# Combatting the Demographic Change

## A Quantitative analysis of the effect of Higher Education and Gender Equity on Fertility Rates in the EU

Master Thesis

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**Abstract**

The European Union faces significant challenges due to the demographic change, including and decreased mortality, an aging population and declining fertility rates, which together contribute to a shrinking workforce. It leads to labor shortages and threatens the sustainability of the welfare state. Although prior research has extensively linked tertiary education to the fertility decline, the findings have been inconsistent.

This thesis integrates Unified Demographic Theory, Gender Equity Theory, and the EU legal framework to form a comprehensive theoretical model. It posits that higher education delays childbearing and increases opportunity costs, thereby reducing fertility rates. In countries with high gender equity, the negative impact of tertiary education is mitigated due to gender equity reducing the dual burden on highly educated women.

This thesis examines ten EU member states from 1992 to 2008 using panel regression. A fixed-effects model is employed to uncover the effect of higher education on fertility rates and how gender equity impacts that relationship.

Contrary to expectations, tertiary education has a positive direct effect on fertility rates on average. Yet, a closer examination of individual countries shows that four out of ten countries still exhibit a negative impact of education on fertility. The positive influence of gender equity is confirmed; for high degrees of gender equity, education has a stronger positive effect.

The results highlight the importance of gender equity for highly educated women. As more women attain higher education, gender equity becomes increasingly relevant for boosting fertility rates and addressing the demographic change.

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## List of Abbreviations

EU – European Union

EVS – European Values Study

GET – Gender Equity Theory

GII – Gender Inequality Index

GRI – Gender Roles Index

TFR – Total Fertility Rate

UDT – Unified Demographic Theory

# 1. Introduction

## 1.1 Topic

Demographic change is believed by many to be one of the megatrends of the 21st century (Lutz, 2021). Within the developed world, including Europe, demographic change describes two central phenomena. First, mortality rates have been dropping nearly continuously in Europe since the 1950s. This has led to what is often labelled an aging population, with the average age increasing, people living longer and fewer people passing away each year (Lutz, 2021). Secondly, fertility rates have been declining over the past half century. Fertility rates indicate the average number of children per woman. As a result of the demographic change, the working-age population is shrinking in relative size and will continue to do so due to fewer children being born and older or elderly people living longer (Goldstein et al., 2009). This is expected to lead to issues with labor markets and welfare states in Europe that need to be mitigated by policymakers. With fewer people being born and a simultaneously aging population, the welfare state has to be financed by fewer people who increasingly many elderly or older people rely on (European Commission, 2023).

Declining fertility rates have become a pressing issue for the European Union (EU). The fertility level that keeps populations stable over time, also called the replacement level, is 2.1 Ever since the 1980s, the EU has had a fertility below this level (Bongaarts, 2002; Parr, 2023). Such a development leads to populations naturally shrinking over time. It is especially problematic in conjunction with the aging populations because it means that fewer people participate in the labor market, leading to large-scale labor shortages. On top of that, the welfare state can only be sustained if enough people are employed in order to finance it. This has prompted scholars to investigate the factors that have caused the fertility decline, such as e.g. policies that have not addressed the needs of parents adequately (Bergsvik et al., 2021; Scherer et al., 2023).

This thesis explores a crucial aspect of the research puzzle: the role of *tertiary education* in shaping fertility. Tertiary education (also referred to as higher education throughout the thesis) has traditionally been associated with lower fertility (Ní Bhrolcháin & Beaujouan, 2012). This poses a potential problem for the EU as increasing education is one of the main mechanisms to combat the labor shortages induced by the demographic change. The reasoning is that a highly educated person is more skilled and can therefore be more productive in the labor market. Given the shrinking labor force due to the demographic change, an increased productivity per worker is desirable for the EU. Alongside, there have been countless measures to give women adequate access to the labor market and to higher education (European Commission, 2023). This could lead to a dilemma in which the increase in tertiary educational attainment leads to a ripple-effect that ultimately decreases fertility rates, worsening the demographic change.

The thesis further examines another factor that is crucial for the effect of education, namely the degree of gender equity within a country. In the context of this thesis, gender equity refers not only to the legal equality between women and men, but also to the equity of societal expectations towards both genders. Scholars have already pointed out gender equity's positive direct effect on fertility rates (Anderson & Kohler, 2015; Brinton & Lee, 2016). This thesis will go one step further and examine how gender equity impacts the relationship between higher education and fertility rates, within the broader context of demographic change and its implications for policy-making.

### 1.2 Research Gaps

The thesis addresses several gaps in the research. Filling them is important in uncovering the true effect of higher education on fertility rates.

Traditionally, education is said to inhibit fertility, including higher education in developed countries. However, other studies are less conclusive, citing societal shifts (Bellani, 2020; Testa, 2012) and policy interventions (Bergsvik et al., 2021) as positively influencing the effect of higher education. At this point, research cannot conclusively explain the effect of education, also because it can be dependent on the context of the chosen sample as well. Therefore, studying European countries by themselves can yield different results than other papers have suggested for different countries and timeframes.

The contextual factor that this thesis focuses on is gender equity, which has been shown to positively affect fertility rates directly. Yet, previous studies have failed to connect gender equity to this research puzzle of education and fertility. Furthermore, previous research includes mostly legal components of gender equity. In this thesis, I make use of Gender Equity Theory (see McDonald, 2000) which emphasizes the importance of informal aspects of gender equity for fertility, namely *gender roles*. Rather than focusing on formal aspects, the societal expectations are in focus here. Gender roles describe people's expectations about who should participate in the labor market, take care of family responsibilities, and maintain the household. Thus, I include an aspect of gender equity into the analysis that is severely understudied. When controlling for gender roles, I can estimate a more robust direct effect of education on fertility.

In order to include gender role expectations in the analysis, they have to be quantified first. This presents the next research gap since, so far, there exists no such measure. Most common measures of gender equity take legal aspects into consideration as well as other figures such as female employment rates or female political power. A measure that solely focuses on gender roles within a population has not been created yet. For this reason, I construct a new index to quantify people's gender role attitudes.

Beyond that, gender roles serve as more than a mere control variable. Previous research has established that an increase in gender equity boosts fertility rates directly. However, how gender equity influences the effect of higher education on fertility has not been tested yet. This thesis presents a compelling argument that more equitable gender roles in a country lead to a more positive effect of higher education on fertility. Given the central role of education in fertility research and the increasing importance that scholars attribute to gender equity, the fact that both concepts are rarely connected in this way poses yet another gap in fertility research.

### 1.3 Research Questions

The research questions are informed by the identified research gaps. The first question considers the role of higher education:

*How does higher education influence fertility rates in the EU?*

Although a lot of research points towards a negative relationship, this question is yet unanswered. When performing the panel regression to uncover the true effect, it is important to account for relevant variables such as gender roles which previous studies do not include in the empirical analysis. I include it into the regression analysis in order to get a more precise estimate of the education effect and to simultaneously verify if the introduction of gender roles into the analysis changes the education effect. This could then further be used to explain part of the contradicting results that previous research has found.

The analysis is restricted to European countries, specifically EU member states, between 1992 and 2008. The timeframe was specifically chosen to be between two major global events, namely the fall of the Soviet Union on the one hand and the great recession in 2008 on the other hand. This provides a sensible timeframe that is long enough to study the variation of education, gender roles, and fertility rates. Yet, it is still short enough to allow for a concise analysis that does not have to account for major cultural shifts. For example, studies have pointed out that different factors are relevant for individual fertility choices after 2008 compared to earlier (Matysiak et al., 2021) . In order to allow the analysis to stay as concise as possible without confounders resulting from these developments, the timeframe of 1992 to 2008 was ultimately chosen even though it limits the generalizability of the findings.

The second research question regards the interaction between gender equity and tertiary education:

*How do gender role expectations impact the relationship between tertiary education and fertility rates?*

So far, gender roles are understudied in fertility research as no measures currently exist to quantify them, leading scholars to focus on other aspects of gender equity. On top of that, despite the extensive research about the positive direct effect of gender equity on fertility, its connection with higher education is much less clear. This research question is not about the direct effect of gender equity but solely how it changes the effect of education on fertility. Given the importance of both education and gender equity in fertility research, a connection between these concepts is highly relevant. Guided by Gender Equity Theory (McDonald, 2000), I present a compelling argument for why gender equity (specifically gender roles) would impact the effect of higher education on fertility, addressing a substantial gap in the literature. This has practical implications for policymakers as well which will be addressed in its own chapter at the end of the thesis.

### 1.4 Aim and Outline of the Thesis

This thesis examines the decreasing fertility rates that EU member states have experienced over the past half century. I examine how tertiary educational attainment and gender roles interact to influence fertility rates.

I formulate two hypotheses. The education hypothesis predicts that increased tertiary education rates have a negative influence on fertility rates. The gender hypothesis states that gender equity influences the effect of education such that higher gender equity leads to a more positive effect of tertiary education on fertility.

The operationalization of gender equity in the analysis is guided by Gender Equity Theory (McDonald, 2000). As of now, there exists no measure that adequately captures the concept of gender roles with all of its dimensions. Therefore, I construct a new index, the *Gender Roles Index* (GRI), a novel metric that quantifies these societal expectations. Thereby, this research not only provides new insights into the interplay between education, gender equity, and fertility. It also provides a novel measurement of gender equity that future research can build upon.

Contrary to the theoretical expectations, the results reveal that higher education has a positive effect on average. While some individual countries exhibit a negative effect, it is not enough to reject the null hypothesis. On the other hand, the gender hypothesis is empirically supported; gender equity is shown to boost the effect of higher education on fertility. It means that in the presence of high gender equity, increased tertiary education leads to higher fertility rates than in the absence of gender equity.

In the final step, the thesis addresses the implications of the results and gives policy recommendations to effectively increase fertility rates in the EU.

## 2. Literature Review

In this chapter, I examine the scholarly literature. The focus will be on fertility rates and how they are affected by higher education and gender equity, and how policies play into it. The most recent literature will be reviewed as well as research that dates further back because of the timeframe of this thesis. As it covers the 1990s and 2000s, I want to present an accurate picture of the situation at that time, balanced out with the latest research and scholarly debate.

### 2.1 Concept Specification

It makes sense to first specify the concept of fertility (rates) since there are different measurements, each with their own strengths and shortcomings. Cohort Fertility Rate refers to the average number of children born to an age-specific cohort of women over their lifetime, typically by the end of their reproductive years. On the other hand, Period Fertility Rate measures the average number of children born to women within a specific period, usually a year, without considering their age. It provides a snapshot of fertility behavior at a specific time, making it sensitive to short-term changes in birth rates. It does not account for the timing of births across a woman's lifetime (Schoen, 2022).

*Total Fertility Rate* (TFR) is the focus of this thesis. It is an estimate of the average number of children a woman would have over her lifetime based on current age-specific fertility rates. It is a synthetic measure that combines the age-specific fertility rates of women at different ages into a single number. It assumes that current fertility rates remain constant throughout a woman's reproductive life (Borgan & Hoem, 1988). It is also used to compare fertility levels between different countries or regions, making it easier to compare across different contexts and time periods (Pison, 2009). TFR is useful for monitoring short-term changes in fertility patterns. It can help identify trends and fluctuations in fertility rates over short periods, which is important for policy-making and demographic analysis (Sobotka, 2003).

Due to its usefulness in comparing fertility rates between countries and times, the focus of this thesis is on the Total Fertility Rate. From here on, any mention of fertility (rate) refers to TFR unless specified otherwise.

### 2.2 Tertiary Education

The relationship between education and fertility has been extensively studied (Nisén et al., 2021). Theoretical reasoning and empirical evidence differ and are not generally conclusive as there is not one single effect of education on fertility but, depending on type of education, time period, location, and other contextual factors, several mechanisms have been identified how education affects fertility. This review is limited to the effects of tertiary education since the mechanisms for primary, secondary, and tertiary education are separate and not applicable to each other (see Lutz, 2021).

Tertiary education is affecting fertility in a multitude of ways. The main mechanisms identified by scholars are (1) fertility postponement, (2) better career opportunities, and alongside that (3) opportunity costs of having children. These concepts are reviewed in the following part.

#### *2.2.1 Fertility Postponement*

With increased educational attainment, people tend to have children at a later age (Beaujouan, 2020; Ní Bhrolcháin & Beaujouan, 2012). The explanation for this is tied to an economic point of view: People typically postpone children until they become financially independent (Scherer & Brini, 2023) which can only happen after entering the labor market. Since more years spent in education lead to a later labor market entry, highly educated women have children at later stages in their life (Beaujouan, 2020).

The question is whether or not this postponement has a negative effect on total fertility and it does not appear to be conclusively answered. Some scholars argue that it causes a fertility decline. After all, biological factors increase the risk of permanent infertility and thereby involuntary childlessness with each passing year, especially for women (Schmidt et al., 2012; Barban, 2015). A later labor market entry means there is less time to become financially independent, find stable employment, and a suitable partner (Raab & Struffolino, 2020). After postponement, women then often have to rush childbearing as soon as possible. The social aspect is expected to play a role here as well insofar that it is perceived as socially inacceptable to have children at an older age (often more so for women), thus a woman feeling that she is already almost 'too old' might feel pressured to have children as soon as possible (Beaujouan, 2020). Such biological and social restrictions could lead to women not conceiving the desired amount of children, thus negatively affecting fertility (Barban, 2015). Other authors have pointed out, however, that at least the social expectation aspect may shift in the future as higher rates of tertiary educational attainment lead to a normalizing of child postponement. There is partial evidence for this, with Schmidt et al. (2012) showing that an increasing number of women wishes to have children over the age of 35. There has also been an increase in women getting children after the age of 40 (late fertility) and even beyond the age of 48 (latest-late fertility), indicating that postponement does not necessarily lead to childlessness (Beaujouan, 2020).

Despite this, the evidence that fertility postponement leads to lower fertility rates appears to be stronger. While some women can manage having children beyond the age of 40 and societies do not regard it as such an anomaly anymore, biological restrictions seem to lead to a lower probability that a woman can conceive a child after a long period of postponement.

### *2.2.2 Better Career Opportunities – Facilitating or Inhibiting Fertility?*

A large body of academic literature points at the importance of economic circumstances in fertility choices of developed countries (e.g. Bastianelli et al., 2023; Comolli et al., 2021; Sobotka et al., 2011). For instance, times of economic recession typically lead to a drop in fertility rates, primarily attributed to young people postponing childbirth as a result of increasing economic precariousness and unemployment (Bastianelli et al., 2023; Kreyenfeld, 2015; van Wijk et al., 2022).

