CAUSES AND CONSEQUENCES OF LOW FERTILITY IN WESTERN COUNTRIES

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Abstract

The UN currently estimates that 70% of the world population will live in countries with below-replacement fertility in 2045-2050, up from 48% today. This dissertation seeks to understand family formation processes in low-fertility settings, focusing on social stratification and intergenerational transmission of inequality. Each chapter addresses a factor associated with low fertility: women’s educational expansion, female labor force attachment, and the extended family.

Chapter 1 analyzes how educational stratification in fertility changes following European educational expansion. Using the Gender and Generation Survey (GGS), I propose a measure for women’s relative educational positioning by country and birth cohort. I use it, together with cohort-specific tertiary education prevalence, to predict early motherhood and childlessness. Despite global convergence towards later motherhood and lower childlessness, I find substantial heterogeneity in trends across time and space. Only countries with high prevalence of college-educated women display lower educational stratification in childbearing.

In Chapter 2, I study the role of intergenerational transmission of inequality in explaining why growth in women’s labor force participation is unevenly distributed and stalling for some demographic groups. I use contextual characteristics and parental education and occupation in the GGS to predict women’s attachment to the labor market throughout childbearing years. Sequence analysis and multinomial regression models show that women from families with lower maternal education and less prestigious occupations have lower labor market attachment. Socio-economic disadvantage, rather than maternal role modelling, drives this result.
In Chapter 3, I propose a new causal estimate of family influences on fertility behavior through an exogenous treatment occurring at the extended family level. I use three-generation data from the Panel Study of Income Dynamics (PSID) and a natural experiment based on grandchildren sex-mix to show that the combination of one’s own children with one’s nieces and nephews matters for fertility progression. These findings re-affirm the relevance of the extended family as a unit of analysis for fertility.

Taken together, these chapters find that the extended family, parental characteristics, and aggregate education all shape childbearing choices. By analyzing the mechanisms underpinning the emergence of low fertility, my dissertation contributes to delineating its implications, especially for socio-economic inequality.
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Introduction

The United Nations currently estimate that almost 70% of the world population will live in countries with below-replacement fertility (less than 2.1 births per woman) in 2045-2050, up from the current 48% (United Nations 2015). What is behind this worldwide phenomenon? How likely is it to spread and persist? In this dissertation, I draw from theories and empirical methods in demography, sociology, and economics to study possible determinants of low fertility in Europe and the United States and its consequences for the intergenerational redistribution of resources. From the first demographic transition onwards, demographic studies of fertility primarily focused on declines from high to low fertility, a transition still happening in many developing countries. However, the persistence of low birth rates over several decades is a new phenomenon that emerged in many developed countries (Kohler et al. 2002) and its long-term consequences for society are still unclear.

This dissertation project studies three factors associated with low fertility: educational expansion, women’s labor market attachment, and extended family influences. The motivation to focus on low fertility settings is two-fold. First, the scale of the phenomenon and its global reach have tremendous consequences. At the macro level, currently nearly half of the world population lives in countries with fertility below replacement levels (Morgan 2003). This has the potential to undermine the sustainability of national health care and pension systems (Mason et al. 2009) and to reconfigure the global geopolitical equilibrium (Jackson and Howe 2008). For example, absent even larger immigration inflows, European countries are beginning to experience population decline (Lutz et al. 2003). Second, studies at the micro level suggest that there is a
persistent mismatch between realized fertility and desired family size, still mostly stable at around two children per woman (Testa 2007). This raises the policy-relevant question of why European and American women, who have access to historically unprecedented resources in terms of education and job opportunities, are not having the number of children they say they want. In other words, women went from exceeding their intended number of births to having fewer children than desired.

The answer to this question lays at least in part on the heterogeneity of family formation experiences for women with different socio-economic characteristics. For this reason, Chapter 1 directly addresses the education gradient in childbearing. Empirical findings on whether highly educated women have fewer children and higher rates of childlessness than women with lower education - negative education gradient in fertility - are growing, but not definitive (Gustafsson et al. 2002; Kravdal and Rindfuss 2008; Wood et al. 2014). Indeed, recent studies argue for a reversal in the gradient by virtue of highly educated women returning to larger families after a transitional trend towards smaller ones (Adserà 2017b; Esping-Andersen and Billari 2015; Goldscheider et al. 2015). This view is supported by faster transitions to second-births for highly educated women (Kravdal 2007) and signs of convergence between educational groups for some demographic indicators (Bailey et al. 2013). However, results currently pertain to women who have not yet completed their reproductive careers, and might not result in changes in the gradient for the overall fertility quantum (Martin 2000; Matysiak and Vignoli 2019). Therefore, social stratification in childbearing remains an open question.

Such stratification by education and socio-economic status has consequences that go beyond the current generation. In particular, family formation processes, such as type
of parental union, timing and number of children, shape the resources invested in the next
generation (McLanahan 2004). Chapter 2 and Chapter 3 more closely analyze multi-
generational links across family members when it comes to labor market outcomes and
childbearing, respectively. In line with McLanahan and Percheski (2008), this
dissertation provides further evidence that the family formation process is an important
mechanism for the reproduction of inequality across generations. Chapter 2 focuses
specifically on labor market attachment since in recent years, economic inequality has
been rising across most developed countries (Adserà 2017a). Economic uncertainty
(Kreyenfeld 2010; Vignoli et al. 2019) and the recent Great Recession, with its rise of
temporary contracts, lowered fertility in the short term (Adserà 2011), but the impact
might be heterogeneous by social class and family-of-origin characteristics, as shown in
this dissertation.

Chapter 3 extends the definition of family-of-origin to include grandparents,
parents, aunts, uncles, and cousins. This allows me to introduce a new causal estimation
approach to address an unsettled question in family demography: are the correlations of
childbearing outcomes across generations and the positive associations between sibling’s
fertility due to co-occurrences or are there causal links within the extended family? This
question is particularly salient in the American context where a decrease in fertility is
accompanied by weaker social ties and increasingly fragmented and complex families
(Seltzer 2019).

Overall, my research seeks to understand family formation processes in low-
fertility settings, focusing on social stratification and intergenerational transmission of
inequality. The principal aim is to elucidate the underlying causes of low fertility and the
impacts on redistribution of resources among families and their children. As the chapter-specific abstracts below show, I develop this research interest in my dissertation project by tackling one hypothesized source of decreasing fertility rates in each chapter: (1) expansions in educational attainment; (2) female attachment to the labor market; and (3) within-family fertility influences. By analyzing the mechanisms underpinning the emergence of this phenomenon, my research contributes to shedding light on its policy implications, focusing in particular on the intergenerational transmission of inequality.

Chapter 1 - The Education Gradient in Childbearing: Changes in the Education Distribution

In the last three decades, two demographic processes have been reshaping developed countries: declines in fertility and increases in women’s education levels. A negative education gradient in fertility – highly educated women have fewer children and higher rates of childlessness than women with lower education, emerged in a number of countries, although its presence is far from uniform. Conversely, recent studies report that highly educated women might be returning to larger families and having faster transitions to second births. However, the composition of different education strata has been changing concurrently with fertility trends. Indeed, the expansions in secondary and tertiary education in European countries occurred at different times and speeds, thus generating composition heterogeneity across time and space. This process has led to a change in the meaning and selectivity of absolute levels of education. Combining the Gender and Generation Survey and international educational attainment data, I construct a relative education measure that includes women’s relative educational positioning by country and birth cohort and I use it to predict early motherhood and childlessness.
Adding cohort-specific aggregate tertiary education prevalence, I also investigate changes in the educational gradient in childbearing as the educational composition changes. Findings over the entire sample suggest an overall convergence towards later motherhood for less educated women and lower childlessness for highly educated ones. However, there is substantial heterogeneity across time and space with the negative education gradient flattening only in recent cohorts and in countries with a higher proportion of women with tertiary education, which might act as protecting factor against childlessness.

**Chapter 2 - Women’s Work Trajectories across the Life Course: Early Life Influences**

Despite their massive entrance into the labor force in the last decades, women still experience an uneven attachment to the labor market over their life course. Previous research has shown how this is linked to demographic factors and family formation as well as early life socio economic status that can shape access to paid work. This study takes a life course perspective and aims at studying how (1) fixed contextual characteristics, including country and birth cohort, and (2) parental characteristics, including education and occupation, predict women’s long-term trajectories of workforce participation. The analytical sample from the Gender and Generation Survey (GGS) includes women from seven European countries who were at least 45 years old at time of survey, and for whom activity status is reported from age 16. It is therefore possible to construct individual employment trajectories over the entire span of their reproductive lives and analyze them with sequence and cluster analysis. Results show four different clusters based on women’s labor market attachment and completed fertility, consistent

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1 Previous versions of Chapter 2 were presented at the 4th GGP User Conference (2017), Population Association of America (2017), and European Population Conference (2018).
with qualitative findings. Multinomial regression models provide evidence of intergenerational transmission of inequality with women whose mothers had lower educational levels and elementary occupations being less likely to be attached to the labor market, even if non-linearly, for recent cohorts.

**Chapter 3 - Family Influences on Fertility: An Extended Family Causal Estimate**

The role of the extended family in maintaining high fertility has been extensively studied in developing countries. However, less is known about whether family members outside the nuclear household still influence childbearing decisions, net of shared characteristics, in increasingly individual-centered Western societies. In this chapter, I use three-generation data to leverage the random variation of sex at birth and the preference for offspring sex-mix to assess whether the sex of nieces and nephews, in combination with the sex of own children, matters for fertility choices. Using the Panel Study of Income Dynamics (PSID), I define the extended family as grandparents, their adult children, and their grandchildren. I then show that if the first two grandchildren are of the same-sex, then the overall extended family is more likely to have more than two grandchildren than if the sex-mix is achieved within the first two grandchildren. This result is consistent across family structures, i.e. if the first two grandchildren are cousins or siblings, and it is robust to alternative sex-related mechanisms and characteristics of the middle and older generation. I find that this effect manifests predominantly within a generation, with the possible exception of a preference for having an uninterrupted line of men across generations. This natural experiment nested in a three-generation approach

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2 Previous versions of chapter 3 were presented at the American Sociological Association (2019), PopDays2019, the 9th Alpine Population Conference (2019), and Population Association of America (2019).
contributes to a new understanding of the influence of the extended family on fertility through an estimation technique that opens new opportunities for causal estimates in family demography.
References


Chapter 1

The Education Gradient in Childbearing:

Changes in the Education Distribution

Introduction

Starting in the 1970s, women in European countries experienced dramatic increases in their enrollment and completion of secondary and tertiary education (World Bank 2012). This phenomenon happened concurrently to a rise in the age at first birth and childlessness (Gustafsson et al. 2002), and rises in women’s education are often offered as explanations for fertility postponement and decline (Ni Bhrolcháin and Beaujouan 2012). Higher education changes women’s career perspectives and opportunity-costs for childbearing, which in turn influence both the timing and the number of children (Kravdal and Rindfuss 2008; Lappegård and Rønsen 2005). Since these considerations apply to different degrees to women across the education spectrum, the expectation is that there would be an education gradient in fertility. Educational expansion might therefore increase educational stratification in family formation, with consequences for the redistribution of resources in the next generation (Adserà 2017a; McLanahan 2004; Wood et al. 2014). Moreover, there is an open debate on whether highly educated women are returning to larger families (Esping-Andersen and Billari 2015; Goldscheider et al. 2015), accelerating transitions to second births (Kravdal 2007) or this only appears to be true for women who have not yet completed their reproductive careers and might
therefore have different completed fertility (Matysiak and Vignoli 2019). In other word, faster transitions might not translate into higher quantum.

Studying the relationship between childbearing and education during a time of women’s educational expansion requires a closer look at nominal and positional notions of education (Colleran et al. 2014; Esteve and Florez-Paredes 2018; Frye and Lopus 2018; Rotman et al. 2016). Doing so is particularly crucial in cross-country comparisons and with data that span several birth cohorts. Indeed, using the absolute level of educational attainment can be misleading in an educational landscape that is rapidly changing. In this context, it may be more meaningful to consider the relative position of a woman within the education distribution in her own country and cohort. In this way, it is possible to appreciate the social meaning of a woman’s educational attainment and not only education as an individual attribute (Frye and Lopus 2018).

The present study re-examines the education gradient in fertility in light of changes in educational composition, and in who selects into higher education, by asking how the relationship between a woman’s education and childbearing timing varies with the education composition of her cohort. It accounts for the difference in the education distribution by constructing a relative measure of education by country and cohort as well as by interacting individual education with the proportion of women in the same birth cohort who completed tertiary education. To do so, I use data from fifteen European countries on individual educational attainment and fertility behaviors from the Gender and Generation Survey (GGS) as well as aggregate data for education by 5-year cohort groupings and countries from the Barro-Lee Educational Attainment Data (Barro and Lee 2013).
Using a newly constructed relative education measure that includes women’s relative education positions by country and birth cohort and an aggregate measure of tertiary education prevalence, I predict early motherhood and childlessness as measures of fertility tempo and quantum. Findings over the entire sample suggest an overall convergence towards later motherhood for less educated women and lower childlessness for highly educated ones as the proportion of women with tertiary education increases. However, analyses done across space for specific birth cohorts and across time for country-based models show substantial heterogeneity. The education gradient for early motherhood flattens mostly in recent cohorts who have not yet completed fertility and in countries that started their educational expansion early and still currently have high proportions of women with tertiary education, such as Sweden and the Netherlands.

**Background and Motivation**

*Individual Education Levels and Childbearing*

In most Western countries, age at first birth has dramatically increased in recent decades, fertility rates have declined, and the share of childless women is at the highest point since the Second World War (Gustafsson et al. 2002). The concurrent rise in educational enrolment is often cited as a possible explanation (Ní Bhrolcháin and Beaufour 2012). Indeed, there are different channels through which education can lead to a postponement or reduction of childbearing. These channels operate differentially based on the level of educational attainment. In turn, the overall distribution of women’s education shapes fertility. Therefore, both forces combined affect the educational stratification in family formation. In terms of levels of educational attainment, being a student and childbearing are generally considered to be incompatible. Therefore, the mere
fact of spending more time in education pushes highly educated women to start families at a later age. The fixed biological window for childbearing in turn means that women with more education who postpone their first birth have less time to have (additional) children and might have fewer of them over their reproductive years (Kravdal and Rindfuss 2008). Moreover, women with additional schooling tend to be on different job trajectories, both because of their higher completed education and because of career aspirations that lead to additional years of education to start with. Indeed, highly educated women tend to further postpone childbearing in order to start a career with an upward trajectory that needs time to be established (Gustafsson 2001). Concurrently, having a university degree and career perspectives increase the opportunity cost for child-related career interruptions for highly educated women (Lappegård and Rønsen 2005).

These channels apply to a lesser extent to women with less education, thus the expectation is that the fertility response to changes in the education distribution would be differentiated by educational attainment. Differential fertility responses in turn potentially increase the educational stratification in family formation, with consequences in the redistribution of resources to the next generation (McLanahan 2004). Indeed, the economics intuition considers children as normal goods, so having more resources such as education and income should translate into more children for highly educated women thanks to the income effect3 (Becker 1960). However, empirical findings are mixed. Indeed, negative education gradients in fertility, i.e. the fact that highly educated women have fewer children and higher rates of childlessness than women with lower education,

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3 It is possible to predict fewer children as income increases if total expenditure on children is the normal good rather than children themselves and the investment per child surges.
have been documented in a number of contemporary developed countries (Gustafsson et al. 2002; Kravdal and Rindfuss 2008; Wood et al. 2004).

However, education gradients in childbearing are far from uniform in European countries. Wood et al. (2004) show that, in line with larger negative effects of opportunity costs than positive income effects, childlessness is more frequent among highly educated women than among those with less education. Conditional on having at least one child, women report negative education gradients in Central and Eastern European countries, but neutral or positive gradients in Northern (Norway), Western (Belgium, France, and the Netherlands), and Southern (Italy and Spain) Europe. Some of this variation has been attributed to differential mediation of welfare regimes (Mertz and Liefbroer 2017), but even comparing two Southern European countries such as Italy and Spain showed different national and sub-national education gradients in childbearing (Garriga et al. 2015), leaving open the question of what else might be explaining this heterogeneity.

In addition to geographical variations in the education gradients in childbearing, there are also significant variations by birth cohorts (Wood et al. 2004). Secular trends in women’s education and labor force participation, together with changing social norms regarding gender roles and families, affected childbearing decisions differently across birth cohorts. Recent studies argue for a reversal in the gradient by virtue of highly educated women returning to larger families after a transitional trends towards smaller ones (Adserà 2017b; Esping-Andersen and Billari 2015; Goldscheider et al. 2015). This view is supported by Kravdal (2007) who, using Norwegian registry data, reports that highly educated women display higher transition rates to second births than those with
less education. If these trends were to be confirmed, it could lead to a gradual convergence in fertility rates across women with different educational attainment. Therefore, we might expect to see a flattening of the education gradient as the highly educated women realize their around-replacement fertility intentions (Esping-Andersen and Billari 2015). This could in turn shape the role of family formation for intergenerational transmission on resources in a context of rising inequality (Adserà 2017a). However, most of the studies reporting faster transitions to second births focus on women who have not yet completed their reproductive careers (Martin 2000; Matysiak and Vignoli 2019). The speed of the transition could be a result of the smaller time window faced by highly educated women rather than an actual increase in the fertility quantum at the end of their reproductive years (Matysiak and Vignoli 2019). This debate reopening the question of the sign and slope of the education gradient in childbearing and specifically how temporal changes such as educational expansion can explain these conflicting results.

