largest p-value in the model pertains to *social benefits* (0.811) that rose from 0.187 in the basic model. Other non-significant variables *female unemployment rate*, *political stability index* and *crude marriage rate* propound a positive relationship with abortion ratio.

5.2 Results on Total Number of Legal Abortions

As in the case of abortion ratio models, the section is divided into two parts describing the basic model and the advanced model, both providing results on the *total number of legal abortions* dependent variable. The total number of legal abortions is presented in its logarithmic form for better interpretation. Moreover, because of the logarithm, the dependent variable is more evenly distributed and therefore, R^2 is generally higher.

5.2.1 Basic Model

The basic model is comprised of the following explanatory variables: a logarithmic form of the total number of live births, crude divorce rate, female tertiary education attainment, female unemployment rate and social benefits. As written in section 5.1.1, the inspiration comes from the studies written by Levine & Staiger (2004), Llorente-Marrónet *et al.* (2016), Medoff (1988), Blank *et al.* (1996) and Gil-Lacruzet *et al.* (2011) respectively. Variance Inflation Factors (*VIFs*) proved no multicollinearity in the model as all values are lower than 1.5. However, the autocorrelation of the errors is observed by the Breusch-Godfrey test in both models. Similarly, homoskedasticity is rejected at p-value equal to 0.019 using the Breusch-Pagan test. The implementation of the Newey-West robust method together with the models' outcomes are to be observed in Table 5.3.

Table 5.3: Regression on Number of Legal Abortions (basic model)

(Emphasized columns are the preferred models according to Hausman test.)

	Dependent variable: Logarithm of Total Number of Legal Abortions (standard errors in the parenthesis)			
	FE	*Newey-West FE*	***RE***	***Newey-West RE***
log(NBirths)	0.333	0.333	**0.738*****	**0.738*****
	(0.268)	(0.322)	(0.103)	(0.092)
EducA_Fem	−0.031***	−0.031***	**−0.026*****	**−0.026*****
	(0.005)	(0.005)	(0.004)	(0.006)
UnempR_Fem	0.004	0.004	**0.014***	**0.014***
	(0.008)	(0.007)	(0.007)	(0.007)
SocBen_%GDP	0.034**	0.034*	**0.016**	**0.016**
	(0.015)	(0.019)	(0.014)	(0.018)
DivorceR	0.105**	0.105**	**0.111****	**0.111****
	(0.050)	(0.050)	(0.049)	(0.044)
Constant			**1.750**	**1.750**
			(1.217)	(1.099)
Observations	165		165	
R^2	0.368		0.481	
Adjusted R^2	0.285		0.464	
F Statistic	16.871*** (df = 5; 145)		147.168***	
Note:			*p<0.1; **p<0.05; ***p<0.01	

According to the overall F-test, both methods are statistically significant at 1 % level. Nonetheless, in this case, the fixed effects model and the random effects model substantially differ in both, the significance of the regressors and the adjusted R^2. In the FE estimation, there are three significant variables while in the RE estimation, there are four. The additional significant variable is the *total number of births* that has a larger coefficient and lower standard error in the RE estimation. Adjusted R^2 in the RE model amounts to 0.46, whereas, in the FE model, it is equal to 0.28. Furthermore, the Hausman test failed to reject the null (p-value = 0.47) and therefore, it suggests the random effects estimators as the more preferred method. In the next paragraph, only the fourth column with the robust outcomes of the RE estimation (*Newey-West RE*) will be illustrated.

There are two variables significant at a 1 % significance level. The first one is the logarithmic form of the *total number of live births*, meaning that if there is 1 % increase in the number of births, the number of abortions is expected to grow by 0.74 %. The second one is *female tertiary education attainment* that, as in the abortion ration models, proposes a negative coefficient. The coefficient can be explained as follows: when the attainment rises by 1 percentage point, the number of abortions decreases by 2.56 %. *Crude divorce rate* variable showed its significance at 5 % level with a coefficient equal to 0.11. The outcome implies that the increase in the divorce rate by 1 divorce per 1 000 inhabitants would raise the number of abortions by 11.09 %. The last significant variable is the *female unemployment rate* at a 10 % significance level. The coefficient equal to 0.014 conveys that if the rate was higher by 1 percentage point, the number of abortions would grow by 1.36 %. Although *social benefits* appeared to be significant in the FE model, in the RE model it is the only non-significant variable with a p-value equal to 0.36, signalling positive relationship with the dependent variable.