Looking at individual circumstances, highly educated women are in a better position on the labor market than less educated women. These trends have been consistent across European countries during the selected timeframe (Teichler, 2001). Employment rates among women of lower education are a lot lower, e.g. around 60 percent in 1999 compared to 82 percent for women with tertiary education (Dolado et al., 2001). Furthermore, women of high education are more likely to work full-time over part-time and have better job opportunities and more secured employment compared to women with only secondary education (Scherer & Reyneri, 2008). This has been argued to positively influence fertility rates since it is more likely that women of higher education become financially independent and employed in a permanent contract (Bellani, 2020; Schmidt et al., 2012). However, an increase in income beyond that appears to inhibit fertility rates. It seems to be important to secure employment and financial stability, not to maximize income (Kageyama & Matsuura, 2018). Nonetheless, this research argues that the more stable employment of highly educated people facilitates fertility.

Other branches of fertility research argue that the better career opportunities of more educated people are actually inhibiting fertility rates. The reasoning lies in the higher opportunity costs of having children which, for better educated parents with better career opportunities, would naturally be higher as they are risking a better career (Kageyama & Matsuura, 2018; Kravdal, 2007). Some scholars also argue that the opportunity cost of having children is lower in times of recession, which can actually increase fertility during recessions, indicating that opportunity costs are a real consideration in fertility choices (Sobotka et al., 2011). Bergsvik et al. (2021) support this by showing that women who are not on a stable career path intend to have more children, presumably because the opportunity costs are lower. This implies that couples who are financially prospering (or that live during an economic boom) may face higher opportunity costs of having children.

The issue of opportunity costs is a consideration for women especially. Scholars have investigated women's career paths and came to the conclusion that achieving higher positions is more difficult for women the higher they climb in the hierarchy, a phenomenon referred to as the *glass ceiling* (Cotter et al., 2001). Women who decide to have children face career obstacles despite legal job guarantees or mandatory maternal leave (Ezzedeen et al., 2015; Purcell et al., 2010). The glass ceiling conundrum pertains to women of all educational backgrounds but it is more prevalent among highly educated women. This is due to the glass ceiling becoming more prominent higher in the hierarchy where positions are generally occupied by more educated people (Cotter et al., 2001).

Better careers and opportunity costs present two sides of the same coin. Women of high education can pursue more rewarding careers, providing her with the financial stability to take care of children but it also means that the full potential of her career may only be realized if she does not have children at all.

### 2.3 Gender Equity

In this review, gender equity broadly refers to both legal aspects and societal views about gender. Scholars have uncovered positive direct effects of gender equity on fertility rates (Anderson & Kohler, 2015; Brinton & Lee, 2016). Due to increasing individual rights granted by national states and supranational institutions such as the EU, it has become easier for women to find employment under similar conditions as men. Societal expectations in large parts of Europe have gradually shifted and now accommodate and even expect women to work in regular employment (Scott, 2008). Aside from social progress, women are needed in the labor force to combat labor shortages, one of the main consequences of the demographic change (Balkenende, 2008). These legal and societal developments have led to a normalizing of women in the labor market (Drutarovská et al., 2016).

Despite this, as pointed out by Han and Brinton (2022), traditional gender expectations have prevailed with women still taking on most of the household and child-caring duties. This is proposed to lead to an additional burden for women as workers and family caretakers. Some studies indicate that men are starting to take more responsibilities at home although this happens at a slower speed than women entering the labor market. As Zannella et al. (2018) show, women work more in total (when combining employment and household) in dualearner couples compared to the male-breadwinner model, providing empirical evidence of the additional burden for women.

Following this line of reasoning, it has been suspected by scholars that higher degrees of gender equity would increase fertility rates. The reasoning is that gender-equal societies make it easier for women of all educational backgrounds to manage child-raising while continuing to participate in the labor market by splitting the responsibilities evenly between men and women. Thereby, women would still be expected to work, just as men, but men would also contribute evenly with regards to domestic responsibilities. That way, raising children becomes easier so there are fewer hurdles to having children, effectively increasing fertility rates in the long run. On the other hand, less gender-equal societies do not accommodate for women's needs as well while still expecting their labor force participation, leading to more women deciding against children, regardless of educational attainment (Brinton & Lee, 2016; Han & Brinton, 2022).

### 2.4 Policies

Scholars have theorized and tested the effects of different kinds of policies on fertility rates in different contexts. They argue that fertility choices depend on purchasing power, time, and monetary costs of childrearing, and preferences for spending resources on children versus other purposes (Bergsvik et al., 2021). In this sense, research on policy effects aligns theoretically with the aforementioned literature on economic considerations insofar as they both highlight the importance of economic security in fertility decision-making.

Generally, policies that support women's careers and  provide access to better child- and healthcare positively impact fertility rates (Bergsvik et al., 2021, Luci-Greulich & Thévenon, 2013). Policies that provide financial support can also increase fertility, though the positive effect can fade away over time (Miranda, 2020). Similarly, Scherer et al. (2023) have shown that social-investment oriented family policies also have a positive effect, yet they remark that superficial policies only yield short-term effects. Yet, Puur et al. (2023) have shown that financial compensation for childrearing can have a permanent positive effect.

Scholars have also studied how the effect of policies differ by educational attainment. In a systematic review of policy effects on fertility, Bergsvik (2021: 41) concluded that "policies that enable mothers' employment and protect their careers should […] be more important for women who have invested in higher education" while direct monetary transfers matter less to them compared to women with lower educational attainment. Rather than monetary compensation, parental leave expansion is shown to cause significant increases in fertility among highly educated women (Bergsvik et al., 2021). Rendall et al. (2010) and Bellani (2020) also show the importance of policymakers providing a framework that allows women to combine employment with family. Failure to do so results in a fertility decline that is larger for more educated women.

## 2.5 Difficulties with Demographic Theories

In conjunction with mortality, fertility rates are a central aspect of demography, the study of populations. As a traditionally rather data-driven science, the theoretical aspects of the discipline had been quite underdeveloped for a long time (Lutz, 2021). Despite some theoretical concepts that were developed, some of which widely cited in fertility and adjacent research, scholars have noted that theories up until recently have lacked explanatory depth and predictive capabilities, often merely describing demographic trends rather than explaining (and predicting) them (Lutz, 2021; Zaidi & Morgan, 2017).

One such approach is the Second Demographic Transition (SDT) Theory. It postulates that after the first demographic transition from high to medium fertility, more developed countries will undergo another transition to even lower fertility. This is presumably caused by a societal shift to post-modern values that focus on individualism and self-fulfillment. Traditional family structures and intentions to have children would drop to the low levels observed today (Zaidi & Morgan, 2017).

Despite the relatively wide use of this theory by scholars (Han & Brinton, 2022), there are conceptual flaws. Firstly, testability and falsifiability are limited (Lutz, 2021; Zaidi & Morgan, 2017) as the SDT Theory does not provide a generalized prediction of when or to what extent any of these developments happen. In a comparative analysis by Han and Brinton (2022), it is shown that theories from other disciplines are better at explaining demographic outcomes than SDT theory. On top of that, it has been criticized for basing its assumptions on Maslow's theories which are outdated in current psychological research (Smallenbroek, 2023), further indicating the relative underdevelopment of demographic theory as a whole.

While there is evidence to suggest that post-modern values are indeed associated with lower fertility, there is little to suggest a natural post-modernization of societies with regards to family planning. In fact, Sobotka and Beaujouan (2014) suggest that the two-child ideal is still prevalent in developed countries despite low fertility rates, indicating that a cultural shift is not the main reason for the lower number of children.

Because of these issues, I will not be using Second Demographic Transition Theory in my own framework despite it being the most prominent demographic theory.

## 3. Theoretical Framework

The thesis makes use of Unified Demographic Theory (UDT) and Gender Equity Theory (GET). Both theories are synthesized into one framework that also includes the legal framework of the EU to explain the effects of tertiary education on fertility levels. Unified Demographic Theory sets the ground rules for how people of different educational backgrounds make fertility choices, while Gender Equity Theory explains the intricate societal and political context that affects these choices.

### 3.1 Unified Demographic Theory

Unified Demographic Theory is a theoretical framework, constructed by Lutz (2021), that combines existing knowledge and approaches from the study of demography into one overarching framework. There are still limitations to how much UDT can predict and explain by itself due to the aforementioned underdevelopment of demographic theories. Regardless, UDT still has value in providing important ground rules of how fertility choices are made and what the most important factors are, thereby providing a more fundamental understanding of fertility.

UDT causally links education to fertility behavior by proposing that higher degrees of cognitive ability lead to a reduction of unplanned fertility and more active family planning. This is in contrast to passive (or natural) family-planning where no effort is made to prevent further children once the desired number of children is reached. In less developed countries, this effect on family planning has been shown by observing fertility rates drop from a high level down to replacement level after women became more educated and made more conscious choices about how many children they want to nurture. The main indicator identified by is the obtainment of secondary education for women such that higher rates in developing countries are associated with lower fertility.

The situation in Europe is very different in that the fertility is already below replacement in every single country but also insofar that most women have already obtained at least secondary education. According to UDT, a logical consequence is therefore a more active family-planning and lower rates of unintended fertility (Lutz, 2021). UDT establishes a basic assumption that is implied in each of the arguments and hypotheses that follow from here on:

*In Europe, individual fertility is a matter of personal choice rather than happenstance.*

Therefore, whenever fertility rates increase (decrease) in this context, I argue that it is the immediate result of a higher (lower) number of women of child-rearing age deciding to conceive a child. This allows us to study the factors that impact individual family-planning and connect them directly to changing fertility rates.

### 3.2 Gender Equity Theory

The central theory for the theoretical framework is Gender Equity Theory (GET), first proposed by McDonald (2000). In the context of this theory, gender equity refers to equality between men and women regarding individual rights on the one hand and gender roles on the other hand (what McDonald calls individual-oriented and family-oriented institutions respectively). Individual rights refer to e.g. voting rights, the ability to own land, access to education and healthcare, and many more. Gender roles refer less to formal standards and more to the expected division of labor between men and women. Gender roles consist of three main aspects (McDonald, 2000: 436):

"*Income generation, caring and nurturing, and household maintenance*"

McDonald (2000) explains low fertility as a mismatch in equality between individual rights and gender roles. In today's highly developed countries, women's individual rights have been increasingly expanded over the course of the 20th century, including better access to education and the labor market. Gender roles, on the other hand, have been much less subject to radical change, meaning that women's role in the family stayed relatively the same and did not adapt to women's increasing individual rights (see also Brinton and Lee, 2016). This had led to great levels of gender disparity within the family, even in developed countries: "In marriages, women remain the predominant providers of care and continue to carry most of the burden of household maintenance" (McDonald, 2000: 436).

Extremely low fertility is, according to this theory, not directly a result of low gender equity in both dimensions. Rather, low fertility occurs when equal individual rights combine with unequal gender roles. The reason is that the increase in individual rights has shifted societal expectations of women, especially concerning their participation in higher education and in the labor market. However, gender roles have not shifted alongside to accommodate for this new development. As a result, society in general as well as political actors expect women to participate in the labor force equally, while women still continue bearing most of the household and child-raising burden, creating a *double-role dilemma* for women: If a woman wants to have a child, she has to accept her role as main caregiver but her career might be threatened by this as labor markets do not accommodate for her double-role, ironically by treating her the same as a man. In seeing this conundrum, some women decide to have children and deal with the negative consequences to her career while some women choose to have fewer children or even opt out of having children altogether for the sake of preserving employment. This issue is theorized to result in lower fertility rates since sufficiently many women choose to have fewer children than they would in the absence of the double-role (McDonald, 2000).

Framing fertility choices through the gender equity lens allows for a better explanation and prediction of the low fertility phenomena observed in Europe. Han and Brinton (2022) have shown that gender equity has a positive direct effect on fertility rates and other scholars have pointed out the importance of gender equity in this field (e.g. Anderson & Kohler, 2015).

The conceptualization of gender roles into three distinct aspects – income, family care, and household chores – is a central aspect of the analysis going forward. In the methods chapter, I will construct an index to measure gender role equality within a country. The index will be constructed to reflect people's attitudes about specifically these three dimensions. That way, the index reflects gender roles according to gender equity theory, unlike the more common measures of gender equity that are not restricted to these three dimensions.

### 3.3 EU Legal Framework

Gender Equity Theory asserts that the mismatch of high legal equity and unequal gender roles causes low fertility rates. The analysis that follows in the methodology and results chapters focuses exclusively on gender roles, because it is assumed that legal equity exists in each of the countries throughout the entire timeframe. The reason for this assumption is that each county in the sample is also a member state of the EU which has been providing an extensive framework regarding the legal aspects of gender equity and non-discrimination.

This can be traced back to the Treaty of Rome (1957), where Article 119 established the principle of equal pay between men and women. The historic Case 43/75, Defrenne v Sabena (No 2) (1976), clarified that this article was not merely about economic conditions but also reflected the EU's role as a social union aimed at generally improving the living standards of its citizens. The ruling stated that “this provision forms part of the social objectives of the community, which is not merely an economic union, but is at the same time intended […] to ensure social progress and seek the constant improvement of the living and working conditions of their people” (Defrenne v Sabena, 1976).

Building on this foundation, the Equal Pay Directive 75/117/EEC (1975) required member states to abolish discriminatory laws regarding gender-equal pay. The Case 61/81 of Commission v UK (1982) reinforced that it is the responsibility of each member state to provide an authority before which a worker could argue that their work was of equal value to someone else's and hence they should receive equal pay. Tis would ensure a process for workers to claim their gender-equal pay rights. The Equal Treatment Directive 76/207/EEC (1976) further expanded the scope of non-discrimination based on gender in the workplace, addressing not only pay but also access to employment and working conditions. Similarly, the Social Security Directive 79/7/EEC (1979) extended the principle of equal treatment to social security, covering areas such as sickness, old age, and accidents at work. Moreover, the Equal Treatment in Occupational Social Security Schemes Directive 86/378/EEC (1986) required equal access and benefits concerning occupational pension and similar schemes. To ensure the safety and health of pregnant women and those who had recently given birth, the Pregnant Workers Directive 92/85/EEC (1992) was established. These legal provisions were supported by multiple action programs by the EU to promote equal opportunities for women which serve to demonstrate the EU's proactive stance on gender equality.