*Aggregate Education Levels*

Most studies relating education and fertility focus on individual educational attainment, but in the wake of women’s educational expansion, there is a growing interest in how nominal and positional notions of education can explain social stratification and family formation processes (Colleran et al. 2014; Esteve and Florez-Paredes 2018; Frye and Lopus 2018; Horowitz 2018; Lopus and Frye 2019; Rotman et al. 2016). Indeed, expansions in education enrollment and achievement not only contributed to the emergence of differential fertility rates across education groups, it also affected the education distribution itself. In particular, where and when an individual achieved her
highest degree of education determines the relative position in the education distribution in addition to the credential itself (absolute level of educational attainment). To illustrate the sizeable differences between absolute and relative measures of education across cohorts and countries, I provide an example based on data from the Barro-Lee educational attainment dataset (Barro and Lee 2013). Take two women with the same level of completed education (high school) and two countries (United States and Greece). The woman who obtained a high school degree in the United States in 1950 was in the 56th percentile in the education ranking of women in her birth cohort. However, the same degree obtained in 1990 would place her in the 25th percentile of her cohort. Meanwhile, a Greek woman with a high school degree in 1990 would be roughly in the 56th percentile in her country-cohort reference group.

The above example illustrates the importance of identifying the appropriate education reference group when studying the role of education on individual-level characteristics or behaviors. Although this work focuses specifically on childbearing outcomes, the relevance of relative or contextual education has been highlighted in other domains as well. Feliciano and Lanunza (2017) recognize the relevance of accounting for the actual educational reference group beyond measures of absolute education in their analysis of the immigrant paradox in education. This paradox is based on the fact that children of immigrants are disadvantaged along a series of socio-economic characteristics, but they perform better in schools than expected given the overall positive association between socio-economic advantage and test scores. Both in the United States (Feliciano and Lanunza 2017) and in France (Ichou 2004) immigrants are positively selected in terms of education, thus relative educational attainment for the immigrant
parents is high in their sending countries. This explains why children of immigrants perform better than expected based on their socio-economic status in the receiving countries, which does not fully reflect their relative position in the education distribution of origin. Similarly, alternative measures of relative education help to reconcile current voter turnout rates with the fact that they should have gone up with time as more education positively correlates with turnout at an individual level (Helliwell and Putnam 2007; Nie et al. 1996; Tenn 2005).

The educational transition into primary and lower secondary education is still ongoing in Africa (Lopus and Frye 2018). Most European countries had already completed this transitional phase for the birth cohorts under analysis in this work. Indeed, the share of women enrolled in tertiary education has been increasing since at least the 1970s across Europe (World Bank 2012). At the beginning of the educational transition, women who achieved bachelor degrees and above were fewer and highly selected. Now, there is more (negative) selection at the bottom of the education distribution as women who do not finish high school are more disadvantaged than in the past along a series of indicators such as income, skills, and union stability (Adserà 2017a). Therefore, while measures of absolute education in years of schooling or highest degree did not change much during the educational expansion, the meaning attached did. This disconnect is particularly problematic in cross-country comparisons since increases in enrollment of women in upper secondary and tertiary education did not happen simultaneously across countries. In other words, there is variation within countries by cohort and variation within cohort by country because the starting point and the speed of increasing educational levels are context-specific. This is still evident today in the different
contributions that countries made in achieving the Europe 2020 education target of raising the share of the population that completed tertiary education to at least 40% (Eurostat 2018).

The change in the education distribution and the changes in the role that an individual woman’s educational attainment plays in childbearing decisions are closely intertwined. For instance, as women achieve higher levels of education than in previous generations, those who complete secondary education and attend tertiary education institutions are the plurality in most European countries and this could lead to a shift in norms around childbearing and childlessness. As Frye and Lopus (2018) point out, educational attainment is not only an attribute of individual women, but also an aggregate phenomenon that shapes their fertility choices depending on their social and cultural contexts. The role of aggregate measures of education is twofold. On one hand, a woman’s level of education has a social meaning tied to the overall distribution of education within her context in terms of her birth cohort and country (Frye and Lopus 2018). On the other hand, the overall educational expansion has ‘general equilibrium’ effects for variables that shape the relational and economic landscapes in which women make their childbearing decisions. Areas closely related to fertility that have been studied in relation to the educational expansion include the labor market through the relative education theory for which the advantages of a college degree depends on the education level of peers (Horowitz 2018), the marriage market (Shen 2019), and assortative mating (Lopus and Frye 2019).
Interplay of individual and aggregate education in childbearing choices

All this considered, there are at least three scenarios of how the educational expansion shaped women’s childbearing choices vis-à-vis their own educational attainment. The first is a stable scenario. In this case, the relationship between education and fertility is shaped by the cumulative experience of schooling and therefore remains stable throughout the educational expansion (Frye and Lopus 2018; Gustafsson et al. 2002). Therefore, women with the same educational status display similar childbearing behaviors across all cohorts because what matters is education per se. In this case, the broader educational context does not matter, but it the fact of having attained more education that progressively delays fertility (Gustafsson et al. 2002). In a stable scenario, the use of absolute or relative measures of education should not change the education gradient in childbearing, nor should there be a significant interaction between individual education and proportion of women with tertiary education.

The second scenario is one of convergence of fertility rates across different educational groups. As secondary and tertiary education becomes more widespread in a country, the educational gap in childlessness and childbearing becomes smaller and the education gradient flattens as a consequence. This convergence can be driven either by the highly educated women or by those with less education. In the former case, as a larger proportion of women in a country pursues and attains college degrees, the highest category of absolute level of education enlarges mechanically. Therefore, this compositional effect renders the highly educated group less positively selected. Now that the signal given by attaining a college degree is attenuated, those with it retain fertility behaviors similar to those who were in the low or medium educational categories and
therefore the gradient flattens. As the ‘vanguard’ of family behaviors such as lower family sizes and fertility postponement spearheaded by the highly educated during the Second Demographic Transition spreads to other educational group, fertility rates converge. In this sense, the case where convergence happens through women in the lower educational categories delaying and foregoing childbearing can be seen as a further development of the Second Demographic Transition. This convergence is further accelerated as highly educated women become a majority group that exemplifies new normative behaviors.

The last scenario is the case where, as the educational expansion unfolds, the educational gap in fertility increases and the negative education gradient in childbearing consolidates. In parallel to the previous case, the divergent scenario can be driven by either educational group. On one hand, in a mirror image of the compositional effect, women who are in lower educational categories are more negatively selected after the educational expansion. Their education level is a marker of relative disadvantage that correlates with distinct fertility behaviors, such as persistent early childbearing. On the other hand, the sheer number of women with a college degree might have spillover effects on the marriage and labor market that they face upon finishing their degrees (relative education hypothesis, Bills 2016; Collins 1979; Freeman 1976; Horowitz 2018). For example, Shen (2019) shows that assortative mating has been mechanically increasing due to the closing of the gender gap in education. Horowitz (2018) empirically demonstrates that the expansion of higher education erodes the value of a college degree, thus increasing the risk for underemployment. In this scenario, those with higher education are ‘competing’ with a larger number of women in the same education strata
both in the marriage and labor market. These added difficulties could lead to further postponement or foregoing childbearing, thus increasing the fertility gap with the other education groups.

**Data**

The two main datasets used in the following analyses are the first wave of the Gender and Generation Survey (GGS) for individual characteristics, such as educational attainment and childbearing behavior, and the Barro-Lee Educational Attainment dataset (Barro and Lee 2013) for aggregate measures of education by country and cohort. The GGS is a longitudinal survey of nationally representative samples of the 18- to 79-year-old resident population in each participating country. It contains highly comparable survey responses from a number of European countries, including information on highest level of achieved education, fertility, and union status histories. There are several advantages in using the first wave of the GGS for these analyses. The included national surveys are highly comparable and designed to allow for cross-country comparisons, allowing me to include up to fifteen European countries in each model.4 Furthermore, this dataset contains the cohorts who were of childbearing age at the time of educational expansion. The first wave of surveys were conducted between 2002 and 2013, thus women who had completed their fertility at time of survey are the ones chiefly affected by the changes in the education distribution.

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4 Countries are Bulgaria, Russia, Germany, France, Hungary, Italy, the Netherlands, Romania, Austria, Estonia, Belgium, Lithuania, Poland, Czech Republic, and Sweden. Not all countries can be included at all times for idiosyncratic survey designs. For example, Austria selected a representative sample for ages 18 to 45 instead of 79, so older cohorts are not available for this country. Other exceptions are noted where relevant.
The GGS measures education in terms of highest education level using the International Standard Classification of Education 1997 scale (ISCED97). The possible educational attainment ranges from 0 to 7, with the educational levels being pre-primary, primary, lower secondary, upper secondary, post-secondary non-tertiary, first stage tertiary, and second stage tertiary. Given the possibility of mortality and response biases by educational attainment, I complement these individual measures of education with data reported in the Barro-Lee Educational Attainment Data (Barro and Lee 2013). This dataset provides educational attainment data for 146 countries disaggregated by sex in 5-year intervals from 1950 to 2010 based on 621 census and survey observations. To include as many countries as possible, the Barro-Lee dataset has broad education categories defined as no schooling, primary, complete primary, secondary, complete secondary, tertiary, complete tertiary. I match individual respondents in the GGS with women who are from the same country and in the same 25-29 age group when they completed their education in the Barro-Lee dataset. In this way, each woman is situated in the broader education distribution of women who belong to the same country and cohort and can therefore constitute a ‘social reference group’ for their childbearing choices.

I use three main measures of educational attainment, two of them at the individual level, and one at the aggregate level. The first individual measure is the absolute level of education. This approach assigns each respondent as having low (ISCED 0 – 2), medium (ISCED 3-4) or high (ISCED 5-6) educational attainment based on their highest level of education achieved reported in the GGS. The second individual measure takes into account the relative position of each respondent within the education distribution of
women in a reference group constituted of women in the same 5-year birth cohort and country, as calculated combining data from the GGS and Barro-Lee. Based on Ichou (2004), this relative education measure is the percentage of women in the reference group who have a lower level of educational attainment, plus half the percentage of women with the same level of education. Therefore, this measure conveys in which quantile a woman with a given level of education is within the education distribution of women in the same country and cohort. Doing this for each country and 5-year cohort combination results in a continuous measure of education on a comparable scale for all respondents. To simplify the comparison with absolute levels of education, I use this measure to divide the sample in bottom, middle, or upper tercile in the education distribution so that each woman is assigned to one of three possible values (low, medium, high).

The use of a relative measure of education is particularly important when conducting cross-country analyses where women experienced the educational expansion differently according to their birth cohort. Figure A1.1 and Figure A1.2 in the appendix show the composition of the three educational categories both for the absolute and relative measures based on the women’s birth cohorts and countries, respectively. The first takeaway is that the absolute categories are unequal in size with most women being in the middle and only a smaller proportion having lower secondary or less education. As expected, those in the lowest category come disproportionally from older cohorts that pre-date the educational expansion. At the same time, Figure A1.2 highlights how country-representation in the lowest absolute educational categories is far from balanced as well. Indeed, most women in this category come from France, Poland, and Italy. Therefore, when comparing childlessness levels with respect to the low educational
category, the reference category is mostly the fertility behavior of French, Polish, and Italian women born in the 1940s and earlier.

By construction, the size of the three relative education categories is the same since they are terciles based on the entire education distribution. Moreover, the distribution of women across countries and cohorts is more even and proportional to the overall size of the country-specific sample (see lower panels in Figure A1.1 and Figure A1.2). This prevents the comparisons across groups to be driven by the fertility behavior specific to a certain demographic group. Figure A1.3 in the appendix provides a comparison between absolute and relative measures of education, and in particular how ISCED-based categories match into terciles. Women with tertiary education mostly fall in the highest terciles, with slightly less than a fifth of women in the middle terciles having achieved tertiary education, the vast majority in recent cohorts who saw a large expansion in women’s college completion. Secondary education is the most redistributed category, confirming the different social and economic meaning that the same degree brings in different contexts and times.

Even using relative measures that identify a woman’s position in the education distribution might conflate the amount of education a woman has achieved with the prevalence of that level of education (Frye and Lopus 2018), which constitutes an important element of the role of aggregate education on individual fertility choices. Therefore, I follow Horowitz (2018) and add a contextual measure of aggregate education. This is an interaction between the individual measures of education defined above and the percentage of women with completed tertiary education within each
country-cohort group. Among the advantages of using this measure of contextual education there are simplicity of interpretation and being able to capture how far along in tertiary education the educational expansion is in each country-cohort subgroup (Frye and Lopus 2018).

Methods

The aim of this work is to study how the relationship between own education and fertility behaviors vary with the educational composition of one’s birth cohort and country. Therefore, I adopt several analytical approaches to account for fertility tempo (when a woman has children in the span of her reproductive life, as measured by age at first birth) and quantum (how many children a woman has by the end of her reproductive years, in this case what is the likelihood that she would have remained childlessness). In addition to overall trends, I exploit the country- and cohort-heterogeneity in the educational expansion to investigate across space and across time variations in childbearing decisions. I report all analyses separately by absolute and relative measures of individual education to allow for comparisons across the educational composition of a woman’s reference group in terms of country and cohort.

The first set of analyses looks at childbearing timing showing the education gradient of childbearing at ages 20, 25, 35, 45. This exercise tests whether the education gradient in childbearing differs according to whether the contextual effect of educational attainment is accounted for (Esteve and Florez-Paredes 2018; Rotman et al. 2016). Second, I use a similar technique to Frye and Lopus (2018) and Horowitz (2018) in

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5 This measure is taken from the Barro-Lee Educational Attainment dataset for women who were 25-29 and includes those with completed tertiary education to correspond to ISCED5 and ISCED6, i.e. first and second stage tertiary. Using both tertiary and completed tertiary does not change the results.
predicting childlessness at the end of the reproductive life by using individual educational attainment, cohort-level educational composition in terms of proportion of women who complete tertiary education, and their interaction. In this way, I can disentangle the amount of education a woman achieves and the prevalence of the highest degree, which increases with the educational expansion. Specifically, to reflect the different evolution of the educational expansion across countries and cohorts, I calculate the proportion of individuals with completed first or second stage tertiary within the same country and five-year birth cohort in the Barro-Lee data (Barro and Lee 2013). Interacting this measure with a woman’s own educational attainment explains how the effect of individual education depends on the overall education distribution in her peers.

Lastly, I focus on early motherhood because of its significance as a marker of relative disadvantage and its availability for most birth cohorts. Here, I run logistic regressions on the probability of having had a child by age 25 including individual education and its interaction with the proportion of women with completed tertiary education in the same country and cohort. I isolate variation across space by running analyses separately by ten-year birth cohort groupings. In this way, everyone in the same cohort is subject to the same time-specific idiosyncrasies and the differences are due to different country-contexts. I focus in a particular way on an older cohort of women born in the 1940s and a younger cohort of women born in the 1970s as means of comparing groups that were at start and at an advance stage in the educational expansion. Similarly, I isolate differences across time by holding space constant and running separate analyses by countries. The combination of these analytic strategies address my research question more directly than a decomposition analysis because the latter estimates the change over
time in fertility keeping education constant and vice versa, while my concern is specifically in studying fertility behaviors in the context of a changing education distribution.

**Results**

*Educational Context and age at first birth*

Figure 1.1 shows the proportion of women who completed tertiary schooling for each country over the 5-year interval when they were between 25 and 29 years of age. The sample covers a wide range, from a low of less than 5% for women born at the beginning of the 1920s in the Netherlands to a high of almost 40% for women born in Lithuania in the most recent cohort. All countries display a positive secular trend, although the tertiary educational expansion occurs roughly 20 years earlier in the Benelux, Nordic, and Baltic countries such as Sweden, Estonia, Belgium and the Netherlands than in the rest of the continent. As a result, heterogeneity in completion of tertiary education increased from the beginning of the period, although it might be diminishing for recent cohorts when more countries close the tertiary education gap.

This expansion of tertiary education was preceded, and sometimes accompanied, by an expansion of secondary education. This gave rise to different education distributions within each country, where the same nominal level of education has a different positional value (seen Figure A1.4 in the appendix). Therefore, results are presented using individual absolute and relative measures of education throughout. Indeed, as described in the data section, there is some redistribution of individuals across educational categories.
Similar to Figure A1.3 in the appendix, Figure 1.2 shows the distribution of relative education categories within each level of absolute educational attainment. Methodologically, this figure is constructed similarly to Ichou (2004), but differs substantially on how relative education maps into absolute education. This is due to the different composition of countries included in the analyses. While Ichou (2004) focuses on mostly developing countries and thus reports more dispersion in primary-level educational attainment, Figure 1.2 shows greater dispersion in secondary education and up. This is in line with expectations as the cohorts included in this study for European countries are past the primary educational expansion described for Africa in Lopus and Frye (2018) and most of the educational expansion occurred for secondary and tertiary level education for the cohorts under study.

