CHAPTER

The economics of fertility: a new era☆

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CONTENTS

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1 Introduction

Once considered an issue outside the realm of economics, starting with Becker (1960) economists have applied the economic model of human behavior to understanding fertility choice. The economics of fertility has been a success story: economists have suggested explanations for many of the key facts characterizing fertility choice and demographic change, including the demographic transition, the baby boom in the mid-twentieth century, and the extraordinarily low fertility rates now observed in many advanced economies. The contributions of economists have complemented and interacted with those of researchers from other fields, such as demography and sociology more widely.

Our aim here is to survey the economics of fertility at the beginning of the 21st century. We focus, in particular, on the evolution of explicit economic models that provide explanations for fertility behavior in high-income economies.[1] The main theme of our overview is that the driving forces behind fertility decisions in advanced economies today are qualitatively different from earlier decades. In other words, substantial change has occurred not only in economic theorizing about fertility, but also in observed fertility behavior itself. Several of the key statistical regularities concerning fertility outcomes in earlier decades have recently weakened or disappeared

[1] Many lower-income countries have also experienced rapid fertility decline in recent decades and much of the research discussed here is applicable to a wider set of countries. We omit, however, issues such as the role of child labor, which is more relevant in developing countries. See Schultz (1997), in an earlier volume of this series, for a survey of the economics of fertility in developing countries and Pörtner (2018) for a more recent treatment.

altogether. In their place, new empirical regularities have emerged that cannot be accounted for by baseline economic theories of fertility. These shifts have inspired new lines of thinking about fertility. We describe the changes in the data, we provide an overview of the recent developments in modeling fertility that address the new facts, and we describe the challenges and opportunities that the economic theory of fertility faces today.

We start by reviewing the regularities that inspired the first generation of economic models of fertility. These include a negative relationship between income and fertility; a link between the demographic transition and economic development; and, at a later stage of development, a negative relationship between women's labor force participation and fertility. We argue that economic models based on two main ideas, relating to the quantity-quality tradeoff and the opportunity cost of mother's time, were able to account for these regularities.

Based on empirical research of the past two decades, we then show that these regularities no longer characterize today's data. The income-fertility relationship is now largely flat within many countries and increasing in the cross-section of high-income countries. Recent work on the quantity-quality tradeoff argues that it is no longer detectable in high-income countries. Meanwhile, the relationship between women's labor force participation and fertility across countries has reversed. Even within countries, the relationship between women's education and their fertility is no longer always decreasing. The literature has also documented new kinds of evidence about fertility behavior. For example, it has been shown that many couples disagree about whether to have more (or any) children. In addition, in countries where fathers provide a small share of childcare, such disagreement is greater and fertility rates are lower.

The new facts about fertility behavior in high-income countries do not mean that the ideas of a quantity-quality tradeoff or of a central role of the opportunity cost of mothers' time were wrong. The tradeoffs emphasized by these models still exist and continue to be important in explaining fertility behavior in many places, including lower-income countries. What has changed, however, is that these tradeoffs no longer drive the major variation in the data for high-income countries.

We highlight a number of factors that have blunted the forces emphasized by the first generation of economic models of fertility. For example, in high-income countries, child labor has disappeared and education for most children continues past childhood into the adult years. These changes imply that the tradeoff inherent in quantity-quality models between sending children to school versus having more resources to raise a larger family has lost salience. Similarly, models based on women's opportunity cost of time posit that raising more children requires mothers to spend less time working in the market. While this tradeoff still exists today, it has weakened as alternative forms of childcare have become more prominent. When childcare is provided by someone other than the mother—whether a hired nanny, a government-run kindergarten, or the child's father—the cost of children is no longer linked as directly to the mother's opportunity cost of time.

To explain why the empirical relationship between women's labor force participation and fertility has not just flattened, but entirely reverted, research has taken directions that go beyond the first-generation models. A general theme in this new literature is that the compatibility of family and career has become a key determinant of fertility in high-income economies. Where the two are easy to combine, many women have both a career and multiple children, resulting in high fertility and high female labor force participation. When career and family goals are in conflict, fewer women work and fewer babies are born. We point out four factors that help mothers combine a career with a larger family: the availability of public childcare and other supportive family policies; greater contributions from fathers in providing childcare; social norms in favor of working mothers; and flexible labor markets. We outline how new-generation models take these factors into account and thereby help explain the new facts concerning fertility behavior in high-income countries.

We also discuss recent developments in modeling fertility choice that go beyond our main theme of career-family compatibility as a determinant of fertility. One example consists of models with discrete fertility choice that allow for childlessness. Such models make it possible to separately account for the role of intensive and extensive margins in fertility choice, and provide explanations for variation in childlessness over time and across social groups. Another example concerns models that study childbearing in different types of families, such as single parents and cohabiting couples. We also review advances in the normative analysis of fertility, including work on efficiency and welfare criteria in models with endogenous population, and applications of such criteria to population policy.

Based on our survey, we propose promising directions for future research on modeling fertility behavior. A recurring pattern in fertility research is that new ideas and themes often first appear in empirical work, which are then elaborated in explicit models of fertility choice some time later. The work conducted on the career-family conflict and childlessness discussed above are prime examples of this pattern. We believe that future research on modeling fertility will likewise be inspired by themes in the recent empirical literature that have yet to find their way into the choice-theoretic literature. We are particularly optimistic about the potential for work that connects to empirical findings on time use in raising children. Recent studies document a variety of facts on how time use for childcare differs between mothers and fathers, changes over time, and varies across different types of families. Such data provide a more detailed look at how couples manage the career-family conflict central to the new economics of fertility. In showing variation in parental investments in children, these data furthermore shed new light on a quantity-quality tradeoff, albeit in a different guise. Other examples include research on childcare in extended and patchwork families as well as the parenting and fertility choices of same-sex couples.

Lastly, fertility research strives not only to understand fertility choice, but also the implications of these choices for the economy at large. To this regard, a new challenge that the literature is only just beginning to address is to work out the macroeconomic implications of ultra-low fertility and possible rapid future population decline.

The issues discussed in this survey are closely related to the large literature on women's labor supply.[2] The theme of career-family compatibility is a major focus in the recent work of Claudia Goldin (Goldin, 2020, 2021). Goldin describes how a career and motherhood were initially an either-or-decision for American women. For subsequent cohorts, this became a sequential choice, with careers either preceding or following a phase of raising children. The most recent cohorts of American women aspire to have a family and a career at the same time, making challenges such as obtaining childcare support and bargaining with fathers over their child-rearing contributions particularly salient. It is precisely this new reality that is the focus of our chapter.

The career-family conflict is also central to the recent empirical literature on motherhood penalties, or the reduction in earnings that mothers experience relative to fathers after giving birth to a child. These studies document motherhood penalties (sometimes also referred to as child penalties or the career costs of children) in different settings and countries (Miller, 2011; Angelov et al., 2016; Adda et al., 2017; Lundborg et al., 2017; Kleven et al., 2019; Gallen et al., 2022).[3] The fact that motherhood penalties differ widely across countries suggests that they depend on country-specific factors such as family policy, the gendered division of childcare duties, social norms, and labor market institutions—the very factors we argue are crucial to understanding today's new fertility facts.[4]

In our survey of the economics of fertility, we primarily focus on the new developments of the past two decades. Hotz et al. (1997) offer a survey of first-generation economic models of fertility in a previous volume of this same series.[5] The historical negative relationship between income and fertility is addressed in greater detail in Jones et al. (2010), who discuss which theories can or cannot generate a negative cross-sectional relationship between income and fertility. Doepke and Tertilt (2016) examine the implications of family decisions such as fertility for macroeconomic outcomes, while Greenwood et al. (2023), in a separate chapter in this handbook, tie the changing role of the family in the United States over the past century to technological progress. Economic research on fertility also builds on and intersects with related work in sociology and demography. Throughout, we highlight a number of the key references; see Balbo et al. (2013) for a recent comprehensive survey of fertility research in these fields.

In the next section, we summarize the main facts and models characterizing the first generation of the economics of fertility. In Section 3, we describe how fertility behavior in high-income economies has changed in recent decades, resulting in a new

2 See Goldin (1990), Olivetti and Petrongolo (2016), and Blau and Winkler (2018) for introductions to this literature.

3 Budig and England (2001) offer an early sociological analysis of the motherhood wage penalty.

4 Kuziemko et al. (2020) argue that recent cohorts of women in the United States and the United Kingdom underestimate the employment costs of motherhood, which matters for their education and career decisions.

5 See also Ermisch (2003) for an introduction to the theory of fertility focused on first-generation models.

set of fertility facts. Section 4 discusses a number of mechanisms that explain why the forces emphasized in the first-generation models have lost strength over time. In Section 5 we introduce new-generation models that stress the career-family conflict as a key determinant of fertility behavior. Section 6 summarizes other new developments in modeling fertility choice, while Section 7 looks at advances in normative analysis. We highlight promising directions for future research on the economics of fertility in Section 8, and Section 9 concludes.

2 Old facts, old models

2.1 The negative income-fertility relationship

When Becker (1960) wrote his seminal work on the economics of fertility, the central empirical observation that needed to be explained was the large, sustained, and pervasive decline in fertility rates over the course of the demographic transition. Before the onset of industrialization, women in most countries gave birth to an average of five or more children over their lifetime. Fertility rates remained high in the first decades of industrialization, in the early nineteenth century. But then, in country after country, and region after region, fertility behavior began to change. Where five or six children had been the norm, an increasing number of families stopped after having four, three, or just two children. This fertility decline gained speed just as economic growth was picking up.

Fig. 1 illustrates this demographic transition for Austria, Belgium, Denmark, Germany, Italy, Japan, Spain, Sweden, Switzerland, the United Kingdom, and the United States. The total fertility rate (i.e., the sum of age-specific fertility rates across ages in the cross-section) in these countries was between four and five children per woman throughout most of the nineteenth century. Around the turn of the twentieth century, fertility started to decline rapidly, and was for the most part well below four children per woman before the onset of World War I. Fertility rates recovered slightly in the postwar baby boom (further discussed below), and then declined yet again, ultimately stabilizing somewhere between 1.4 and 2.1 starting in the late twentieth century.

The demographic transition became a universal feature of successful economic development, repeated in a similar fashion in each and every country that managed to escape preindustrial stagnation and successfully industrialize.

As a result of the demographic transition, the relationship between the living standards of a country (as measured by income per capita) and fertility turned sharply negative, both within countries over time and across countries at different stages of development. A negative income-fertility relationship also became prevalent across families in a given country, with richer and more educated parents in the upper-middle and upper classes choosing to have fewer children than poorer working-class parents. Fig. 2 displays this negative income-fertility relationship for different birth cohorts in the United States. Starting from the first cohorts to undergo the demographic transition, fertility is sharply declining in income. The relationship has flattened over time, but is still apparent in the 1948 birth cohort.

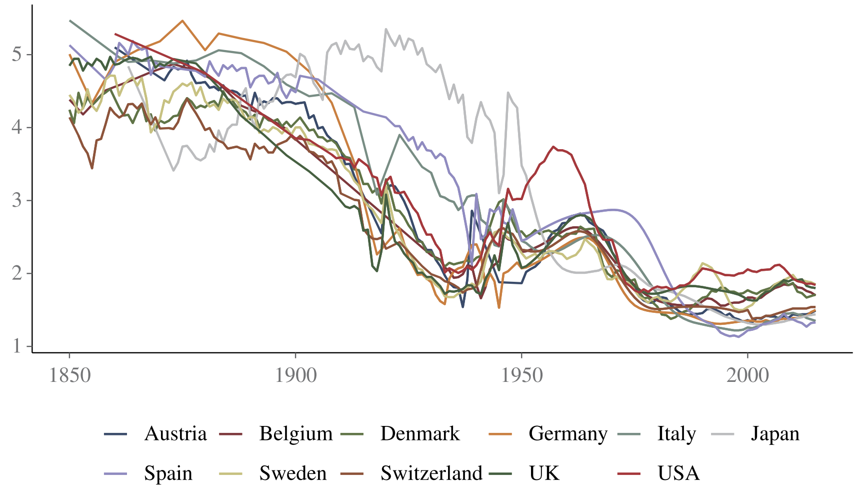

FIGURE 1 Total fertility rates since 1850.

Notes: Data on the total fertility rate come from various sources that are summarized in the Appendix, Table A1.

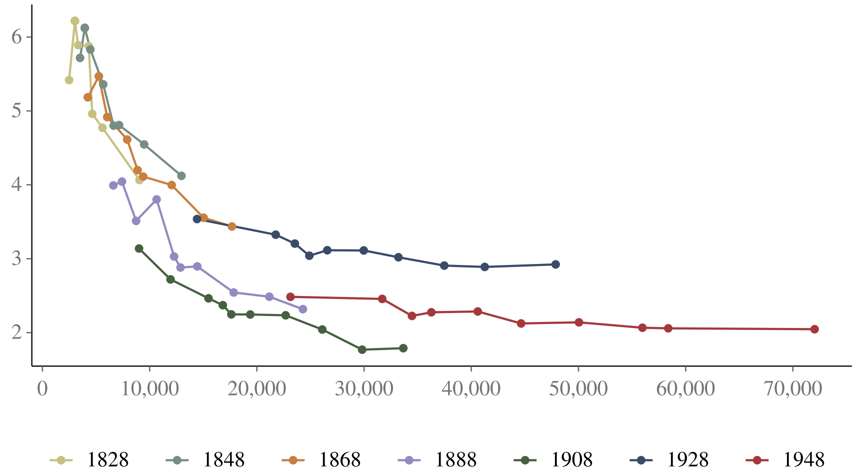

FIGURE 2 Children ever born by income, selected US cross-sections.

Notes: Figure reproduces selected cross-sections from Jones and Tertilt (2008), Figure 4. Income is occupational income, which is constructed based on husbands' occupations and converted into 2000 USD, see original paper for details.