Legal amendments pertaining to gender equality have not stopped since the beginning of the selected timeframe with women’s rights only becoming stronger over time e.g. through the Charter of Fundamental Rights in 2000. Regardless, thanks to the comprehensive measures outlined before, by 1992, the EU had already established a robust legal framework ensuring that men and women were equal before the law across all member states. Non-discrimination at the workplace had been a concern of the EU ever since the Treaty of Rome (1957) with more directives following that did not only pertain to the labor market. Since the directives apply to all member states, which was further confirmed by court rulings, I argue that during the period examined in this thesis from 1992 to 2008, individual rights have already been relatively equal for men and women in EU member states. This allows the analysis to shift the focus to gender roles. Therefore, when referring to gender equity henceforth, I refer to its gender role aspect since I assume a constantly high legal gender equity throughout the analysis.

## 4. Hypotheses

### 4.1 Education Hypothesis

In the following, I argue why I expect fertility rates to drop as a result of increased tertiary education rates within a country.

Generally, women who decide to obtain higher education stay in the education system for a longer period of time and therefore enter the labor market at a later point in time which means they become financially stable at a later stage (Beaujouan, 2020, Ní Bhrolcháin & Beaujouan, 2012). From a biological perspective, it is possible for women to have children while pursuing higher education, yet I still expect them not to. Rather, I argue that they make a more conscious choice to have children only after they become financially independent and have a sufficient economic security. Unified Demographic Theory asserts that educated people engage in more active family-planning and choose the timing and number of children more carefully. For the transition to family-planning as a conscious choice by the parents, obtaining secondary education is shown to have the biggest effect. Considering this, it is unlikely that students would decide to have children right away since they already obtained secondary education and are therefore more likely to make conscious family plans. In seeing that their economic situation is a lot more precarious before entering the labor market, they are more likely not to opt for having children right away. Scholars have shown that economic precariousness is one of the main factors in people's decision not to have a child (e.g. Scherer & Brini, 2023). Therefore, it is much more likely that students wait until they are settled in a stable employment situation before having children.

Previous research does not provide conclusive evidence that this postponement ultimately leads to a fertility decline or if it merely leads to having children at an older age. Yet, I expect a negative tertiary education effect due to postponement. The reason for this is that women have a shortened timeframe to work with in which it is feasible to have children (Barban, 2015). They have to settle in the labor market, become financially independent, get settled in their career and find a suitable partner, all while fertility decreases with each passing year. Zanella et al. (2018: 752) describes this as the "rush hour of life". Especially women at this stage have to rush these steps, which I argue will naturally lead to lower fertility because of the increased hurdles. Out of the educated women who wish to have children, some will become naturally infertile due to increased age (Barban, 2015), some will not have been able to settle financially in the shortened amount of time.

Postponement is not the only hurdle for highly educated women though as opportunity costs are also expected to play a big role. Not only is higher education strongly associated with better career opportunities, which means higher opportunity costs of having children. At work, they are also faced by the glass ceiling, much more so than women of lower educational background. Cotter et al. (2001, p. 658) characterizes the glass ceiling as an "inequality [that] represents a gender […] difference that is greater at higher levels of an outcome than at lower levels of an outcome". This means that, by its very definition, the existence of the glass ceiling becomes an increasing issue in higher positions in the hierarchy of an organization. I argue that since highly educated people occupy higher positions more frequently (Ezzedeen et al., 2015), they are disproportionately affected by the glass ceiling. Therefore, the career risk resulting from childbearing is higher for them than for women with only secondary education. This is because they often have a better careers to begin with which means that the opportunity costs are generally higher already. On top of that, more educated women are more likely to occupy higher positions at work which means the glass ceiling effect is stronger for them compared to less educated women.

Policies that protect women's careers may be able to mitigate some of these effects related to the labor market. However, research points out that women's careers are not adequately protected in most countries, especially not in the time period of 1992 to 2008 (Bergsvik et al., 2021). While a lot of progress has been made compared to prior decades, it is likely not able to offset the negative effects outlined above. On top of that, postponement is not addressed by policy-makers in any effective way. The *Education-Hypothesis* follows:

*H1: Increased tertiary education rates have a negative effect on fertility rates.*

### 4.2 Gender Hypothesis

McDonald (2000) argues that low fertility results from high gender equity regarding individual rights paired with low equity regarding gender roles. From this, it follows that increasing gender role equity would mitigate the negative effect. This happens regardless of educational background.

In the EU, the legal aspects of gender equality and women's institutional rights have already been firmly cemented in the legal framework, starting as early as the Treaty of Rome (1957), and being further specified in directives and confirmed by courts. Therefore, increasing gender role equity likely has a positive effect here as a direct implication of gender equity theory. The positive direct effect of gender equity, regardless of educational background, has also been shown by other scholars.

Going one step further than previous research, I argue that gender equity positively impacts the effect of higher education on fertility. When high levels of gender equity are present, the effect of higher education is more positive than for low gender equity. The reason for this is that highly educated women are more likely to be in a situation where the double role mismatch is especially problematic. Gender Equity Theory states that gender roles are the key issue. Low fertility is argued to be a result of women not being able to fulfill their role in the labor market while keeping their traditional home and family responsibilities (McDonald, 2000). This means that the double role is particularly problematic for women who work full time, which is much more likely for women of higher education, especially during the timeframe. Women of only secondary education are less likely to work full-time, both because they work part-time more often and they are also more likely not to be employed at all (Scherer & Reyneri, 2008). Scholars such as Fuchs (2017) have shown a negative association between full-time work and fertility. From the perspective of GET, there is no reason for why those women who do not work full time could not combine their roles since it is not part of their role to generate income. Therefore, since highly educated women are more likely to be in full-time employment, it is more likely that they are in a position where high degrees of gender equity support them significantly. Furthermore, Rendall et al. (2010) have shown that incompatibility between employment and family life affect highly educated women to a greater extent.

To summarize, gender equity alleviates the double role problem. Highly educated women are more likely to face the double role due to their increased full-time employment. Thus, the alleviating effect of gender equity applies more to highly educated women than to less educated women. The *Gender-Hypothesis* follows:

*H2: Gender equity impacts the effect of tertiary education on fertility rates, such that increased gender equity leads to a more positive effect of tertiary education on fertility rates.*

## 5. Methodology

In order to estimate the effects of higher education on fertility rates, I use panel regression for a dataset of ten European countries between 1992 and 2008. This time period was chosen specifically because it is situated between two major global events: the fall of the Soviet Union and the global financial crisis. Previous research indicates that material concerns and the state of the economy have played a more vital role in people's fertility choices after the financial crises following 2008 (Matysiak et al., 2021). Therefore, that year fits as a natural cutoff point.

### 5.1 Gender Roles Index

Before examining the exact methodology for the panel regression analysis, I explain how gender roles are operationalized in this thesis as it involves the creation of a new index. Because of this, gathering the data for gender roles has been more complex than for the other variables and therefore it merits a separate explanation.

Out of the various measures for gender equity, none are operationalizing the theoretical concepts that we outlined previously. In the theory chapter, I have argued that the aspect of gender disparity that are mainly affecting fertility rates is the gender roles i.e. the expected division of labor between men and women (see McDonald, 2000). Therefore, I created a separate index called the *Gender Roles Index* (GRI). The purpose of this index is not to display a legal or economic view on gender equity but rather to reflect how equal people's expectations are towards both genders. This allows us to quantify the notion that women are expected to work in dual roles which is one of the main mechanisms that renders getting children more difficult for women.

The GRI takes into account each of the three dimensions of gender roles and turns survey responses on each of them into one final index. The European Values Study (EVS, 2022) provides questions about gender expectations regarding working, caring (for children), and household chores, which are the three dimensions of gender roles. Therefore in the first step, appropriate variables were selected from the survey. Then the index was created for each country-year combination by calculating the proportion of people that have equal gender role expectations. EVS participants are coded such that an unequal expectation on any of the three dimensions counts as a unit-specific value of 0. In case of gender-equal expectations across each dimension, a study participant is coded as 1. The final GRI is then the proportion of people per country and year that have gender-equal expectations, from a scale of 0 (least equal) to 100 (most equal).

Cronbach's Alpha for the variables going into the GRI calculation was estimated to be 0.62. This value is a bit lower than is typically desirable in social science research, with 0.7 often being regarded as the ideal threshold (Bujang et al., 2018). Our value is still reasonably high and the variables are measuring different aspects of gender role expectations, therefore this Cronbach's Alpha value is overall acceptable. In the later section about robustness checks, alternative measures of gender equity are also used to cross-check and confirm the main results achieved with the GRI.

### 5.2 Panel Regression – Fixed-effects vs. Random-effects

In the next step, values for the GRI are used to construct a panel dataset in conjunction with tertiary education rates as well as fertility rates for each country and each year from 1992 up to 2008. From this dataset, I estimate the effect of education on fertility rates using panel regression analysis.

There are two main ways in which effects can be estimated, namely fixed-effects (FE) and random-effects (RE). The choice between the two hinges on the question if *confounding variables* are assumed to exist. Those are variables that influence the variables in the analysis even if the confounder is unaccounted for. In a simple regression model, such confounders lead to biased estimates if they are not included.

A fixed-effects model automatically cancels out all country-specific effects that are time-invariant, i.e. effects that do not change over time. In this case, this would include factors that contribute to both education and fertility rates such as e.g. religiousness (Bein et al., 2021;

Mogi et al., 2022). Religiousness differs between countries and could explain part of the differences in the results but it is also likely stable over time within a country. A fixed-effects model accounts for all such factors that do not change over time without the need to include them into the model. Even if a confounder varies within a country over time, it is still not an issue for the fixed-effects model as long as this change happens equally across all countries, e.g. because of an external shock that affects the entire continent.

A random-effects model assumes that those kinds of confounders do not exist. The advantage of a random-effects model is that it often has lower standard errors, meaning a higher confidence in the results but there is the risk of unobserved heterogeneity which would lead to biased results (Cunningham, 2021; Wooldridge, 2010).

After computing the results, statistical tests empirically assess which model is more appropriate for the data but I will also argue theoretically what model should be preferred here before analyzing the results. From reviewing the literature, a *fixed-effects* model seems more appropriate. The model choice revolves around the existence of country-specific effects on the independent variables, in this case the attainment of higher education. Research has shown numerous factors that influence education rates, many of which differ between countries. Societal factors such as religiousness (Bein et al., 2021; Mogi et al., 2022) and healthcare systems (Bergsvik et al., 2021) are different between countries but are likely stable within a country. I argue that there are many such factors that differ between countries due to differences in social and political culture but do not significantly differ within a country across this time period. Higher education would likely be influenced by some of those factors. Therefore, the assumption that there are no unique country-specific effects that correlate with a country's higher education rate does not appear to be sensible. Therefore, fixed-effects models should be the preferred choice here.

Nonetheless, I will report each model both as a fixed-effects and as a random-effects model. I will then use a Hausman test to empirically assess which kind of model is more appropriate. A Hausman test takes fixed-effects estimates and random-effects estimates and tests if country-specific time-invariant effects are correlated with the independent variables. If this is the case, the computed test statistic that compares both estimates will turn out significantly large and the null hypothesis that the random-effects model is more appropriate would be rejected (Wooldridge, 2010).

### 5.3 Interaction Effect and Structural Model

The regression model includes tertiary education rates and the GRI as independent variables, and fertility rates as the dependent variable. Additional control variables that are added are outlined later in this chapter.

This thesis is not concerned with the direct effect of gender roles on fertility rates. Instead, I examine how it influences the effect of tertiary education. To do this, an interaction term is added into the model between GRI and tertiary education. Interaction terms indicate how the effect of one variable changes as the other one increases. In this case, it would show if the effect of education becomes weaker or stronger, depending on the GRI level.

However, this causes an issue with the interpretability of the direct effect of education because that changes if an interaction effect is present. Without an interaction effect, a direct effect can be interpreted as the change given that all other variables are constant. In the presence of an interaction term, the direct effect reflects the effect given that the other variable is zero. Therefore, when I include the interaction term, the direct effect of education assumes that the GRI value is exactly zero (Wooldridge, 2010). This is an issue for interpretation because a GRI value of zero does not occur in the data. In order to give the direct effect a meaningful interpretation, Grand Mean Centering is performed on the tertiary education variable and the GRI. This method adjusts a variable such so that their mean is zero which is done by subtracting the mean from each value. The resulting values then reflect how much they deviate from the variable mean. Using centered variables for the regression analysis allows us to interpret the direct effect more intuitively (Enders & Tofighi, 2007). Now the direct effect of education represents the effect of education while assuming an average GRI value which is more sensible than assuming a GRI value of zero.

The resulting theoretical model can be represented with the following equation:

$$Fertility_{it} = \beta_1 Education_{it} + \beta_2 GRI_{it} + \beta_3 (Education \times GRI)_{it} + \alpha_i + \epsilon_{it}$$

The subscript i represents the different countries while t denotes the year. In this model, $\beta_1$ represents the effect of tertiary education on fertility rates, $\beta_2$ captures the effect of gender roles as indicated by the GRI, and $\beta_3$ denotes the interaction effect between tertiary education and gender roles. The term $\alpha_i$ represents the country-specific effects that are time-invariant, and $\epsilon_{it}$ is the error term.[1]

## 5.4 Control Variables

The fixed-effects model accounts for time-invariant variables, but other confounders still have to be controlled for manually. Specifically, the FE model does not automatically account for variables that (1) affect tertiary education rates, (2) vary over time within a country, and finally (3) vary differently across countries (Wooldridge, 2010). In the following I present the three variables that, according to relevant literature, fulfill these three criteria:

*Total public spending on education (% of GDP*) is one of the clearest ways in which governments can influence educational attainment, as Yang and McCall (2014) have shown in their panel data study covering many different countries between 1998 and 2009. This variable captures the political as well as the economic dimension of education since government policies to increase education usually do so via increased spending. Over the course of our timeframe, public spending can greatly vary with new policy strategies being implemented at different points during different legislative periods. It can also be assumed to vary differently across the sample countries since education policy is not an exclusive competence of the EU, leaving education policy largely to the member states. Therefore, more inter-country variation can be expected than in other policy areas. *GDP per capita* has also been shown by Yang and McCall (2014) to have a positive influence on higher education rates. The values are log-transformed and representing a constant US dollar value to account for potential issues of inflation. Lastly, Yang and McCall (2014) identified the *proportion of people aged 65 and older* to be negatively correlated with higher education rates.