Table 1.1 shows descriptive statistics for the relative education measure by country and cohort. As expected, the mean decreases across cohorts within the same country as absolute education increases with each subsequent cohort. The speed of the decline differs across countries with sustained drops across cohorts in the Czech Republic, while mean relative education does not drop in Estonia and Poland until the cohorts born in the 1970s and 1980s. This measure also shows that changes occur differently at the ends of the distribution. At the upper end, most changes within countries happen in the top 25% rather than in the top 10% (not shown), and they are particularly pronounced in Italy, Czech Republic, and Romania. At the lower end, there are dramatic decreases in the bottom 10%, especially in Germany, France, and the Netherlands. The bottom decile starts with similar values for cohorts born before the 1940s and then it grows diverse until it aligns again at a lower level for cohorts born in the 1980s.
The most noticeable trends in fertility behaviors for the same cohorts is a dramatic increase of age at first birth in recent decades. Fertility rates declined to levels under replacement level, but then fluctuated around similar values. Figure A1.5 and Figure A1.6 in the appendix show cohort trends for childlessness and number of children, respectively. Mechanically, childlessness rates spike for women who were 25 to 29 years old in and after the late 1990s because they were still in prime reproductive age at the time of the survey and many of them will eventually become mothers. However, for women who completed their education between 1955 and 1985, the childlessness rates falls in the 5%-15% range for almost the totality of countries and cohorts. Therefore, childlessness rates (as well as the total number of children) display substantially less heterogeneity across time than the education distribution.

Figure 1.3 and Figure 1.4 show time trends in the percentage of women who had a first child by age 20, 25, 35, and 45 (completed fertility) stratified by absolute and relative education, respectively. There is a clear stratification by education for an early onset of maternity. Women with higher educational attainment experience later transitions to motherhood and a very small proportion of them, regardless of how education is measured, has a child before age 20. Concurrently, women who did not complete secondary education (lowest category for absolute education) seem to have children before age 20 in larger proportion in recent cohorts, but this uptick disappears when looking at women in the lowest education tercile (lowest category for relative education), which are fluctuating at around 60%. Indeed, when setting higher age thresholds to look at whether a woman has had her first child, differences between the low and medium terciles disappear and the women in the top of the education distribution
approximate the same childbearing rate from below. Regardless of the education measure, most women have at least a child by the end of their reproductive years. Taken collectively, these results suggest that postponement for the highly educated women is the main driver of the educational stratification in the birth of the first child.

*Role of the education distribution in childlessness*

Table 1.2 and Table 1.3 report how the probability of remaining childless changes contingently to the expansion of secondary and tertiary education. The first two columns report results, with and without country and cohort controls, for women who were at least 45 years old at the time of interview and that are therefore considered at the end of their reproductive lives. Columns 3 through 7 report the results separately by ten-year birth cohorts.

Table 1.2 and Table 1.3 present three key sets of covariates from logistic regressions for absolute and relative education, respectively. The first variable of interest is the proportion of women in the same country and cohort who completed tertiary education. The second is the measures of individual education used thus far, i.e. low (ISCED 0 – 2), medium, (ISCED 3-4), high (ISCED 5-6: high) for absolute education and terciles for relative education. The third is a set of interaction between the individual education level and the proportion of women with tertiary education.

All the main coefficients support the existence of a negative gradient. For example, the second column in Table 1.2 reports that, by the end of the reproductive years, a woman with tertiary education has close to double the odds to remain childless than a woman who has not completed secondary school. However, both tables show that, as the proportion of women who has tertiary education increases, more educated women
have lower odds to remain childless than if they lived in a society where tertiary
education was rarer, as indicated by odds ratios lower than one for the interaction terms.
These results suggest that education distributions where more women have high levels of
educational achievement have a protective effect against childlessness for the most
educated.

Figure 1.5 corroborates these findings by showing the predicted probabilities of
remaining childless for women at the end of their reproductive lives. The probability of
remaining childless for women who are at least 45 years old at the time of survey is
predicted to converge for countries where there are about 10-15% of women who have
completed tertiary education. In this sub-sample of older women, most belong to cohorts,
which, regardless of country, have much lower proportions of women with a tertiary
education than the one where the cross-over is predicted to happen. This group displays a
clear negative gradient in the cross-section. However, taking into consideration all
country and cohort combinations in the sample, the average proportion of tertiary
education achievement is 11.03% and the median is 8.94%, suggesting that the
educational expansion could lead to cases where the education gradient in childlessness
flattens. This convergence is driven by a sharp decrease in childlessness for women with
medium and high educational achievements. These two groups have much higher odds of
being childless when tertiary education is very rare, but then converge to the levels of
childlessness of the women within the low education category. This phenomenon is
particularly clear using the relative measure of education. While medium and high
absolute level of education follow similar trajectories, in the case of relative education,
women in the three terciles are remarkably different before the educational expansion.
The two top terciles converge to a similar level of childlessness when roughly 10% of women complete tertiary education and are then projected to continue with similar levels of childlessness. In sum, the overall trends for women who completed their childbearing suggest that there is convergence toward lower levels of childlessness, driven by the top two educational categories.

Variations across space and across time

To investigate how the relationship between educational attainment and childbearing timing varies across space, I estimate logistical models separately by cohort as reported in Table 1.2 and Table 1.3 for absolute and relative measures of education, respectively. Figure 1.6 visually reports the results for women born in the 1940s (older cohort) and those born in the 1970s (younger cohort). The range of percentage of women who had completed tertiary education is substantially different across these two groups because of the educational expansion for women that occurred in between. For example, in the older cohort, the highest proportion of women with completed education is about 12%, while for the more recent cohort some countries have more than 30% of women with tertiary degrees. This proportion is now even higher thanks to the Europe 2020 education target of raising the share of the population aged 30 to 34 that have completed tertiary or equivalent education to at least 40% (Eurostat 2018).

Women in the younger cohort had not completed fertility by the time of the interview, but they were all at least 25 years old. Therefore, Figure 1.6 reports the predicted probabilities of having a child before the age of 25 for both cohorts to allow for comparability. Considering the substantial postponement of motherhood occurred in the
analyzed cohorts, this age cutoff is informative for the educational variation in the (early)
onset of motherhood.

The two cohorts exhibit different trends across space. In the case of the older
cohort, the dominant trend is convergence. This trend is in line with the results presented
in Figure 1.5 as these women completed their fertility and are therefore part of that
sample as well. Similar to the findings for the reduction of childlessness at the end of the
reproductive years, women with completed tertiary education drive the convergence in
the case of absolute education. However, the fact that more highly educated women tend
to have a child before age 25 more in contexts where tertiary education is more
widespread is counterintuitive and could be driven by countries that had an earlier start to
the education expansion as suggested by findings by country reported in the next section.
Moreover, this result is not supported by looking at fertility in the older cohort using a
relative education measure, where women in the top tercile (regardless of whether they
have a college degree) are equally probable to have a child before age 25 across the range
of realized proportions of women with completed tertiary education. Here, the low and
medium groups are driving the convergence towards the elite group, which display a
lower likelihood of becoming mothers before age 25 throughout the older cohort.

The younger cohort displays a clear negative education gradient. Countries where
the percentage of women with complete tertiary is higher display delayed fertility for
everyone. Indeed, the predicted probability of having a child before age 25 is
progressively lower in higher education contexts regardless of the individual education
level or the relative position in the education distribution. This finding supports a general
shift across space for postponement of motherhood that occurs simultaneously in all 
education groups, thus maintaining the relative differences across educational groups.

Finally, by estimating models separately by country, I look at within-country 
trends. Thanks to the overall secular trend in tertiary education increase, these results 
give an over-time perspective. Although the overall trend predicts convergence of 
childlessness rates across educational groups, the picture for individual countries rates for 
early motherhood are much more heterogeneous and often display trends towards 
divergence driven by women in the top two educational categories. Figure A1.7 in the 
appendix shows separate models for each country, while Figure 1.7 focuses on three 
paradigmatic cases.

Figure 1.7 displays the predicted probabilities of having a child before age 25 by 
individual educational levels based on the proportion of women who completed tertiary 
education. Panel (a) shows that in Sweden, a country with sustained and long-standing 
trend of increased of women in higher education, early motherhood is decreasing across 
the board and converging towards the low levels of highly educated women. This is in 
line with a trickling down of social norms that include later age at childbearing to all 
education strata. Panel (b) shows a contrasting story in Hungary where highly educated 
women are postponing motherhood more as tertiary education becomes widespread. 
Differently from Sweden, the other educational groups do not follow this trend, thus the 
educational gap diverges. This result is not surprising given the different ability for 
women in Sweden and Hungary to integrate work and motherhood and the different 
stages in the educational transitions as well as gender roles. Panel (c) offers another case 
of divergence in early motherhood rates, but in this case there is no clear education group
that is driving this trend. Indeed, in Romania all groups are accentuating their relative positions, reinforcing the negative education gradient in fertility.

**Discussion and Conclusions**

Findings in the full model suggest an overall convergence towards lower levels of childlessness at the end of the reproductive years as the proportion of women with completed tertiary education increases. This comes mostly from women with higher levels of educational attainment, consistent with a compositional effect due to the underlying change in the education distribution. As the educational expansion into secondary and tertiary education advances, women who would have previously not enrolled in tertiary education now do so. Therefore, their childbearing behaviors resemble those of women in the middle education categories, thus flattening the negative education gradient. When using a relative measure of education the middle and higher terciles display an even starker gradient in childlessness at lower levels of tertiary education.

However, the main convergence pattern is confirmed. Indeed, this work shows that the increase in the proportion of women in the same country and birth cohort who complete tertiary education has a ‘protective effect’ against childlessness for those with high education.

As highlighted in the results, convergence happens at proportions of tertiary education that are around the overall mean of the entire sample. Given that the proportion of women with completed tertiary is much lower for older birth cohorts, it is not surprising that this sub-population has higher rates of childlessness for highly educated women and a starker negative education gradient. Younger cohorts and countries where the educational expansion started earlier and progressed further tend to display
convergence to lower levels of childlessness for highly educated women. This is accompanied by a general decline in early motherhood and a postponement of childbearing, especially for women in the middle of the education distribution.

Based on these results, this work suggests that the heterogeneity by country and birth cohort of what women experienced in their reproductive careers is behind the conflicting findings on the relationship between education and fertility reported in the literature. Depending on the country analyzed and on the cohorts available in a given dataset, the changes in the education distribution allow for different slopes for the education gradient in fertility. Indeed, this work presents a more heterogeneous picture than a general convergence when looking at specific cohorts and countries. For example, looking across space but within younger cohorts, the convergence pattern is driven by the middle tercile in the education distribution. This group of women starts with early motherhood rates similar to the lower end of the distribution when tertiary education is rare, and progressively moves towards rates similar to those women in the highest category. This is consistent with a trickling down of social norms from the increasing-in-size college educated women to those women who are in the middle of the distribution. This trend can be further accentuated in the future as the labor market adjusts to the demands of reconciliation between family and work (Yu and Kuo 2017).

This general tendency is already visible in countries like Sweden and the Netherlands. There, the educational expansion started earlier and the current proportions of women who completed tertiary education are among the highest in Europe. In these countries, early entrance into motherhood is converging to the low levels displayed by the highly educated. Of course, in addition to higher levels of female education and labor
force participation, these countries are also promoting gender equality in all spheres and supporting the combination of work and family. Other Eastern and Baltic countries, like Lithuania, saw a rapid increase in tertiary education for women. Differently from Nordic countries, in Lithuania this expansion was accompanied by a divergent fertility behavior for women with low educational attainment. This phenomenon is again consistent with a change in the composition of education where those who are in the lowest tercile in the education distribution in a time of great expansion are in a position of relative disadvantage and their lack of fertility postponement sets them apart from women with higher educational attainment.\(^6\) Conversely, in countries such as Italy and Romania where the proportion of women with tertiary education is somewhat lower we observe divergence driven by highly educated women. In these contexts, where motherhood and work are harder to reconcile and there are persistent traditional gender norms, highly educated women continue to postpone their first child and have smaller families overall.

The approach of this work to include both absolute and relative measures of individual education as well as contextual measures of the tertiary education expansion in 15 European countries provides a promising avenue to reconcile discordant fertility patterns in light of changes in the education distribution. The overall finding is that a higher proportion of women with tertiary education is associated with lower childlessness rates for the highly educated, thus supporting the theory that highly educated women are returning to larger families (Esping-Andersen and Billari 2015; Goldscheider et al. 2015).

\(^6\) It is interesting to note that in the case of Lithuania those with both low (ISCED 0 – 2) and medium (ISCED 3 –4) absolute levels of education have higher levels of childbearing before age 25, while rates are decreasing for the middle tercile when using the relative education measure. In some Eastern European countries, the dismantling of childcare and other services after the fall of communism might have affected women with lower educational attainment in particular.
Enabled by higher education, women’s prospects in the labor market are not yet declining like in the case of men (Horowitz 2018), especially in countries where it is possible to combine motherhood and work and this leads to delayed motherhood but less childlessness. However, there is sizeable heterogeneity in the trends across time and space that need to be explored accounting for specific education distributions and speed of transitions. Future studies also need to examine higher parity births to study the changes in the education gradient in how fast subsequent parity transitions occur to predict the fertility quantum of women who are still in their reproductive years.
Figures and Tables

Figure 1.1 – Changes over time in the percentage of women who completed tertiary education in 15 European countries

Notes: Proportion of women with completed tertiary education (comparable to ISCED97 codes 5 and 6) per birth cohort and country is based on Barro-Lee Educational Attainment Dataset (Barro and Lee 2013). The x-axis reports the first year of the 5-year period when these women were 25 to 29 years old.
Figure 1.2 – Box plots of the distribution of women’s relative educational attainment in each category of absolute educational attainment

Notes: This box plot compares absolute and relative measures of education based on the Gender and Generation Survey (GGS) and Barro-Lee Dataset of Educational Attainment (Barro and Lee 2013). The box represents the 25th, 50th, and 75th percentiles and the whiskers are the differences between the first and third quartile and 1.5 times the interquartile range. The black dots represent the mean of relative educational attainment in each category of absolute educational attainment as measures by ISCED97 codes 1–6.
Figure 1.3 – Cohort trends in percentages of women who, by absolute level of educational attainment, experienced a first birth by age 20, 25, 35, 45.

Notes: Data for 13 European countries come from the Gender and Generation Survey (GGS). Individuals’ highest education level uses the ISCED97 scale categorized as low (ISCED 0 – 2), medium (ISCED 3-4), and high (ISCED 5-6). Birth cohorts are on the x-axis. Most recent cohorts had not reached all age thresholds by the time of the survey.
Figure 1.4 – Cohort trends in percentages of women who, by relative level of educational attainment, experienced a first birth by age 20, 25, 35, 45.

**Notes:** Data for 13 European countries come from the Gender and Generation Survey (GGS). Relative education is categorized in terciles constructed from the Barro-Lee Educational Attainment dataset based on women who were in the same 5-year birth cohort and country. Birth cohorts are on the x-axis. Most recent cohorts had not reached all age thresholds by the time of the survey.
Figure 1.5 – Convergence of the probability of remaining childless in the full model for women who are at least 45 years old. Plotted without controls.

Notes: Absolute education: individuals’ highest education level using the ISCED97 scale categorized as low (ISCED 0 – 2), medium (ISCED 3-4), high (ISCED 5-6). Relative education: terciles constructed from the Barro-Lee Educational Attainment dataset based on women who were in the same 5-year birth cohort and country.
Figure 1.6 – Comparison of predicted probabilities to have a child before age 25 across space, for women born in the 1940s (panel a, older cohort) and 1970s (panel b, younger cohort).