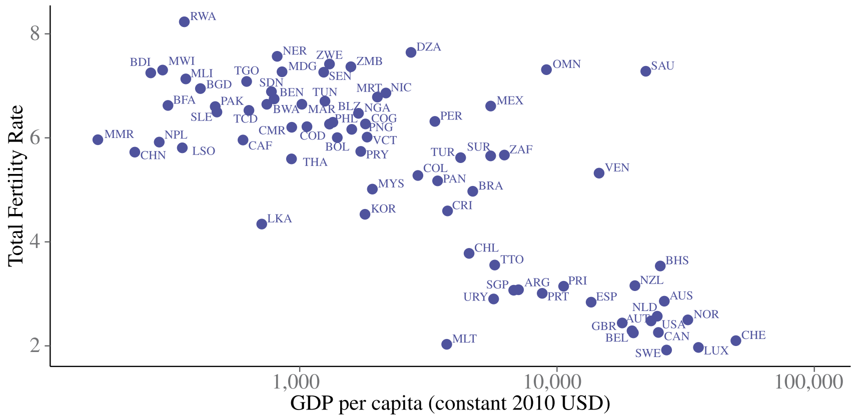

FIGURE 3 Fertility and income across countries in 1970.

Notes: We plot total fertility rates against GDP per capita in constant 2010 USD in 1970. Data comes from the World Development Indicators (2021), "Fertility rate, total (births per woman)," https://data.worldbank.org/indicator/SP.DYN.TFRT.IN (accessed on 30 June 2021) and "GDP per capita (constant 2010 US$)," https://data.worldbank.org/indicator/NY.GDP.PCAP.KD (GDP per capita, accessed on 30 June 2021).

While the negative income-fertility relationship in the cross-section is pervasive (see also the literature review in Jones and Tertilt, 2008), it does not necessarily imply a causal relationship between pure income changes and fertility. In fact, an empirical literature aiming to estimate causal effects argues that fertility usually rises when there is an exogenous increase in men's income.[6] These studies typically control for factors such as the wife's wage, the cost of raising children, and even education, which are all correlated with male income. In doing so, they endeavor to isolate a pure income effect, which is usually positive even in models that can generate a negative income-fertility relationship. Thus, the finding of a positive causal effect of male income on fertility, holding everything else constant, is consistent with the unconditional negative relationship.

This negative income-fertility relationship was equally prevalent when comparing different countries. Fig. 3 displays the relationship between income per capita and the total fertility rate in a cross-section of countries in 1970. A sharply negative relationship between income and fertility can be seen over the entire range of development levels. Among the poorest countries with an income per capita below USD 1,000 (in 2010 prices) almost all had fertility rates above five children per woman, and most of the richest countries with income levels above USD 20,000 had fertility rates below three.

[6] For early contributions see, among others, Fleischer and Rhodes (1979), Borg (1989), and Heckman and Walker (1990), and more recently Black et al. (2013), Kearney and Wilson (2018), Autor et al. (2019).

2.2 The first big idea: the quantity and quality of children

At first glance, the empirically observed negative income-fertility relationship could be interpreted as an argument against a mainly economic explanation for fertility choices. After all, when people get richer, they usually obtain more of everything.[7] Rather than reflecting an economic tradeoff faced by a maximizing consumer, the decline in fertility could be suggestive of a waning "taste" for children, perhaps due to changes in cultural and social norms outside the reach of economics. Gary Becker's explanation of this puzzle is the first big idea in the economics of fertility, namely the concept of the quantity-quality tradeoff.

In his classic 1960 paper, Becker suggested treating children as goods that parents not only "buy," but can also invest in. Parents thus derive utility both from their number of children, i.e., child "quantity," and from the level of their child investments, referred to as child "quality." Becker's notion of child quality applies to many kinds of investments in and spending on children. For instance, wealthier parents may choose to provide more space for their children by buying a house with additional bedrooms or to spend more on their children's wardrobe. As spelled out by Becker and Lewis (1973), if such spending increases with income, children are more expensive for richer parents. Hence, if the demand for child quality is sufficiently elastic with respect to income, the number of children may well decline with income.

The aspect of child quality that drew the most attention concerned investments in children's education, in part because these investments make up a large part of total spending on children. Even if direct outlays are small (e.g., when free public schooling is provided by the government), there is still a large opportunity cost, in that children that spend their day in school cannot work. Before the rise of mass schooling, child labor provided a substantial fraction of total income for many families (Horrell and Humphries, 1995). This loss of child labor income makes up the majority of the opportunity cost of education for many families.

In addition to being a large part of the overall cost of child quality, education is also closely correlated with income. This is equally true across countries, for given countries over time, and within countries across richer and poorer families. As an example, Fig. 4 shows the average completed years of schooling of the population aged 25 and above for the same set of countries as displayed in Fig. 1. At the same time as these countries were undergoing rapid growth in income per capita throughout the late nineteenth and twentieth centuries, education levels rapidly increased.

In the United States, a trend towards educating children started particularly early, and coincided with a decline in fertility. Such patterns support the idea of a quantity-quality tradeoff. Improving education opportunities—from increased provision of primary schooling around the turn of the twentieth century to rising demand for college-educated workers in subsequent decades—resulted in a rising quality of children throughout the twentieth century. As increased quality also means that having

[7] The "inferior" goods that are discussed in Econ 101 do not contradict this observation; inferior goods are usually inferior because close substitutes of higher quality (e.g., car ownership instead of bus rides) are available, which does not fit the case of children well.

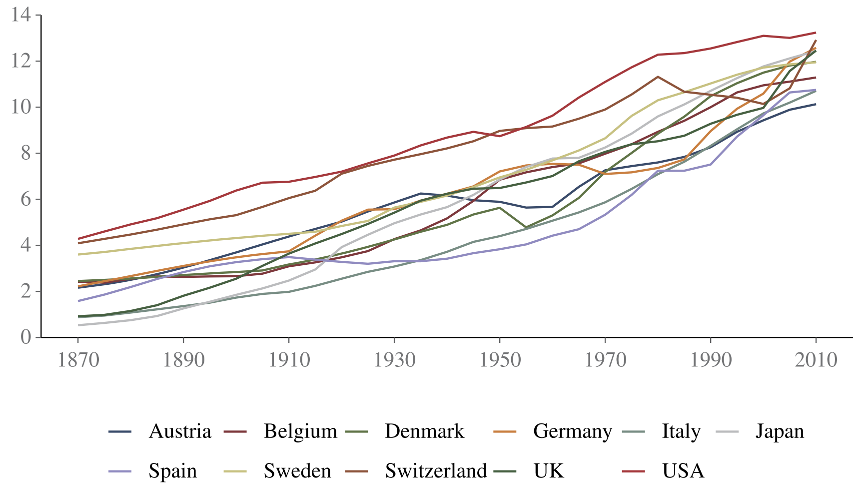

FIGURE 4 Average years of schooling since 1870, selected countries.

Notes: Data on average years of schooling comes from Barro and Lee (2013).

a child becomes more costly, parents substituted for the increased child quality by choosing to have fewer children overall.

The main ideas behind the quantity-quality tradeoff can be illustrated with a model that analyzes the decisions of a parent who derives utility from consumption c, the number of children n, as well as the children's quality denoted by h (i.e., human capital). The parent's preferences are represented by a utility function that is increasing in each of its arguments:

$$u(c, n, h).$$

Child quality is produced through parental investments of e (education) per child, which raise the children's human capital according to the investment technology $h = (\theta + e)^\gamma$, where $\gamma \geq 0$ captures the return to education investments and $\theta > 0$ captures the fact that children have some human capital (say, a capacity for physical labor) even without parental investment in education.

In this formulation of the quantity-quality model (which follows de la Croix and Doepke, 2003), the utility derived from child quality is of the "warm glow" type; that is, the parent cares directly about the child quality variable h. An alternative formulation, first proposed by Becker and Barro (1988), envisions the parents as altruistic in the sense of caring about their children's lifetime utility. In such a model, parental utility will be increasing in h as long as a higher level of human capital makes the child better off. Hence, in addition to the level of human capital, the economic return to that human capital in the children's life will also affect the parent's concern for child quality. The parameter γ in the production function for child quality h is a reduced-form representation of this return to human capital.

The parent earns a market wage w. In addition to the education investment $e \geq 0$, raising each child takes a fixed amount of time, ϕ. The price of education investment e is given by p. We can think of education investment as being provided by teachers, such that p would be given by a teacher's wage.

Normalizing the time endowment to one, the budget constraint for the parent is:

$$c + p\,e\,n \leq (1 - \phi n)w. \tag{1}$$

For concreteness, we consider the logarithmic utility function:

$$u(c, n, h) = \log(c) + \delta \log(nh), \tag{2}$$

where $\delta > 0$ represents the weight attached to utility derived from children. The parent's utility maximization problem can then be written as:

$$\max_{c,n,e} \; \log(c) + \delta \log(n) + \delta\gamma \log(\theta + e)$$

subject to (1). The parent's optimal choices for fertility and education are:

$$n = \frac{\delta}{1+\delta} \cdot \frac{1-\gamma}{\phi - \frac{p}{w}\theta} \quad \text{and} \quad e = \frac{\gamma\phi w - p\theta}{p(1-\gamma)}.$$

Hence, when we consider a set of parents with different wages w but facing the same cost of education p, fertility is decreasing and education is increasing in income.

How does this quantity-quality model account for the income-fertility relationship? As children are a normal good in the model, an exogenous increase in wealth (a pure income effect) would in fact increase fertility. However, most income differences between families represent not exogenous wealth, but potential earnings, here captured by the market wage w. Changes in the wage w have both an income and a substitution effect on fertility, where the income effect is positive and the substitution effect is negative. The substitution effect has two different components. First, children are costly in terms of time, so that an increase in the wage makes children more costly relative to consumption. Second, an increase in the wage makes child quality (human capital h) cheaper relative to child quantity (the number of children n). The combination of these effects leads to a dominating substitution effect, so that fertility declines in the wage w.

When applying the model to cross-country comparisons or to changes in aggregate fertility in a country over time, we would expect the price of education p to vary in proportion with the wage w, because p represents primarily the wages of teachers. Then, variation in the overall level of wages across countries or over time would leave both fertility and education unchanged in this model. However, education is increasing and fertility is decreasing in the return to education γ. Hence, at the aggregate level, a negative income-fertility relationship still obtains if the return-to-education parameter γ is positively related to income. Such a correlation can emerge if economic growth (and hence income per capita) is ultimately driven by rising returns to human capital investment, which is a feature of a number of benchmark models of economic growth. In such models, technological changes that raise the return to human capital will both increase income per capita and lower fertility.

Similarly, the negative income-fertility relationship in a given country is further strengthened if there is a positive relationship between the wage w and returns to education within the family. Such a relationship can arise if more educated families have a higher return to educational investment because of complementarities between investment in schooling and direct human capital spillovers in the family. Institutional barriers to social mobility can also amplify these mechanisms, for instance, when academically oriented schools and higher education are accessible only to children from the higher social classes. Further explanations and models of the link between income and fertility are discussed in Jones et al. (2010).

The literature on the quantity and quality of children was initially developed by Gary Becker, together with a number of coauthors. Becker and Lewis (1973) represents a key contribution in its formalization of the notion of a quantity-quality tradeoff, widely used in subsequent studies.

Until the 1980s, the economic literature on fertility mostly focused on understanding fertility choices as such, as opposed to analyzing the repercussions of these choices for the wider economy. This changed after Gary Becker and Robert Barro connected the economics of fertility to theories of economic growth (Barro and Becker, 1989). Fertility and economic growth are linked in that birth rates determine population growth, which is in turn a driver of economic growth in models with fixed resources and capital accumulation. More importantly, the central role of human capital in quantity-quality models of fertility provided a link between the economics of fertility and models of human-capital-driven economic growth following the initial contribution of Lucas (1988).

Becker et al. (1990) was one of the first papers to exploit this connection. Their work placed quantity-quality models of fertility choices at the center of models of long-run development that can account for both a regime of stagnation in living standards, which characterized all countries before the onset of industrialization, and a modern regime of human-capital-driven growth and much lower fertility rates. The initial contribution of Galor and Weil (2000) lay the groundwork for a literature on unified growth models that provide an account of the basic characteristics of economic and demographic outcomes in the preindustrial era, in the modern era, and in the economic and demographic transition between these regimes. Galor (2005) provides a survey of unified models of demographic and economic change. A recent contribution to this literature is Delventhal et al. (2021), who show that a simple unified growth model based on the quantity-quality tradeoff that also allows for technological spillovers across countries can account for the basic characteristics of the demographic transition in a large set of countries.

Quantity-quality models have also been recently used to examine the link between mortality rates and fertility decisions (Cervellati and Sunde, 2005, Doepke, 2005, Soares, 2005, de la Croix and Licandro, 2013), the roles of sectoral change and urbanization in the demographic transition (Greenwood and Seshadri, 2002), the impact of fertility differentials within a population for slowing economic growth and generating persistent poverty (de la Croix and Doepke, 2003, Moav, 2005), the importance of tax policy for understanding cross-country fertility rates (Manuelli and Seshadri, 2009), and even the evolution of women's rights (Doepke and Tertilt, 2009).

2.3 The negative relationship between women's labor force participation and fertility

The literature on the quantity-quality tradeoff generally focuses on the decisions of an entire "household," without an explicit distinction between mothers and fathers. In reality, of course, mothers and fathers often do have distinct roles in raising children. Before industrialization, the boundaries between female and male spheres were still blurry. Families lived and worked together, be it on a family farm or in a dwelling that served both as home and a craftsman's workshop, and both mothers and fathers had some involvement in childrearing.[8] Industrialization sharpened the separation between work and home spheres. The husband and father now spent much of his day at a factory, office, or other workplace, and the wife and mother stayed at home to care for the house and children. Consequently, the time cost of raising children now became primarily the time cost of the mother. This also meant that when women's labor force participation started to rise, raising children and working became competing uses for women's time. This leads us to the second main fact motivating first-generation models of fertility, namely the negative relationship between women's labor force participation and fertility.

In most industrialized countries, married women's labor force participation (the relevant variable, given that most childbearing took place within marriage at the time) was low at the beginning of the twentieth century, but then started to rise gradually in the 1930s and 1940s, and much more rapidly after World War II. Fig. 5 shows this for the United States. As more women joined the labor force, the gender wage gap between women's and men's pay declined. The left panel of Fig. 5 shows the ratio of female to male wages for full-time workers. Except for a dip from the 1950s to 1970s (around the baby boom period—more on this below), women's wages increased steadily over a century, from less than 50 to about 80 percent of men's wages. The right panel displays the rise in women's labor force participation during the same period. The increase in women's wages and participation coincided with a substantial decline in fertility (see Fig. 1). In other words, we see a clear negative relationship between female labor force participation and fertility emerge in the time series.