5.2.2 Advanced Model

The advanced model results from adding another four independent variables to the basic model from section 5.2.1. The four variables are GDP per capita, real GDP growth rate, political stability index and marriage rate. Although the Variance Inflation Factors (*VIFs*) evince the largest values when comparing them with the other three models, they still demonstrate no multicollinearity in the model since the largest value (VIF = 6.12 for *political stability index*) is lower than the set threshold $VIF = 10$. As in the previous cases, the Breusch-Godfrey test proved the serial correlation of the errors in both models at 1 % significance level. However, what seems compelling is that the Breusch-Pagan test failed to reject the assumption of homoskedasticity at the p-value equal to 0.624. The Pesaran's test did not display any signs of cross-sectional correlation. Therefore, even though the heteroskedasticity is not suspected in the model, the Newey-West method treating both serial correlation and heteroskedasticity is employed. To clarify, in the homoskedastic models, the robust standard errors become conventional standard errors. Since applying the heteroskedasticity-robust method on homoskedastic standard errors will have no impact on the errors and since there is still the problem of serial correlation that needs to be rectified, the Newey-West method is an appropriate solution. For the results of the regressions see Table 5.4.

The strongly significant outcomes of the F-tests prove the overall significance of the models. Adjusted R^2 for the RE method ($\bar{R}^2_{RE} = 0.64$) is substantially larger than for the FE method ($\bar{R}^2_{FE} = 0.28$). Moreover, when comparing it to the basic model results, adjusted R^2 for the advanced FE model slightly declined. The RE estimation proposes five significant variables, whereas, the FE estimation proposes only three significant variables. As in the case of the basic model, the difference lies in the *total number of births* variable and in the *political stability index* variable for which each method suggests a different coefficient sign. Nevertheless, in contrast to the basic model, the null hypothesis of the Hausman test is rejected (p-value $< 2.2e{-}16$) and therefore only the fixed effects estimators are consistent. Interpretation of their robust outcomes (*Newey-West FE* column) is provided in the following paragraph.

At a 1 % significance level, there is only one independent variable significant, namely the *female tertiary education attainment*. The explanation of the coefficient is as follows: if the attainment grows by 1 percentage point, the number of abortions will fall by 3.58 %. The coefficient evinces the same sign as in the basic model, however, it has a larger magnitude in comparison

Table 5.4: Regression on Number of Legal Abortions (advanced model)

(Emphasized columns are the preferred models according to Hausman test.)

	Dependent variable: Logarithm of Total Number of Legal Abortions (standard errors in the parenthesis)			
	FE	***Newey-West FE***	*RE*	*Newey-West RE*
log(NBirths)	**0.164**	**0.164**	0.864^{***}	0.864^{***}
	(0.318)	(0.326)	(0.073)	(0.060)
EducA_Fem	−**0.036*****	−**0.036*****	-0.015^{***}	-0.015^{*}
	(0.006)	(0.007)	(0.005)	(0.008)
UnempR_Fem	**0.004**	**0.004**	0.012	0.012
	(0.009)	(0.010)	(0.008)	(0.009)
GDPpc	**0.00001**	**0.00001***	-0.00001^{**}	-0.00001^{**}
	(0.00001)	(0.00001)	(0.00000)	(0.00000)
GrowthR_GDP	−**0.002**	−**0.002**	−0.002	−0.002
	(0.005)	(0.005)	(0.005)	(0.005)
PolitStab_Index	**0.071**	**0.071**	-0.182^{*}	-0.182^{**}
	(0.108)	(0.066)	(0.102)	(0.084)
SocBen_%GDP	**0.031**	**0.031**	−0.006	−0.006
	(0.020)	(0.021)	(0.017)	(0.018)
DivorceR	**0.116****	**0.116****	0.118^{**}	0.118^{**}
	(0.057)	(0.057)	(0.053)	(0.054)
MarriageR	−**0.011**	−**0.011**	−0.025	−0.025
	(0.031)	(0.053)	(0.031)	(0.063)
Constant			0.743	0.743
			(0.863)	(0.866)
Observations	165		165	
R^2	0.381		0.661	
Adjusted R^2	0.280		0.641	
F Statistic	9.626^{***} (df = 9; 141)		301.972^{***}	
Note:				*p<0.1; **p<0.05; ***p<0.01

with the basic RE model. *Crude divorce rate* variable affirms the positive relationship with the number of abortions from the previous models at 5 % significance level. Specifically, when the divorce rate rises by 1 divorce per 1 000 inhabitants, the number of abortions is expected to increase by 11.65 %. The last significant variable is *GDP per capita* that appeared to be significant at 10 % level only after the employment of the robust standard errors. If GDP grew by 1 000 € per capita, the coefficient equal to 0.00001 would represent 1.04 % change in the total number of legal abortions.