## 5.5 Data

The panel dataset is constructed out of data from various sources. The GRI uses survey responses to the European Values Study (specifically its second wave from 1990, the third wave from 1999, and the fourth wave from 2008). The biggest advantage of using the EVS is the large scope of the survey with many different questions and over 75,000 participants just

[1] Additional control variables are considered and outlined in the next section, yet empirical tests later reveal that they do not significantly improve the model. Thus, they are not included in this model equation.

from the countries included in this analysis across the three EVS waves. The EVS (2022) captures, among many more things, the expectations that people have regarding gender roles across most European countries. Appropriate survey questions that capture the three dimensions of gendered division of work were selected.[2] Then I calculate the proportion of people that agree on each of the questions, grouped by both country and year. This provides us with GRI values for 1990, 1999 and 2008. In order to obtain values for the remaining years, I used linear interpolation between the values so there are equal, linear steps in the years between the EVS waves. I argue this is sufficient to capture gender role expectations. In the covered time period, there is a nine year gap between each wave. I argue that societal expectations towards men and women do not significantly fluctuate in the meantime and that gender roles, like other social constructs, are relatively stable over time (see e.g. Clarke et al., 1993). Using empirical data in nine-year intervals is then sufficient to capture large-scale societal changes. Furthermore, even though each EVS wave is associated with just a single year, the actual studies are carried out across several years so any changes between years already likely permeate into the empirical data.

Education and fertility data were largely provided by Eurostat (2024 a, b) as it is generally the most reliable source of education data for EU member states. I examine the rate of tertiary educational attainment in a country at any given year. I included only people age 25 to 64 to make the estimates more precise as the analysis is not concerned with people outside this age range. The Eurostat data was complemented by education data from the Swedish statistics institute (Statistiska Centralbyrån, 2024) for the years 1992 to 1994. Missing data on total fertility rates in Germany was complemented by the German statistics institute (Statistisches Bundesamt, 2024). For France, missing fertility rates for the years 1992 to 1997 were filled in with data from the Human Fertility Database (2024). Finally, the data for the control variables were provided by the World Bank (2024 a, b, c).

### 5.6 Countries Included in the Analysis

In order to construct the panel dataset to be as representative as possible, all states were included that were EU member states between 1992 and 2008 and had available data for all

[2] Selected survey questions:
*Generating income:* "Both the husband and wife should contribute to household income"
*Caring and nurturing:* "If someone says a child needs a home with both a father and a mother to grow up happily, would you tend to agree or disagree?"
*Household maintenance:* "Here is a list of things which some people think make for a successful marriage or partnership. Please tell me […] whether you think it is very important, rather important or not very important? Sharing household chores"

relevant variables. The only exceptions to this rule are Sweden, Finland, and Austria which I included as candidates for the analysis (though Finland and Austria had to be excluded due to missing data). These countries became EU member states in 1995 so they were technically not EU member states for the entire timeframe selected for the analysis. However, the missing three years of non-membership from 1992 to 1994 are arguably not long enough to justify an exclusion. More importantly though, my argument for only including EU countries in the first place is that the EU provides each member state with a legal framework that accounts for non-discrimination based on gender. But since these three countries are quite advanced in that regard anyway – especially Sweden around that time (Eriksson & Pringle, 2011) – I argue that they fulfill the criteria regarding the legal aspects of gender equity at least as much as the other EU countries, including the time period of the early 1990s.

Greece and Luxembourg are excluded from the analysis because neither country participated in the second wave of the European Values Study in 1990 (EVS, 2022). Therefore, there is no GRI value for 1990 which in turn means that all GRI values between 1992 and 1998 are missing from the final dataset. Given that the calculation of the GRI hinges on the specific answers from the EVS, substituting the missing values with data from other sources is not feasible.

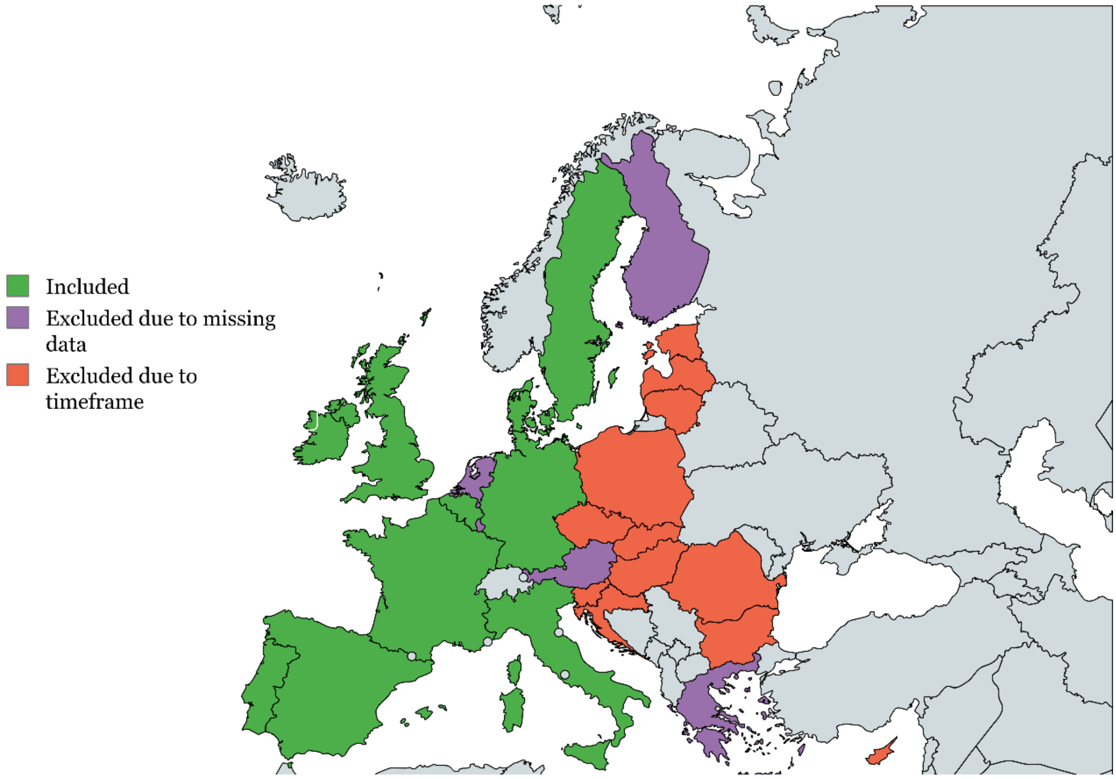
Austria has different issues with data availability and reliability. It has missing values for tertiary education rate for seven out of the 17 years. The values that are available tend to have issues with low reliability, as indicated by Eurostat and I was unable to find more reliable data from other sources. Therefore, I exclude Austria as well.

Finland and the Netherlands had to be excluded due to missing education data for the years 1992 to 1994 and 1992 to 1995 respectively. Even after extensively screening the statistics office data for both countries (Tilastokeskus and Centraal Bureau voor de Statistiek respectively) as well as other potential sources, no reliable data could be found.

For some other countries, however, the data availability issue is not so grave. Four countries (France, Germany, Ireland, and the UK) have a single missing value each where the tertiary education rate is unclear. Rather than excluding these countries entirely, I argue that an interpolated value as a replacement for the missing value is sufficient as educational attainment rates are cumulative, i.e. they apply for the entire population even for those who have attained a degree many years ago. As such, it is unlikely that the rate in any given year is far away from the rate in the year before or in the year after. While this does introduce uncertainty into the data, I argue that this uncertainty is fairly small and has only a limited impact on the results. Being able to include four more countries in the analysis makes the results more robust and representative which I argue outweighs the uncertainty that is introduced.

**Figure 1**

*EU Countries Included in the Analysis*




This leaves a final list of ten countries included in the analysis, consisting of Belgium, Denmark, France, Germany, Ireland, Italy, Portugal, Spain, Sweden, and the UK.

## 6. Results

### 6.1 Descriptive Statistics

In the following, I will present descriptive statistics on the relevant variables. The focus lies on fertility rates, tertiary education rates and the Gender Role Index as those are the main variables of the analysis. Therefore, the control variables (GDP per capita, public education spending and the rate of people over 65) receive less focus.

**Table 1**

*Descriptive Statistics*

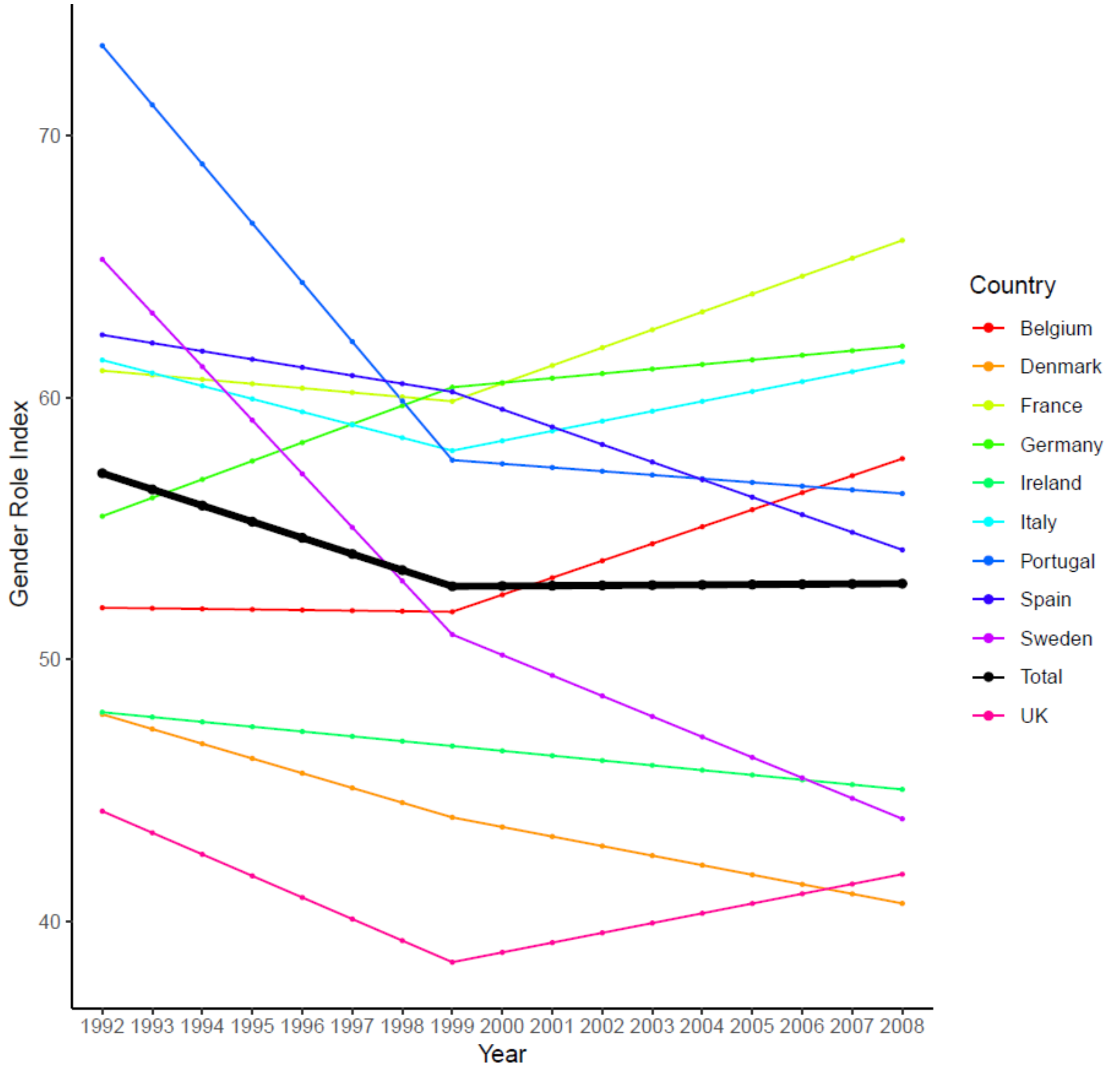
| | Mean | SD | Min | Q1 | Median | Q3 | Max | Skew-ness | Kurto-sis |
|---|---|---|---|---|---|---|---|---|---|
| Fertility rate | 1.60 | 0.25 | 1.13 | 1.36 | 1.65 | 1.80 | 2.09 | -0.13 | -1.24 |
| Tertiary Education | 22.20 | 7.30 | 6.80 | 17.65 | 23.75 | 27.60 | 35.90 | -0.51 | -0.75 |
| Gender Role Index | 53.85 | 8.02 | 38.44 | 46.38 | 56.43 | 60.52 | 73.45 | -0.26 | -1.03 |
| GDP per capita (log) | 10.39 | 0.30 | 9.62 | 10.28 | 10.42 | 10.60 | 10.90 | -0.66 | -0.05 |
| Education spending | 5.21 | 1.18 | 2.99 | 4.38 | 4.85 | 5.66 | 8.22 | 1.04 | 0.36 |
| Population aged 65+ | 15.97 | 2.02 | 10.68 | 15.27 | 16.05 | 17.13 | 20.22 | -0.85 | 1.17 |

Note: N is 170 for all variables

Table 1 shows the descriptive statistics for the main variables in the analysis. Fertility rates stay between 1.1 and 2.1 throughout the dataset, with an interquartile range (IQR) from 1.36 to 1.8, covering half of the data. The average tertiary education rate is 22%, with a standard deviation of 7 percentage points and an interquartile range (IQR) from 17% to 28%. Gender roles have a mean value of around 50%. This value does not directly represent how much equality there is between men and women, e.g. it does not mean that gender roles are on average 'half equal'. Values closer to zero represent a more unequal expectation about labor division while values closer to 100 percent indicate more equity in that regard but the substantive interpretation of any single number only makes sense in comparison to other countries or years. Each of the three main variables have a slight negative skewness, which generally indicates that the distribution of a variable has a longer 'tail' on the left side. The bulk of the values (including the median) are then concentrated on the right side of the distribution. That means that most countries have fertility rates, tertiary education rates and gender role index values that are slightly above average with a few countries that are far below average dragging down the mean. Though the size of the skewness appears to be relatively small for each of the variables. Appendices A, B, and C visualize the distribution of tertiary education rates, the GRI, and fertility rates in the sample.