A similar negative relationship between women's labor force participation and fertility can be observed in the cross-section within a given country: women who work full-time usually have fewer children than women who are homemakers, with women who work part-time falling in between. For example, Baizán (2007) shows

[8] To be sure, there were clear distinctions in gender roles even then. Nevertheless, daily proximity implied a greater involvement of fathers in the family, especially with regards to older children (and particularly boys) who would often work with the father from an early age.

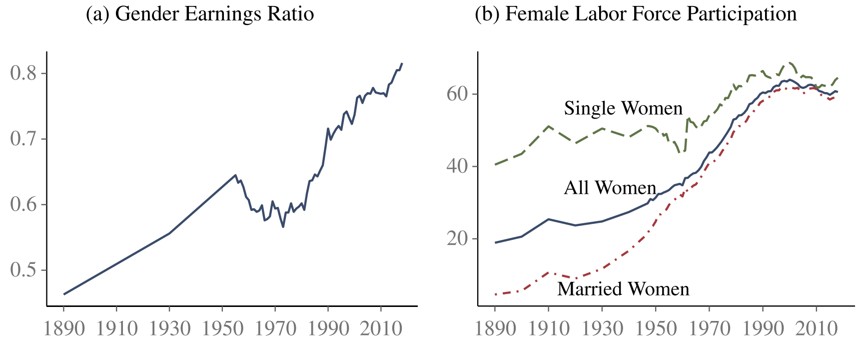

FIGURE 5 Female labor market opportunities, United States.

Sources: Panel (a): Female-to-male ratio of median earnings between 1890 and 2018. Data for 1890 and 1930 and 1955 to 1959 comes from Goldin (1990). Data from 1960 to 2018 comes from Shrider et al. (2021), Table A-7. Panel (b): Female labor force participation for the 16 and older age group. Data between 1890 and 1961 comes from US Department of Commerce (1975), Tables D49–62. Data from 1962 to 2018 comes from the CPS-ASEC, author's calculations. Singles do not include widowed, divorced, or separated women.

that working mothers have fewer higher-order births in several European countries, and Aaronson et al. (2021) document a strongly negative relationship between maternal labor supply and fertility in a large set of countries at higher levels of economic development. Naturally, the link between fertility and participation runs both ways. Women who want to have many children have less time for work, and women who are focused on having a successful career have less time for children.

The negative relationship between women's labor force participation and fertility was also observable in comparisons of different countries. Until the 1980s, countries with lower female labor force participation rates had higher fertility rates than countries where many women worked—see the left panel of Fig. 12. We discuss this relationship in greater detail in Section 3.2.

2.4 The second big idea: the opportunity cost of women's time

The observed negative relationship between women's labor force participation and fertility motivated the second big idea in the economics of fertility, namely, the role of the opportunity cost of women's time in determining fertility rates. If women do most of the childrearing, the time cost of having children depends primarily on women's wages rather than average wages. Hence, the gender wage gap and women's participation in the formal labor market become primary determinants of a country's fertility rate.

We can illustrate the separate role of women's and men's wages with a variation of the quantity-quality model of fertility choice developed in Section 2.2. Rather than analyzing decisions of a generic parent of unspecified gender, consider the fertility decision of a couple consisting of a wife f and husband m. Women earn wages w_f and men earn wages w_m and, consistent with a gender wage gap, we set $w_f < w_m$. There is no conflict of interest between the spouses and they jointly want to maximize a utility function that continues to be given by (2). There are now, however, two time constraints, one for the husband and one for the wife. Given that the wife has a lower wage, optimal specialization implies that she will provide all of the childcare time as long as the total childcare time does not exceed her time endowment. In this case, the husband will use his entire time endowment for market work, and the wife's time constraint reads:

$$l_f + n\phi \leq 1.$$

The couple's maximization problem can now be written as:

$$\max_{c,n,e} \ \log(c) + \delta \log(n) + \delta\gamma \log(\theta + e) \quad \text{s.t.} \quad c + p\,e\,n = w_m + (1 - \phi n) w_f. \tag{3}$$

To focus on the role of the gender wage gap rather than child quality, we set the return to education to zero, $\gamma = 0$, implying that the optimal education investment is also zero, $e = 0$. The optimal fertility choice of the couple is then:

$$n = \frac{\delta}{1+\delta} \cdot \frac{1}{\phi} \cdot \left[1 + \frac{w_m}{w_f}\right]. \tag{4}$$

Hence, the gender wage ratio w_m / w_f emerges as a determinant of fertility rates. When the gender wage gap closes and women see better opportunities in the labor market, fertility declines:

$$\frac{\partial n}{\partial \left(\frac{w_f}{w_m}\right)} = -\frac{\delta}{1+\delta} \cdot \frac{1}{\phi} \cdot \left[\frac{w_f}{w_m}\right]^{-2} < 0.$$

Intuitively, a rise in men's wages w_m holding women's wages constant now represents a pure income effect and therefore raises fertility. An increase in women's wages implies both income and substitution effects. The force of the positive income effect on fertility is reduced by the fact that the majority of household income comes from men's earnings. Hence, the substitution effect dominates, and a rise in women's wages lowers fertility.

The gender wage gap also matters for labor supply. When women's wages rise, the lower number of children frees up time in the household's time budget, and women's labor supply accordingly increases. In our model, this increase happens on the intensive margin, i.e., women split their time between working and childrearing.

This model, which distinguishes between women's and men's wages and labor supply, also has implications for the cross-section of fertility within a country. A major determinant of wages is education. As long as wives' and husbands' education levels are not perfectly correlated, the model predicts that fertility and women's education should be negatively correlated in the cross-section.

The opportunity cost of women's time was a major theme in first-generation economic research on fertility choice (as surveyed in Hotz et al., 1997 and Schultz, 1997). Butz and Ward (1979) provided a well-known early analysis of the separate roles of men's and women's earnings in determining fertility. While these authors do not specify a full decision problem, they model the impact of a rise in male wages on fertility as a pure income effect that increases fertility, while a rise in women's wages implies both income and substitution effects, with the substitution effect usually being dominant.

Building on the same insight, Galor and Weil (1996) construct a full general equilibrium model in which mutual feedback between capital accumulation, women's relative wages, and fertility generate a demographic transition and accelerate economic growth. In their model, physical capital (which replaces physical labor) is complementary to women's labor. Hence, capital accumulation reduces the gender wage gap, which over time induces more women to join the labor force. Rising female participation, in turn, reduces fertility, and fertility reductions lead to faster capital accumulation (in per capita terms) due to lower capital dilution.

Coskun and Dalgic (2020) examine the role of women's opportunity cost of time for variation in fertility rates over the business cycle. In recent US recessions (apart from the pandemic recession of 2020–2021), men's employment declined sharply, whereas women, who were more likely to be employed in acyclical sectors such as education and healthcare, had fairly stable employment over the cycle. The drop in men's relative employment in recessions means that women's labor income becomes more important in downturns. This, in turn, increases the opportunity cost of having children and reduces fertility. The result is that, as women's labor force participation has risen, fertility has become procyclical at the aggregate level. This finding is moreover consistent with the observation by Currie and Schwandt (2014) that high state-level unemployment rates during young adulthood reduce women's subsequent fertility. The size of the effect builds over time and is largely driven by women who remain childless, meaning that this does not simply reflect a postponing of births during downturns. One possible interpretation is that in places with high unemployment more young women enter more demanding and high-paid career paths that also come with a greater likelihood of not having children later on.

The opportunity cost of women's time is also central to life-cycle models of fertility and women's career choices; Moffitt (1984) represents an early contribution to this literature. We discuss such models from the perspective of the changing relationship between women's labor supply and fertility in Section 4.3 below. More generally, models of the role of women's opportunity cost of time in fertility choices form the foundation of research on the relationship between career-family compatibility and fertility, the focus of Section 5 below.

2.5 Accounting for the baby boom

While we are primarily interested in recent changes in fertility behavior, an earlier challenge for the economics of fertility continues to be a subject of ongoing research, namely, how to account for the baby boom. As Fig. 1 shows, many high-income economies experienced a substantial rise in fertility following World War II that lasted throughout the 1950s, until a trend towards low fertility was once again established in the 1960s. The quantity-quality mechanism does not provide a convincing account of the baby boom, in that this would require investments in child quality to drop during the boom, something for which there is little evidence. In fact, investments in human capital, as measured by schooling levels, continued to increase (see Fig. 4). Recent explanations of the baby boom have instead focused on either the link between women's labor market opportunities and fertility, or on other sources of change in the cost of children.

Greenwood et al. (2005a) explore the role of technological improvements in the household in generating the baby boom. Starting in the 1930s and continuing through at least the 1950s, appliances such as the refrigerator, washing machine, and dishwasher were adopted by a large share of households in the United States and other countries. Greenwood et al. (2005a) argue that these innovations greatly reduced the time required for household production. The resultant time savings, in turn, freed up time for having more children. Bailey and Collins (2011) question the quantitative importance of this mechanism, noting that the spread of household appliances and electrification at the US county level does not predict fertility decline. In a later paper, Greenwood et al. (2015) argue that this correlation is not, however, informative for the household technology hypothesis, given that both appliance ownership and fertility are related to income.

Along similar lines, Albanesi and Olivetti (2014, 2016) consider the role of technological innovations affecting maternal health, such as the introduction of antibiotics that greatly reduced the risk of dying from childbirth, and formula that facilitated the feeding of infants. Like the household innovations considered by Greenwood et al. (2005a), these changes arguably led to a persistent decline in the cost of having children, resulting in a baby boom before the long-run trend to lower fertility reestablished itself.

Doepke et al. (2015) examine the role of women's labor market opportunities in generating the baby boom, suggesting that the baby boom is at least in part an aftereffect of World War II. During the war, millions of US women were drawn into the labor force to support wartime production while men were drafted into the armed forces. This wartime rise in women's participation had a persistent impact on the postwar labor market, as many of the women who joined during the war then continued to work afterwards, throughout the 1950s.

Given that working and having children are competing uses of women's time, one might expect that this change would lower fertility. Doepke et al. (2015) argue, however, that the war shock had opposite effects on the war generation of women as opposed to the younger cohorts who entered the labor market later on. These younger women, who came of age in the 1950s, faced more competition in the labor market since many of the jobs available to them in a still gender-segregated labor market were already occupied by older women of the war generation. This depressed younger women's wages, reduced their labor force participation, and induced many to marry

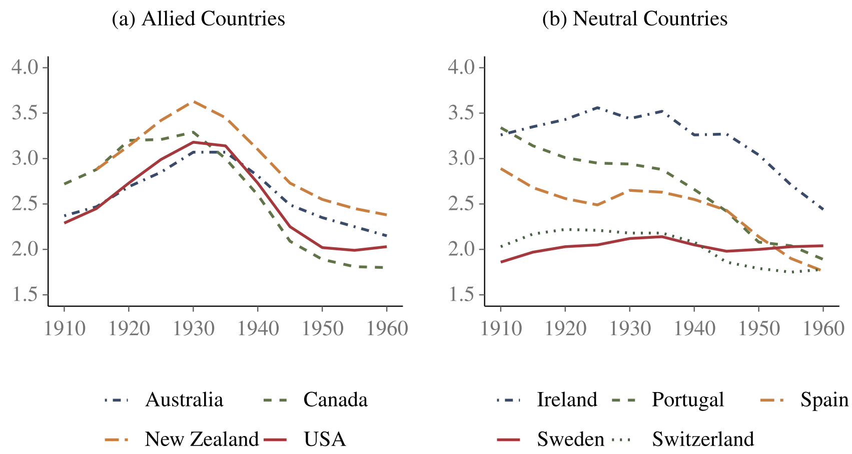

FIGURE 6 Children ever born, 1910-1960.

Sources: Children ever born by year of birth in Allied and neutral countries. Data was kindly provided by Jean-Paul Sardon of the Observatoire Démographique Européen. Some of these data are published in Sardon (1990) and Sardon (2006).

earlier and begin having children at a younger age. It is this shift to early childbearing by these younger cohorts that led to a baby boom.

These authors also provide empirical evidence that in the United States, those states that had larger mobilization rates also experienced a larger subsequent rise in fertility. Given that the shock on women's labor market was larger where more men were mobilized, this is consistent with a link between wartime mobilization and the baby boom. Brodeur and Kattan (2022) point out that these state-level empirical results are not always robust to allowing for different trends across states with distinct initial demographic characteristics. To address this issue, they carry out an empirical analysis at the more disaggregated county level, using variation in casualty rates. They find that counties with higher casualty rates saw higher employment of women of childbearing age in 1950 and lower fertility during the baby boom. These results are again consistent with the view that the market for women's labor played an important role in the baby boom. In particular, wartime casualties (unlike being mobilized but remaining unharmed) lowered men's postwar labor supply, which, all else equal, increased demand for young women's labor and hence lowered fertility. For example, a woman married to a veteran with a disability (due to wartime injury) preventing him from working would have accordingly been more likely to join the labor force and to have fewer children.

The notion that wartime mobilization was a major driver of the baby boom is also supported by the fact that Allied countries that participated in World War II and drew women into the labor force during the war had much larger baby booms than those that remained neutral. Fig. 6 shows completed fertility rates across the Allied countries of Australia, Canada, New Zealand, and the United States for the cohorts having children before, during, and after the baby boom (left panel). In each case, we observe a large baby boom and a remarkably similar timing in the rise and fall of fertility. In contrast, baby booms in the neutral countries are either much smaller or nonexistent (right panel).

Overall, these explanations for the baby boom draw on ideas from first-generation models of fertility that emphasize both the overall cost of children and women's opportunity cost of time, while simultaneously taking into account the specific historical circumstances that shaped fertility choice in the baby boom years.

3 The changing relationships between income, labor force participation, education, and fertility

Our basic thesis is that the economics of fertility has entered a new era that goes beyond the first-generation work on the quantity-quality tradeoff and the negative relationship between women's labor market participation and fertility. The trigger for this new development is a shift in fertility behavior itself. Indeed, the basic empirical relationships that characterized fertility decisions from the onset of the demographic transition through the second half of the twentieth century no longer hold true in the most recent data from high-income economies. They have instead been replaced by new empirical regularities in need of explanation. In this section, we summarize this new evidence.

3.1 Income and fertility

As outlined in the previous section, the key empirical observation driving much of the initial research on the economics of fertility was a negative relationship between income levels and fertility that once characterized fertility behavior both within and across countries. This relationship is still intact when comparing the richest and poorest countries around the world today. The countries with the lowest income levels (in particular in sub-Saharan Africa) are still in the midst of the demographic transition and continue to have high fertility rates. In contrast, within and among high-income economies (the focus of this survey), the negative income-fertility relationship has largely disappeared.