Other six explanatory variables did not show any signs of statistical significance with the Newey-West FE method. *Social benefits* proposing positive coefficient sign lost its significance (p-value = 0.15) from the basic FE model. Another interesting outcome is that *political stability index* is not significant (p-value = 0.29) despite its significance in the advanced RE model. Moreover, in the RE estimation, the sign of the coefficient suggested a negative relationship with the dependent variable while in the FE estimation, it suggests a positive relationship. Another two non-significant variables propounding a positive impact on the number of abortions are the *number of live births* and *female unemployment rate* although they both proposed significance in the basic RE model. The last two regressors without any significance are *real GDP growth rate* and *crude marriage rate* both suggesting a negative influence on the dependent variable.

5.3 Discussion

As demonstrated in section, even though the measured variables are based on the same measure, models for both variables were introduced since their interpretations slightly differ (for a detailed explanation see section 3.1). Nonetheless, as expected, the results on the *total number of abortions* generally affirm the results on the *abortion ratio* and vice versa. In other words, in most cases, the signs of the coefficients of individual regressors and their significances appeared to be similar for both dependent variables. Hence, the section provides reasoning about the significant and compelling outcomes on both measured variables, including comparisons of the results with the previous studies described in sections 2.2 and 2.3.

The indicators that appeared to be substantially significant in all four models are *female tertiary education attainment* and *crude divorce rate*. Female tertiary education attainment suggests a negative relationship with the number of abortions which opposes the study conducted by Medoff (1988) that demonstrated no statistically significant effect of the female education on abortion demand. A possible explanation of the negative impact of the female tertiary education might be that the women with a university degree tend to advisedly plan their decisions about having a family. Therefore, when a well-educated woman decides to conceive with deliberation, it is more likely that she will give birth instead of undergoing an abortion as was for instance proven by Eskild *et al.* (2007) on Norwegian women. By contrast, the positive coefficient of the crude divorce rate affirms the findings of Rothstein (1992) and Llorente-Marrón *et al.* (2016) stating that most induced abortions occur to unmarried women. For instance, Finer *et al.* (2005) ascribe this to the problem of insufficient resources to raise a child when being a single mother.

GDP per capita is the only economic indicator that evinced significance in both advanced models. Although one would expect a negative relationship with the number of abortions as the developed economies tend to have lower abortion ratio than the developing economies (see section 3.1.1), the outcome suggests a positive coefficient that is always slightly above 0. The result can be possibly rationalized by the closer inspection of the average GDP per capita in individual countries between 2007 and 2017. In the data set, there are a few countries that have large average GDP as well as substantial abortion ratio mean. Primarily, these countries are Estonia (13 895 € and 461.9 respectively) and Spain (23 192 € and 234.9). As the sample of countries is quite small, these few exceptions probably impacted the resulting GDP coefficient to be slightly above 0.

Another interesting outcome appears when comparing the *abortion ratio* and the *total number of legal abortions* models in terms of births. The significant outcome on the *crude birth rate* in the abortion ratio advanced model confirms the negative relationship between abortions and birth rate described across studies. (Sklar & Berkov 1973, Levine & Staiger 2004, Guldi 2008) The significance of the birth rate is reasonable since the abortion ratio is measured as the total number of abortions per 1 000 live births. In other words, they are based on the same measure, the number of births. Nonetheless, in the total number of legal abortions models, the *total number of births* variable proposes a positive coefficient (significant only in the RE models). The probable explanation is that in the case of the number of births, the size of the population is incorporated in both the number of abortions and the number of births. Therefore, it is likely that populous countries, for instance, Germany, will have a larger number of abortions and births than the less populated countries, for example, Czechia. On the contrary, the coefficient of the birth rate is only about the relationship with the abortion ratio, free of the population size as follows from the definitions of the variables. To conclude, the different behaviour of the two independent variables was expected because of their distinct nature.

The last variable to be briefly discussed is the *female unemployment rate*. Its coefficient appeared to be positive in the overwhelming majority of cases but occurred to be significant only in the RE model in section 5.2.1. The resulting coefficient is consistent with the outcomes of the paper written by Blank *et al.* (1996). The positive relationship is quite reasonable as the possible explanation may be that the unemployed woman is likely to abort, for instance, due to the deficient resources to raise a child.

6 Conclusion

The thesis scrutinizes potential impacts of various socio-economic determinants on the legally induced abortion in Europe by examining a sample of 15 European countries for the 2007-2017 period. For the panel data regression, fixed effects estimation and random effects estimation, both with the Newey-West robust standard errors, are applied.