Notes: Absolute education: individuals’ highest education level using the ISCED97 scale categorized as low (ISCED 0 – 2), medium (ISCED 3-4), high (ISCED 5-6). Relative education: terciles constructed from the Barro-Lee Educational Attainment dataset based on women who were in the same 5-year birth cohort and country.
Figure 1.7 – Three countries’ contrasting trends in childbearing before age 25.
Notes: Absolute education: individuals’ highest education level using the ISCED97 scale categorized as low (ISCED 0 – 2), medium (ISCED 3-4), high (ISCED 5-6). Relative education: terciles constructed from the Barro-Lee Educational Attainment dataset based on women who were in the same 5-year birth cohort and country.
Table 1.1 – Descriptive Statistics for Relative Education by Country and Cohort

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<th>Russia</th>
<th>Germany</th>
<th>France</th>
<th>Hungary</th>
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<tr>
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Source: Author’s calculations Gender and Generation Survey (GGS) and Barro-Lee Educational Attainment Dataset (Barro and Lee 2013).
Table 1.1 – Descriptive Statistics for Relative Education by Country and Cohort

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*Source:* Author’s calculations Gender and Generation Survey (GGS) and Barro-Lee Educational Attainment Dataset (Barro and Lee 2013).
Table 1.1 – Descriptive Statistics for Relative Education by Country and Cohort

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Source: Author’s calculations Gender and Generation Survey (GGS) and Barro-Lee Educational Attainment Dataset (Barro and Lee 2013).
Table 1.2 – Results from logistic regression models showing differential effects of absolute education on the probability to remain childless as the proportion of women with tertiary education in own cohort and country increases

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Standard errors are in parenthesis

*** p<0.01, ** p<0.05, * p<0.1

Notes: Absolute education: individuals’ highest education level using the ISCED97 scale categorized as low (ISCED 0 – 2), medium (ISCED 3-4), high (ISCED 5-6). Controls include country of birth and birth cohort expressed in five categories by decade.
### Table 1.3 - Logistic regression models showing differential effects of relative education on the probability to remain childless as the proportion of women with tertiary education in own cohort and country increases

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Standard errors are in parenthesis

*** p<0.01, ** p<0.05, * p<0.1

**Notes:** Relative education: terciles constructed from the Barro-Lee Educational Attainment dataset based on women who were in the same 5-year birth cohort and country. Controls include country of birth and birth cohort expressed in five categories by decade.
Appendix

Figure A1.1 – Composition of absolute and relative measures of individual education by cohort

Notes: Absolute education: individuals’ highest education level using the ISCED97 scale categorized as low (ISCED 0 – 2), medium (ISCED 3-4), high (ISCED 5-6). Relative education: terciles constructed from the Barro-Lee Educational Attainment dataset based on women who were in the same 5-year birth cohort and country.
Figure A1.2 - Composition of absolute and relative measures of individual educational attainment by country of residency

Notes: Absolute education: individuals’ highest education level using the ISCED97 scale categorized as low (ISCED 0 – 2), medium (ISCED 3-4), high (ISCED 5-6). Relative education: terciles constructed from the Barro-Lee Educational Attainment dataset based on women who were in the same 5-year birth cohort and country.
Figure A1.3 – How absolute levels of education match into relative education categories

Notes: Absolute education: individuals’ highest education level using the ISCED97 scale categorized as low (ISCED 0 – 2), medium (ISCED 3-4), high (ISCED 5-6). Relative education: terciles constructed from the Barro-Lee Educational Attainment dataset based on women who were in the same 5-year birth cohort and country.
Figure A1.4 – Educational attainment distribution by country

Notes: Author’s calculations based on the Gender and Generation Surveys (GGS). Education categorized as individuals’ highest education level using the ISCED97 scale as follows: low (ISCED 0 – 2), medium (ISCED 3-4), high (ISCED 5-6). These graphs are pooling all cohorts together, but the distribution is not uniform across cohorts.
Figure A1.5 – Changes over time in the percentage of women who had no children in 14 European countries by the end of their reproductive years

*Notes:* Proportion of women who have no children. The x-axis reports the first year of the 5-year period when these women were 25 to 29 years old. Women in this figure are at least 45 years old at the time of interview. Without this restriction, there is a sharp increase in childlessness starting in the late 1990s. This is due to women who have not had a child yet at time of interview, but might have one later since they have not reached the end of their reproductive years at time of survey.
Figure A1.6 – Cohort changes in the distribution of number of children

Notes: Distribution in the number of children as none, one, two, three and more. The x-axis reports the women’s birth cohort in ten-year intervals. Not all women born in the 1970s had completed fertility by the time of survey and those born in the 1980s are not represented because they were early in their reproductive year when the interviews were conducted.
Figure A1.7 – Estimated models separately by country to look at trends over time.
Notes: Absolute education: individuals’ highest education level using the ISCED97 scale categorized as low (ISCED 0 – 2), medium (ISCED 3-4), high (ISCED 5-6). Relative education: terciles constructed from the Barro-Lee Educational Attainment dataset based on women who were in the same 5-year birth cohort and country. These models are run separately by country. Excludes Estonia (no age at first birth), Germany (skewed childlessness rates), Czech Republic (no absolute low education), Austria (not all cohorts).
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Chapter 2

Women’s Work Trajectories across the Life Course: Early Life Influences

Introduction

Women are spending an increasing amount of their lives employed: female labor force participation in OECD countries was around 40 percent in 1960, but it is now up to roughly two-thirds (Adserà 2005). However, the rapid growth in women’s employment seems to have stalled in recent years, and it is shown to be unevenly distributed (England 2010; Goldin 2006, 2014). Previous research has shown that women who come from disadvantaged backgrounds and racial minorities are less likely to work full time (England et al. 2004) and that social stratification, gender beliefs, and work-family constraints matter from a very early age (Damaske and Frech 2016).

This work uses demographic characteristics and various measures of parental socio-economic status to study how women’s early life experiences predict their attachment to the labor market later in life. Its contributions are twofold: on the one hand, it considers women’s employment holistically, including the full sequence of events from when the woman was 16 until she was 45. Thus, it encompasses all childbearing years that are shown to be the most critical for women’s employment (Pertold-Gebicka et al. 2016; Lu et al. 2017). On the other hand, this work includes a comprehensive set of early life and parental characteristics so as to identify what contributes to the ‘tracking’ of
women into certain work pathways from an early age found in Damaske and Frech (2016).

To answer the question of how early life socio-economic circumstances are associated with labor market attachment during childbearing years, I use the Gender and Generation Survey (GGS), which has been designed as a longitudinal dataset to study the relationships between different generations. Due to the richness of data on the respondents’ current and parental families, it is possible to consider early-life socio-economic status through a range of parental characteristics. Moreover, the survey’s second wave contains detailed data on activity status of respondents for their entire life. Although the data is collected mostly retrospectively and thus is prone to recall bias, it includes the month and year when each activity began and ended. Therefore, it has been possible to construct a full sequence of activities indicating whether the respondent was either a student, employed, unemployed, homemaker, retired, in paid leave or in another status for each year since she was 16 years old. The sample includes only women who were at least 45 at the time the last interview was conducted so that the information on their activities covered their entire childbearing ages.

These so-constructed employment trajectories constitute the basis for sequence analysis. This technique has been used in social sciences to study a number of issues, from childlessness (Morgan and Rybińska 2016) to employment differential between immigrants and native born (Kogan 2007). As per previous works, after establishing the dissimilarity across sequences (Abbott and Hrycak 1990) and matching them through Optimal Matching (OM, Abbott and Forest 1986) the respondents were grouped in four different clusters based on their attachment to the labor market, ranging from attached to
the labor market to weakly attached, and completed fertility. These clusters constitute the outcome variable for a series of multinomial logit regressions where the predictors are the contextual and parental characteristics to which respondents were exposed before the age of 16, when the employment trajectories start.

Results confirm what Van Winkle and Fasang (2017) find when it comes to contextual variables: the country where the woman was born and raised has a stronger predictive power for her labor market attachment than her birth cohort does. Parental characteristics also matter in different degrees, suggesting intergenerational transmission of inequality. Indeed, a simple indicator of having had a working mother when the respondent was 15 is not a significant predictor of life-long attachment to the labor market, but maternal education and the status of the mother’s occupation are, especially when interacted with cohort. These findings are consistent with the fact that a large proportions of mothers were employed in agricultural and elementary occupations (such as cleaners and helpers) and, as these professions became increasingly rare, they became a marker of lower socio-economic status.

**Background**

Recent years have witnessed important transformations in the role of women in the labor market. Female labor force participation in OECD countries was around 40 percent in 1960 (Adserà 2005), but recent Eurostat reports (2017) indicate that, on average, more than 70% of European women actively participate in paid work, thus spending a significant amount of their adult lives in the labor market. However, the rapid growth in women’s employment experienced in the last decades seems to have stalled in recent years and is unevenly distributed (England 2010; Goldin 2006, 2014). Moreover,
in the United States, there is some evidence that women who are less likely to work full
time come disproportionally from disadvantaged backgrounds and racial minorities
(England et al. 2004).

The objective of this study is to identify factors from early life that could help predict women’s attachment to the labor market through their entire childbearing years. It contributes to the body of literature treating employment trajectories as “process outcomes” rather than “point in time outcomes” where the focus is on single employment transitions, often in combination with family formation (Abbott 2005). As summarized in Aisenbrey and Fasang (2017), studies on women and the labor market have focused on female labor force participation and the gender wage gap, often narrowing down on the unidirectional impact of family events (e.g. marriage, childbirth, divorce) on employment outcomes in a limited timeframe (Anderson et al. 2002). Conversely, family demographers use indicators of education and employment status as determinants of fertility and family formation (Kreyenfeld 2010; Carlson et al. 2004). Studies in both directions of the family-employment relationship contribute to the understanding of the interplay of these two important phenomena; however, rich insights can be gained by studying their relationships across the life course (Aisenbrey and Fasang 2017). This approach also allows for identifying whether the so-called “opting out revolution”, i.e. leaving the labor market either temporarily or permanently in response to childbirth found in recent American data (Antecol 2010; Percheski 2008), is more widespread in certain sub-groups of European women.

The goal of this work is to conduct a more comprehensive study of how women’s early life environments and experiences relate to their attachment to the labor market in
the long term. The first variables considered are contextual elements and fixed demographic characteristics: birth cohort and country of residence. This is because when and where women are born, and consequentially when and where they enter the labor market, constitute important structural factors that shape life-long attachment to the labor market. In particular, members of the same birth cohorts experience idiosyncratic shocks that have different effects depending on when in their career trajectory they occur. For example, a decline in demand for workers can be especially felt by those at the critical transition from school to work (Byner 1998). Birth cohorts also experience different levels of inequality (Adserà 2017) as well as prevalence of education and service-oriented job opportunities. These generational variations are especially significant for women as their ability and the social acceptance of combining a career and family has fluctuated with time (Goldin 2014).

There is even a greater variation in the country-level structure of the labor market as well as welfare state provisions that can encourage or hinder continuous attachment to the labor market throughout the life course. Typical examples include whether unemployment is a sporadic events that punctuates a career trajectory or rather a chronic systemic feature (Grunow and Aisenbrey 2016) as well as whether women drop out of the labor force after childbearing (Percheski 2008). In particular, maternal leave policies are extremely heterogeneous across countries (Gauthier 2002) as it is the friction of re-entry and human capital depreciation (Görlich and de Grip 2009; Grunow and Aisenbrey 2016). Both country and cohort contextual characteristics play a role in labor market attachment, though the exact amount remains unclear. For example, Van Winkle and
Fasang (2017) find that employment trajectories for men and women born between 1918 and 1963 vary across countries and only to a much smaller extent across birth cohorts.

A second set of relevant variables includes parental characteristics: Damaske and Frech (2016) report on the importance of early socio-economic status in shaping women’s life chances in the framework of cumulative advantages/disadvantages. Indeed, unequal access to resources early in life may, among other things, restrict women’s opportunity to be attached to the labor market in the course of their careers, especially while in their childbearing years (Frech and Damaske 2012; O’Rand 2006). Maternal and paternal education and occupation are useful proxies for socio-economic status and home environment during the early years of life.

Parental employment and type of occupations provide information on the economic situation of the family through inferences on the available income and status. In a bread-winner family model, paternal occupation is particularly salient for situating the family in the income distribution. Moreover, maternal employment provides a ‘role model’ channel for influencing offspring’s subsequent labor market attachment in addition to increasing available income and socio-economic status in the early years. Indeed, the role model that a working mother provides is different than the example set by a non-working mother (Hoffman 1974). This role modelling effect is especially strong for daughters who have an increased propensity to work outside the home in adulthood if they did not have a stay-at-home mother in childhood (Hasson et al. 1977). However, Menaghan and Parcel (1995) find heterogeneity on the role of maternal employment on early life experiences based on the type of occupation the mother has. Indeed, the home environment improves particularly in families where the mother has higher quality
employment defined as higher wages and higher complexity (Menaghan and Parcel 1995).

Parental education plays an additional role to occupation in signaling access to resources like human and social capital that go beyond income. Education can be considered a mark of socio-economic status especially for mothers since educational expansion for women occurred temporally after men’s in most countries. The combination of parental occupation and education provides and approximation of socio-economic status experienced by children in their formative years. However, the theoretical predictions of how childhood socio-economic situations shape labor market attachment over the childbearing years are ambiguous. Women from a higher socio-economic background have more resources to access the labor market and to secure higher quality jobs with built-in flexibility to combine family and work. For example, their higher income, potentially combined with a higher partner’s income due to assortative mating, allows for externalization of childcare provisions. This would in turn increase their possibility to remain attached to the labor market. However, the high-demands of certain professions (Goldin 2014) and the lower financial need to have two incomes might in turn decrease labor market attachment for women with higher socio-economic status. Conversely, higher financial needs of women from lower socio-economic backgrounds who do not have a family safety-net to rely upon incentives them to be continuously active on the labor market. However, these groups of women are more subjected to disruptions in their career trajectories and unemployment thus fragmenting their attachment to the labor market (England et al. 2004).
Against this backdrop and in order to identify the variables that best predict women’s attachment to the labor market based on early life conditions, this work uses retrospectively constructed employment trajectories for women who reached the end of childbearing years (15 to 45 years old). Sequence and cluster analysis are then used to classify trajectories based on attachment to the labor market. Subsequently, birth cohort, country of residence, and parental characteristics including education, income, and occupation are used to predict women’s labor force attachment.

Data

The Generations and Gender Programme (GGP) is a system of national Generation and Gender Surveys (GGS) and contextual databases, designed to complement the micro-level data with macro-level indicators and policy information. The GGS is a longitudinal survey of nationally representative samples of the 18- to 79-year-old resident population in each participating country. Currently, data are available for 19 countries for wave 1 and 10 countries for wave 2, which occurred roughly three years later in the late 2000s. The subsequent analyses exploit a series of questions posed in the second wave regarding the main activity status throughout the respondent’s life. Therefore, only countries with reliable data on such questions are included in this study. These are Bulgaria, Georgia, Germany, France, the Netherlands, Austria, and Lithuania, leaving out Southern and Northern European countries.

Previous studies of the interplay between individual employment histories and fertility have sometimes used cross-national datasets such as the European Community Household Panel Survey (ECHP, Adserà 2011). Others have opted for national registers, for example the Danish one in Pertold-Gebicka et al. (2016), or national surveys, like the
Spanish Fertility Surveys in Adserà (2006) and the German Socio-Economic Panel in Kreyenfeld (2010). However, there are several advantages in using the GGS for this analysis. First, it was designed to be mainly a fertility and intergenerational survey and to capture all family dynamics in great detail, given its focus on the interaction of multiple generations. Therefore, it contains complete information on biological, step-, and adopted children, including the month and year they entered the household, whether they left it and when, plus fairly complete information on the respondent’s family of origin. This makes it one of the few datasets to collect information of this kind in such detail, thus allowing examination into whether employment outcomes differ according to the family formation type and the conditions experienced before entrance in the labor market.

Secondly, it is a recent survey, containing detailed information around the crucial years of the onset of the so-called Great Recession. Thirdly, the second wave of the survey contains a very detailed set of retrospective questions regarding the respondent’s entire working history, which is largely exploited in this work.

Indeed, the questions that guide this analysis ask information about previous employment, for up to 26 different possible activities, and include the month and year of start, the month and year of end, and type of activity. The GGS asks for the activity that best describes what respondents were doing at age 16; then, it repeats the question with what they were doing next and so on until it reaches the time of interview. In this way, changes between education, employment, leave from work, retirement and so on are captured by these data, but not, for example, the switch from full time to part time work, as the respondent remains under the employed categorization. Given the large number of possible types of activities, different options were condensed into a subset of categories.
These are comprehensive, but allow for clearer visualization of patterns: (1) student, (2) employed (includes also self-employed and helping a family business), (3) unemployed, (4) homemakers, (5) retired, (6) in paid leave (includes maternity, parental and care leave), and (7) other (mainly includes military and social service, ill or disabled). As these questions are retrospective, older respondents might have greater difficulty in remembering transitions that happened long in the past, but they should be able to recall major changes and roughly the year when they occurred. As long as the ordering of activity status is correct, this analysis is robust.

The temporal span covered by this set of questions is very wide: one respondent had his first activity starting in 1928, and the data go all the way to the current employment of the last person being interviewed in wave 2. As the focus on this study is on women in childbearing age who had enough time to finish even post-graduate education and establish themselves in a career path, the sample is restricted to women who were at least 45 years old at the time of last interview. Although employment trajectories can be computed starting when the respondent started the activity she was doing when she was 16 (for example, entered school at 6 years old and was still in school) until her age at the second interview, all analyses present trajectories truncated at 16 and 45. Thus, each respondent has the same exposure time to experience a transition. This means that the latest cohorts included in the sample were born in the 1960s, and that their parents were roughly born up to WWII. The analytical sample is comprised of 12,126 women born between 1922 and 1969 and who reside in one of the seven above-mentioned countries.
Table 2.1 reports the main covariates of interested by country. The size of the four cohorts are similarly sized in every country but Austria, that sampled only younger women by survey design and therefore does not include older cohorts. Maternal education is divided in low (ISCED 0 and 1), medium (ISCED 2, 3, and 4), and high (ISCED 5, and 6) according to the highest achieved educational attainment. Most recent studies include lower secondary (ISCED level 2) as low education, but this is a sample of older women that was not uniformly exposed to higher schooling legal requirements. Therefore, the separation between primary, secondary, and tertiary is more salient. This classification means that Germany, Austria, and the Czech Republic have very low percentages of women whose mothers had low levels of education. However, the proportion of women with less educated women in the other countries are a third or more. Maternal employment is divided in not working outside of the household, agricultural and elementary professions such as cleaner and helpers, and other professions with higher standing, such as medicine, law, civil servants, and clerks. Roughly half of the mothers of women in the Georgian, German, French, and Austrian samples were homemakers. With the exception of the Czech Republic that had a more educated female population that participated in larger numbers to professional positions, the other countries are around the one third mark.