One manifestation of the waning income-fertility relationship in the time series is that the fertility transition in rich countries was essentially completed by the mid-1980s. Since then, the total fertility rate has leveled out or even slightly increased in many of these countries, even though levels of income per capita have continued to grow (see Fig. 7).[9] There are, however, still persistent differences in fertility rates across countries. Fig. 7 shows that starting in about 1990, high-income economies

[9] A similar picture emerges when considering completed cohort fertility instead of total fertility rates, see Fig. A4 in the Appendix.

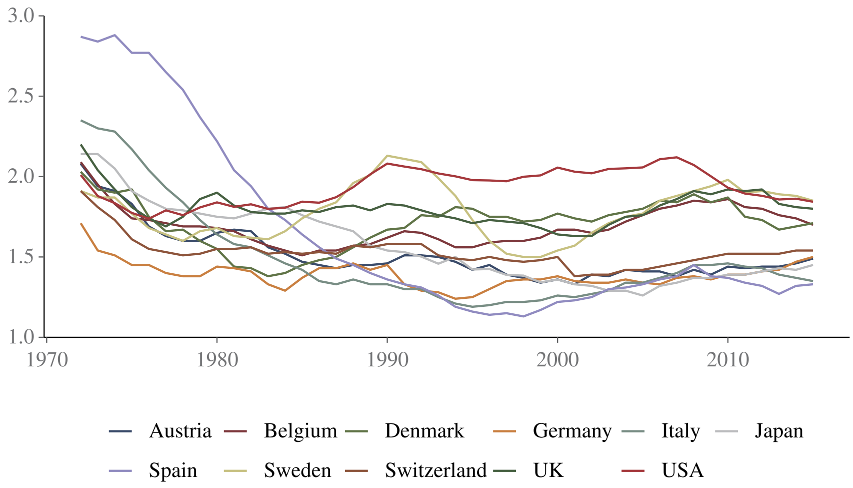

FIGURE 7 Total fertility rates since 1970.

Notes: Data comes from the World Bank Development Indicator database, https://databank.worldbank.org/source/world-development-indicators (accessed on 30 June 2021). We plot the total fertility rate (births per woman), indicator SP.DYN.TFRT.IN.

have largely separated into two groups: one with fertility rates close to the replacement level and the other with fertility rates well below a value of 1.6. Unlike previously, the countries in the higher fertility group do not have lower income levels; in fact, the United States, the country with the highest income per capita in the sample, belongs to the group with higher fertility rates.

Fig. 8 illustrates the changing income-fertility relationship in the cross-section of high-income countries (OECD members). In 1980, there was still a clear negative relationship between income per capita and fertility, with the highest fertility rates in countries such as Portugal and Spain, which at the time had the lowest income levels in this group. By the year 2000, this relationship had reversed: richer OECD economies now have slightly higher fertility rates than poorer ones. The new pattern is not unique to the year 2000. Fig. 9 shows that the correlation between fertility and income per capita was negative throughout the 1970s and early 1980s, turned positive in the year 1987 and has stayed positive since.[10]

Given that income levels are higher across the board in the year 2000 compared to 1980, an alternative interpretation of Fig. 8 is that there is a U-shape in the relationship between income per capita and fertility at the country level, with most high-income countries having now entered the rising part of this shape. Either way,

[10] The sample of countries in Fig. 9 increases over time as data for more countries become available. As a robustness check, we show in Fig. A1 in the Appendix that the changing correlation is not driven by changes in the sample of countries. If we fix the sample to the ten countries for which we have data throughout the entire sample, the same pattern emerges.

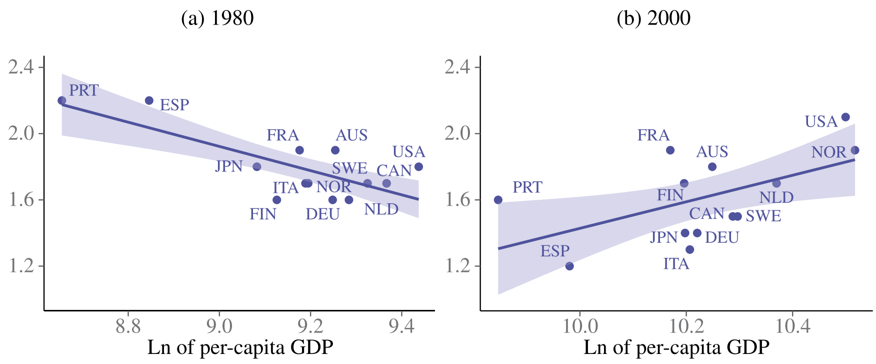

FIGURE 8 Fertility and GDP per capita across OECD economies.

Notes: We plot total fertility rates against the natural log of per-capita GDP in 1980 and 2000. In each year, we include a linear regression of the total fertility rate on the natural log of per-capita GDP and show 90% confidence intervals. Data on total fertility rates comes from the OECD Statistical Database, "Fertility rates" (indicator), https://doi.org/10.1787/8272fb01-en (accessed on 30 June 2021). Data on per-capita GDP also comes from the OECD Statistical Database, "Level of GDP per capita and productivity," https://stats.oecd.org/ (accessed on 30 June 2021). GDP per head of population is expressed in current USD. We plot the 13 OECD countries for which data on female labor supply is available in 1980, excluding South Korea, making the sample consistent with the one used in Fig. 12.

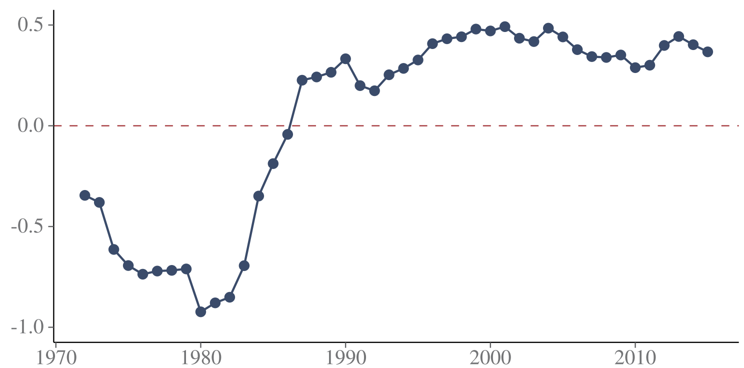

FIGURE 9 Cross-country correlation between total fertility rate and per capita GDP.

Notes: The figure plots the correlation coefficients between total fertility rates and per capita GDP across 22 OECD countries in each year. Data for the total fertility rate and per capita GDP comes from the OECD's statistical database. See Fig. 8 for details on the data sources.

accounting for these observations requires new models that do not exhibit a monotonically negative relationship between income and fertility.

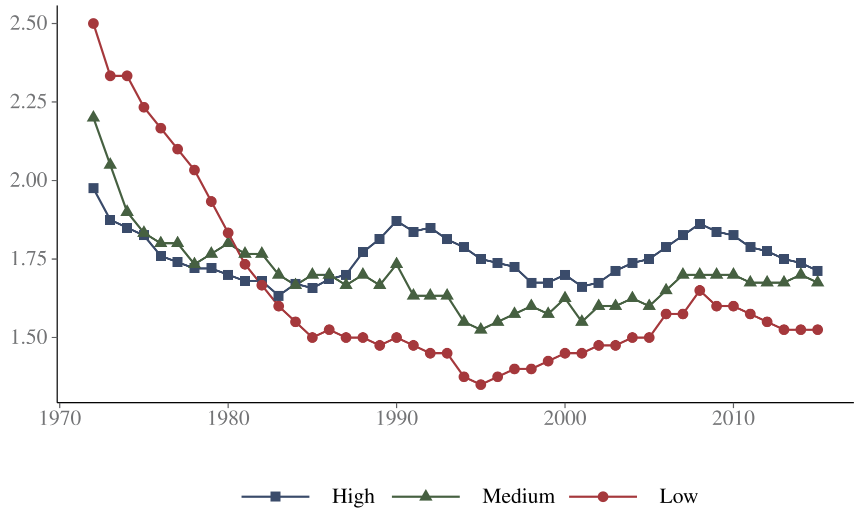

FIGURE 10 Total fertility rate in countries with low, medium, and high female labor force participation.

Notes: The figure plots the average total fertility rate when countries are grouped into low, medium, and high female labor force participation (FLFP) countries based on the average FLFP between 1970 and 1990, following Ahn and Mira (2002). High FLFP countries include Canada, Denmark, Finland, Great Britain, Norway, Sweden, USA, and Switzerland. Medium FLFP countries include Austria, Australia, France, and Germany. Low FLFP countries include Belgium, Italy, Netherlands, and Spain. Data for the total fertility rate and female labor force participation rate (25-54-year-old age group) comes from the OECD's statistical database. See Fig. 12 for details on data sources.

3.2 Women's labor force participation and fertility

A second observation that informed the first generation of economic models of fertility was that countries where the female labor force participation rate was higher had lower fertility rates. Yet, just like the income-fertility relationship, this relationship too has reversed in recent decades in high-income economies, a fact that has been noted and analyzed in both the economics (e.g., Ahn and Mira, 2002, Del Boca, 2002, Apps and Rees, 2004, Adserà, 2004) and sociology (e.g., Rindfuss and Brewster, 1996, Brewster and Rindfuss, 2000, Engelhardt and Prskawetz, 2004, Billari and Kohler, 2004, Brehm and Engelhardt, 2015) literature.

Fig. 10 shows the dynamics of the total fertility rate in three distinct country groups. We follow Ahn and Mira (2002) and categorize countries by their average female labor force participation rate between 1970 and 1990, which gives us three groups: those with a low, medium, and high female labor force participation. The classic negative relationship between fertility and female labor force participation still holds in the 1970s. However, over the course of the 1980s, the picture flips. Whereas the total fertility rate increases after 1980 in countries with high female

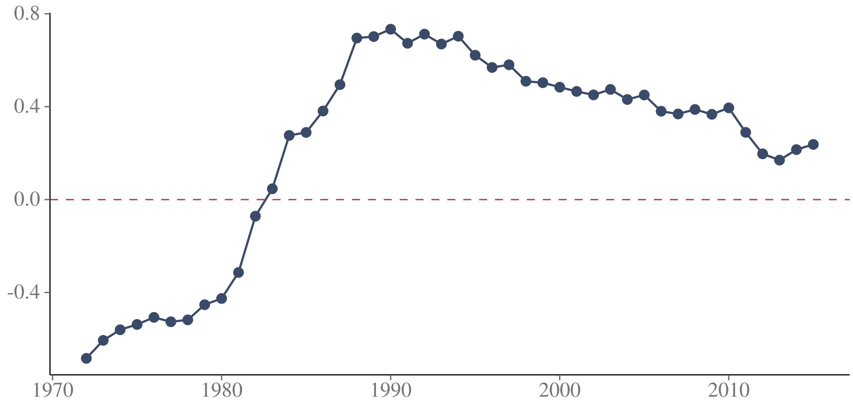

FIGURE 11 Cross-country correlation between total fertility rate and female labor force participation rate.

Notes: The figure plots the correlation coefficients between total fertility rates and female labor force participation rates across 22 OECD countries in each year. Data for the total fertility rate and female labor force participation rate (25-54-year-old age group) comes from the OECD's statistical database. See Fig. 12 for details on the data sources.

labor force participation, it declined sharply in low participation countries between the 1970s and 1990s. Then, from 1990 onward, fertility is increasing in female labor market participation across these groups of countries.

We now want to investigate this cross-country relationship more systematically. Once again following Ahn and Mira (2002), Fig. 11 displays the correlation coefficient between a country's total fertility rate and its female labor force participation rate.[11] The reversal in the relationship between fertility and female employment is evident. Throughout the 1970s, countries with high female labor force participation still experienced lower fertility rates. However, in the 1980s, this relationship inverts. The correlation coefficient rises from -0.5 in 1980 to about 0.75 over a decade. After 1990, the correlation coefficient declines somewhat, but a positive relationship between fertility and female employment persists today.

To further illustrate this reversal, Fig. 12 displays the cross-country relationship between female labor force participation and a country's total fertility rate in 1980 and in 2000. What used to be a negative relationship in 1980 became a positive relationship by 2000. Further, Fig. A3 in the appendix shows that fertility in countries with a low female labor force participation rate in 1980 subsequently declined, while fertility in countries with high participation rates in the 1980s increased.

[11] The sample of countries in Fig. 11 changes over time as data on female labor supply becomes available for more countries. As a robustness check, we show in Fig. A2 in the Appendix that the changing correlation is not driven by changes in the sample of countries. If we fix the sample to the ten countries for which data on female labor force participation is already available in 1972, the same pattern emerges.

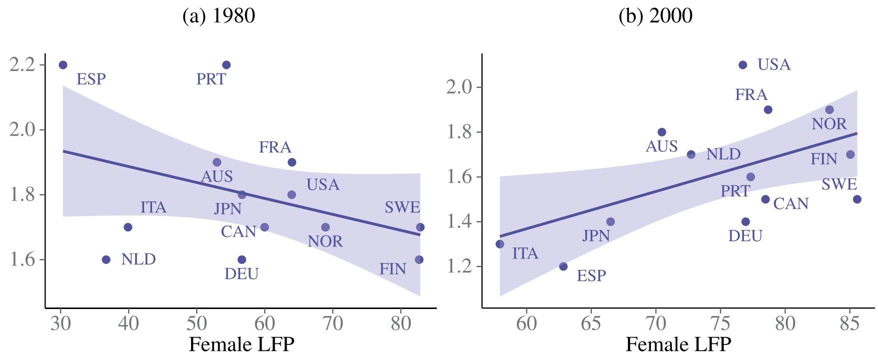

FIGURE 12 Fertility and female labor force participation across OECD economies.

Notes: We plot total fertility rates against the female labor force participation rate for the 25-54-year-old age group in 1980 and 2000. In each year, we include a linear regression of the total fertility rate on the female labor force participation rate and show 90% confidence intervals. Data on total fertility rates comes from the OECD Statistical Database, "Fertility rates" (indicator), https://doi.org/10.1787/8272fb01-en (accessed on 30 June 2021). Data on female labor force participation comes from the OECD Statistical Database, "LFS by sex and age," https://stats.oecd.org/ (accessed on 30 June 2021). We plot the 13 OECD countries for which data on female labor supply is available in 1980, excluding South Korea.