**Figure 2**

*Gender Roles Index over time per Country*




There is a wide range of GRI values across different countries and years. Gender Role equity has taken a substantial dip between 1992 and 1999 in most countries. Trajectories afterwards are more mixed, with France, Germany, Italy, Belgium, and the UK having an increased GRI compared to the GRI decreasing in Portugal, Spain, Sweden, Ireland, and Denmark while the aggregate GRI stayed roughly the same throughout the 2000s. Both at the start and the end of the timeframe, GRI values vary widely between countries, showing that the fact that these are all EU member states have to abide by the same legal framework but do not necessarily share the same attitudes regarding gender roles.

## 6.2 Panel Data Analysis

For the final analysis, different models were estimated that each contain different variables (see Table 2 below). Each model contains fertility rates as the only dependent variable. I started with a simple panel regression that uses only tertiary education rates as the explanatory variable. The next model includes the Gender Roles Index as a control variable. Afterwards, the third model estimates an additional interaction effect between tertiary rates and the GRI. An interaction effect indicates that the effect of one variable on fertility becomes stronger if the other variable is higher. So in case of a positive interaction effect between higher education and gender roles, it would mean that higher education has a more positive impact on fertility for higher GRI values, which is what my Gender Hypothesis predicts. In the final model, the additional control variables outlined in the previous chapter (GDP per capita, public spending on education, and the rate of people aged 65+) were included to ensure that potential confounders were accounted for.

I have argued for the use of fixed-effects estimation over random-effects estimation previously. Nonetheless, for the sake of transparency and in order to verify this assertion, each of the four models was estimated both as a random-effects and as a fixed-effects model. This means there are four model types, each estimated as a fixed-effects and random-effects, meaning there are eight models in total. Unlike many other panel regression analyses, standard errors are not weighed here since each country has the same amount of observations (10 countries across 17 years, totaling 170 observations).

### *6.2.1 Summary of Main Results*

Contrary to the education hypothesis, the direct effect of education is positive and significant in each of the models, regardless of estimation method. Across each of the different models, the effect size stays relatively stable, always staying between 0.011 and 0.014. This indicates a robustness of the direct effect of education as there appears to be no single variable that has a major impact on this effect. The interaction effect is also positive in each of the four models that it appears in, and significant at the 5% level in three of them, with the last one having a p-value of 0.069 which is still close to the 5% significance level.

The overall explanatory power of the model, represented by the $R^2$ and the adjusted $R^2$ value, indicate that the biggest additional factor beyond education is the introduction of the GRI into the model.

**Table 2:** *Panel Regression Results (Dependent variable: Fertility rate)*

| Model | Basic (including only education) | | Additional gender roles effect | | Additional interaction effect[a] | | Additional control variables | |
|---|---|---|---|---|---|---|---|---|
| Estimation method | Random-effects[b] (1) | Fixed-effects (2) | Random-effects (3) | Fixed-effects[b] (4) | Random-effects (5) | Fixed-effects[b] (6) | Random-effects[b] (7) | Fixed-effects (8) |
| Tertiary Education | 0.01133*** | 0.01103*** | 0.01313*** | 0.01290*** | 0.01391*** | 0.01375*** | 0.01171*** | 0.01106*** |
| | (0.00174) | (0.00176) | (0.00167) | (0.00166) | (0.00169) | (0.00169) | (0.00312) | (0.00320) |
| Gender Roles | – | – | 0.00933*** | 0.01020*** | 0.00935*** | 0.01009*** | 0.01042*** | 0.01125*** |
| | | | (0.00188) | (0.00189) | (0.00185) | (0.00187) | (0.00218) | (0.00218) |
| Education:Gender | – | – | – | – | 0.00033* | 0.00033* | 0.00048* | 0.00037 |
| | | | | | (0.00015) | (0.00015) | (0.00020) | (0.00020) |
| GDP per capita (log) | – | – | – | – | – | – | 0.14239 | 0.11827 |
| | | | | | | | (0.09450) | (0.09606) |
| Education spending | – | – | – | – | – | – | -0.00997 | -0.01551 |
| | | | | | | | (0.01349) | (0.01357) |
| Population aged 65+ | – | – | – | – | – | – | -0.01036 | -0.00184 |
| | | | | | | | (0.00906) | (0.00947) |
| Observations | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 |
| $R^2$ | 0.20153 | 0.19747 | 0.30382 | 0.32236 | 0.32518 | 0.34175 | 0.32925 | 0.35464 |
| Adjusted $R^2$ | 0.19678 | 0.14700 | 0.29548 | 0.27518 | 0.31298 | 0.29143 | 0.30456 | 0.29178 |

*Notes:* *p<0.05; **p<0.01; ***p<0.001

[a] Model including tertiary education, gender roles, and their interaction preferred according to Wald test

[b] For each model (except the basic model), fixed-effects is preferred according to Hausman test

### *6.2.2 Best Model Fit*

In order to confirm which model provides the best fit, Hausman and Wald tests were conducted between the different model specifications. Wald tests assess if added variables significantly improve the explanatory power of the model. Conducting a Wald test on all four models reveals that including the GRI as well as its interaction with tertiary education significantly improves the model fit while the additional control variables do not improve the model. This holds true for both fixed-effects and random-effects variants of the models (see Appendices D and E). Although the control variables were argued to be potentially confounding the relationship between higher education, gender role equity, and fertility rates, their impact is not significant. Only the introduction of the GRI and the interaction term between the GRI and education significantly improve the model.

Hausman tests can be used to empirically assess if a fixed-effects or a random-effects model is more appropriate (Wooldridge, 2010). After conducting Hausman tests on each model, it turns out that fixed-effects are the preferred estimation methods for each model. For the model with the interaction effect and without further controls – the best fitted model according to the Wald test – a fixed-effects model is preferred according to the Hausman test (p-value of 0.014). This also aligns with the theoretical reasoning.

These test results, when combined, indicate that the best fit is reached by the fixed-effects model including tertiary education, gender roles, as well as their interaction (model (6) in the regression table). Therefore, model (6) will be regarded as the *main model* from now on. In this model, each of the independent variables and their interaction have a positive effect and are significant.

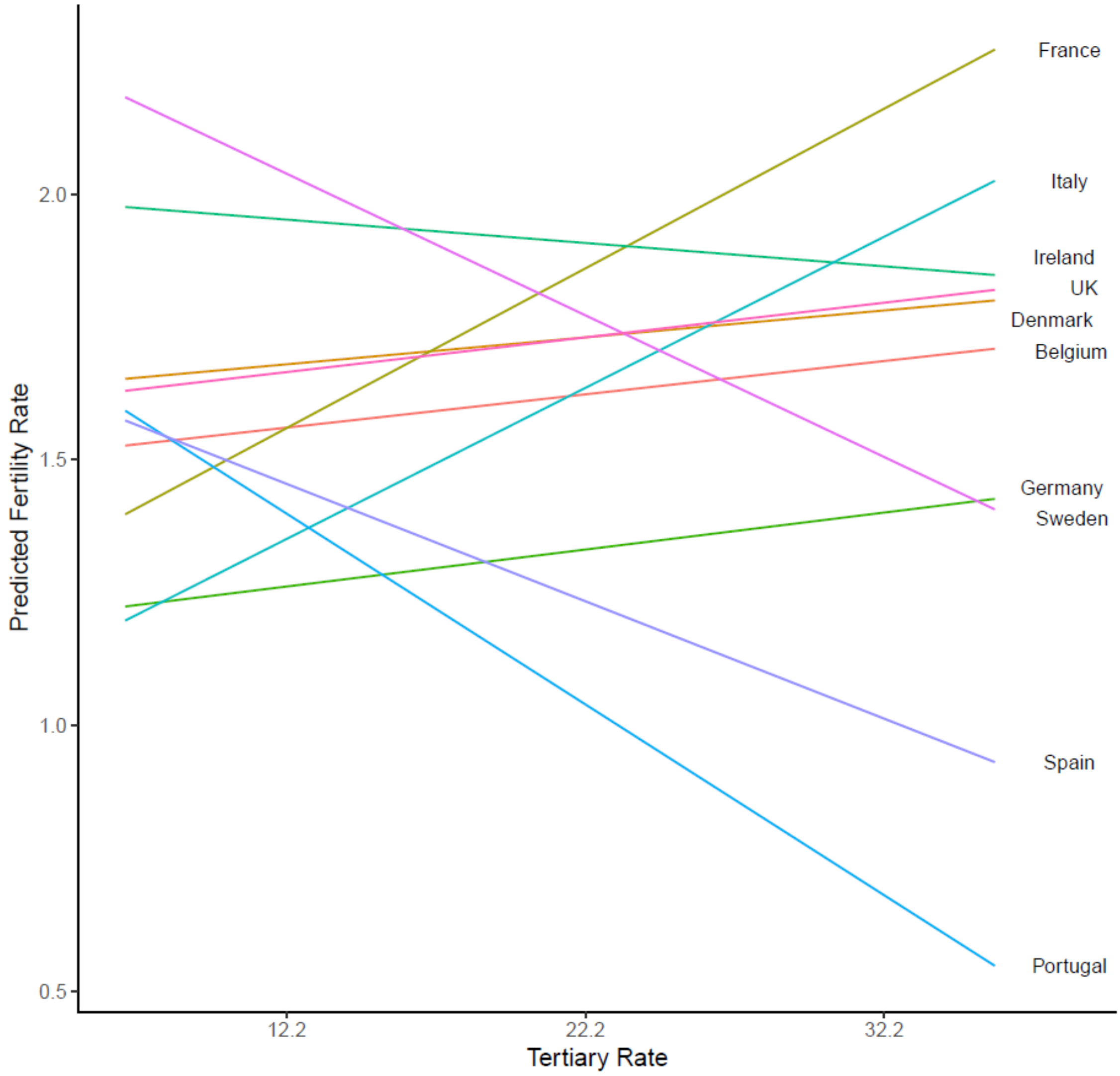
### *6.2.3 Direct Effect of Education*

Due to the prior centering of tertiary education and GRI around their mean, the direct effect of education has an intuitive interpretation. The direct effect of tertiary education rates in the main model is 0.01375. This may not appear to be a big effect. However, across the entire panel dataset, tertiary education rates can differ by up to almost 30 percent, meaning this effect can be quite sizable in practice. It is important to consider that fertility rate differences of just 0.3 or 0.4 are already considered to be quite large and have implications for the demographic change in any given country. That the effect appears to be small is mostly the result of the scaling of the variables.

The effect is positive and significant which contradicts the theoretical expectations. The education hypothesis specifically predicted a negative value.

**Figure 3**

*Direct effect of Tertiary Education by Country*




***6.2.4 Country-specific Effects***

Even though the regression results seem to draw a clear picture about the positive effects of tertiary education, estimates vary widely across countries. Figure 3 uses predicted fertility values to demonstrate the effect of education, assuming each country to be at its own mean GRI value. Predicted values are not the actual observations but rather estimated values based on the regression model. They are useful in providing visual clarity of the relationship between variables in the model.

Of the ten countries, six of them show a positive education effect, while the remaining four – Ireland, Sweden, Spain, and Portugal – have a negative direct effect. The countries vary widely in the direction and size of the education effect The discussion chapter will further analyze and evaluate possible explanations for why there exists such a discrepancy between these countries and analyzes the implications.

Even though four countries do exhibit a negative education effect, the education hypothesis is ultimately not supported.

#### *6.2.5 Interaction Effect*

The interaction effect is positive and significant at the 5% level, indicating that tertiary education has a stronger effect on fertility rates when GRI values are higher. In other words, the positive association between tertiary education  and fertility is especially pronounced in countries with high gender equity. This can be quantified using marginal effects. It provides empirical evidence in favor of the gender hypothesis since higher levels of gender equity boost the effect of education.

**Table 3**

*Marginal Effects of Tertiary Education (Main Model)*

| Variable | Min. | Mean. | Median. | Max. |
|---|---|---|---|---|
| Tertiary Education Rate | 0.00871 | 0.01375 | 0.01459 | 0.02016 |

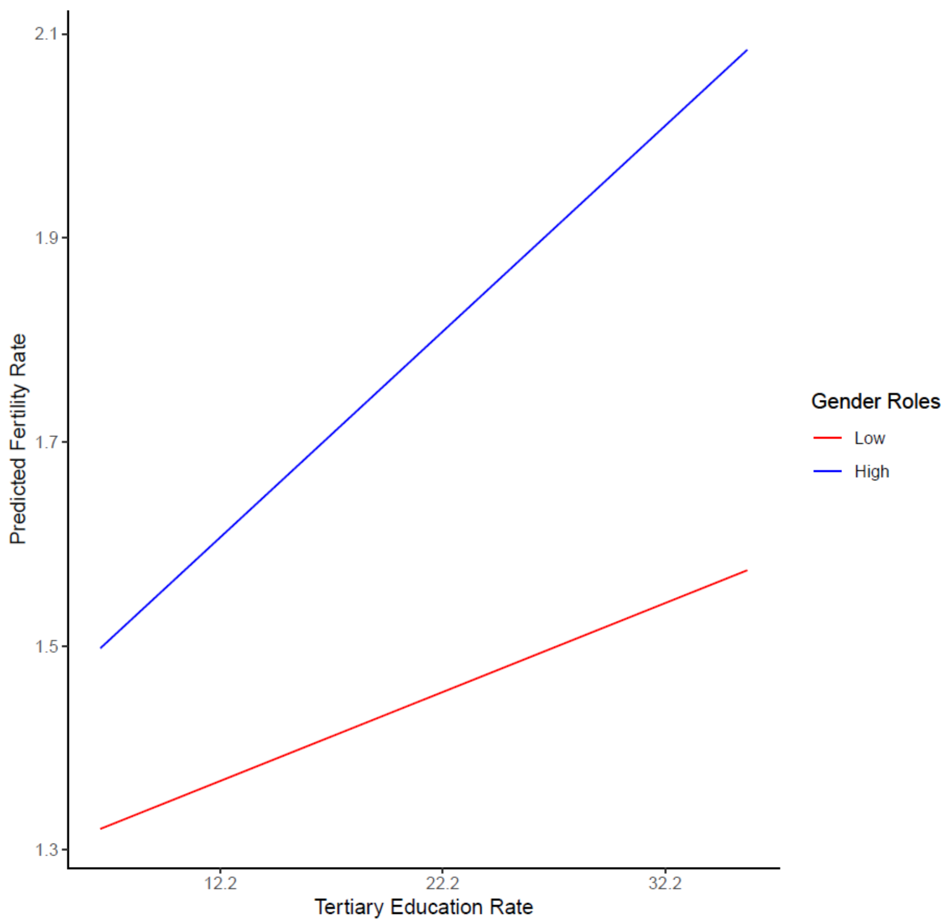
Marginal effects can help isolate the effect of a variable when interaction effects with other variables are present. The range from minimum to maximum marginal effect hinges on the GRI value. If a country has very high levels of gender equity, the effect of education can increase up to 0.020. On the other hand, the effect of tertiary education rate can be as low as 0.009 if the GRI value is at its lowest. Substantially, this means that at the highest GRI value, the positive effect of education is *more than twice as strong* as for the lowest GRI value. Notably, that means even with low gender role equity, education still has a positive effect.