The measured variables are the abortion ratio and the total number of legally induced abortions. Although both variables are based on the same measure, they are both included as their interpretations are distinct. After conducting summary statistics for both variables, it can be easily observed that there has been an overall trend of slowly declining abortion ratios since 2007. Switzerland and Germany, the representatives of Western European countries, evince the lowest ratios in the data set. By contrast, South-Eastern European countries present the largest mean ratios in the sample, with Georgia in the lead.

Since the dependent variables are based on the same measure, as expected, the results on the total number of abortions generally affirm the outcomes on the abortion ratio and vice versa. Specifically, the significant variables in all models are *female tertiary education attainment* and *crude divorce rate*. The regressions results demonstrate a negative relationship between female tertiary education attainment and abortions and a positive impact of divorce rate on abortions. The former outcome opposes the study conducted in the United States by Medoff (1998) who suggested no significant effect of education, whereas, the second result complies with the findings of Rohstein (1992) and Llorente-Marrón *et al.* (2016).

GDP per capita is the only solely economic determinant that revealed statistical significance for both measured variables, proposing a positive influence of the GDP on abortions. The possible rationalization is that in the data set, there are a few countries that have large average GDP as well as substantial abortion ratio mean, primarily, the countries are Estonia and Spain.

Other socio-economic factors evincing significance are *crude birth rate* affirming negative influence on the abortion ratio described across studies (Sklar & Berkov 1973, Levine & Staiger 2004, Guldi 2008), and the *total number of births* suggesting a positive relationship with the total number of abortions. The divergent coefficients may be explained by the difference in the interpretations. The coefficient of the birth rate describes the pure relationship with abortion ratio, while in the coefficient of the total number of births, the size of the population is incorporated and consequently, the populous countries will have a larger number of abortions and births than the less populated countries. The last significant regressor *female unemployment rate* shows a positive coefficient in the majority of models and appears to be significant in the preferred basic model on the total number of abortions. The outcome is in compliance with the study by Blank *et al.* (1996).

The additional variables that display no significance in any of the preferred models are *social benefits* as % of GDP, proposing positive relationship with abortion, *GDP growth rate*, suggesting negative influence on abortion, *political stability index*, signalling positive effect on abortion, and *crude marriage rate*, propounding different coefficient for each dependent variable.

To conclude, significant results generally correspond to the previous studies with the exception of the female tertiary education that signals substantial negative impact on abortions in the context of European countries. In addition, the thesis introduces new economic variables to the topic of abortions, however, except the positive effect of GDP per capita on abortions, the other economic variables did not appear to be significant.

Nevertheless, the limitations lie in the relatively small sample of 15 European countries. To attain balanced panel data, only the countries for which the full set of explanatory variables was available for the course of the 11 years were included. A larger sample would increase statistical power, however, due to plentiful missing values, the implementation of more advanced methods would be needed. For that reason, further research in this field can be performed in the future.

Furthermore, the thesis can be possibly extended by comparing the results to the other demographic regions for the 2007-2017 period. The observation of whether the outcomes differ in Asian countries or South America, primarily, in the impact of education and economic indicators on legally induced abortions, would be surely valuable.

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Appendix

Figure A.1: Abortion Ratios of Individual Countries

(Countries depicted in alphabetical order from left to right starting on the bottom row.)