3.3 Women's education and fertility

While the relationship between female education and fertility has, historically, been negative, Hazan and Zoabi (2015) and Bar et al. (2018) point out that this is yet another relationship that has shifted in recent times. Fig. 13 displays the education-fertility relationship for five cohorts of US women spanning a fifty year period. For each cross-section, we computed hybrid fertility rates for five different education groups.[12] The figure displays fertility rates relative to that of the bottom education category, allowing for a better comparison of the slopes.[13] In the 1980s, the relationship between education and fertility was negative along the entire education distribution. By 1990, the relationship had flattened at the upper end, so that women with a postgraduate education (such as an MA or PhD) had about the same number of children as those with a college degree. In the last two cross-sections, we see an increase at the upper end. Note that the patterns differ across racial groups. Fig. 14

[12] Hybrid fertility rates are defined as $\text{HFR}_t = n_{24,t} + \sum_{a=25}^{55} \text{AFR}_{a,t}$, where $n_{24,t}$ is the average number of children ever born in year t for women age 24 and $\text{AFR}_{a,t}$ is the age-specific fertility rate of women in the a age group in year t. Hybrid fertility rates (the number of children women aged 24 will end up with if age-specific fertility rates remain constant) are used here because they are similar to completed fertility rates while not being restricted to considering cohorts that are already beyond child-bearing age. HFR is estimated separately for women in five different education groups: less than high school (< 12 years of education), high school (12), some college ($13 - 15$), college (16), and more than college ($16+$).

[13] See Table A2 and Fig. A5 in the Appendix for the raw numbers.

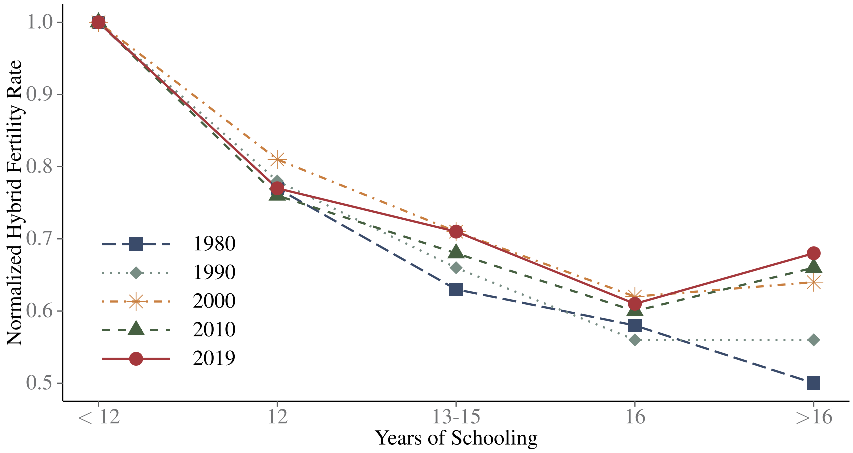

FIGURE 13 Normalized hybrid fertility by women's education in the United States.

Notes: The figure is based on Bar et al. (2018), Figure 1, with additional years added. We divide hybrid fertility rates (HFR) by the value of the HFR for the lowest education group in each decade. Data comes from the Census, accessed through IPUMS. Please refer to Footnote 12 for a definition of hybrid fertility rates in the Census data.

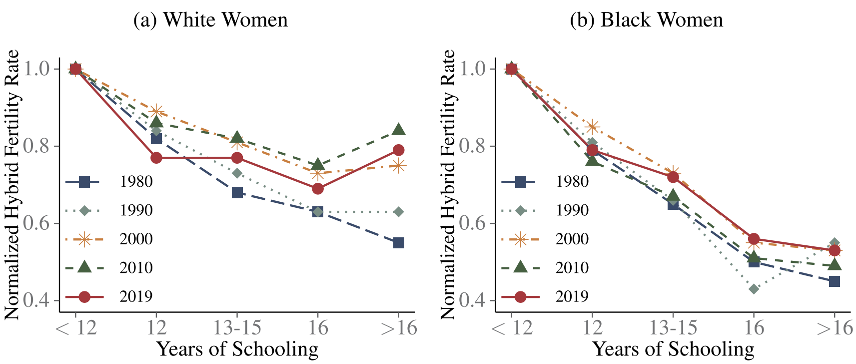

FIGURE 14 Normalized hybrid fertility by women's education in the United States by race.

Notes: The figure is based on Bar et al. (2018), Figure 1, with additional years added. We divide hybrid fertility rates (HFR) by the value of the HFR for the lowest education group in each decade. Please refer to Footnote 12 for a definition of hybrid fertility rates in the Census data.

displays fertility by education separately for white and Black women. The increase at the upper end is particularly pronounced for white women, while among Black women fertility still monotonically declines with education in the most recent cross-sections. In addition, the relationship is steeper among Black women, with the most

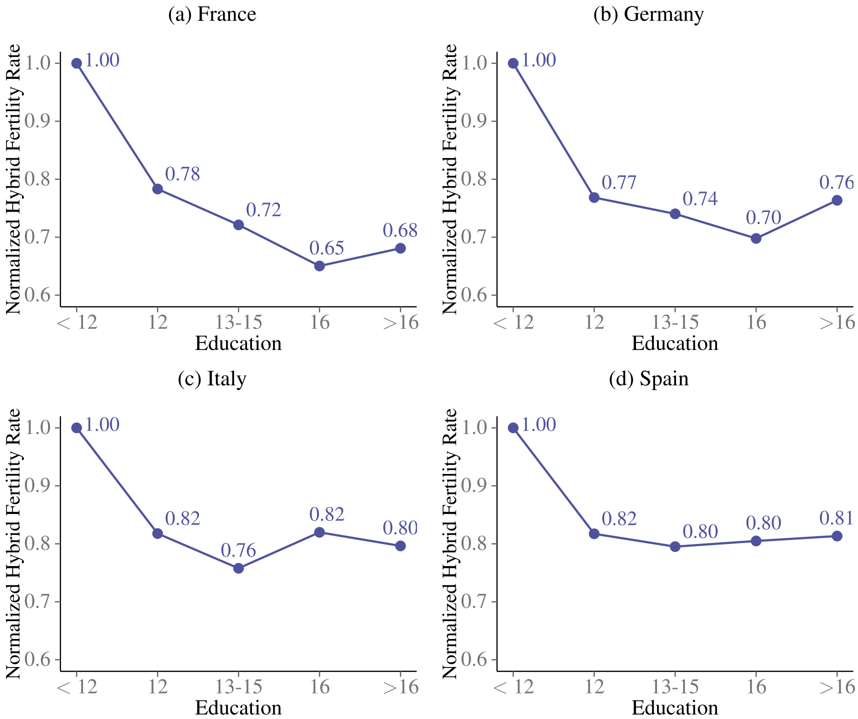

FIGURE 15 Normalized hybrid fertility by women's education: evidence from Europe.

Notes: Data comes from the European Labor Force Survey between 2014 and 2018. Hybrid fertility rates are constructed following Bar et al. (2018), Figure 1, except that we use number of children of the 30-34-year-old age group and add age-specific fertility rates for women between the ages of 35 and 44. Please refer to Footnote 15 for a definition of hybrid fertility rates in the European Labor Force Survey.

educated women only having about half as many children as the least educated.[14] A possible factor behind these different outcomes is the large and persistent gender education gap among Black Americans (McDaniel et al., 2011).

Fig. 15 displays the education-fertility relationship in several European countries. We use the European Labor Force Survey (ELFS) between 2014 and 2018 to again compute hybrid fertility rates.[15] The recent cross-sections in these countries resemble

[14] The apparent U-shape in 1990 for Black women is likely due to the small number of 24-year old women with more than 16 years of education in that year. There are only 72 such women in our data and their number of children is higher than 10 years before and afterwards.

[15] In the ELFS, age is only observed in five-year bins. Hence, we adjust the definition of the HFR accordingly: $\mathrm{HFR}_t = n_{30-34,t} + \sum_{a=35}^{49} \mathrm{AFR}_{a,t}$, where $n_{30-34,t}$ is the average number of children in year t for women of the 30-34-year-old age group and $\mathrm{AFR}_{a,t}$ is the age-specific fertility rate of women in the a age

the US pattern. In France and Germany, hybrid fertility rates similarly show an increase in fertility for the highest education group. Meanwhile, in Italy and Spain, two countries with some of the lowest fertility rates in Europe, we do not see an uptick in fertility for the highly educated, though the slope of the education-fertility relationship is almost flat for all women who have at least a high school degree. Overall, the data shows that in a number of high-income countries, a monotonically negative relationship between women's education and fertility no longer exists.[16]

3.4 Disagreement over fertility

The recent literature has also established new facts on fertility behavior that speak to the changing relationships between income and women's labor supply and fertility. One particular set of facts—central to our discussion of the mechanisms behind these changing relationships—concerns the fertility preferences of women and men and potential disagreement over fertility decisions between partners or spouses.

It has been known for some time now that women and men do not always agree on fertility. In particular, the Demographic and Health Surveys (DHS) have long collected information on desired fertility separately for women and men, and this data shows that in many countries, especially poor ones, men desire more children than do women (Bankole, 1995; Bankole and Singh, 1998; Westoff, 2010; Field et al., 2016; Doepke and Tertilt, 2018).

A disadvantage of the DHS data is that the focus is on desired fertility, i.e., an ideal lifetime fertility rate, with no information available on disagreements between partners over issues such as the timing of fertility. In a recent paper, Doepke and Kindermann (2019) use data from the Gender and Generations Programme (GGP), which includes information on fertility preferences that can be linked more directly to fertility decisions. Specifically, respondents are asked whether they "would like to have a/another baby now," and, if they are married or in a relationship, they are asked the same question about the preferences of their partner. Doepke and Kindermann consider how couples answer these questions in eleven high-income economies and observe that many couples disagree, especially if they have one or more children already. Among couples with two or more children, there are many more couples who disagree on wanting another child (i.e., one partner wants to have a baby, the other does not) than there are couples who agree on wanting one more child.

group in year t. As we only observe detailed education groups after 2014 in the ELFS, we depict the most recent education-fertility relationship in these European countries, rather than changes over time.

16 There is also a literature on the causal relationship between female education and fertility. For example, Monstad et al. (2008) and McCrary and Royer (2011) exploit variation in education generated by mandatory schooling laws and the school entry age, and argue that more education does not lower fertility. These findings do not contradict the finding that the unconditional relationship between education and fertility used to be negative; in particular, causal-identification studies hold constant individual characteristics such as skills and preferences that may drive both education and fertility. Either way, economic models of fertility choice need to address the changing relationships in the data.

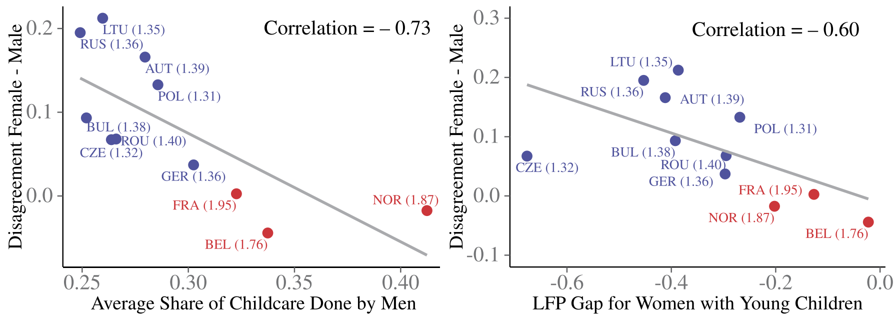

FIGURE 16 Fertility disagreement by fathers' share of childcare and mothers' labor force participation.

Notes: Figures reproduced from Doepke and Kindermann (2019). Each dot is a country, with its total fertility rate displayed in parentheses. "Disagreement Female" indicates the number of couples where the woman does not want a child but the man does, as a fraction of all couples in a given country where at least one partner wants a child. "Disagreement Male" is the analogous fraction of couples where the man does not want a child but the woman does. We report the difference between "Disagreement Female" and "Disagreement Male" on the vertical axis. A high value on the y-axis means that, in a given country, it is women who tend to disagree on having a (or another) child. The horizontal axis in the left panel displays fathers' contribution in carrying out a set of major childcare tasks. The horizontal axis in the right panel is the difference between the labor force participation of mothers of young children and other women.

Doepke and Kindermann also document that stated fertility intentions are highly predictive of whether or not the couple will have a child over the next three years. A child is born with a high probability only if both agree that they want a baby; if there is disagreement (i.e., only one of the partners wants a baby), the likelihood of having another child is small. Duvander et al. (2020) come to similar conclusions using data on fertility intentions and outcomes from Sweden.

The finding that partner agreement is a precondition for having a baby suggests that the distribution of the costs and benefits of having children among mothers and fathers in part determines fertility. Specifically, if one of the parents has to bear most of the cost of having a baby and is therefore less likely to agree to having another one, fertility will be low no matter how much the other parent would like to have more children. The GGP evidence provides direct support for this implication. In all countries in the GGP sample, mothers provide more childcare than do fathers. That said, fathers' contribution varies from less than 25 percent of total time in Russia to more than 40 percent in Norway. The left panel of Fig. 16 shows that in countries where men do little childcare, women are more likely to be opposed to having another child. The three high-fertility countries (red dots) are those where fathers make the greatest contribution to total childcare, whereas in all low-fertility countries (blue dots; total fertility rate of less than 1.6) mothers provide at least two-thirds of the

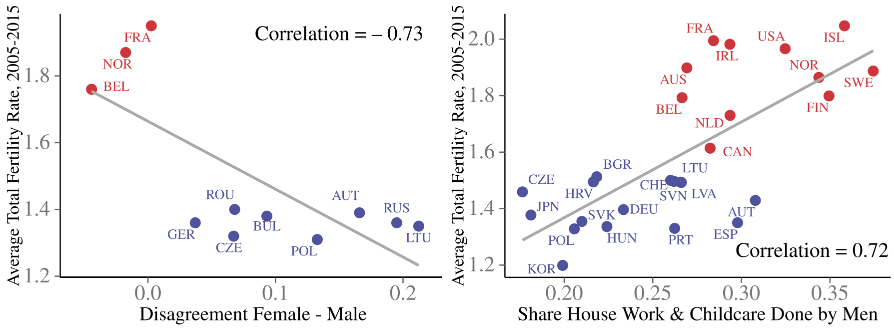

FIGURE 17 Fertility by disagreement and men's share of house work.