Methods

The main method of analysis is sequence analysis (Abbott 1995), which, in this application, is used for activity sequences along the life course of each respondent. It allows for graphically representing clusters of patterns emerging from the data, which are used as outcome variables in a multinomial regression analysis (Kogan 2007). Recent
developments of a statistical package in Stata (Brzinsky-Fay et al. 2006, all analyses here presented are conducted with their SQ-Ado module) and more longitudinal data have allowed researchers to apply sequence analysis to a wider range of demographic issues. These include comparisons between employment trajectories of migrants and native born (Kogan 2007 for the German case), fertility delay and childlessness (Morgan and Rybińska 2016), and employment related to family dynamics (Lu et al. 2017; Van Winkle and Fasang 2017; Damaske and Frech 2016; Halpin and Cban 1998, among others).

The very first step necessary to conduct this analysis is to construct employment “life-lines” based on the information provided by the questions in wave 2 and described above. Afterwards, Optimal Matching (OM) yields a vector of distance measures between each sequence and the mode sequence of education followed by employment. A constant substitution cost of 2 and an indel cost of half of it was used to assess the similarity to the mode (Jalovaara and Fasang 2017) as this cost setting has been shown to be suited for identifying sequence similarity for both order and timing of the various activity statuses (MacIndoe and Abbott 2004).

On this measure of similarity distance, and using the woman’s number of children as a secondary matching characteristic to control for different family formation patterns, a k-means cluster analysis was performed. This is a non-hierarchical clustering technique, and therefore the Calinski-Harabasz rule is used to define the optimal number of clusters rather than the Duda-Hart stopping rule (Mikolai and Lyons-Amos 2017). This cutoff criterion identifies four as the optimal number of clusters for these data. Those four
clusters are also substantially meaningful, as shown in the results section, therefore
meeting the criterion of construct validity as in Aisenbrey and Fasang (2010).

One nice feature of sequence analysis is the ability to represent graphically the
typical trajectories in index plots. In these plots, each horizontal line is the employment
trajectory of a woman and, given the large sample size, only a selection of representative
sequences is included. The x-axis reports calendar years, while each respondent’s
employment history is composed of different colors, one for each of the seven possible
activity statuses described in the data section. It is important to note that each woman’s
employment status starts when she is 16 and ends when she is 45. Therefore, each line
has the same length and lines starting in the same calendar years are for women born in
the same year. In this way, each “entrance step” is a cohort, and the cohort effect can be
read by moving down to more recent entries in the graphical representation.

The clusters identified through optimal matching into various degrees of
attachment to the labor market and subsequently are used as the dependent variable for a
multinomial logit regressions where the main predictors are socio-economic
characteristics pre-dating the entrance in the labor market. The contextual characteristics
are birth cohort in ten-year intervals and country of birth, while parental characteristics
such as maternal and paternal education and occupation serve as proxies for socio-
economic status in the early years. Given that maternal employment and type of
occupation might convey different aspects of maternal role modeling for their young
daughters, analyses include both an indicator for whether the mother was working outside
of the household and the type of occupation divided between lower-status jobs
(agriculture, cleaners, helpers, and similar elementary occupations) and other professions such as medicine, law, civil servants, and clerks.

**Results**

Figure 2.1 shows an index plot for each of the four identified clusters for women aged at least 45 at last interview for their employment trajectories between ages 16 and 45. The most distinct feature is that the two largest clusters, comprising together 73.53% of the sample, include women attached to the labor market, in line with current employment data (Eurostat 2017). The other two clusters encompass a more diverse set of employment trajectories, among which stable employment is less prevalent.

In order to clarify the differences between the two clusters of women attached to the labor market, it is useful to look into the four most common sequences within them. While the two most frequent sequences in these two clusters are either education followed by employment or only employment, the largest cluster includes women with two children who took one or two paid leaves and then went directly back to employment. Instead, in the other cluster women have zero or one children and the third and fourth most common sequences are indicative of women who either went back to get further education between jobs or who experienced a spell of unemployment before finding gainful employment, respectively. Thus, this group is called “non-linearly attached” to the labor market because, although those women are working by age 45 and show attachment by going back to work, they experience statuses that are not as conventional as those in the largest cluster. A relevant presence of homemaking characterizes the more diverse clusters, which include women with higher parity births.
Homemaking is present both in between employment (especially for the moderately attached) and as end state at the age of 45 (especially for the weakly attached).

After having been identified, these four clusters are used as the dependent variable for a series of multinomial logit regressions. The predictors consists of pre-age-16 characteristics that can help predict why certain women are more attached to the labor market than others are. These variables are country of birth and residence, four cohorts of birth (pre-1940, 1940s, 1950s, 1960s), mother’s and father’s education (three categories: low, medium high), a dummy variable for whether the mother was working when the respondent was 15, maternal occupation separating agricultural and elementary occupations from all other professions conditional on mother working, and father’s occupation (in three categories). The educational measures are the same for both parents, but due to the fact that parents of women born in the 1960s or before faced very different economic systems that the ones these women experience, occupational experience of mothers and fathers are not compared along the same scale to account for the higher male participation to the labor market and the high prevalence of employment in the agricultural sector. For ease of interpretation, results from the multinomial logits are reported in graphs representing the predicted probabilities of a given predictor controlling for all others with 95% confidence intervals.

Contextual and parental characteristics predict belonging to different clusters of labor market attachment differently. The most studied influence in the literature is country of birth and residence. Indeed, country specific studies indicate how the labor market structures shape women’s attachment to it, from paid leave (Gauthier 2002) to unemployment rates (Kreyenfeld 2010). In larger cross-national studies, a broader
classification of welfare states helps identifying clusters of similar behaviors across countries.

Figure 2.2 reports the predicted marginal probabilities of belonging to one of the four above-mentioned clusters based on the country of residence. Consistently with previous literature (Van Winkle and Fasang 2017), country is an important predictor of women’s labor force attachment. Eastern European countries appear on the left-hand side of Figure 2.2, while Western countries are on the right. Women residing in the latter countries are associated with higher probabilities, especially in Germany and France, of being non-linearly attached to the labor market than those in the East. Bulgarian women have a high probability to be attached to the labor market, while Georgian women have the highest probability of being moderately attached to the labor market among the countries included in this study. This is accompanied by a low probability of been non-linearly attached, which might indicate difficulties to transition back to work after an interruption.

While countries are strong predictors of women’s labor force participation, birth cohorts are less so, even though they are theoretically important because of the different conditions met by women as they enter the labor market in different time periods (Goldin 2014). However, this finding is consistent with Van Winkle and Fasang (2017) who, for men and women born between 1918 and 1963, find that “change across cohorts is negligibly small, compared with a sizeable variation in complexity in employment trajectories across countries”. Indeed, there seems to be a long term of decrease in non-linear attachment to the labor market in favor of women who are moderately attached to the labor force. Women born before 1940 constitute the group with the most different
behavior. Although sample size is roughly constant between these birth cohort categories, this group is the most heterogeneous because of a higher variance in age, and an increased exposure to differential mortality at the time of survey. Results remain unchanged when removing Austria, which by design has upper age limit at 45 years of age because of survey design.

Turning to parental characteristics, mothers’ highest level of achieved education is a predictor of the respondents’ labor force participation, especially when considering the fact that women were progressively acquiring more education in the years under study. Indeed, women with mothers with low levels of education are increasingly more attached and moderately attached to the labor market as they are born in later cohorts. Women whose mother achieved a medium level of education follow a similar general tendency, although the trends are less pronounced and the starting probabilities to be attached to the labor market (both linearly and non) are higher. The sample size of women who had mothers with high levels of education is too small to draw any conclusion on this group of women.

Maternal occupation, when proxy with a dummy for having had a working mother when the respondent was 15 years old, is not significant even when interacted with birth cohort (not shown). This is probably due to the fact that 56.76% of women in the sample had working mothers. This somewhat surprisingly high proportion of mothers who were working is due to their participation in low skilled occupations, including agriculture and be at service in other people’s household. Specifically, 8.58% of women were employed in agricultural activities and 17.72% had elementary occupations, which includes helpers and cleaners. I then collapse this low skilled jobs together and separate them from
homemakers for their own household (which are considered out of the labor force), and other occupations of higher status. Figure 2.5 reports the results for such classification, conditional on mothers being employed when the respondent was 15 years old. Results show that having a mother who worked in agricultural and elementary occupation predicts a different attachment to the labor market for the moderately attached and the attached, non-linearly, clusters, and especially so for women born in later cohorts when being in an agricultural-based family is a clearer mark of lower socio-economic status.

Given that 97.86% of the respondents’ fathers worked, fathers’ occupation is classified as low (mostly agricultural and elementary occupations), medium (clerks, service workers, etc.), and high (legislators, senior officials, managers, etc.). Fathers’ education has the same categories as mothers’ education. The results for fathers, reported in appendix (Figures A2.1 – A2.3), mostly reflect the findings of maternal education, suggesting that they capture a similar dimension of the SES context in which the respondent grew up.

**Discussion and Conclusions**

A majority of European women now actively participate in the labor market, spending an increasing amount of their adult lives employed. However, the recent trends of increasing female labor force participation and reduction of the gender pay gap seem to be stalling. This is coupled with low fertility rates and uneven distributions of whom has, and maintains, a stable full-time work (Billari and Kohler 2004; Herr 2015; England 2010). As noted in Damaske and Frech (2016): “race, poverty, educational attainment, and early family characteristics significantly shaped women’s work careers”.
This work focuses in particular on the role of early life characteristics, both at the family and at the contextual level, to predict women’s employment until the end of the childbearing age. The contribution to the literature is two-fold. First, these analyses provide evidence for the entire employment history of women over the years of family formation and career development, and they do so for a wide range of birth cohorts and countries. Second, the richness of information on the respondents’ parents collected by the Gender and Generation Survey allows for adding early life socio-economic status as predictors of later-in-life attachment to the labor market.

Identification and visualization of women’s employment trajectories shed light on the prevalence of each pathway of work. This allows one to move beyond one point in time or the time surrounding childbirth to study how women relate to the labor market while in their prime age to form a family. In this respect, these findings are in line with official statistics in reporting that around 70% of women are actively engaged in paid employment (Eurostat 2017) and do so returning to work after taking a limited amount of paid leave or, for those who followed a less-linear path, after getting further education or experiencing spells of unemployment. However, there are also women who, after securing an education and/or actively participating in the labor market, become inactive for more or less lengthy periods of time, and a non-negligible proportion of women is not working by the end of their reproductive lives.

Interestingly, this variation is more due to differences across countries rather than between cohorts. Along this dimension, the findings presented in this paper are in line with what Van Winkle and Fasang (2017) report: focusing on cohorts born from the early 1920s to the late 1960s, the difference is pronounced only for the pre-1940s compared to
the latest cohort. This indicates that, if there is a generational trend of differential attachment to the labor market, it is very slow in its manifestation. Instead, France and Germany (and, in a distinct way, Georgia) display a higher propensity to experience different pathways into labor market attachment. This finding once again brings attention to the necessity to focus on national policies that constitute the institutional framework in which these women are deciding their balance between work and family (Gauthier 2002; Nielsen et al. 2004).

Thanks to the detailed information collected in the GGS given its inter-generational perspective, this work also explores the role of parental socio-economic status in shaping the respondents’ early life experiences. There are at least two possible mechanisms explaining the intergenerational transmission of work inequality over the life course. The first one is the maternal role model approach, according to which mothers through their attachment to the labor market, model their daughters’ subsequent behavior. This work finds no evidence supporting that having had a mother working outside of the house changes the daughters’ own likelihood to be attached to the labor market. However, it is important to pay attention to the historical context when interpreting this result. Indeed, the mothers of women born in the cohorts analyzed here had a relatively high prevalence of working for pay, predominantly in agricultural and low-skilled jobs. Therefore, although there is not much evidence in this study to support the idea that having a stay-at-home mother was different in the 1940s than in the 1960s, the maternal role modeling could come from the type of occupation. More fine-grained analyses suggest that, as working in agricultural and elementary occupations became a clearer marker of disadvantage, women were less likely to be non-linearly attached to the labor
market and more moderately attached, i.e. they experienced more homemaking spells over their childbearing years. This is coherent with the scarcity of options offered for women in the labor market for the previous generation as well as the results for maternal education.

The second mechanism is more strictly related to early life socio-economic status per se. A limitation of this data is the lack of income measures for the parents, so it is not possible to test this mechanism directly. However, if lower-status paternal occupation and lower maternal education are considered as signals of lower socio-economic status in the family, then these results suggest that they play a role in predicting daughters’ labor market attachment later in life. This is consistent with findings in Damaske (2011) and Damaske and Frech (2016): family poverty and early unfavorable conditions shape the way women relate to the labor market in the long term, in line with a cumulative advantages/disadvantages perspective.

In conclusion, this study corroborates previous studies in underlying the importance of taking a holistic and comprehensive approach to women’s employment. In doing so, it confirms the importance of country variation over cohort changes found in Van Winkle and Fasang (2017). At the same time, this work provides further evidence on the importance of early life influences, especially in terms of parental socio-economic status, on subsequent attachment to the labor market when trying to combine a family and paid employment. It does so moving beyond qualitative or point-in-time research and extends it to quantitative method covering seven countries and four decades of birth cohorts.
Figures and Tables

Figure 2.1 – Women’s employment trajectories at age 16-45 by the four identified clusters

Notes: Calendar years are on the x-axis and each horizontal line is an individual respondent’s activity statuses according to the colors in the legend. Cluster 1: Attached to the labor market. Cluster 2: Moderately attached to the labor market. Cluster 3: Weakly attached to the labor market. Cluster 4: Non-linearly attached to the labor market.
Figure 2.2 – Predictive Margins by Country of Residence

Predictive Margins by Country

Notes: The outcome variable is the four identified clusters. Predictors control for all other characteristics, including parental background.
Figure 2.3 – Predictive Margins by Birth Cohort

Notes: The outcome variable is the four identified clusters. Predictors control for all other characteristics, including parental background.
Figure 2.4 – Predictive Margins of the interaction between Birth Cohort and Maternal Education

Notes: The outcome variable is the four identified clusters. Predictors control for all other characteristics, including parental background. Mothers’ highest achieved education is categorized as low (ISCED 0 and 1), medium (ISCED 2, 3, and 4), and high (ISCED 5, and 6).
Figure 2.5 – Predictive Margins of the interaction between Birth Cohort and Maternal Occupation, conditional on having had a working mother at age 15.

**Notes:** The outcome variable is the four identified clusters. Predictors control for all other characteristics, including parental background. Dashed lines indicate agricultural and elementary occupations and solid lines indicate other professions.
Table 2.1 – Descriptive Statistics by Country

<table>
<thead>
<tr>
<th>Country</th>
<th>Bulgaria</th>
<th>Georgia</th>
<th>Germany</th>
<th>France</th>
<th>Austria</th>
<th>Lithuania</th>
<th>Czech Republic</th>
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<tr>
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<td>2,824</td>
<td>1,140</td>
<td>2,196</td>
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<td>Cohort (%)</td>
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<td>22.20</td>
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<td>26.89</td>
<td>-</td>
<td>28.12</td>
<td>32.67</td>
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<td>35.26</td>
<td>33.33</td>
<td>-</td>
<td>30.20</td>
<td>32.97</td>
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<tr>
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<td>19.02</td>
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<td>86.99</td>
<td>2.65</td>
<td>66.58</td>
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<tr>
<td>Medium</td>
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<td>60.98</td>
<td>90.77</td>
<td>10.04</td>
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<td>28.80</td>
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<td>9.38</td>
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<td>Employment (%)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Not Working</td>
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<td>47.91</td>
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<td>47.86</td>
<td>47.95</td>
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<td>30.56</td>
<td>34.81</td>
<td>33.86</td>
<td>54.75</td>
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</table>

Notes: Data from the first wave of the Gender and Generation Survey (GGS). Mothers’ highest achieved education is categorized as low (ISCED 0 and 1), medium (ISCED 2, 3, and 4), and high (ISCED 5, and 6). Maternal employment is divided in not working outside of the household, agricultural and elementary professions such as cleaner and helpers, and other professions with higher standing, such as medicine, law, civil servants, clerk, etc.
Appendix

Figure A2.1 – Predictive Margins of the interaction between Birth Cohort and whether respondent’s Mother Worked

Notes: The outcome variable is the four identified clusters. Predictors control for all other characteristics, including parental background. Solid lines are for working mothers and dotted lines are for not-working mothers when the respondent was 15 years old.
Figure A2.2 – Predictive Margins of the interaction between Birth Cohort and Father’s Education

Notes: The outcome variable is the four identified clusters. Predictors control for all other characteristics, including parental background. Fathers’ highest achieved education is categorized as low (ISCED 0 and 1), medium (ISCED 2, 3, and 4), and high (ISCED 5, and 6).
Figure A2.3 – Predictive Margins of the interaction between Birth Cohort and Father’s Occupation

Notes: The outcome variable is the four identified clusters. Predictors control for all other characteristics, including parental background. Fathers’ occupation is in three categories obtained from ISCO codes as follows: (i) low: agricultural, forestry and fishery; plant and machine operators and assemblers; elementary occupations; (ii) medium: clerks; service workers, shop and market sale workers; craft and related trades; (iii) high: armed forces; legislators, senior officials and managers; professionals; technicians and associate professionals.
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Chapter 3

Family Influences on Fertility:

An Extended Family Causal Estimate

Introduction

A large body of demographic evidence documents family influences as facilitating higher fertility across cultures and times (Notestein 1945), with the overall number of children declining as families move to nuclear structures and into urban areas (Axinn and Yabiku 2001; Caldwell 1976). This idea of childbearing as a social process (Coale and Watkins 1986) has been recently re-evaluated in developed countries where individual fertility behavior still depends to some extent on the fertility decisions of other members of their networks and their interactions (Balbo and Barban 2014; Bernardi and Klärner 2014; Diaz et al. 2011; Lois and Becker 2013). However, the size of these networks and the frequency of interactions are declining, leaving a majority of Americans relying solely on their partners for personal decisions such as childbearing (McPherson et al. 2006). This is in line with increasing uncertainty and instability of relationships within the extended family (Seltzer 2019), which suggests a decline in the role of the family in shaping individual fertility decisions. This weakening of ties prompts the question underlying this work: does the extended family, comprised of parents, adult siblings and their children, still influence fertility behavior within the nuclear family? More specifically, I explore whether there is a causal effect of the sex-composition of not only
one’s own children (as has been previously established) but also the combination of one’s own children with one’s nieces/nephews.