The marginal effects provide evidence in favor of the gender hypothesis. I argued that high degrees of gender equity would result in a more positive education effect. This is clearly the case here as we see the education effect become more than twice as strong for high degrees of gender equity.

Figure 4 shows the effect of tertiary education on fertility rates for different GRI levels using predicted values for fertility. It is already visually apparent that even for low GRI levels, the effect of education is positive, and even more so for high GRI levels. At the highest GRI value (blue line) and the maximum tertiary education rate in the sample, the model predicts a fertility rate of almost 2.1, contrasting with a predicted rate of only 1.5 for the same education rate at the lowest GRI value in the sample. The steeper slope of the blue line indicates that the effect of education is stronger. These results speak in favor of the gender hypothesis that predicted a more positive effect of education for high levels of gender role equity.

**Figure 4**

*Effect of Tertiary Education for High and Low GRI values*



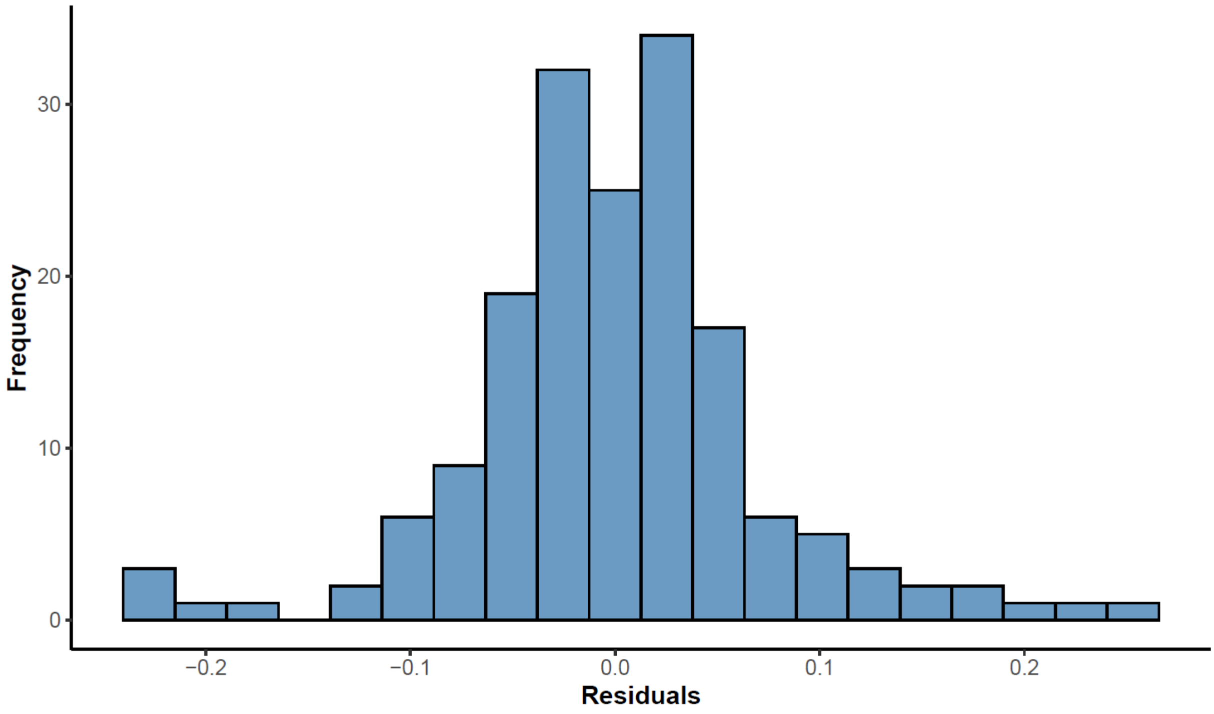
### 6.3 Diagnostic Tests

The final step in the analysis of the main results are the diagnostic tests. These are tests that check if the mathematical assumptions that the regression calculations rely on, are actually fulfilled by the data. If they do not hold, the results may be biased and cannot be directly interpreted in the usual manner anymore. For the diagnostic tests, I used only the main model. I focus on the assumptions that pertain to the residuals, the differences between predicted values in the model and the actually observed values.

First is the assumption of residual normality, meaning that residuals should follow a normal distribution around the mean of zero. Figure 5 shows the histogram of residuals which I can use as a first visual test.

**Figure 5**

*Histogram of Residuals*

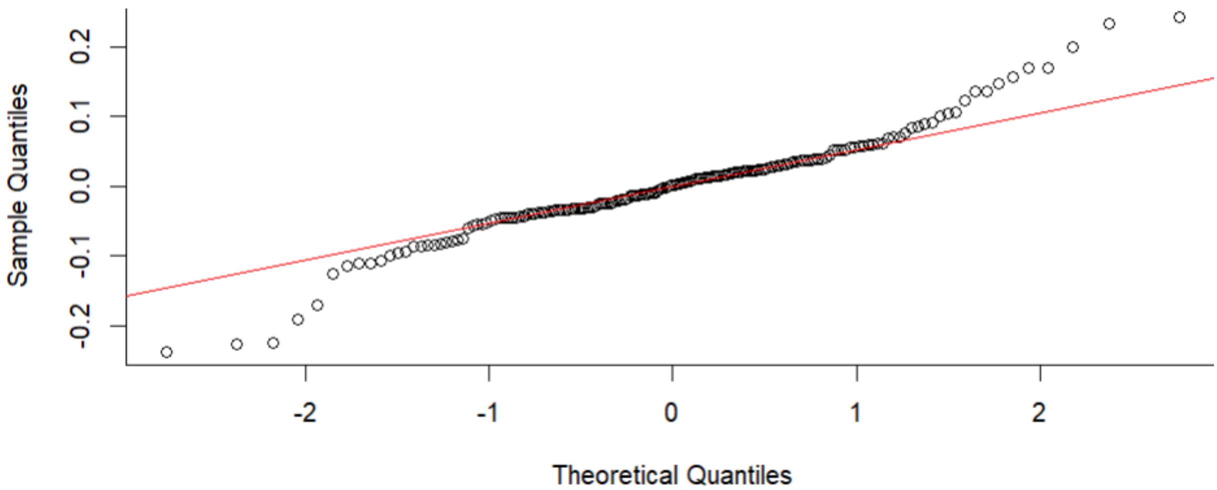



From the visual test, the assumption of residual normality already appears questionable. Most residuals indeed have a value close to zero, yet the bell-shape of the distribution is quite rough with outliers on both sides, especially the left side.

I can further visualize this using a normal Quantile-Quantile (Q-Q) plot (Figure 6). With it, I can visually compare the residual distribution to a theoretical normal distribution to check if both align and if there are deviations. In Figure 6, the red line represents the theoretical normal distribution which the residuals would ideally follow closely. The plot shows that the points in the center of the plot (around the mean) lie close to the red line, indicating that the residuals in the middle of the distribution are approximately normal. Around both tail ends, the actual data deviates quite a bit from the normal distribution, they are more extreme than what would be expected under normality. From this, I can argue that observations around the mean are roughly normally distributed, with extreme outliers at both ends.

**Figure 6**

*Normal Q-Q plot of Residuals*




These visual tests give a decent insight into residual normality but I can also employ a more quantitative method to measure the normality using a Shapiro-Wilk test. It tests whether the residuals deviate from a normal distribution, with the null hypothesis being that the residuals are normally distributed (Royston, 1992). Applying the Shapiro-Wilk test reveals a p-value below far below 0.05, which means a significant deviation from normality.

To conclude, both the visual tests and the Shapiro-Wilk test indicate that the residuals are not normally distributed. This is a problem for the interpretation and generalizability of the results.

Finally, I test for heteroscedasticity using the Breusch-Pagan test. Heteroscedasticity means that the variance of the residuals is not constant across all levels of the independent variables. The presence of heteroscedasticity violates one of the key assumptions of panel regression which assumes a constant variance of residuals. Mathematically speaking, the Breusch-Pagan test performs a separate regression of the squared residuals onto the independent variables. It then examines the $R^2$ of this so-called auxiliary regression. The idea is that if the variance of the residuals is constant across all values of the independent variables, then this regression would not produce a large $R^2$ (Frees, 1995). If the $R^2$ is too large, however, it is an indication that the residual variance is not constant and deviates for different values of education and GRI which is exactly what heteroscedasticity refers to.

Performing the Breusch-Pagan test on the residuals, it turns out that heteroscedasticity is present as indicated by the significant test result (p-value $< 0.001$). This, on top of the residual non-normality, is another limiting factor regarding the validity of the results.

### 6.4 Robustness Check

As of right now, the biggest potential for unrobust components in the analysis lies in the Gender Roles Index as it is a newly created index. Therefore, the robustness check section focuses on using an alternative measure that is conceptually similar to gender role equity. In the previous chapters, I explained why I think that traditional measures are not able to fully capture the theoretical aspect that this thesis focuses on, which is including expectations about the division of labor, and excluding legal aspects. Despite this, it would be useful to use measures to cross-check the results. This can both help validate the results and give more credibility to the GRI. One such alternative is the Gender Inequality Index (GII), created by the United Nations Development Programme (2024). Their data goes back until 1990 and covers all ten countries between 1992 and 2008. Other similar measures exist, such as the EU's own Gender Equality Index. However, the data for this one only starts in 2013, making the GII the best suited alternative to check the main results. The GII measures inequality so I reversed the scale such that the GII in the analysis ranges from 0 (least equal) to 100 (most equal). The variable has been centered around the global mean in the same way as other variables before.

For the robustness check, I limit the focus to the most appropriate model. According to Wald testing, this is the model including the GII, the interaction with education, as well as all control variables (p-value = 0.019). When choosing between the random-effects and the fixed-effects model, the Hausman test preferred the fixed-effects model (p-value < 0.001).

**Table 4**

*Regression using GII instead of GRI*

| | Fixed-effects |
|---|---|
| Tertiary Education | 0.01343$^{***}$ |
| | (0.00340) |
| GII | -0.00048 |
| | (0.00620) |
| Education:GII | 0.00060$^{*}$ |
| | (0.00027) |
| GDP per capita (log) | -0.11479 |
| | (0.09164) |
| Education spending | -0.02580 |
| | (0.01617) |
| Population aged 65+ | 0.02041 |
| | (0.01106) |
| Observations | 170 |
| $R^2$ | 0.25841 |
| Adjusted $R^2$ | 0.18618 |
| *Note:* | $^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$ |

Table 4 shows the regression results. They align with the theoretical expectation and with the results that I got for the Gender Roles Index previously. The Wald test shows a preference for a more complex model with more control variables here than before but aside from that, the direction and significance of the variables of interest stayed the same: The direct effect of education is positive and significant and so is its interaction with the GII, meaning that more equal levels of GII lead to education having a stronger effect on fertility rates. Just as before, the direct effect of the GII remains without substantive interpretation.

This does come with some qualifiers though. Generally, GII values are quite high for the sample of countries with less variation compared to the GRI values. Quite a few countries in the sample already have index values of above 90 with relatively little room improve in the context of the GII. This means that in practice, the interaction effect I see here will be less impactful for countries improving their gender equality indicators. In the main analysis, some states scored under 50 in the Gender Role Index so there so there is a bigger room to grow and amplify the positive effect of education.

Nonetheless, the robustness check backs the results of the main analysis quite well as the main variables of interest are still positive and significant, further showing that the education hypothesis is not empirically supported by the data. It further indicates that the Gender Role Index is a sensible construct to measure gender equity in the context of fertility. More refined ways to measure gender roles should be researched, however, its preliminary results are clearly backed up by more conventional measures such as the Gender Inequality Index.

## 7. Discussion

There are some limitations to the validity of the results. The most glaring one is the issue with the residuals, the differences of the actual observations from the regression predictions. As the Shapiro-Wilk normality test and the Breusch-Pagan test have shown, the residuals are neither normally distributed nor of equal variance. This is a severely limiting issue because those are two assumptions that are computationally necessary for a valid interpretation of the results. Having acknowledged this limitation, I will proceed with analyzing the implications of the results.

### 7.1 Direct Effect of Higher Education

The results regarding the direct effect of education diverge depending on if I examine the results across all countries as an aggregate or if I compare the education effect of countries individually. I originally predicted a significantly negative effect, yet the results indicate a positive effect on fertility. This is counter to the expectation but it holds true even after accounting for more variables, such as gender roles, GDP per capita, age structure, and public spending, across all kinds of model specifications. Even for low levels of gender role equity, the aggregate effect of education is positive.

Despite the negative effect seen in four of the ten countries, the education hypothesis is clearly rejected. In the following, I try making sense of the unexpected results and offer possible alternative explanations that can explain the results. The discussion revolves around (1) why six countries showed a positive a positive education effect and (2) how these countries differ from the four countries with a negative effect that could explain the discrepancy.

#### *7.1.1 Positive Effect*

The results reveal a complex interaction between higher education and fertility rates. An increase in tertiary education rates is positively and significantly correlated to fertility. However, this is only true for the aggregate effect of education. Out of the dataset, six of the ten countries exhibit this positive effect. In the following, I attempt to analyze what the reason for this may be.