Notes: Data from Doepke and Kindermann (2019) and the International Social Survey Programme: Family and Changing Gender Roles.

childcare. The flip side to this is that mothers in countries where fathers contribute little to childcare have a harder time returning to work after giving birth. To this regard, the right panel in Fig. 16 shows that low-fertility countries (blue dots), where mothers provide most of the childcare, also exhibit a larger gap between the labor force participation rate of young mothers and other women.

The left panel of Fig. 17 shows that in countries where many women are opposed to having children, fertility rates are low. The relationship between father's contribution to childcare and fertility also holds for a larger sample of countries, as can be seen in the right panel of this same figure. Here, following Feyrer et al. (2008), we rely on data from the 2012 "International Social Survey Programme: Family and Changing Gender Roles," which asks about men's participation in typical housework and caring activities. The five countries with the highest male contribution to housework and childcare all have a fertility rate of 1.8 or higher. Conversely, the five countries with the lowest male contribution all have fertility rates below 1.5. Overall, the correlation between the male share of housework and childcare with fertility exceeds 0.7.

Together, these facts suggest that bargaining between mothers and fathers plays an important role in determining fertility, a dimension that is absent from the first generation of economic models of fertility choice.

4 Why have the old relationships weakened or disappeared?

As a first step in exploring the economics behind the new fertility facts, we take a closer look at the fading negative income-fertility relationship, which was, from the onset of the demographic transition until the 1980s, the main stylized feature of the fertility data in high-income economies. As outlined above, the principal economic explanation for this pattern was provided by the quantity-quality model. In our view, the general idea of a quantity-quality tradeoff continues to be relevant, but changes in the economic environment of high-income countries have reduced the overall impact of this tradeoff on fertility decisions.

4.1 Public schooling and child labor laws

When fertility declined during the demographic transition, the contemporaneous expansion of formal education imposed a powerful monetary tradeoff on parents. Where schooling was either fully private or required at least some spending (e.g., expenses for books, fees, or supplies) each year of education imposed further burdens on parents. More importantly, even when schooling was free, children who went to school could not work. Before the onset of the fertility decline, working children made a substantial contribution to total income in many families (Horrell and Humphries, 1995). The loss in child labor income when children started to attend school implied a large opportunity cost of education and hence a strong quantity-quality tradeoff (Hazan and Berdugo, 2002; Doepke, 2004).

Even when narrowly defined child labor (work by children up to age 14) disappeared and many children received at least some secondary schooling, the monetary tradeoff implied by attending school continued to bear some relevance. Indeed, not so long ago, in high-income countries many children would leave school at age 15 or 16 and begin working. If these children continued to live at home, they would usually be expected to turn over some of their income to support the family. Where they left the parental home, expenses on these children would also decline. In other words, parents continued to face a monetary tradeoff between the quantity and quality of children.

Some of these tradeoffs are still in place today, but in high-income countries recent developments have removed much of their strength. Most importantly, public education has expanded to cover essentially all of childhood—in most high-income countries, a large majority of children stay in school for at least 12 years and graduate as young adults at age 18 or older.[17] The margin for education decisions, such as whether to attend college or to continue on to postgraduate studies, is now usually reached only after children become adults, when the children's own budgets are more affected than that of their parents. Students in higher education still have to weigh the loss of potential earnings from education and the potential burden of student loans, but this is now primarily their own decision rather than that of their parents.

This is not to say that there are no relevant education tradeoffs at all for parents. Many parents do support their children throughout college and various financial links between parents and children continue to exist into adulthood. Rather, the argument is one of degree: potential interactions of education and fertility decisions are diminished, reducing the strength of the quantity-quality tradeoff.

[17] According to the World Bank Development Indicators, the net enrollment rate in secondary schooling in OECD countries was almost 90 percent in 2018, and the gross enrollment rate for tertiary education was above 75 percent.

Consistent with this interpretation, recent empirical studies have found little evidence of a continuing fertility-education tradeoff in high-income countries. Earlier investigations that did document a quantity-quality tradeoff focused on low-income settings. For example, Rosenzweig and Wolpin (1980) find that an exogenous increase in fertility through twin births decreases education in India, and Rosenzweig and Zhang (2009) obtain similar results for China. In contrast, Black et al. (2005) use Norwegian administrative data to measure the causal impact of an increase in the number children (again instrumented using twin births), and find a negligible impact on educational attainment once they control for birth-order effects. Angrist et al. (2010) come to the same conclusion in a study using Israeli data. Both of these papers look at settings with high-quality public education, where most children complete 12 or more years of education.[18]

4.2 Marketization of childcare

A second factor weakening the forces emphasized in the first generation of economic models of fertility is the marketization of childcare. The models described in Section 2.4 build on the notion that women have to reduce their labor supply if they want to have more children. This tradeoff between working and caring for children is diminished if childcare services can be bought on the market. Being able to outsource childcare converts a time cost into a monetary cost, and the relevance of women's opportunity cost of time accordingly diminishes. Indeed, as we document in Section 8.1, working mothers spend much less time on childcare than do nonemployed mothers.[19]

The force of marketization applies not just to childcare itself; time can also be freed up by paying others to do general housework related to having children, such as cooking, cleaning, and washing clothes. Indeed, in the United States, time spent on housework other than childcare has declined over time (Ramey and Ramey, 2010).

We can illustrate the implications of marketization with an extension of the model of the role of women's opportunity cost of time for fertility decisions developed in Section 2.4. As in the maximization problem (3), a couple chooses consumption c and the number of children n. We abstract from a child quality choice here, but allow for both a time cost of raising each child ϕ as well as a monetary cost ψ, which represents expenditures for children such as clothing or food. To introduce marketization, we allow that, instead of providing childcare on their own, a couple can buy this childcare on the market for a price p_s. We denote by $s \in [0, \bar{s}]$ the share of childcare the couple buys, where $\bar{s}$ is the maximum amount of childcare that can be outsourced.

[18] See Liu (2015) for a recent survey of the empirical literature testing the quantity-quality tradeoff, which shows, in line with our argument, that this tradeoff is now primarily found in low-income countries.

[19] Though, it is also true that parental primary childcare time has risen in recent years. We discuss the increase in the intensity of parenting in Section 8.1.

The couple's choice problem is:

$$\max_{c,n,s} \ \log(c)+\delta\log(n) \quad \text{s.t.} \quad c+\psi n+sp_s n\phi = w_m + w_f\big[1-(1-s)n\phi\big]. \tag{5}$$

For a given s, the optimal fertility choice is:

$$n=\frac{\delta}{1+\delta}\cdot\frac{w_m+w_f}{\psi+\big[sp_s+(1-s)w_f\big]\phi}. \tag{6}$$

Utility as a function of purchased childcare s is

$$u(s)=\log\left(\delta^{\delta}\left[\frac{w_m+w_f}{1+\delta}\right]^{1+\delta}\right)-\delta\log\big(\psi+\big[sp_s+(1-s)w_f\big]\phi\big).$$

This expression is monotonic in s. A couple where the wife's wage is lower than the cost of childcare ($w_f < p_s$) would provide childcare on their own, $s=0$, whereas a couple where $w_f \geq p_s$ would buy as much childcare as possible from the market, $s=\bar{s}$. Women with high market wages would therefore continue to participate in the labor force, while lower-wage women would provide more childcare and reduce their labor supply.

Now let us turn to the relationship between the wage w_f and fertility. Given (6), we have:

$$\frac{\partial n}{\partial w_f}=\frac{\delta}{1+\delta}\cdot\left(\frac{\psi+(sp_s-(1-s)w_m)\,\phi}{\big[\psi+\big[sp_s+(1-s)w_f\big]\phi\big]^2}\right). \tag{7}$$

The relationship between the woman's wage and the number of children depends on the choice of s. Assuming that the monetary cost of having children ψ is small relative to the time cost ($\psi < w_m\phi$), we have:

$$\frac{\partial n}{\partial w_f}\begin{cases} <0 & \text{if } s<\frac{w_m\phi-\psi}{(p_s+w_m)\phi} \\ =0 & \text{if } s=\frac{w_m\phi-\psi}{(p_s+w_m)\phi} \\ >0 & \text{if } s>\frac{w_m\phi-\psi}{(p_s+w_m)\phi}. \end{cases}$$

If no marketization of childcare is possible ($\bar{s}=0$), then all women would have to choose $s=0$ and fertility is therefore monotonically decreasing in women's wages and women's labor supply. If $\bar{s}$ were exactly at the threshold level of $\frac{w_m\phi-\psi}{(p_s+w_m)\phi}$, all women with wages $w_f < p_s$ would choose $s=0$ and therefore fertility is first decreasing in wages. Women with wages $w_f \geq p_s$, in contrast, would demand market based childcare s at exactly this threshold level and therefore the fertility-wage relationship would turn flat. Hence, a rise in marketization possibilities, represented by an increase in $\bar{s}$, would gradually flatten the relationship between women's labor supply and fertility until fertility becomes independent of labor supply among high-wage women. If $\bar{s}$ rises all the way to $\bar{s}=1$ (full marketization is possible), Eq. (7) implies a U-shaped relationship between fertility and female wages. At the lower end of the wage distribution, a higher female wage increases the opportunity cost of raising a child and therefore leads to a lower fertility rate. At the upper end of the distribution, a higher female wage has no impact on the marginal cost of having an additional child, and only induces a positive income effect that leads to more instead of fewer children. As a result, when childcare can be purchased on the market, female labor force participation and high fertility rates can go hand in hand.

In reality, there are limits to marketization—high-wage parents continue to spend a considerable amount of time on childcare. That said, marketization has likely played a role in weakening the historical relationship between women's labor supply and fertility. The same mechanism also contributes to the weakening of the fertility-income relationship. When childcare can be marketized, the cost of raising children can be converted from opportunity costs into pure monetary costs. Consequently, richer couples will be able to have more children as they have more resources available to purchase childcare.

The importance of the marketization of childcare in the weakening relationship between fertility and income and education has been emphasized by Ahn and Mira (2002), Hazan and Zoabi (2015), and Bar et al. (2018). Hazan et al. (2021a) focus on the role of marketization in the decline in childlessness among women with advanced degrees. Furtado and Hock (2010) and Furtado (2016) provide causal evidence of the importance of the market price of childcare in shaping the joint family-work decision. They start from the observation that the inflow of low-skilled immigrants into the United States depressed the prices of nontraded services, amongst them housekeeping and childcare (see also Cortes, 2008). This change should be particularly important for women with a college degree, as (given their high wages) they are especially likely to marketize childcare. Indeed, these scholars find that high-skilled women in US cities with a greater low-skilled labor inflow face a blunted tradeoff between working and having children and respond to increased low-skilled migration with higher fertility rates.

The marketization of childcare is only one element in a more general trend towards declining home work hours and the marketization of formerly home-produced goods. Another aspect is technological progress within the household. The introduction and diffusion of home appliances in the twentieth century lowered the time cost of producing household services such as cooking, cleaning, and washing. This freed up time especially for women, which facilitated the transition towards higher female labor force participation (Greenwood et al., 2005b) as well as increased leisure consumption (Aguiar and Hurst, 2007). Greenwood et al. (2023) provide a more general overview of the trends in market and household technology and show that a model that incorporates these technological trends can help account for changes in fertility, women's employment, education, and marriage over the twentieth century. Beyond changing household technologies, the rise of the service economy has also facilitated the marketization of home production. Goods and services like meals, care, and cleaning can now be purchased on the market. Freeman and Schettkat (2014) shows that varying degrees of marketization of home production contribute to differences in women's employment between the United States and Europe. Ngai and Petrongolo (2017) and Buera et al. (2019) more generally investigate how the rising service economy has influenced the economy as a whole.

4.3 Careers and the timing of fertility

In the classic models of fertility based on women's opportunity cost of time, women's wages are taken as given, and there is a simple tradeoff between working more and having more children. Such a setting captures a world where most women work in jobs with limited possibilities of career advancement and low returns to experience. While this may be a workable approximation of women's labor market opportunities in earlier times, it no longer is today. A new generation of economic models of fertility aims to capture more elaborate interactions between women's fertility decisions and work careers. Such models provide additional insight into why the old regularities describing fertility choice have, over time, weakened or even reversed.

One key implication of models that account for career decisions is that the timing of births takes center stage. The opportunity cost of having a child when young not only comprises lost wages at this stage, but also lower human capital accumulation through missed career opportunities. If returns to experience and education are high, women may prefer to postpone childbirth to later ages and invest in a career instead. This means that children will be born precisely in those years when the returns to education materialize and wages are high. Delaying births moreover means a higher risk of infertility. Both factors imply that postponing childbirth may lead to fewer births overall.

We illustrate this tradeoff in a simple model.[20] A woman lives for two periods and makes decisions on fertility and career planning. In the first period, she can invest a fraction e of time into her career. As a reward, her human capital in the second period will be $h(e) = \kappa e^{\gamma}$. In addition to career planning, she has to choose whether or not to have children. In order to focus on the timing of fertility, we abstract from the question of how many children to have, and only consider whether to have any and when to have them. The woman can decide to have children early in life, in which case $n_1 = 1$ and $n_2 = 0$. She can also have children later in life, in which case $n_1 = 0$ and $n_2 = 1$. However, the older the potential mother, the less likely that she will still be fecund. Hence, when planning to have children late, she will only actually be able to have children with a certain probability $0 < \pi < 1$. We abstract from nonlabor income and savings. As in our baseline model of women's opportunity cost of time, children induce time costs of ϕ. The budget constraints in the two periods are:

$$c_1 = w_f [1 - n_1\phi - e] \quad \text{and} \quad c_{2,n_2} = w_f \kappa e^{\gamma} [1 - n_2\phi] .$$

[20] The model is based on Caucutt et al. (2002), who provide a more elaborate analysis of these mechanisms, which also includes the decision to marry.

The woman maximizes expected utility given by:

$$\log(c_1) + (1 - \pi n_2)\log(c_{2,0}) + \pi n_2 \log(c_{2,1}) + \nu n_1 + \pi \nu n_2.$$

We impose that the woman can have at most one child; hence if $n_1 = 1$ we have $n_2 = 0$ and vice versa. Note that the utility derived from children is linear in this model, which is without loss of generality given that fertility n_1, n_2 is either zero or one. Mothers enjoy their children in the same way regardless of whether they are born earlier or later in life. The choice of when to have children derives from the career-fertility tradeoff, rather than hard-wired preferences.