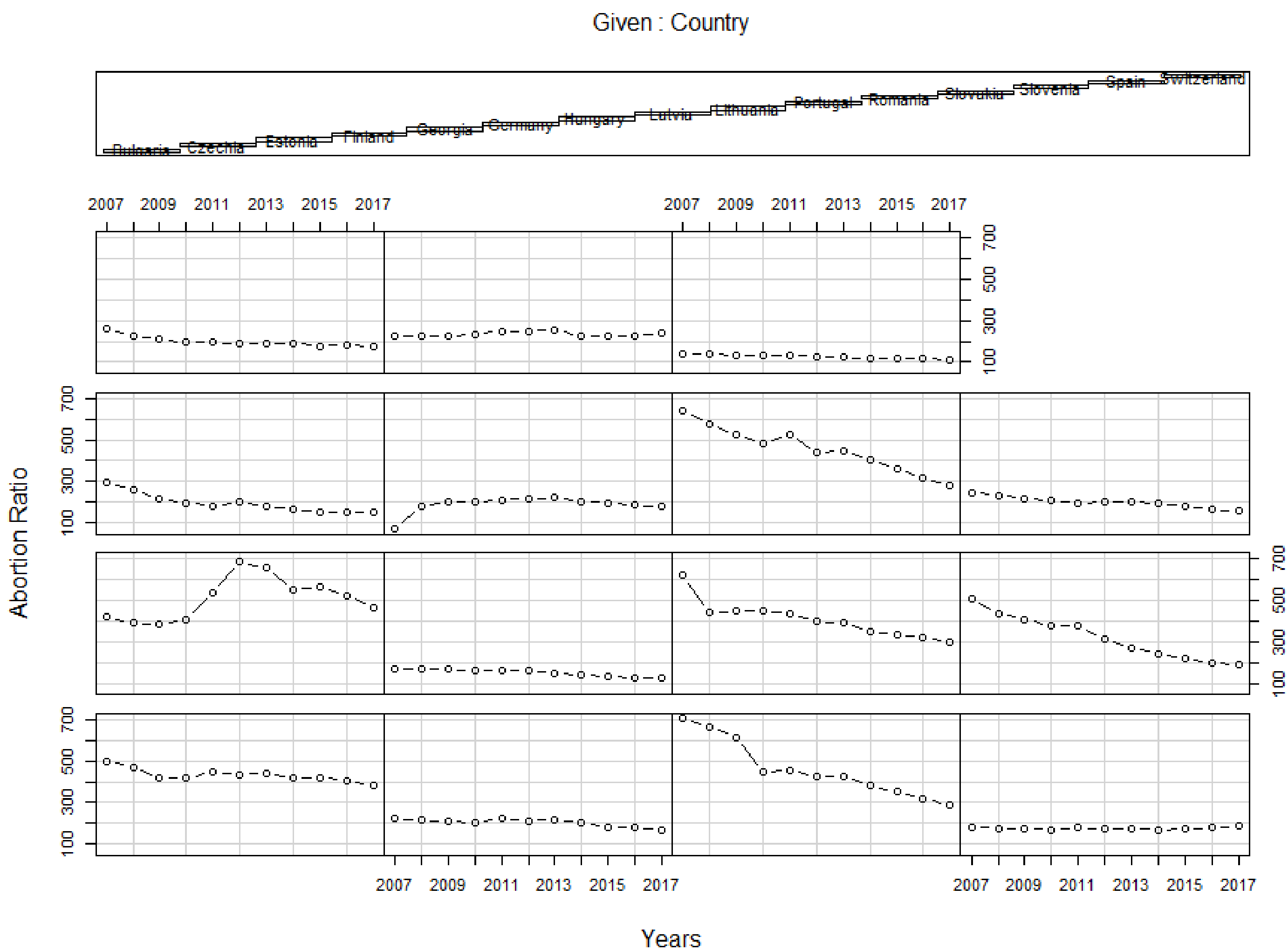

Table A.1: Description of Potential Independent Variables in the Dataset

(Emphasized variables are the final regressors included in the models.)

Full Name	***Shortcut***	***Source***
Consumer price index, base year 2010	CPI_2010	UNECE
Crude birth rate	**BirthR**	Eurostat
Crude divorce rate	**DivorceR**	Eurostat
Crude marriage rate	**MarriageR**	Eurostat
Female tertiary education attainment	**EducA_Fem**	Eurostat
Female unemployment rate	**UnempR_Fem**	Eurostat
Final consumption expenditure per capita	FinalConsExp_pc	UNECE
Global gender gap index	GendGap_Index	World Bank
Gross average monthly wage	MonthWage_Avg	UNECE
Gross domestic product at market prices per capita	**GDPpc**	Eurostat
Industrial production index	IndProd_Index	UNECE
Labor force participation rate	LForceR_Fem	World Bank
Male tertiary education attainment	EducA_Male	Eurostat
Male unemployment rate	UnempR_Male	Eurostat
Political stability index	**PolitStab_Index**	World Bank
Real GDP growth rate	**GrowthR_GDP**	Eurostat
Social benefits paid by general government as % of GDP	**SocBen_%GDP**	Eurostat
Total Number of live births	**NBirths**	Eurostat

Table A.2: Coefficients of Variation

NBirths	1.35	BirthR	0.14
EducA_Male	0.33	**CPI_2010**	**0.07**
EducA_Fem	0.32	SocBen_%GDP	0.23
UnempR_Fem	0.49	PolitStab_Index	0.80
UnempR_Male	0.51	**GendGap_Index**	**0.06**
GrowthR_GDP	2.25	DivorceR	0.28
GDPpc	0.79	MarriageR	0.28
FinalConsExp_pc	0.41	IndProd_Index	3.57
MonthWage_Avg	0.91	**LForceR_Fem**	**0.08**