The theoretical reasoning in favor of the hypothesis of negative effect boil down to fertility postponement and the opportunity costs related to the higher income and career advancement hurdles (glass ceiling). Previous research has addressed fertility postponement and comes to the conclusion that it does happen more frequently among women with higher educational attainment (see Beaujouan, 2020). Postponement is associated with the risk of not finding a suitable partner and financial stability in time before the biological fertility naturally declines. The results contradict this line of reasoning, implying that this is not a significant enough hurdle for women to overcome compared to the positives of higher education. As Beaujouan (2020) points out, biological fertility decline only starts to become a risk for the majority of women past the age of 35. So it is a possibility that postponement is a hurdle for highly educated women, but still leaves enough time for the majority of women to get settled financially and still give birth to the desired amount of children.

The specifics of the timeframe should also be taken into consideration as it was intentionally chosen to cut off at 2008. This choice was made because prior research suggested that economic factors became more relevant in people's fertility choices after the global financial crisis (Matysiak et al., 2021). This shift in priorities may also have influenced how education affects fertility, both by itself and in conjunction with gender equity. Therefore, 2008 provides a natural cutoff point for the panel dataset because the timeframe of the sample can now be assumed to have a homogenous effect of education across its entirety. But this may exactly be the reason for the positive effect. The EU had been relatively spared from economic recession between 1992 and 2008. Because of this, it may be possible that settling financially after graduating from university may have been easier for most women before 2008. Financial independence has been theorized to be an important factor in fertility choices (see e.g. Beaujouan, 2020) so the additional employment stability may have worked in favor of more educated people despite the postponement.

While this possible explanation is plausible, further research needs to empirically examine the interplay between fertility postponement and employment stability that seem to counteract each other for people with higher education as it may not hold true for different time periods.

#### *7.1.2. Discrepancy Between Countries*

In order to explain the positive result, I can also examine if there are substantial differences between the country group with a positive effect and the one with a negative effect. Six countries – Belgium, Denmark, France, Germany, Italy, and the UK – show a positive and only four countries – Ireland, Portugal, Spain, and Sweden – show a negative relationship between education and fertility. When comparing these groups of countries, no pattern is immediately apparent. Sweden and Denmark, often comparable on socio-economic dimensions, show opposite effects. Portugal, Spain and Italy are often comparable as well, yet Portugal and Spain show negative effects while Italy has one of the strongest positive effects. Neither do economic recessions during this time period explain the discrepancy nor labor market reforms or other similar events that would align with two different country groups. This calls the generalizability of the aggregate effect into question as it seems to hinge on the specific selection of countries in the sample.

However, there is one pattern that may explain this discrepancy and it has to do with how the gender role equity developed over time in these countries (see Figure 2). Regardless of their absolute GRI value, countries with a positive effect saw their GRI increase over time while the countries with a negative effect had a decreasing gender role equity over time. To illustrate, Spain is one of the four countries to exhibit a negative effect and it started with a GRI value of 62 in 1992 that decreased to 60 in 1999 and finally to 54 in 2008. Notably, the GRI was still above average for the entire timespan. This pattern can be seen in all countries that have a negative education effect: Their gender role equity is clearly decreasing over time. Contrastingly, the countries with a positive effect have either an increasing or a relatively stable GRI. The only exception to this pattern in Denmark which sees a positive education effect despite a decreasing GRI over time. Regardless, this observation indicates that the absolute gender role equity may matter less than the direction over time.

One possible explanation for this is that women of these countries may be used to a certain standard of gender equity. If the gender roles become more equal over a long period of time, highly educated women may feel that their double role is alleviated, even if the absolute GRI value suggests that the double role would still be an issue. Instead of looking at the absolute equity of gender roles, the fact that gender equity is rising at all may be reason enough to consider having more children. So the mere increase of gender role equity would lead to positive education effects.

Previous fertility research has found similar mechanisms, such as Lutz et al. (2006) who pointed out that worsening living standards affect fertility rates negatively because people are used to a baseline economic standard and have ambitions to improve on them. If living standards unexpectedly decrease, the gap between ambition and reality causes frustration and insecurity, lowering fertility rates. This happens regardless of the actual economic standard and hinges more on individual perceptions (Lutz et al., 2006). Other research shows that policies that support parents financially have a positive short-term impact on fertility but quickly lose their positive effect, presumably because people are getting used to the supporting policies (Miranda, 2020).

A similar baseline-mechanism may be at play here with women's double role where an increase in gender equity leads to alleviated double roles and therefore it becomes more attractive for women to have children, regardless of the absolute equity of gender roles. On the other hand, if there is a trend towards less gender equity, worries about the double role could emerge even if gender roles are still more equal than in most other countries. This would imply that fertility choices depend less on an exact gender equity threshold that is deemed acceptable. Rather, perceptions of a more gender-equal society could already be enough to boost fertility. This reasoning is sound but would need further research to be confirmed and elaborated.

Regardless of the explanation of the results, it is clear that the education hypothesis is rejected. Most countries show a positive association between higher education and fertility and as an aggregate, no model specification produced an aggregate negative direct effect.

### 7.2 Interaction Effect

For the gender-hypothesis, I can reject the null hypothesis of no effect as education and gender have a positive and significant interaction effect. This means that for higher levels of gender equity, higher education has a stronger positive effect on fertility.

I operationalized gender equity using the three dimensions of gender roles. Survey participants were only coded as 1 if they agree on equal gender roles on all three dimensions. Therefore, gender role equity boosts the effect of higher education. This not only lends credibility to the theorized double-role mechanism in general as argued by McDonald (2000), it also indicates that gender equity becomes more important the more education people obtain. I have argued that this is happens because the double role is a more common phenomenon among highly educated women, at least in that time period. Higher education has led to a higher chance of full-time employment, especially for younger women. Career expectations, combined with the glass ceiling mean that those women have less time for family and household responsibilities. Without gender role equity, the extra burden stemming from raising children disincentivizes childbearing.

Previous research has already shown that expansive childcare policies raise fertility levels by alleviating the mothers' burden of raising a child. In the same vein, gender equity – specifically regarding gender roles – are another mechanism that alleviate women's childcare responsibilities by involving the fathers more in the home life.

For the purposes of raising fertility levels, gender equity is not necessary as it is historically observed that fertility rates were often far above replacement level during the times when the male-breadwinner model was more common (Lutz, 2021). Since then, large societal shifts towards a greater independence of women alongside integration into the labor market caused a shift towards more equal employment. What policymakers have largely failed to consider is that generating income is only one of the three dimensions of gender roles and that leaving family and household responsibilities as they used to be causes an incongruence. If everyone is expected to work full-time now, the state and society needs to accommodate for the implications of that development, namely that raising children is becoming unattractive (McDonald, 2000). In the mid-20th century, the male-breadwinner model accommodated for the family by taking the burden of childcare from the men and the burden of employment from the women. Society has largely shifted away from this model and women work in regular employment, both to gain financial independence and due to economic necessity.

Especially during the timeframe examined in this thesis, the increased employment was especially pronounced among highly educated women. This shift, however, has largely failed to accommodate for childcare and household responsibilities, creating issues of double-role responsibilities (McDonald, 2000). This is arguably still the case since EU strategies to combat the demographic change largely focus on the labor market and its immediate needs (European Commission, 2023). Given that fewer children are born to sustain public needs he goal is to increase employment and productivity, the latter of which is achieved by increasing skills – mostly a matter of education. The problem is not that more women are encouraged to pursue higher education but that expectations about family care have not changed accordingly. Without gender equity, these developments run the risk of further pushing women into childlessness, ironically worsening the labor shortage due to demographic change.

## 8. Policy Recommendations

The demographic change is characterized by low fertility below replacement level in nearly all EU member states. The EU has gone to great political lengths to combat the demographic change with most measures serving two main purposes: Employing as many people as possible and increasing educational attainment. In practice, this has meant addressing the gender gap in employment and education. Thanks to these measures, more and more women obtain a university degree and have access to full time employment. The problem for fertility is that women's role at home is not properly accounted for. When women are expected to work just as much as men while still having to take care of the family and the household, raising children simply becomes unattractive. Women's double role as full-time worker and family caregiver is one of the biggest inhibitors to restoring healthy fertility levels.

The goal is neither to reduce female employment nor female education. Instead, the EU, in cooperation with its member states, needs to enable the conditions under which modern career expectations of highly educated women become compatible with motherhood. This is something that effective policies can affect. A single regulation cannot change people's perception but it is the responsibility of policymakers to set the best circumstances for women to be able to combine employment with child-raising. Women nowadays are expected to participate in the labor market just as men. This is partially the result of decades of political effort to integrate women into the it. In the same vein, policymakers need to set the stage for a gender-equal role distribution. The strategy is outlined consists of (1) promoting gender equal roles, (2) alleviating pressure from both parents, and finally (3) alleviating pressure from mothers specifically by encouraging fathers to become more active in their home life.

**Consider the implications of increased education in policymaking.** Policymakers at both the EU and the national level need to carefully consider the implications that tertiary education has for the individual. The postponement of having children can pose a great challenge for the recently graduated (Beaujouan, 2020). On top of that, expectations that everyone should work as much as possible puts additional pressure on women, putting them into the double-role dilemma and disincentivizing child-rearing if the proper support is not provided. Trying to increase full-time work and educational attainment can be effective to eliminate labor shortages in the short run but it also runs the risk of putting more women into a position where they face the double role (McDonald, 2000). If it is not effectively alleviated, this could lead to further decreases in fertility that would perpetuate the demographic change, worsening labor shortages in the long term.

Herein lies a challenge but also an opportunity to finally get fertility rates back onto sustainable levels. Increasing fertility levels will naturally decrease labor shortages. This does not mean that higher educational attainment should not be a goal of the EU and its member states. Rather, this needs to be incorporated into a strategy that alleviates the double burden for highly educated mothers.

**Promote gender equity across all member states.** Equal division of labor, not just at work but also at home, needs to be the reality for working mothers. Beyond the legal aspects of gender equity, the EU should promote equity by initiating large-scale campaigns aimed at shifting societal attitudes about gender roles. These campaigns should highlight the benefits of gender equity in all aspects of life, including workplace, home, and community. Promote that gender-equal societies are more attractive for women to have children. It is important to promote gender-equal roles in society across all countries.

Campaigns by themselves will not suffice to solve the problem. Rather, they serve to support additional policies that should be set in place to alleviate the burden from mothers.

**Extend childcare services.** Labor force participation among women has been steadily increasing over the past decades to the point that everyone is expected to participate in the labor force as much as possible. On top of that, labor shortages induced by the demographic change necessitates that most people are working (Goldstein et al., 2009). Due to this development, the state has a greater responsibility to provide childcare since parents have less time to take care of their children during the day (Bergsvik et al., 2021). The EU has to ensure that high-quality, affordable childcare is universally accessible. This includes investing in more childcare facilities and providing subsidies not just to lower the cost for families but also to support women and men in their role as family caretakers. Lifting part of the childcare responsibilities off both parents makes it easier for men and women to share the remaining responsibilities among each other.

**Encourage men to take on more family responsibilities.** Campaigning for gender equity can play a role in that. Yet, more importantly, it means that fathers should be supported in the family life. Just as women have been supported in the labor-market, so too should men receive the political support to effectively take care of their children. This can be achieved with policies that encourage men to take paternal leave by providing higher compensation rates and ensuring career protection. Furthermore, the EU could introduce mandatory quotas for paternity leave that cannot be transferred to the mother so that fathers are encouraged to take a more active role in early childcare. Additionally, policies should be promoted that encourage flexible working hours and remote working options for both men and women. This helps parents balance work and family responsibilities and further normalizes that fathers play an active role at home, further alleviating pressure from mothers.

## 9. Conclusion

This thesis has examined the effect of tertiary education on fertility rates in a panel dataset of ten European countries from 1992 to 2008. Beyond the direct effect of education, I investigated how gender equity, more specifically gender roles, affect this relationship. I hypothesized a negative direct effect of education that would be alleviated for higher degrees of gender equity. In order to measure gender roles, I constructed an index from EVS survey responses regarding the gendered division of labor. The results regarding the direct effect are inconclusive yet ultimately counter to the expectations. The aggregate effect is clearly positive. Examining the results for each country individually reveals that some countries exhibit a positive, and some a negative effect of higher education. The reason for this discrepancy can be theorized but remains unclear, especially since there is no obvious distinction between these groups of countries. The moderating effect of gender equity is more clear. I uncovered a positive interaction effect, showing that higher levels of gender role equity cause education to have an even stronger effect on fertility.

This thesis is the first to operationalize the theoretical distinction between the formal and informal aspects of gender equity (see McDonald, 2000) and include it into an empirical analysis, including multiple countries over a substantial period of time. This is the first time Gender Equity Theory was tested in this way and the results align with the implications of this theory. I further contributed to the theory by introducing higher education and how it interacts with gender equity. Results indicate that further research should take this distinction into account as it could be a factor for why the effect of education on fertility is so unclear across previous research. Regarding the direct effect of education, even though the results are not conclusive, they indicate that higher education is not universally inhibiting fertility. It is unclear what the exact mechanism is that either increases or decreases fertility rates or if there even exists such a universal mechanism at all. Regardless, the results contrast with the general assumption that education necessarily leads to low fertility. I have shown this using robust methodology and provided possible explanations for the discrepancies regarding the effect of education.

However, the operationalization of gender roles is imperfect. The GRI reflects attitudes on each of the three dimensions of gender roles using a survey of thousands of respondents. The survey questions were carefully chosen but they cannot reflect gender role expectations in their entirety. For such a complex and multi-faceted concept, an index consisting of three questions is likely not enough to capture each individual's perception. On top of that, the EVS waves I used were each nine years apart from each other. I have argued that gender roles likely stay consistent and do not vary too much between survey waves. Yet, having access to yearly data would certainly contribute to the robustness of the construct. The biggest limitation with regards to the validity and generalizability of the results lie in the regression assumptions that are shown to be violated. Both residual non-normality as well as heteroscedasticity pose a problem to the interpretation and the implications that I have presented. Further research should be conducted to confirm the conclusion of this thesis.