Given a fertility decision n_1, n_2, the optimal career investment is given by:

$$e = \frac{\gamma}{1+\gamma}\left[1 - n_1\phi\right]. \tag{8}$$

This result demonstrates the tradeoff between early fertility and career planning. Having children at a younger age conflicts with the career planning of the mother. Interpreting jobs with higher human capital in the second period as distinct occupations from those with lower human capital, this model captures the tradeoff highlighted by Adda et al. (2017), who disentangle the different aspects of the career costs of children in a structural model.[21]

We can now look at the utility levels that arise from different fertility choices:

1. No children ($n_1 = n_2 = 0$):

$$u_{00} = \log\left(\frac{w_f}{1+\gamma}\right) + \log\left(\kappa w_f \left[\frac{\gamma}{1+\gamma}\right]^{\gamma}\right). \tag{9}$$

2. Children early ($n_1 = 1, n_2 = 0$):

$$u_{10} = u_{00} + (1+\gamma)\log(1-\phi) + \nu. \tag{10}$$

3. Children late ($n_1 = 0, n_2 = 1$):

$$u_{01} = u_{00} + \pi\left[\log(1-\phi) + \nu\right]. \tag{11}$$

[21] To make our model even more explicit, we could assume there are two types of jobs. One job offers a flat earnings path, i.e. $\kappa = 1$ and $\gamma = 0$, while the other job has an increasing earning path that is a function of education investments. In addition to the higher required human capital investments early in life, career jobs often also come with long (daily or weekly) time requirements. These are sometimes called nonlinear occupations, as earnings do not linearly increase in hours. The importance of this aspect, together with the rising return to experience, has been emphasized in the literature seeking to understand female labor supply, such as Goldin (2014), Erosa et al. (2022), and Jang and Yum (2022). The mechanism is clearly related to children and fertility choices.

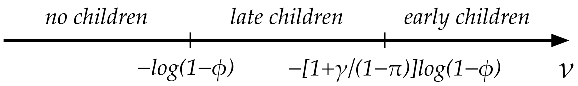

FIGURE 18 Child preferences and career decisions.

By comparing the different utility levels, we see that it is better to have children early rather than late when:

$$\underbrace{(1-\pi)[\nu+\log(1-\phi)]}_{\text{expected costs of infecundity}} > \underbrace{-\gamma\log(1-\phi)}_{\text{career cost of early children}} . \tag{12}$$

Whether a woman chooses to have any children at all depends on a simple cost-benefit comparison. She will decide to have children when the utility ν of having a child satisfies:

$$\begin{cases} \nu > -(1+\gamma)\log(1-\phi) & \text{for early births,} \\ \nu > -\log(1-\phi) & \text{for late births.} \end{cases}$$

Since the last inequality is less strict than the first one, it will be satisfied first as child preferences ν increase. Hence, a woman with low child preferences will opt for no children, a woman with somewhat higher levels will choose to have children later in life, and a woman with a very high ν will choose to have children earlier on. This is illustrated in Fig. 18.

Returning to the interpretation of different job types or occupations, women with high fertility preferences will select into jobs with flatter career paths in order to forego the risk of infecundity, allowing them to have more children, as in Adda et al. (2017).

As the thresholds in Fig. 18 show, fertility preferences ν are not the only determinant of fertility choices. Another important factor is the return to investing in a career γ. Olivetti (2006) shows that women's returns to experience have increased over time both relative to men and in absolute terms, raising their desire to have careers. Increases in γ enlarge the region of later child births in our model, such that more women will wait to have children. This raises the average age at birth, a fact that is mirrored in the data. Fig. 19 depicts average age at first birth since the 1980s in nine countries.[22] Across the board, a sizeable increase has occurred. The most dramatic trend can be seen in Spain, where average age at first birth rose from 25 in 1980 to 31 by 2019. Increases in other countries have been more moderate, though changes in the timing of births are a universal phenomenon. Moreover, not only is women's fertility decreasing at younger ages, but it is also increasing at older ages, as in our model. In

[22] See Fig. A6 in the Appendix for the time series of average age at birth in the same countries. Average age at birth displays a U-shape over time, since it includes all births. When fertility rates were high, births at later ages were also common.

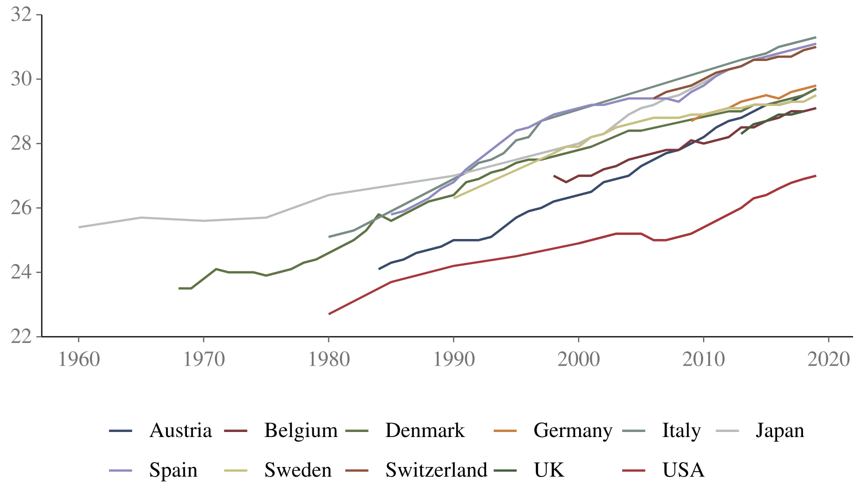

FIGURE 19 Average age at first birth, selected countries.

Notes: We plot the evolution of women's average age at first birth over time and across a selection of OECD countries. The data comes from OECD (2022), Family Database, "Fertility indicators - SF2.3 Age of mothers at childbirth and age-specific fertility," https://www.oecd.org/els/family/database.htm (accessed on 8 February 2022).

the United States, for example, birth rates among women ages 35–39 have more than doubled since 1980 (Buckles et al., 2019), even as overall fertility has been declining.

Both fertility preferences ν and investment returns γ may differ across women in the cross-section. If so, women with lower preferences for children and those with higher returns to experience will opt for later births. In an empirical investigation in the United States, Caucutt et al. (2002) find support for this implication. They first document the average fertility behavior of women in three successive cohorts, born in 1938–1947, 1948–1957, and 1958–1967, observing that the age of mothers at first birth has increased by about 2 years, from 22.5 to 24.3 years. In addition, the fraction of women who remained childless until the age of 27 rose from 23 to 44 percent. Along with these aggregate trends, the authors document substantial heterogeneity across the wage distribution of women. While the average age of mothers at first birth is 23 in the lowest wage quintile, it is almost 27 in the highest quintile. In addition, the fraction of childless women at age 27 more than doubles from the lowest to the highest wage group. Since wages are measured as the average wage between the ages of 30 and 40, part of the wage differences likely arise from women choosing different education and career options, which in turn also influences the timing of their children.

How do models of careers and the timing of births speak to the changing relationships between income, women's education, and fertility? The model reproduces the classic negative relationships between income/education and fertility: women who choose to invest in a career have both higher incomes and fewer children. The slope of this relationship depends on the model parameters π (infertility risk) and γ (returns to experience). If infertility risk π declines, the gap in average fertility between women in career positions and others closes, which flattens the income-fertility relationship. We examine this aspect in detail in the next section.

The relationship between returns to experience γ and the slope of the income-fertility relationship depends on how many women are originally in each regime. If γ is initially so low that no women choose careers and all have kids early, the income-fertility slope is flat over the observed range, and a rise in γ inducing some women to choose careers would steepen this slope. Conversely, if initially only some women choose careers, and γ rises so much that most or all women do so, the empirical income-fertility relationship would flatten. Hence, career concerns may have contributed to the flattening of the income-fertility and education-fertility relationships if they have become more important across the entire population. Indeed, it is no longer true that only college-educated women aiming for a career as, for example, doctors or lawyers choose to delay motherhood. Rather, educational investments and returns to experience now also matter for many noncollege occupations such as medical technician, beauty technician, or dental hygienist.[23] Further to this, many more women now obtain a college education. Rising education levels and returns to experience mean that delayed fertility has become a mass phenomenon, as evidenced by the considerable increase in average age at first birth in high-income economies. These factors have thereby contributed to flattening the relationships between income/education and fertility.

The models discussed in this section build on the literature on female labor supply and fertility in life-cycle models; key contributions include Moffitt (1984), Francesconi (2002), Keane and Wolpin (2010), and Eckstein et al. (2019).[24] While fertility decisions play an important role in these papers, their primary focus is on labor market outcomes, returns to experience, and understanding the gender wage gap. Life-cycle models of fertility and labor supply also provide the starting point for a number of studies on the career-family conflict as a determinant of fertility rates, which we turn to in Section 5.

4.4 Birth control and infertility treatments

Our model of the timing of births relies on the assumption that delaying fertility is actually feasible, which depends on the availability of effective birth control. The biggest historical advance in contraceptive technology was the introduction of the birth control pill in the 1960s (Bailey, 2010). Although this occurred more than half a century ago, the diffusion of knowledge about and use of effective birth control has taken time. Goldin and Katz (2002) argue that improved access to birth control for

[23] For a reflection on this trend in the media see "Why American Women Everywhere are Delaying Motherhood," New York Times, June 16, 2021.

[24] An early version of a life-cycle model of fertility has already been described in a previous handbook chapter by Hotz et al. (1997).

single women in the 1970s greatly increased women's incentive to invest in a career and thereby contributed to delayed marriage and childbearing. Consistent with this view, Bailey et al. (2012) find that women who had access to the pill at younger ages had substantially higher wages by age 50. Liberalized access to abortion starting in the 1970s accelerated these trends (Myers, 2017).

Given that more educated women are more likely to choose occupations that reward career investments, improved contraceptive technology contributed to the negative education-fertility relationship in the earlier data. The slope of this relationship is amplified if knowledge and use of effective birth control varies with education. Indeed, Guzzo (2017b) shows that unintended or mistimed births are much more common among women with up to a high school education and are rare among women with more than a college education. The recent overall decline in unintended births in the United States (Buckles et al., 2019) is therefore likely to contribute to a flattening of the relationships between income/education and fertility.

In the model, the gap in fertility between women who choose to delay fertility and those who don't is determined by the infecundity risk $1 - \pi$. Better health has increased π in recent decades, such that delaying child birth to later ages has become an option for many women. Infecundity risk has also been diminished by recent advances in assisted reproductive technology (ART), which facilitates combining early career investment with having children later in life.[25] Fig. 20 shows how the fraction of births that involves some use of ART has increased in six countries over time. In Denmark, for example, in 2015 more than six percent of all births were conceived with some degree of medical help. Spain too has seen a substantial rise in ART use. Meanwhile, Gershoni and Low (2021) show empirically that the adoption of in-vitro fertilization (IVF) in the 1990s in Israel substantially increased age at first birth.

Sommer (2016) and de la Croix and Pommeret (2021) use quantitative models to assess the potential impact of ART on fertility rates. Sommer (2016) studies a life-cycle model of labor productivity and infertility risk, arguing that the increase in earnings risk in the late twentieth century has led to a substantial postponement of fertility. With infertility risk, however, the delay in child birth also causes a decline in overall fertility. Introducing universal access to IVF technology can undo about a third of the fertility decline triggered by rising income uncertainty. The limited impact of IVF technology on overall fertility is due to several reasons. First, its success rate is still relatively low for women older than 40, when they are planning higher order births. Second, the very availability of IVF treatments causes women to delay their entire fertility planning further into later periods characterized by lower IVF success, thereby rendering the technology less effective. de la Croix and Pommeret (2021) propose a related model, and find that while providing free ART would not affect the age at first birth much, it would lower the childlessness rate.

Even if the impact on overall fertility is limited, the spread of ART (an increase in the late fecundity probability π in the model) reduces the gap in fertility between

[25] Many employers, among them major tech firms such as Apple and Facebook, have started to offer fertility benefits such as egg-freezing to female employees.

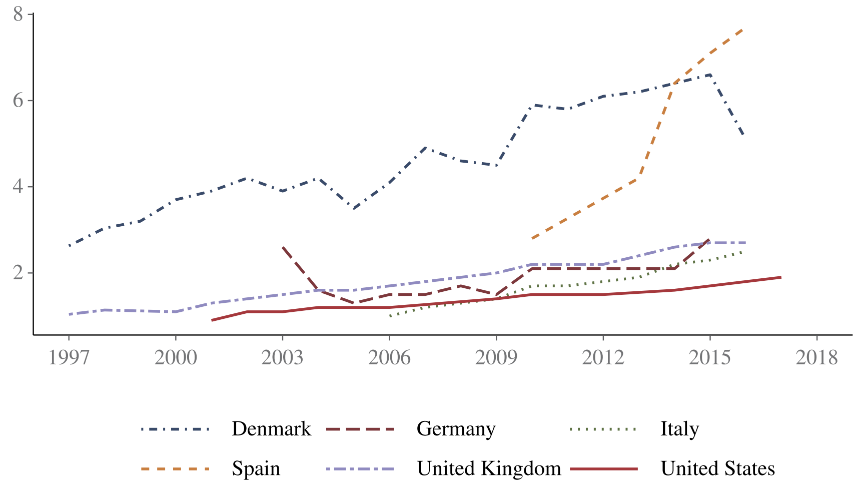

FIGURE 20 ART-infants per national births.

Notes: ART stands for assisted reproductive technology. Data comes from the European Society of Human Reproduction and Embryology (ESHRE) and the Assisted Reproductive Technology Surveillance Report for the United States.

women who have children early and those who have them late. As women who delay fertility tend to have higher education and higher wages, wider use of ART contributes to flattening the cross-sectional relationships between income/education and fertility.[26] What is more, to the extent that π can be influenced through higher spending on ART, even conditional on the timing of a birth, such technology will likely be used more frequently by higher educated and better-paid women. In line with this prediction, Groes et al. (2017) find a steep education gradient in IVF success in administrative data from Denmark. This differential success in using ART further flattens the education-fertility relationship.

5 A new big idea: the ease of combining career and family as a determinant of fertility

The mechanisms outlined in the previous section all provide reasons for why the traditional forces of the quantity-quality tradeoff and the negative impact of women's opportunity cost of time on fertility have weakened. But the evidence laid out in Section 3 shows not just a weakening of existing channels, but an outright reversal of the cross-country relationship between women's labor force participation and fertil-

[26] Indeed, de la Croix and Pommeret (2021) find in their quantitative model that free ART reduces childlessness most among highly educated women.

ity. How can we explain that today, in countries in which more women work, fertility rates are also higher?