In this paper, I leverage the random variation of sex at birth (Angrist and Evans 1998) and the preference for mixed sex offspring (Andersson et al. 2006) to test the hypothesis that the extended family unit is relevant to fertility decisions. This natural experiment approach provides estimates net of unobservable characteristics shared within families that might correlate with fertility, thus removing a source of bias. Using three-generation data from the Panel Study of Income Dynamics (PSID) I construct extended family links, defined to include grandparents, adult children in the middle generation (siblings), and grandchildren. I then show that if the first two grandchildren are of the same sex, then the overall extended family is more likely to have more than two grandchildren than if the sex-mix is achieved within the first two grandchildren.

Therefore, fertility decisions are not only impacted by the sex mix of one’s own offspring but by that of one’s siblings as well. This result is consistent across family structures, i.e. if the first two grandchildren are cousins or siblings, and it is robust to alternative sex-related mechanisms and characteristics of the middle and older generation.

Such data with linked generations allows us not only to ask whether the extended family is a relevant unit for sex-mix preference manifestation, but it also allows us to understand whether such preferences manifest only horizontally (i.e. within a given generation) or vertically as well (i.e. across generations). In this vein, I show that sex-preferences manifest only within a generation and there is not a preference for heterogeneity across generations. For example, if the middle generation is comprised only of men, there is no additional preference for granddaughters over grandsons beyond
the preference for a mix within the youngest generation. Overall, I do not find preferences for grandsons or granddaughters, but there is suggestive evidence that a desire for the preservation of the “family name” through an uninterrupted line of males could still play a role in influencing the number of grandchildren. In particular, if a grandson carrying the grandfather’s last name is born within the first two grandchildren, the extended family as a whole is less likely to have more grandchildren.

This work contributes to our understanding of the role of the extended family in modern society with respect to childbearing choices, but the proposed extended family level shock to fertility could be used to study any number of outcomes of interest. Indeed, using three-generation data, a treatment occurring at the extended family rather than in the immediate household can identify effects beyond the marginal effect of the third child and it is less subject to threats to the exclusion restriction when used in an instrumental variable framework.

**Background**

*Role of the Extended Family in Childbearing Decisions*

Childbearing is mostly studied as an individual or couple-level decision, especially as social ties decrease, families become more fragmented and complex, and children are conceptualized as part of the parents’ self-realization (Lesthaeghe 1995; McPherson et al. 2006; Seltzer 2019). However, there is a recent body of literature that emphasizes the role of social ties in general (Bernardi and Klärner 2014; Lois and Becker 2013), and family networks in particular (Balbo and Mills 2011; Bernardi 2003), in shaping individuals’ fertility choices. Balbo and Mills (2011) highlight that the influence that family networks exercise on the realization of fertility intentions is doubled-edged.
On one hand, the probability of realizing the intentions for the first child increases if a sibling has a young child. On the other hand, they find a deterrence effect to have a second child in individuals with high levels of family social capital. Aassve et al. (2012) find that the availability of grandparents for childcare increases the probability of childbearing, but the same probability decreases if the grandparents are already taking care of young nieces and nephews. This indicates that it is not only the presence of members of the extended family that influences individual choices, but it is a more complex interaction between own intentions, parents, siblings, nieces and nephews. The idea that the extended family is the relevant unit of analysis for fertility decisions is also supported by qualitative studies (see for example Bernardi 2003). In in-depth interviews, participants implicitly or explicitly acknowledge that their decisions to form a family and have children keeps into account what other members of the extended family expect and what they are doing within their own nuclear families.

The overall influence of the extended family is less explored in quantitative studies because of data complexity and endogeneity problems in identifying the effect. In a rare example of a previous study that addresses extended family influences causally, Cools and Hart (2017) use Norwegian registry data and a sex-mix based instrumental variable approach to tackle one of the main aspects of family influences on fertility, that of childhood family size on fertility in adulthood. Indeed, adult children tend to replicate their parents’ family size, an empirical pattern of intergenerational transmission of fertility confirmed across developed countries in recent studies (Beaujouan and Solaz 2019; Murphy 2013). These intergenerational correlations could be driven by genetic, environmental, and socio-economic characteristics. Therefore, Cools and Hart (2017) use...
the random positive fertility shock in sibship size due to the first two siblings being of the same sex to show that an additional sibling has a positive effect on men’s adult fertility, inducing them to be more likely to have a third child themselves. However, the effect on women’s fertility is negative, counter to theoretical expectations that the family size has a uniformly positive influence on overall childbearing. These expectations build on empirical evidence from studies conducted in developed countries that show how the family of origin influences family size preferences (Axinn et al. 1994), childbearing intentions (Barber 2000), and fertility behavior (Dahlberg and Kolk 2018).

While these works mostly focus on parent-to-child influences, the extended family includes not only parents, but also adult siblings and their children. Dahlberg and Kolk (2018) report that parental fertility behavior and social background can explain some of siblings’ similarities in age at first birth and a small part of their resemblance in completed fertility. However, they find that most of siblings’ shared fertility behaviors cannot be explained by parental characteristics and fertility. A growing literature tries to explain these similarities in siblings’ fertility by a direct role of siblings’ peer effects in shaping each other’s fertility decisions. This line of research finds that, on average, adult siblings have a positive effect on each other’s fertility, but with significant heterogeneous effects based on parity, gender, and proxies for strength of social ties (Hart and Cools 2019; Kumzienko 2006; Lyngstad and Prskawetz 2010). For example, Lyngstad and Prskawetz (2010) find relatively strong cross-siblings influences for first births and weaker for the second child, in line with what Balbo and Mills (2011) report for the entire family network. Kumzienko (2006) finds additional heterogeneous effects with stronger effects when the siblings are sisters, close in age, or live in the same state. This suggests
some degree of extended family coordination to increase fertility in a way that reflects not just a tempo effect, but also quantum as the increase in the expected number of children close to nieces and nephews is not offset by lower rates of childbearing later on (Kumzienko 2006). Hart and Cools (2019) use an instrumental variable approach to study whether own fertility increases if a sibling was inducted to have third birth by either having the first two children of the same sex or twins at second birth. They find no significant effects from this exogenous fertility shock, except for firstborn women: if a younger sibling has a third birth due to the same-sex instrument, then the older sister is also more likely to have an additional child, although the mechanism is not established. Even in this context, Hart and Cools (2019) empirically demonstrate positive correlations of first and third birth across siblings. This re-actualizes Manski’s (1993) point that similarity in networks and social interaction effects can only be disentangled within a plausibly causal framework, and this holds especially true if individuals’ fertility choices happen within the broader influence of the extended family.

*Sex-Mix as a Source of Exogenous Variation*

Family influences on fertility are complex to identify because the lives of family members are interconnected by definition (Manski 1993). Parents and their children, and adult children and their siblings, share genetic, environmental, socio-economic, and cultural traits that could all influence fertility behavior above and beyond observable characteristics. Therefore, in order to establish a link between two family members’ fertility choices, it is necessary to rule out third factors that those family members share. For example, the intergenerational transmission of family size might go through the transmission of socio-economic status that then generates the fertility choices rather than
fertility in one generation influencing childbearing in the next. At the same time, it is possible to conceive a thought experiment that could lead to empirically strong siblings’ influences on fertility with no actual peer effect mechanisms. If, by an external law of nature, all women have their first child at around age 30, the fact that siblings are on average two or three years apart would lead to peaks in the probability of having a child two or three years after a sibling, even though both childbearing decisions were mechanically determined by a third factor. There are recent attempts to causally identify interaction effects between siblings’ random fertility shocks like the above-mentioned work by Hart and Cools (2019; see Kolk 2015 for an example of a twin-based study).

The Hart and Cools (2019) study relies on an instrumental variable approach widely used in economics, and first introduced by Angrist and Evans (1998). In their original paper, Angrist and Evans exploit parental preferences for a mixed sibling-sex composition to create a sex-mix instrument for the number of children in order to estimate labor force participation of the parents. The first stage linking sex mix and fertility shows that women with two same-sex children are between six and seven percentage points more likely to have a third child than those who have a boy and a girl. As they underline in their paper “because sex mix is virtually randomly assigned, a dummy for whether the sex of the second child matches the sex of the first child provides a plausible instrument for further childbearing among women with at least two children” (Angrist and Evans 1998, p. 451). This allows for a rare opportunity for causal interpretation of the results in family demography. Indeed, this instrument has since been used in a number of substantive areas, from estimating the effect of family size on fertility (Cools and Hart 2017) to grade retention (Conley and Glauber 2006), and public
housing and educational attainment (Currie and Yelowitz 2000). The effect of fertility on female labor force participation was also replicated in studies outside the United States. For example, Cruces and Galiani (2007) find very similar results to Angrist and Evans (1998) in Mexico and Argentina, two Latin American countries characterized by higher fertility rates than the United States at the time of their study.

However, sibling-sex composition appears to be a weaker instrument in low-fertility, low-employment settings like Greece (Daouli et al. 2009). The Greek results provide empirical support to the concern expressed in Del Boca et al. (2005) regarding the implementation of the sex-mix instrument in contemporary developed countries where the transition to third births is becoming increasingly rare and the proportion of women with at least two children is typically small. While decreases in family sizes pose limits on the applicability of random variation of sex at birth, preferences for offspring sex-mix continue to be documented (Andersson et al. 2006; Pollard and Morgan 2002). For example, even in the just-mentioned Greek study (Daouli et al. 2009), there is evidence of sex-mix preference. The same holds in other developed countries. Dahl and Moretti (2008) provide suggestive evidence that parents in the United States favor boys over girls, but also that if there are two children in the family, then a sex-mix is preferred both over two girls and over two boys. Andersson et al. (2006) conduct a more systematic review of offspring sex preferences using registry data from four Nordic countries. They find no effects of the sex of the firstborn child on second-birth risks, a preference for a daughter in Danish, Norwegian, and Swedish parents in third births (and son for Finnish parents), and a strong preference for at least one child of each sex among parents of two children across the board.
The present study leverages the natural experiment of randomness in offspring sex distribution to propose an estimation strategy for family influences on fertility that maintains the properties of sex-mix random assignment while surpassing the issue created by a decrease in third births within a nuclear family. Here, the theorized pathway for the extended family to influence nuclear families childbearing choices is that the sex-mix preference manifests itself at the pooled grandchildren level. If this holds, multigenerational families with the first two grandchildren of the same sex would be more likely to experience the birth of a third grandchild. Crucially, this would need to hold regardless of family structure, i.e. both for cases in which the first two grandchildren are siblings or cousins.

Data

I use the Panel Study of Income Dynamics (PSID), which is a survey initiated in 1968 with a nationally representative sample of American households. It was conducted annually until 1997 and bi-annually since. The key advantage of this dataset is that, in addition to the original sampled household members, it also interviews non co-residing children and siblings, and it is thus possible to identify cousins as well as siblings. Indeed, adult children of initial respondents are invited to join the survey once they form their own economically independent households. Therefore, there are now up to four generations included in the sample (PSID 2018). The offspring of the original PSID respondents are now on average older than the mean age at first birth in the United States (NCHS 2018), although not all might have completed their fertility.7 Following the PSID

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7 Lundberg (2019) identifies 703 households in the PSID with grandchildren aged 25-45, whose parents can be assumed to have completed their fertility. Age distribution in the middle generation is similar by treatment status, as shown in Table 3.2.
language, I use ‘dynasty’ to indicate a multigenerational family that comprises at least grandparents, a middle generation, and one or more grandchildren, while I use ‘family’ to indicate a nuclear family within a dynasty.

Figure 3.1 helps clarify the difference between families and dynasties. Panels (a)-(d) represent four dynasties with different family structures. The grandparents (GP) are the original respondent household sampled in 1968, their children constitute the middle generation, and are siblings to each other (hence, S1, S2). The youngest generation (grandchildren, GC) is a combination of grandsons (M) and granddaughters (F). The number of (grand)children can differ between families and dynasties. For example, in panel (a) the dynasty has two grandchildren, while S2’s family is childless.

As depicted in Figure 3.1, the main sample restriction is that subsequent analyses only include dynasties with two siblings in the middle generation. This limits the sample to 5,706 dynasties and the generalizability of the results. However, it is important for at least two reasons. First, by restricting my sample to two people in the middle generation, I avoid the problem of intergenerational transmission of fertility that could otherwise be a driving force in the results. With this setup, each person in childbearing age in the study grew up with one, and only one, sibling, thus preventing the potential of intergenerational transmission channel to influence the results. Second, this choice follows previous studies addressing sibling influences (Lyngstad and Prskawetz 2010; Cools and Hart 2019), and it is motivated by the necessity to avoid additional complications in data construction and modeling. Additionally, dynasties with half-siblings and adopted children are not

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8 Given the higher number of missing father IDs compared to mother IDs, I identify two individuals as siblings if they share their mother ID and have non-different father IDs. One or both might however have a missing father ID. The reported maternal number of children needs to
included in the analyses, nor are those dynasties that do not report information on the sex and year of birth of all the members in the middle and youngest generations. The resulting analytic sample consists of 1,213 dynasties with at least one grandchild and 906 with at least two grandchildren.9

Table 3.1 presents the mean values and the standard deviations for characteristics at the dynasty level and for the distributions of sex at birth of the first two grandchildren within dynasties. On average, dynasties in the sample have 1.52 grandchildren. This includes the mode of zero grandchildren and 26% of dynasties that have more than two grandchildren, pooling all of them together. Family structures are unevenly represented with 71% of the dynasties having the first two grandchildren born within the same nuclear family, i.e. the first two grandchildren are siblings rather than cousins (panels (a) and (b) in Figure 3.1). The sex distribution of the grandchildren is slightly in favor of boys, especially for the first birth. However, roughly a quarter of the dynasties have only boys or only girls as first two grandchildren as expected. The remaining half achieves a sex mix within the first two grandchildren.

Methods

This work extends the natural experiment behind the original Angrist and Evans (1998) sex-mix instrument within a nuclear family to an intergenerational dynasty. To identify extended family influences independently from shared socio-economic

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9 Table A3.2 in the Appendix reports observable characteristics for dynasties based on the number of grandchildren. As it could be expected, dynasties with more than two grandchildren are, on average, older both in the oldest and middle generation than dynasties with less than two grandchildren. Both siblings are also more likely to be married. However, in half of the dynasties the middle generation is composed of a brother and a sister regardless of the number of children.
characteristics, I use the sex-mix in the first two grandchildren pooled across nuclear families who share a grandparent to predict the overall number of grandchildren in that dynasty. Because the sex-mix is randomly assigned, the estimation strategy is straightforward. I use an indicator for whether the first two grandchildren born within a dynasty have the same sex to predict whether the grandchildren pool contains more than two grandchildren. This can be estimated by OLS regression as follows:

\[ MORETWOGC_i = \beta_0 + \beta_1SAMESEXGC_i + \beta_2X_i + \epsilon_i \]

Where the subscript \( i \) indicates that the measures are at the dynasty level, \( MORETWOGC_i \) is a dummy variable equal to one if a dynasty has three or more grandchildren, \( SAMESEXGC_i \) is a dummy variable equal to one if first two grandchildren born into a dynasty have the same sex, and \( X_i \) is a vector of control variables. The methodology mirrors the first stage of an instrumental variable approach, but the outcome of interest is fertility itself and therefore there is no second stage, nor concerns for an exclusion restriction.