Future research can produce a more nuanced GRI using an original survey that explores gender expectations in a greater nuance. For example, such a survey could ask participants if they think that women should work just as much as men, if they should earn the same amount and if that changes a woman has a child. Also, a distinction between part-time and full-time work in the questions could be sensible. As gender roles are a complex social construct, individual opinions can greatly vary depending on context, and also across time and country. So the survey should capture those nuances to make it possible to compare roles across countries unambiguously. From this, a more sophisticated variation of the Gender Roles Index can be created. Furthermore, the results of my thesis contradict the education hypothesis as well as most of previous fertility research. Further studies should be conducted not only to confirm these results but also their generalizability, using more countries and covering different time periods. The current state of fertility research cannot adequately explain under what conditions tertiary education has a positive or a negative effect. The arguments used to formulate the hypothesis of a negative education effect need to be empirically assessed as well. These include the fertility postponement as well as the opportunity costs argument. More rigorous empirical testing is necessary here, also if gender equity moderates these effects as well.

The results highlight the importance of gender equity. Previous research has already established its direct connection with fertility rates (see e.g. Anderson & Kohler, 2015; Brinton & Lee, 2016). This thesis adds to this by showing that it also contributes to a more positive effect of higher education on fertility. In the sample, increased tertiary education rates are associated with higher fertility levels, even when gender-equity is relatively low but this positive effect becomes a lot stronger in the presence of high gender role equity. Gender Equity Theory makes the theoretical distinction between individual rights and gender roles. Societies have shifted to give men and women equal access to education and the labor market. However, expectations of women taking care of children and the household have not shifted accordingly and have been lacking behind. This has caused women with children to be stuck in a double role that policymakers, focusing largely on women's role in the labor market, have not adequately accounted for. Since more and more women are pursuing higher education and working in full-time employment, the double role will likely present a challenge to an increasing number of young women. If societies do not shift to accommodate for women's new role in the labor market, further supported by policymakers, this could affect fertility rates negatively. On the other hand, because so many more women are expected to attain higher education over the coming years (European Commission, 2023), gender equity presents an opportunity to boost fertility rates back to population-sustainable levels across the EU. Gender equity can mitigate the double role issue and accommodate mothers, not just in rights but in roles as well. If men participate more actively at home and the state further alleviates pressure from both parents, this could become a key element in the long-term strategy to combat the labor shortages associated with the demographic change.

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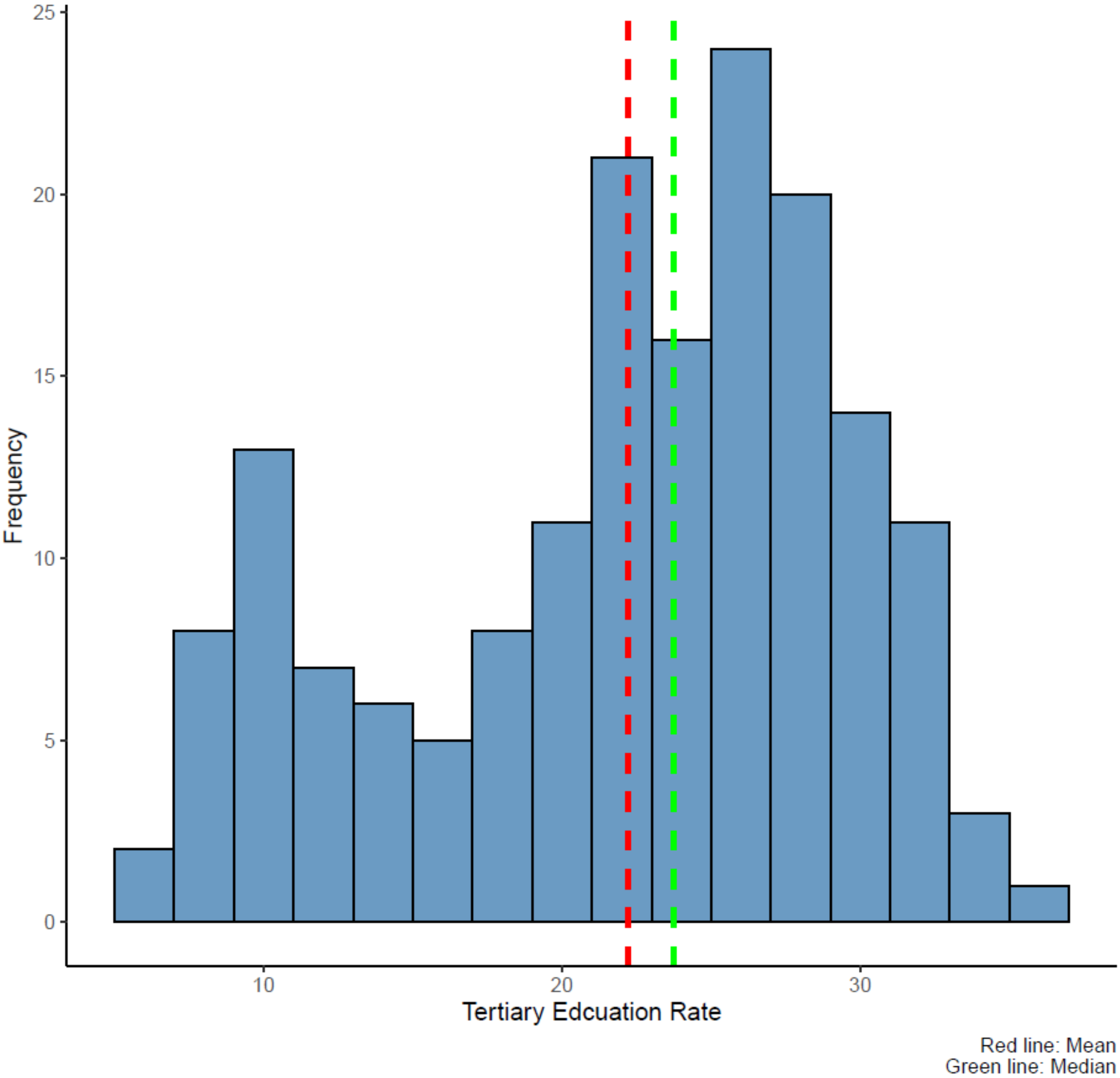
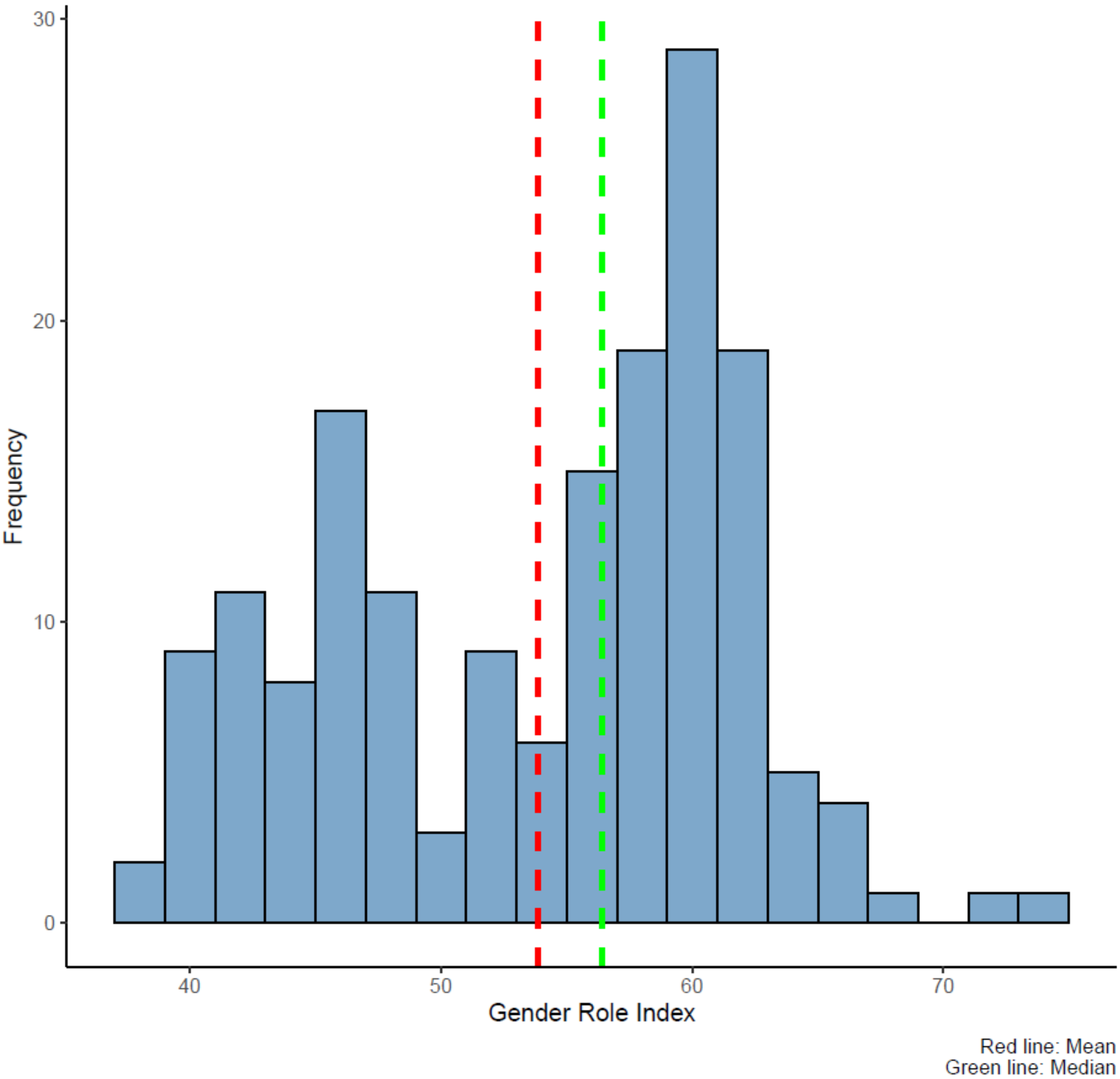
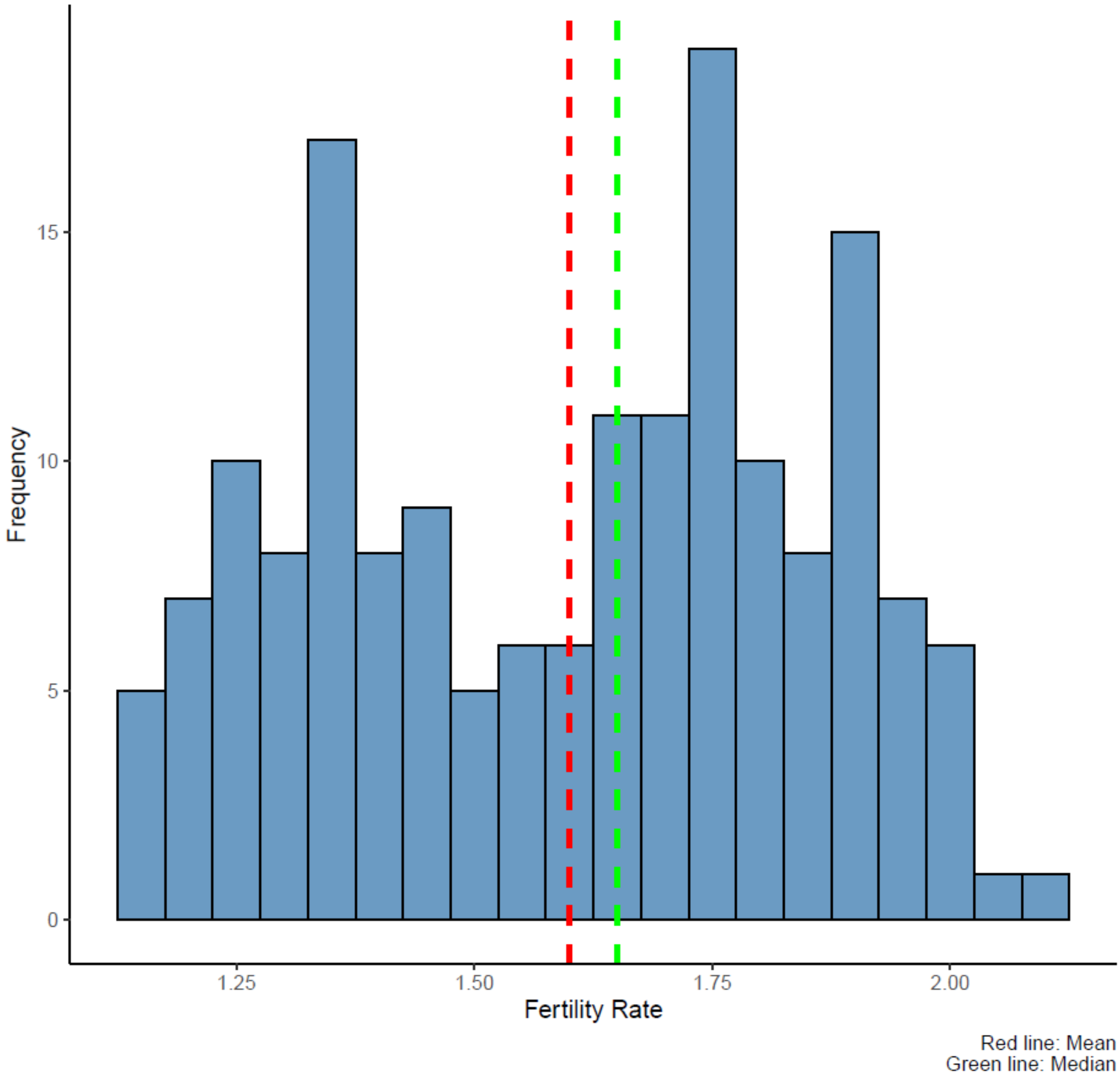
## Appendix A: Distribution of Tertiary Education Rates in the Sample



**Appendix B: Distribution of Gender Roles Index values in the Sample**



## Appendix C: Distribution of Fertility Rates in the Sample



## Appendix D: Wald Test for Fixed-effects Models

| Model | Residual DF | Chi-squared | P-value |
|---|---|---|---|
| Basic | 159 | NA | NA |
| Additional gender effect | 158 | 29.118629 | 0.0000001 |
| Additional interaction effect | 157 | 4.625134 | 0.0315068 |
| Additional control variables | 154 | 3.075459 | 0.3801365 |

## Appendix E: Wald Test for Random-effects Models

| Model | Residual DF | Chi-squared | P-value |
|---|---|---|---|
| Basic | 168 | NA | NA |
| Additional gender effect | 167 | 24.661230 | 0.0000007 |
| Additional interaction effect | 166 | 4.653176 | 0.0309962 |
| Additional control variables | 163 | 3.622722 | 0.3051908 |