The key assumption underlying this causal estimation is the randomness in which dynasties achieve a grandchild sex-mix with the first two grandchildren and which have same-sex grandchildren instead. This holds if the sex at birth is random, is not correlated across siblings, and parents cannot influence the sex of their offspring. These are theoretically reasonable assumptions in developed countries where there is no evidence of severe malnutrition or sex-selective abortion (Almond and Edlund 2008). To corroborate these assumptions empirically, Table 3.2 compares observable characteristics of dynasties with and without sex-mix. There are no statistically significant differences across sex-mix for observable characteristics at the grandparental level (grandmother’s
birth year), grandchildren sex or family structure, or middle generation sex composition. The only significant difference is whether sibling 1 was ever married, slightly higher if the first two grandchildren within the dynasty are of different sexes.\footnote{This is probably an artifact of testing multiple observable characteristics. If anything, married couples are associated with higher fertility, so the fact that a sibling was less likely to be married if the first two grandchildren are of the same sex will reduce towards zero the effect of interest, thus making my estimates more conservative.}

Therefore, dynasties in the sample are similar along observable characteristics and, thanks to the randomness of the sex at birth, plausibly also on unobservables. The only difference is whether dynasties achieved a sex-mix within the first two grandchildren. Persistent preferences for offspring sex-mix (Andersson et al. 2006) could lead to higher transitions to more grandchildren in dynasties with no sex-mix. The original Angrist and Evans (1998) instrumental variable approach focused on the individual family and found that having two boys or two girls increased the probability of having a third child by more than seven percentage points. Relating this back to Figure 3.1, the original instrument would compare sibling 1 in panel (a) to sibling 1 in panel (b), but would consider neither sibling 2 in those panels, nor siblings in panels (c) and (d) because they do not have two children to start with. In this work, the eligibility criteria of two children moves from the nuclear family to the dynasties, so all four schematic families in Figure 3.1 are included in the analyses. Panel (a) and panel (c) are the “treated” dynasties because they do not achieve offspring sex-mix within the first two grandchildren, while (b) and (d) do.

Of course, pooling across all grandchildren in a dynasty presents some key differences from a nuclear family level analysis. The main one is the role of family structure in shaping fertility behavior, as transition rates differ by parity. In my setup, a
third grandchild in dynasties represented in panels (a) and (b) in Figure 3.1 would be
either a parity 3 birth for sibling 1, or a firstborn for sibling 2. Those transition rates
would be different from families nested in dynasties (c) and (d), where the third
grandchild would be a second born regardless of which family experiences the birth.
Therefore, a key test of whether family influences work through sex-mix is to check if the
coefficient on the indicator for the lack of sex-mix remains the same after controlling for
dynasty structure, namely by whether the first two grandchildren are siblings or a born to
different parents (i.e. they are cousins).

Lastly, I run a series of additional tests for alternative sex-related mechanisms
influencing dynasty fertility to show that sex-mix in the first two grandchildren is the one
driving the results. First, I check if a sex-based preference for either boys or girls
manifests as preference for grandsons or granddaughters. Second, the preference for one
of the two sexes might also emerge starting from the first grandchild so I conduct
robustness checks estimating the probabilities of having more than one grandchild based
on the sex of the first-born. Third, the three-generation setup allows me to test the role of
the middle and older generation, both in isolation and interacting their sex composition
with those of the grandchildren generation.

Results

Table 3.3 presents the main results of estimating the probability of having more
than two grandchildren in a dynasty based on the sex-composition of the first two
grandchildren. As expected, if the first two grandchildren have the same sex there is a
positive and significant effect on dynasty fertility. At the same time, family structure
plays an important role in dynasty fertility as dynasties in which the first two
grandchildren come from the same nuclear family (panels (a) and (b) in Figure 3.1) are less likely to have more than two grandchildren overall. What is most noteworthy is that the positive effect of the lack of sex-mix on fertility remains significant and unchanged in sign and magnitude when controlling for family structure, indicating a separate effect of this exogenous component. The introduction of an interaction allows covering all schematic possibilities presented in Figure 3.1. While the model remains jointly significant, the interaction coefficient is not. It does not change the magnitude of the other coefficients, albeit it reduces the statistical power due to reduction in the degrees of freedom. Analyses conducted on separate sub-samples of dynasties depending on whether the first two grandchildren are siblings or cousins yield very similar results (see Table A3.3 in the Appendix).

As mentioned above, the introduction of a measure of family structure does not change the main coefficient on the same-sex dummy. The coefficient on the two oldest grandchildren having the same parents indeed captures family structure in that the grandchildren are siblings rather than cousins. Table 3.4 explores the role of family structure more in detail. It reports the distribution of grandchildren for dynasties with at least three grandchildren by their family structures and the sex of the first two grandchildren. Column (1) describes the various birth order possibilities for a third birth, given different combinations of which sibling had the first two grandchildren. These can be referred back to Figure 3.1 panels (a) and (b) for the first and fourth rows and to panels (c) and (d) for the middle two rows where the fact that the third grandchild is a second birth necessarily means that the first two grandchildren were cousins. These latter family structures are less prevalent as shown in the descriptive statistics and in column
(5). Column (2) represents the family structure types described in the first column as events. Event one is realized if sibling 1 has a birth and, conversely, event two if the birth occurs to sibling 2. This representation highlights that symmetrical family structures (e.g. sibling 1 has all three grandchildren or sibling 2 has all three) are grouped together. Columns (3) and (4) confirm that there is a larger share of dynasties with no sex-mix in the first two grandchildren, and this is true for each of the distributions of grandchildren. Therefore, the results are not driven by a particular family structure.

Alternative Sex-Related Mechanisms

There is a large literature on the preferences for an offspring sex-mix, therefore this variation has been widely explored as an instrument for fertility, from the first formulation in Angrist and Evans (1998) to recent work by Hart and Cools (2019). However, there might be other sex-related factors driving the influence of the extended family on fertility found in Table 3.3. Table 3.5 explores alternative sex-related mechanisms linking the sex of the extended family members, and grandchildren in particular, to overall fertility within a dynasty. Column (1) shows that the sex of the oldest grandchild alone has no significant effect on the probability of having more than one grandchild. This addresses the concern that a preference for sons might lead families with a firstborn daughter to have more children overall (Dahl and Moretti 2008). The insignificant result of the sex of the first grandchild is also consistent with Rupert and Zanella (2018). Columns (2), (4), and (5) explore a broader intergenerational preference for diversity rather than just focusing on the sex composition in one generation. Therefore, “descendant heterogeneity” reflects a possible cross-generation interaction in terms of sex-mix between the middle generation and the grandchildren. In order to have
no descendant heterogeneity, the sex of the middle generation and the grandchildren match. Examples of dynasties with no descendant heterogeneity are two brothers in the middle generation and grandsons in the youngest generations, or sisters with granddaughters. The rationale is that, in the absence of sex-mix in the middle generation, seeking the opposite sex in the youngest generation might be even more salient than in a dynasty with a middle generation with a sister and a brother, or in a dynasty where the first grandchild is of the opposite sex than their reference parent. I test this for the transition from the first grandchild in Table 3.5, column (2), and for the transition to more than two grandchildren (conditional on having at least two) in column (4), and in column (5), where I additionally control for family structure. There is no evidence at any grandchildren parity that this is the case and the combination of middle and youngest generation sex is insignificant across all models.

Finally, I test whether a preference for boys drives the results. First, columns (6) and (7) test the same mechanism reported in Table 3.3, but instead of an indicator for same-sex in general I use an indicator for the first two grandchildren being boys. The original coefficient halves, suggesting that there is no preference for grandsons or granddaughter, but for a sex-mix over either one. Second, going back to the interaction between the middle and the youngest generation, it is possible that the main relevant chain for a dynasty is the male line. The “family name” is traditionally transmitted through men and therefore a grandson born of a male child might bear higher importance for the extended family. If this was the case, the presence of a grandson who carries the grandfather’s last name could make the dynasty less likely to have additional grandchildren. I test this in column (3) for transition to more than one grandchild, and
columns (8) and (9) for more than two grandchildren. The first estimate is negative, but insignificant showing once more that sex of the first grandchild is not a predictor for having additional ones, in isolation or in combination with the sex of the parent in the middle generation. The other two coefficients for the male line are negative and significant, but, differently from what happens with the same-sex indicator, the magnitude changes when controlling for family structure in column (9). This is due to the *de facto* restriction to dynasties with at least a brother in the middle generation that increases the collinearity between the male line and family structure. Therefore, this result should be interpreted with caution and in light of the results presented in the following section, in which I focus on the role of the middle generation (see also Rupert and Zanella 2018).

*Role of the Middle and Older Generations*

The three-generation contribution in this paper adds the possibility that family members in different generations within the extended family play a role. Table 3.6 reports results from characteristics of the middle generation. The main takeaway from the table is that the primary result of the lack of sex-mix in the first two grandchildren positively affecting the number of grandchildren in the overall dynasty remains unchanged. However, column (1) provides an interesting insight on the role of the sex in the middle generation. Indeed, the fact that the two siblings in the middle are both men is negatively associated with the dynasty having more than two grandchildren. There are at least two avenues of research to explain this result within this context. The first is that Kumzienko (2006) shows that sisters are more likely to influence each other’s fertility and this could be seen as the mirroring result. Possibly more relevant, Rupert and Zanella
(2018) use the sex of the first child in the middle generation to instrument fertility and predict grandparents’ labor force participation. Their strategy is based on men tending to have children later, thus influencing the timing of their parents becoming grandparents. It is therefore possible that having two sons in the middle generation reduces the probability of having more than two grandchildren because the childbearing time window extends to later ages for men and they might not have completed fertility compared to dynasties with daughters or a mixed-sibling composition. Table 3.6 also shows that siblings that are less than four years apart do not have different effects than those who are further apart in age, and that the marital status of the siblings in the middle generation is positive and significant. The PSID does not include measurements of cohabitation throughout the period, so being ever married is a rough proxy for the middle generation being in a union during their childbearing years. This finding is thus in line with demographic intuition that being in a union increases the likelihood of childbearing.

In addition to the middle generation, the grandparental influence can also be at play in exerting extended family influences. A possible avenue to partially disentangle the two channels is assuming that family members in geographical proximity are more able to exert influence. Unfortunately, there is not sufficient variation in siblings living near each other but far from parents, or close to the parents and far from each other to estimate their effect. In 2015, slightly more than 7% of older siblings in this analytic sample do not live in the same state as their mother. The corresponding figure is slightly less than 7% for younger siblings. About 11.4% of siblings do not live in the same state as each other in 2015. For comparison, Rupert and Zanella (2018) using restricted PSID data report that 65.4% of adults live in the same county as their parents. Similarly, not enough grandparental deaths occurred in between births of different grandchildren so it was not feasible to identify discernable patterns.

In 2015, slightly more than 7% of older siblings in this analytic sample do not live in the same state as their mother. The corresponding figure is slightly less than 7% for younger siblings. About 11.4% of siblings do not live in the same state as each other in 2015. For comparison, Rupert and Zanella (2018) using restricted PSID data report that 65.4% of adults live in the same county as their parents.
between dynasties that had an active grandparental channel and those in which the grandparents were not alive. It is possible that preferences for sex-mix in the grandchildren pool undergo cohort changes, but a proxy like the grandmother’s year at birth is precisely estimated to be zero, therefore suggesting that it is not a channel likely to explain the above results. The spread of ages in the grandparental generation might not be wide enough to capture changes in preferences that are slow to change (results available upon request).

**Discussion and Conclusion**

Using an identification strategy based on the randomness of sex at birth and preference for (grand-)offspring sex-mix, findings presented in this work confirm a positive influence of the extended family on fertility. Unlike most previous studies, this strategy allows for obtaining an effect that is independent of characteristics shared within families, both observable and unobservable, that may be correlated with fertility and thus bias estimated coefficients. Taking a three generational extended family, or dynasty, as the unit of analysis, I show that dynasties with no sex-mix in the two oldest grandchildren are more likely to have more than two grandchildren overall than those dynasties in which the first two grandchildren are of different sexes, even if the two types of dynasties are otherwise identical. Even though family structure has its own sizable impact on overall fertility at the dynasty level, this result holds both in cases where the first two grandchildren are born of the same parents and when they are cousins.

As an innovative feature, this work introduces three generations in a causal estimation framework, thus contributing to the understanding of influences of fertility behaviors beyond couples. The inclusion of grandparents, adult siblings, own children,
and nieces and nephews provides novel insights in the following ways. First, using a natural experiment originally employed within the nuclear family extends the range of applicability of this methodology to low fertility contexts (Daouli et al. 2009; Del Boca et al. 2005). Indeed, the prevalence of the two-child norm is at the nuclear family level, while currently there is no prevailing norm on the number of grandchildren. This empirical approach within extended families and multigenerational data also opens new estimation avenues for investments in children human capital, parental employment, and labor force participation in the grandparents’ generation, an area of growing interest due to population ageing. Indeed, there is a robust literature that has used the sex composition of own children as an instrumental variable for additional fertility. However, this instrument can only identify the marginal effect of the third child. Moreover, it is possible that, for example, sex-specific returns to scale can make having two children of the same sex directly affect parents’ outcomes, thus threatening the exclusion restriction. By having the treatment occur in the extended family rather than in the nuclear household, the causal framework proposed in this work can be used as an instrument that is less subject to similar threats to the exclusion restriction.

Second, this approach highlights the differences in family structures, which have a sizable role in the probability of having more than two grandchildren. Interestingly, there is not a specific distribution of grandchildren driving the results. The short time intervals between two children within the same family is reflected into higher prevalence of families in which the first two grandchildren are siblings rather than cousins. Among these, roughly 40% of the third grandchildren were born of the sibling that was previously childless. Regardless, transitions to third births happened disproportionally to
dynasties with no sex-mix in the first two grandchildren. Third, the introduction of three
generations allows for interactions across them. I show that what matters most is
achieving diversity within the same generation, while overall descendant heterogeneity is
less salient. This possibly suggests a desire for interaction with children of different
sexes, be it siblings or cousins, as part of the formative process rather than desire of
(grand)parenting both girls and boys. This is corroborated by the lack of sex preferences
for granddaughters or grandsons. However, transmission of the family name through the
male line might still play a role in the extended family, though the causal interpretation is
weakened by the different fertility behaviors of men and women in the middle generation,
especially when it comes to timing (Rupert and Zanella 2018).

Using three generations also comes with some limitations. The most evident is the
constraint on data choice, the PSID being one of the very few datasets containing three
generations, especially in the American context. Only in a very limited number of cases
both the husband and the wife are PSID sample members. Therefore, a limitation of this
study is that the other side of the extended family cannot be included. While access to
this type of data would constitute an important addition to the present study, there are no
theoretical reasons for which the non-surveyed side of the dynasty should be
systematically different by the sex distribution of the grandchildren, especially
considering that the sample is balanced on a number of other observable variables (see
Table 3.2). Another data-related limitation is that, once attrition and childlessness are
taken into account, the sample size does not allow for additional stratifications beside the
ones shown without falling into a small cell size problem.12 This is particularly evident

12 Although F-tests for all models including both the indicator for the two oldest grandchildren
having the same sex and the indicator for family structure are above 10 (conventional threshold in
for the geographical distribution of the extended family members, as most live close to their family of origin. Therefore, separating those adult siblings who live close to their parents, close to each other or far from both did not yield enough variation. Similarly, grandparental death occurring between the first two grandchildren or after the first two but before the third grandchild amounted to less than one percent each. The small prevalence of grandparental death around the time of childbirth does not allow studying the role of exogenous reduction of grandparents’ availability to support the middle generation.

A second limitation of this project is the restriction to dynasties in which the middle generation is comprised of two and only two siblings. This helps to rule out the intergenerational fertility correlation channel, but limits the inferences that can be drawn for other dynasty structures. There are reasons to believe that, as the number of adult siblings in the middle generation increases, so does the probability that dynasties would have more than two grandchildren. First, mechanically because of the larger number of people who could experience childbearing, and secondly because the third child is increasingly a deviation from the two-child family norm favored by individuals from larger families (Beaujouan and Solaz 2019). However, the case of only children in the middle generation is less clear-cut and it could go either way depending on the strength with which preferences for a sex-mix are held, and on the sources of the family influences on fertility.

In light of these limitations, future research should address how to disentangle the influences from the different actors comprising the extended family in a way that

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the first stage of a non-weak instrument), power calculations based on the effect size found in this work suggest that at least 1,500 dynasties are necessary for further stratification.
preserves the exogenous variation within the dynasties. This would help us with policy-relevant questions and population predictions exercises for what happens when fertility decreases further (Lutz et al. 2006). For example, going back to what happens if the middle generation is comprised of an only child, the overall number of grandchildren is probably a combination of pressures to increase fertility from grandparents and own preferences for a sex-mix, and the decrease in social learning from siblings (Kumzienko 2006). Registry data from other contexts come with larger sample sizes, and it is increasingly possible to link three generations. The increased power from more observations can allow for stratification beyond the results presented in this work. For example, this type of data could help isolate the effect of grandparents in cases in which they have less influence on fertility choices through either geographical distance or death. Lastly, this methodological contribution can be used to study outcomes outside fertility as well. A natural extension is to use the results so far obtained as the basis for an intergenerational instrumental variable. The models here presented pass the heuristic measure for a non-weak instrument when family structure is accounted for and it is therefore possible to study the effect of more grandchildren on early retirement or labor force participation of the grandparents using an alternative instrument less subject to exclusion restriction threats.
Figures and Tables

Figure 3.1 - Schematic representations of Families within Dynasties by First Two Grandchildren Distributions

\[(a) \quad \text{GP} \quad (b) \quad \text{GP} \quad (c) \quad \text{GP} \quad (d) \quad \text{GP} \]
\[
\text{S1} \quad \text{S2} \quad \text{S1} \quad \text{S2} \quad \text{S1} \quad \text{S2} \quad \text{S1} \quad \text{S2}
\]
\[
\text{M} \quad \text{M} \quad \text{M} \quad \text{M} \quad \text{M} \quad \text{F}
\]

Notes: Author’s representation. GP: grandparents; S1 and S2: sibling pair; F: granddaughter; M: grandson. This is a schematic representation of possible family and dynasty structure, and of course variations are possible on the sex of the siblings, grandchildren and where the grandchildren are distributed within the individual families.
Table 3.1 - Descriptive Statistics for three-generational dynasties: distribution of grandchildren across dynasties and their characteristics.

<table>
<thead>
<tr>
<th>Dynasty-level characteristics</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Grandchildren</td>
<td>1.52</td>
<td>1.882</td>
</tr>
<tr>
<td>More than Two GC in dynasty</td>
<td>0.26</td>
<td>0.441</td>
</tr>
<tr>
<td>First Two GC are siblings</td>
<td>0.71</td>
<td>0.454</td>
</tr>
<tr>
<td>First Two GC are of same sex</td>
<td>0.56</td>
<td>0.496</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grandchildren within dynasty</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girl First</td>
<td>0.44</td>
<td>0.496</td>
</tr>
<tr>
<td>Girl Second</td>
<td>0.48</td>
<td>0.500</td>
</tr>
<tr>
<td>Grandsons – First Two GC are boys</td>
<td>0.32</td>
<td>0.465</td>
</tr>
<tr>
<td>Granddaughters – First Two GC are girls</td>
<td>0.25</td>
<td>0.432</td>
</tr>
</tbody>
</table>

*Notes:* Mean coefficients; standard deviations in second column. Overall, there are 2,500 grandchildren across 5,706 dynasties with two siblings in the middle generation. Table A3.2 in the Appendix reports characteristics of dynasties by number of grandchildren.
Table 3.2 - Balancing Tests

<table>
<thead>
<tr>
<th></th>
<th>(1) First Two GC Same Sex</th>
<th>(2) First Two GC Different Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Grandmother’s Birth Year</td>
<td>1947.7</td>
<td>14.02</td>
</tr>
<tr>
<td>Girl First</td>
<td>0.441</td>
<td>0.497</td>
</tr>
<tr>
<td>Oldest Two GC are siblings</td>
<td>0.691</td>
<td>0.462</td>
</tr>
<tr>
<td>Brothers</td>
<td>0.257</td>
<td>0.438</td>
</tr>
<tr>
<td>Sisters</td>
<td>0.235</td>
<td>0.424</td>
</tr>
<tr>
<td>Mixed-sex middle generation</td>
<td>0.508</td>
<td>0.500</td>
</tr>
<tr>
<td>Sibling Age Difference</td>
<td>3.370</td>
<td>5.301</td>
</tr>
<tr>
<td>Sibling 1 birth year</td>
<td>1968.6</td>
<td>14.25</td>
</tr>
<tr>
<td>Sibling 1 was ever married</td>
<td>0.722**</td>
<td>0.448</td>
</tr>
<tr>
<td>Sibling 2 was ever married</td>
<td>0.583</td>
<td>0.493</td>
</tr>
</tbody>
</table>

\[N\] 583 451

*Notes*: Mean coefficients; standard deviations in second column; *** p<0.01, ** p<0.05, * p<0.1
Table 3.3 - Effect of No Sex-Mix in Grandchildren pool on Dynasty Fertility

<table>
<thead>
<tr>
<th></th>
<th>Dynasty has more than two GC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Two Oldest GC Same-Sex</td>
</tr>
<tr>
<td></td>
<td>0.0688** (0.0317)</td>
</tr>
<tr>
<td></td>
<td>0.0615** (0.0312)</td>
</tr>
<tr>
<td></td>
<td>0.0646 (0.0546)</td>
</tr>
<tr>
<td>Observations</td>
<td>906</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.005</td>
</tr>
</tbody>
</table>

Notes: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; GC stands for grandchildren.
Table 3.4 - Distribution of Grandchildren for dynasties with at least three grandchildren by Sex-mix and Family Structure

<table>
<thead>
<tr>
<th>(1) Family Structure of 3rd births</th>
<th>(2) Distribution of who has GC</th>
<th>(3) Different sex Two oldest GC</th>
<th>(4) Same-Sex Two oldest GC</th>
<th>(5) Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third GC is a first birth</td>
<td>{1,1,2}, {2,2,1}</td>
<td>64</td>
<td>104</td>
<td>168</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(38.1%)</td>
<td>(61.9%)</td>
<td>(28.19%)</td>
</tr>
<tr>
<td>Third GC is a second birth</td>
<td>{1,2,1}, {2,1,2}</td>
<td>32</td>
<td>43</td>
<td>75</td>
</tr>
<tr>
<td>(cousin in between)</td>
<td></td>
<td>(42.7%)</td>
<td>(57.3%)</td>
<td>(12.58%)</td>
</tr>
<tr>
<td>Third GC is a second birth</td>
<td>{1,2,2}, {2,1,1}</td>
<td>51</td>
<td>55</td>
<td>106</td>
</tr>
<tr>
<td>- No alternating</td>
<td></td>
<td>(48.1%)</td>
<td>(51.9%)</td>
<td>(17.79%)</td>
</tr>
<tr>
<td>Third GC is a third birth</td>
<td>{1,1,1}, {2,2,2}</td>
<td>95</td>
<td>152</td>
<td>247</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(38.5%)</td>
<td>(61.5%)</td>
<td>(41.44%)</td>
</tr>
<tr>
<td>Totals</td>
<td>242</td>
<td>354</td>
<td>596</td>
<td>(100%)</td>
</tr>
<tr>
<td></td>
<td>(40.6%)</td>
<td>(59.4%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** GC stands for grandchildren. Column (1) describes the family structure for the first three grandchildren, where in the first and last row the first two grandchildren are siblings, i.e. born of the same parents. Column (2) has all the eight possible family structures for the first three grandchildren. 1 indicates that the birth occurred to sibling 1, and 2 indicates a birth to sibling 2. For example, {1,1,2} means that sibling 1 has the first two grandchildren, while sibling 2 has the third grandchild.
Table 3.5 - Alternative Mechanisms through which Sex Composition of Grandchildren can influence Dynasty Fertility

<table>
<thead>
<tr>
<th></th>
<th>More than one grandchild</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Sex Oldest GC</td>
<td>0.0264</td>
</tr>
<tr>
<td></td>
<td>(0.0251)</td>
</tr>
<tr>
<td>No Descendant Heterogeneity</td>
<td>-0.0368</td>
</tr>
<tr>
<td></td>
<td>(0.0280)</td>
</tr>
<tr>
<td>Grandsons</td>
<td></td>
</tr>
<tr>
<td>Male Line</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Two Oldest GC from Same Parent</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.739***</td>
</tr>
<tr>
<td></td>
<td>(0.0166)</td>
</tr>
<tr>
<td>Observations</td>
<td>1213</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Notes: Columns (1) – (3) only use the sex of the first grandchild born in the dynasty, while columns (4) – (9) consider the sex of the first two grandchildren, and are therefore restricted only to dynasties with at least two grandchildren.

No descendant heterogeneity is equal to one if the middle generation and the grandchild(ren) are all of the same sex.

Male line is equal to one if there is at least one grandson who shares his grandfather’s last name.

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Table 3.5 - Alternative Mechanisms through which Sex Composition of Grandchildren can influence Dynasty Fertility [Continued]

<table>
<thead>
<tr>
<th></th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than two grandchildren</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex Oldest GC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Descendant Heterogeneity</td>
<td>-0.0536</td>
<td>-0.0513</td>
<td>(0.0424)</td>
<td>(0.0416)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grandsons</td>
<td>0.0388</td>
<td>0.0271</td>
<td>(0.0338)</td>
<td>(0.0333)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male Line</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two Oldest GC from Same Parent</td>
<td>-0.192***</td>
<td>-0.191***</td>
<td>(0.0328)</td>
<td>(0.0328)</td>
<td>-0.202***</td>
<td>(0.0328)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.671***</td>
<td>0.799***</td>
<td>0.650***</td>
<td>0.781***</td>
<td>0.687***</td>
<td>0.829***</td>
</tr>
<tr>
<td></td>
<td>(0.0172)</td>
<td>(0.0276)</td>
<td>(0.0190)</td>
<td>(0.0293)</td>
<td>(0.0196)</td>
<td>(0.0301)</td>
</tr>
<tr>
<td>Observations</td>
<td>906</td>
<td>906</td>
<td>906</td>
<td>906</td>
<td>906</td>
<td>906</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.002</td>
<td>0.038</td>
<td>0.001</td>
<td>0.037</td>
<td>0.005</td>
<td>0.045</td>
</tr>
</tbody>
</table>

Notes: Columns (1) – (3) only use the sex of the first grandchild born in the dynasty, while columns (4) – (9) consider the sex of the first two grandchildren, and are therefore restricted only to dynasties with at least two grandchildren.

No descendant heterogeneity is equal to one if the middle generation and the grandchild(ren) are all of the same sex.

Male line is equal to one if there is at least one grandson who shares his grandfather’s last name.

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Table 3.6 - Moderation of Middle Generation Characteristics on Dynasty Fertility

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two oldest grandchildren have the same sex</td>
<td>0.0667**</td>
<td>0.0620**</td>
<td>0.0604**</td>
<td>0.0661**</td>
</tr>
<tr>
<td></td>
<td>(0.0310)</td>
<td>(0.0312)</td>
<td>(0.0300)</td>
<td>(0.0299)</td>
</tr>
<tr>
<td>Two oldest grandchildren from same parent</td>
<td>-0.187***</td>
<td>-0.188***</td>
<td>-0.142***</td>
<td>-0.140***</td>
</tr>
<tr>
<td></td>
<td>(0.0326)</td>
<td>(0.0330)</td>
<td>(0.0320)</td>
<td>(0.0319)</td>
</tr>
<tr>
<td>Two men in middle generation (Brothers)</td>
<td>-0.125***</td>
<td></td>
<td>-0.133***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0370)</td>
<td></td>
<td>(0.0356)</td>
<td></td>
</tr>
<tr>
<td>Siblings Close in Age (less than four years apart)</td>
<td>0.0118</td>
<td></td>
<td>-0.00288</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0325)</td>
<td></td>
<td>(0.0311)</td>
<td></td>
</tr>
<tr>
<td>Sibling 1 ever married</td>
<td></td>
<td>0.0804**</td>
<td>0.0851**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0354)</td>
<td>(0.0352)</td>
<td></td>
</tr>
<tr>
<td>Sibling 2 ever married</td>
<td></td>
<td>0.248***</td>
<td>0.249***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0317)</td>
<td>(0.0315)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.777***</td>
<td>0.745***</td>
<td>0.506***</td>
<td>0.527***</td>
</tr>
<tr>
<td></td>
<td>(0.0331)</td>
<td>(0.0406)</td>
<td>(0.0465)</td>
<td>(0.0512)</td>
</tr>
<tr>
<td>Observations</td>
<td>906</td>
<td>906</td>
<td>906</td>
<td>906</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.053</td>
<td>0.041</td>
<td>0.115</td>
<td>0.128</td>
</tr>
</tbody>
</table>

Notes: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
## Appendices

### Table A3.1 - Effect of No Sex-Mix in Grandchildren pool on Dynasty Fertility for Dynasties with No Missing Father IDs

<table>
<thead>
<tr>
<th></th>
<th>Dynasty has more than two GC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Oldest GC Same-Sex</td>
<td>0.0926**</td>
</tr>
<tr>
<td></td>
<td>(0.0362)</td>
</tr>
<tr>
<td>Two Oldest GC Same Parent</td>
<td>-0.188***</td>
</tr>
<tr>
<td></td>
<td>(0.0376)</td>
</tr>
<tr>
<td>Interaction: same parent x</td>
<td></td>
</tr>
<tr>
<td>same sex</td>
<td>-0.0170</td>
</tr>
<tr>
<td></td>
<td>(0.0760)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.611***</td>
</tr>
<tr>
<td></td>
<td>(0.0272)</td>
</tr>
<tr>
<td>Observations</td>
<td>686</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.009</td>
</tr>
</tbody>
</table>

Notes: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; GC stands for grandchildren.
Table A3.2 - Characteristics of Dynasties by Number of Grandchildren

<table>
<thead>
<tr>
<th></th>
<th>(1) Dynasties with less than two GC</th>
<th></th>
<th>(2) Dynasties with more than 2 GC</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Grandmother’s Birth Year</td>
<td>1956.3***</td>
<td>10.57</td>
<td>1948.1</td>
<td>12.29</td>
</tr>
<tr>
<td>Sibling 1 birth year</td>
<td>1980.1***</td>
<td>11.32</td>
<td>1968.3</td>
<td>13.22</td>
</tr>
<tr>
<td>Sibling 2 birth year</td>
<td>1982.7***</td>
<td>11.39</td>
<td>1971.6</td>
<td>12.93</td>
</tr>
<tr>
<td>Sibling 1 was ever married</td>
<td>0.264***</td>
<td>0.441</td>
<td>0.794</td>
<td>0.405</td>
</tr>
<tr>
<td>Sibling 2 was ever married</td>
<td>0.177***</td>
<td>0.382</td>
<td>0.726</td>
<td>0.446</td>
</tr>
<tr>
<td>Brothers</td>
<td>0.269***</td>
<td>0.444</td>
<td>0.188</td>
<td>0.391</td>
</tr>
<tr>
<td>Sisters</td>
<td>0.214**</td>
<td>0.410</td>
<td>0.267</td>
<td>0.443</td>
</tr>
<tr>
<td>Mixed-sex middle generation</td>
<td>0.516</td>
<td>0.500</td>
<td>0.545</td>
<td>0.498</td>
</tr>
<tr>
<td>Sibling Age Difference</td>
<td>2.554***</td>
<td>4.462</td>
<td>3.358</td>
<td>4.996</td>
</tr>
<tr>
<td>N</td>
<td>1681</td>
<td></td>
<td>606</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Mean coefficients; standard deviations in second column; *** p<0.01, ** p<0.05, * p<0.1.
Table A3.3 - Effect of No Sex-Mix in Grandchildren pool on Dynasty Fertility

Separating Dynasties in which the first two Grandchildren are Siblings vs. Cousins

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cousins Only</td>
<td>Siblings Only</td>
</tr>
<tr>
<td>Two Oldest GC Same-Sex</td>
<td>0.0646</td>
<td>0.0599</td>
</tr>
<tr>
<td></td>
<td>(0.0478)</td>
<td>(0.0401)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.752***</td>
<td>0.565***</td>
</tr>
<tr>
<td></td>
<td>(0.0370)</td>
<td>(0.0299)</td>
</tr>
<tr>
<td>Observations</td>
<td>301</td>
<td>605</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.006</td>
<td>0.004</td>
</tr>
</tbody>
</table>

Notes: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; GC stands for grandchildren.
References


https://doi.org/10.1177/0003122414531596


https://doi.org/10.1023/B:POPU.0000020892.15221.44


https://doi.org/10.2307/1971615


https://doi.org/10.3368/jhr.XLI.4.722


Conclusion

Low fertility is looming on American society, and it is not limited to Western counties. European countries provide an example of the magnitude of possible consequences. Since the 1990s, they have seen total fertility rates at or below 1.3 children per woman, a level that implies a reduction of the birth cohort by 50% and a halving of the stable population size every 45 years. Indeed, absent even larger immigration inflows, population decline is on the horizon for the European Union, which has consequences ranging from undermining the sustainability of national health care and retirement systems to reconfiguring the global geopolitical equilibrium.

My dissertation shows that we can learn from countries that have been experiencing below-replacement fertility in past decades to promote policy changes that enable those women who desire more children to act on their preferences while maintaining their careers. As I discuss in Chapter 1, this depends critically on their level of education. As the proportion of women completing tertiary education increases, childlessness rates decrease for highly educated women who are more likely to realize their fertility intentions than when only a minority of women attend college. At the same time, higher overall education also benefits women with lower relative education. Indeed, they enter motherhood later than in countries where the educational expansion is at earlier stages.

In turn, delayed motherhood is associated, for women of all education levels, with participation in the labor market. One of Chapter 2’s contributions is to take a life course perspective of labor market attachment over all childbearing years. There, I show that it is not enough for women to enter the workforce initially; it is also important that they have the opportunity not to drop out of it after forming a family. Policies that favor appropriate
maternity leaves and re-entry programs are beneficial not only for the mothers, but also, as I show in the second chapter, for their daughters as well. Therefore, these policies are relevant for reducing current inequality as well as reducing a channel of its intergenerational transmission.

Lastly, Chapter 3 complements the descriptive findings in the first two chapters by proposing a new causal estimate approach using three generations. I find a persistent extended family influence on overall fertility through the natural variation of sex at birth and preference for offspring sex-mix. Indeed, the overall extended family is more likely to have more than two grandchildren if the first two are of the same-sex. This finding contributes to the debate on the role of the extended family in modern society with respect to social stratification and opens new estimation avenues for labor market outcomes and education.