The explanations for this reversal that have been proposed in recent years are united by a common theme, namely a central role for the compatibility of women's plans for their careers and their family goals. Underlying this reasoning is the fact that, in most high-income countries, a trend towards near-universal participation of women in the labor force for at least a substantial part of their lives has largely been completed. That is, the earlier pattern of women leaving the labor force upon marriage and never returning, which was still common in the mid-twentieth century, is now an exception. Instead, the aspiration of most women is to work for much of their lives, ideally in a fulfilling career, and to also have a family.[27] This, of course, has been both an ambition and a reality for most men for many decades; hence, we can interpret this shift as a convergence in women's and men's overall life plans after a long period of sharply divided gender roles.

Whereas this shift in women's plans and aspirations is shared across all high-income countries, there continues to be much variation in just how achievable meeting both career and family goals is for women. Where local institutions, policies, social norms, or economic conditions make it difficult to do both, more women will be forced to either step back from the labor force (at least temporarily), to delay their family plans, or to have smaller families than they otherwise would have liked. In the aggregate, the result is both a lower female labor force participation rate and a lower fertility rate in such countries. If, in contrast, combining a career with having a family is relatively easy to do, more women will both work and have multiple children.

The theme of career and family compatibility has been prominent in the sociological literature on fertility for some time; see, for example, Rindfuss and Brewster (1996) for an early discussion. In economics, Ahn and Mira (2002) and Feyrer et al. (2008) were among the first to point out the changing relationship between women's labor supply and fertility and to conjecture that factors influencing this compatibility could be a driving force. More recently, Goldin (2021) emphasizes the impact of the career-family tension for cohorts of American women. Research that incorporates some of these factors into formal models of fertility choice has only recently become more widespread. These models do not repudiate earlier research on fertility and continue to build on the ideas highlighted in previous sections. In fact, some of the new ideas can be framed within the models already discussed, though they focus on previously neglected sources of variation across countries or groups of women within a country. In other cases, the new research extends earlier work by including new mechanisms useful for understanding both cross-country and cross-sectional fertility patterns in recent data.

In what follows, we describe a number of specific mechanisms that fit into this general theme and relate them to the evidence on the changing relationship between

[27] The transition from career and motherhood as an either-or-decision to a sequential, and now simultaneous choice, is discussed for the case of American women in Goldin (2021).

women's labor force participation and fertility. Our discussion centers around four factors that facilitate combining a career with a family: family policy, cooperative fathers, favorable social norms, and flexible labor markets.

5.1 Family policies

Above, we highlighted the role of the marketization of childcare in flattening the relationship between women's labor force participation and fertility. An alternative to marketization is the public provision of subsidized or free childcare. Public childcare lowers the cost of having children and can thereby raise fertility. It also frees up mothers' time and hence may contribute to higher female labor supply. If there is variation in the extent of public childcare provision across countries, a positive relationship between women's labor supply and fertility can arise. Early models establishing this point include Del Boca (2002) and Apps and Rees (2004).

To illustrate the role of public childcare in accounting for the new facts concerning fertility in high-income countries, we return to the model of fertility and women's labor supply in Section 4.2. There, we focused on the role of the marketization of childcare; here we examine how outcomes change if the government provides, free of charge, a share $s \in (0, 1)$ of the total childcare cost to all households. Public childcare is financed via general tax revenue; we do not model taxes explicitly, but can interpret the wages w_f and w_m as representing after-tax wages. After introducing public childcare and abstracting from marketization, the optimization problem (5) of a couple reads:

$$\max_{c,n} \ \log(c) + \delta \log(n) \quad \text{s.t.} \quad c + \psi n = w_m + w_f\big[1 - (1-s)n\phi\big], \tag{13}$$

where s now is a policy parameter. As before, ψ represents the goods cost and ϕ the time cost of raising children, and we impose that the time cost is provided either by mothers or by public childcare. The optimal fertility choice is:

$$n = \frac{\delta}{1+\delta} \cdot \frac{w_m + w_f}{\psi + (1-s)w_f\phi}. \tag{14}$$

Women's labor supply l_f is given by:

$$l_f \equiv 1 - (1-s)n\phi = 1 - \frac{\delta}{1+\delta} \cdot \frac{(w_m + w_f)(1-s)\phi}{\psi + (1-s)w_f\phi}. \tag{15}$$

Fertility and women's labor supply are both increasing in the provision of public childcare s. Specifically, we have:

$$\frac{\partial n}{\partial s} = \frac{\delta}{1+\delta} \cdot \frac{(w_m + w_f)w_f\phi}{(\psi + (1-s)w_f\phi)^2} > 0,$$
$$\frac{\partial l_f}{\partial s} = \frac{\delta}{1+\delta} \cdot \frac{(w_m + w_f)\psi\phi}{\big(\psi + (1-s)w_f\phi\big)^2} > 0.$$

An increase in s lowers the opportunity cost of having children, so that the income and substitution effects induced by the rise in s both push fertility higher. Women's labor supply also increases because of a positive income effect on consumption. Put differently, the increase in public childcare frees up women's time, and they use this additional time in part to have more children and in part to work and consume more. While the effect on women's labor supply depends on the strength of the income effect and hence on the functional form for preferences, the case we consider is the one which aligns with the evidence discussed below. The impact of a change in s would generally also depend on how this additional spending is financed. In practice, general tax revenue rather than taxes specifically on parents with children is used to finance childcare spending, which limits the importance of this channel for determining fertility and labor supply.

The availability of public childcare also affects the within-country relationship between mothers' labor market opportunities and fertility. We have:

$$\frac{\partial n}{\partial w_f} = \frac{\delta}{1+\delta} \cdot \frac{\psi - (1-s) w_m \phi}{\left[\psi + (1-s) w_f \phi\right]^2}.$$

Assuming (as in Section 4.2) that goods costs of children are small relative to time costs, $\psi < w_m \phi$, the relationship between fertility and women's wages is negative if no public childcare is provided, $s = 0$, but flattens and ultimately turns positive as s is increased. Given that education is reflected in higher wages, this also implies that in countries with a high level of public childcare provision, the cross-sectional relationship between female education and fertility will be positive.

The public-childcare mechanism is supported by the observation that across-high income countries, there are now positive correlations between public childcare provision and both fertility and women's labor supply. Specifically, Fig. 21, which is based on Olivetti and Petrongolo (2017), shows that both the total fertility rate and women's employment-to-population ratio are positively related to government spending on early childhood education programs, which generally also serve as free or subsidized childcare. Olivetti and Petrongolo (2017) also confirm a positive relationship between fertility and public spending on childcare and early education using cross-country panel regressions with country and year fixed effects.

There is a sizeable recent literature that assesses the relationship of public childcare provision and fertility in greater detail, both empirically and with the aid of quantitative models.[28] For example, D'Albis et al. (2017) stress the importance of access to childcare for the decision to have a second child. Both in a model and in data from EU countries, they show that when childcare coverage is low, there is a U-shaped relationship between a women's potential wage and the probability of having

[28] Olivetti and Petrongolo (2017) provide an excellent survey of this literature. There is also a large body of work analyzing the role of public childcare for female labor supply in models with exogenous fertility. See for example Connelly (1992) and Ribar (1995) for early work on this topic and Attanasio et al. (2008) for a more recent contribution.

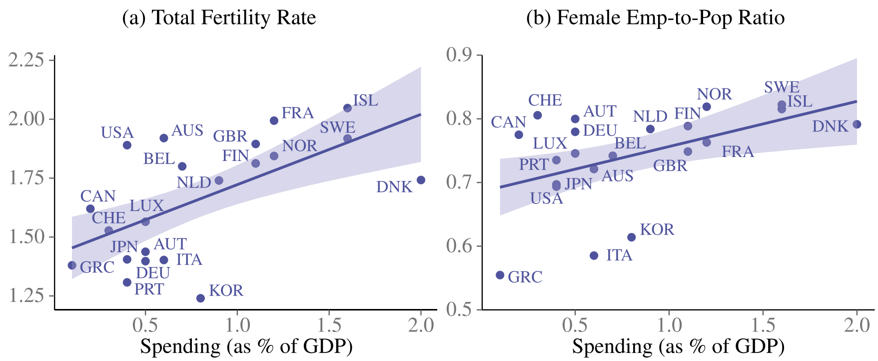

FIGURE 21 Fertility and the female employment-to-population ratio by early childhood education spending.

Notes: Data comes from Olivetti and Petrongolo (2017)'s replication files for Table 2 and Figure 2 of their paper. We plot early childhood and education spending as a percentage of GDP against the total fertility rate and the female employment-to-population ratio for women aged 25-54. We also include a linear regression of education spending as a percentage of GDP on the total fertility rate and the female employment-to-population ratio, respectively, and show 90% confidence intervals.

a second child. In countries with easy and cheap access to childcare, the relationship is increasing instead. Bick (2016) analyzes the role that childcare plays in determining maternal employment and fertility in a quantitative model calibrated to Germany. In his counterfactual analysis, he finds that extending subsidized care would increase maternal labor supply but not lead to an increase in fertility. Bauernschuster et al. (2015) study the expansion of public childcare in Germany in the mid-2000s. They find that the reform increased both the fertility rate and women's employment. Rindfuss et al. (2010) use longitudinal data from Norway to investigate the relationship between the availability of high-quality affordable childcare and completed fertility. Their empirical results suggest that providing 60 percent of preschool children with childcare slots would raise completed fertility by about 0.5 to 0.7 children per woman. Beyond impacts on fertility and labor supply, a related question is how public childcare affects child development. Brilli et al. (2016) investigate the impact of public childcare availability on maternal employment and child development in Italy. According to their estimates, an increased availability of childcare raises both the likelihood of a mother taking up work and the language test scores of children.[29]

[29] While a number of studies show that high-quality public childcare can promote child development, a notable counterexample is the introduction of universal childcare in Quebec, which appears to have had an negative impact on children's noncognitive skills (see for example Baker et al., 2019). Bernal (2008) obtains a similar result in a structural model calibrated to the United States. See Blau and Currie (2006) and Björklund and Salvanes (2011) for two useful surveys.

Another policy that could play a role similar to that of public childcare provision concerns parental leave benefits.[30] If mothers are able to take a temporary leave from their jobs to care for their children while also receiving financial support, they may be both more likely to continue working and to choose to have more children. Assessing the impact of parental leave policies is complicated by the fact that the design of such interventions involves many dimensions, including the duration of the leave, whether it is paid, and if so, what fraction of the salary is being replaced. Policies also vary by whether leave is available only to mothers or to both parents, and whether there are incentives to induce fathers to take at least some parental leave. It is thus not surprising that empirical findings on the impact of parental leave policies on fertility are mixed.

In an early study of nine European countries over the 1969–1993 period, Ruhm (1998) finds that parental leave policies were associated with higher women's employment. He does not, however, examine fertility outcomes. In more recent cross-country data, Olivetti and Petrongolo (2017) observe a nonmonotone impact of parental leave policies on employment: female employment rises with job-protected parental leave (paid or unpaid) up to 50 weeks, but declines thereafter. In addition, they see only a small effect of parental leave policies on fertility. Other papers have exploited policy reform in a given country to determine the causal impact of parental leave policies. Lalive and Zweimüller (2009), for example, estimate the effect of a parental leave reform in Austria on fertility and return to work. They find that mothers who gave birth to their first child immediately after the reform have more second children than do prereform mothers. The effect is large, with an additional 12 children born per 100 women. Raute (2018) meanwhile studies a reform in Germany and shows that earnings-related paid leave is linked to higher fertility, especially among the well-educated. Dahl et al. (2016), in contrast, find little impact of paid maternity leave on either female labor force participation or fertility in their analysis of a policy reform in Norway. Erosa et al. (2010) is the only paper to date that studies parental leave policies in a quantitative model. In their analysis, more generous leave policies lead to higher fertility rates and a shift in bargaining power towards women, though such interventions have only a small net impact on women's employment.

While the policies discussed thus far are explicitly targeted at families with children, a couple's child-bearing decisions may also depend on other fiscal policies. Take, for example, the tax treatment of households, in particular whether a married couple files taxes jointly or individually.[31] Apps and Rees (2004) point out the importance of taxation for the relationship between fertility and female labor supply. Several studies have quantified the effect of taxation schemes on married women's labor supply, among them Guner et al. (2012), Bick and Fuchs-Schündeln (2017), Holter et al. (2019), Borella et al. (2021), and Hannusch (2021). All of these studies

[30] Olivetti and Petrongolo (2017) provide a survey of the facts and empirical literature on parental leave policies.

[31] The study of joint versus individual taxation in the presence of household production dates back to a discussion between Piggott and Whalley (1996), Apps and Rees (1999), and Gottfried and Richter (1999).

find that the joint taxation of couples inhibits female labor supply, especially that of mothers. Fehr and Ujhelyiova (2013) investigate the joint effects of tax and family policies on women's labor supply and fertility in an overlapping generations model. Moving from joint to individual taxation increases female labor force participation, but reduces fertility, as the total tax burden on married couples increases. If, however, the additional fiscal revenue from such a tax reform is used to expand public childcare availability, fertility also increases. Eckstein et al. (2019) come to similar conclusions in a rich life-cycle model matched to US data: without adjustments to other policies, moving from joint to individual taxation would substantially increase women's labor supply but also reduce fertility.

Overall, the evidence suggests that policies in the areas of childcare provision, parental leave, and taxation can have a substantial impact on women's labor supply and fertility. Variation in such policies across countries can help account for the reversed cross-country relationship between women's labor force participation and fertility, as well as changing within-country relationships between income/education and fertility. Among the policies considered, those related to the public provision of childcare are likely the most important force behind the new empirical relationships characterizing fertility choice.

In this reversal, the causality between women's labor supply and public policy changes likely runs both ways. If public policy supports working women and mothers, more women will work. Conversely, if women's labor force participation is already high, the political support for policy changes that aim to support working women will be greater. For instance, countries where initially few mothers were working, such as Spain and Italy, had less reason to provide public daycare compared to countries with higher initial participation such as Sweden and Denmark. Over time, female labor force participation has increased in all countries, but in places with less support from public policy, this increase has been slower, and with more women opting for smaller families.

5.2 Bargaining over fertility

The models considered thus far envision a single decision maker who chooses fertility, consumption, and labor supply so as to maximize a single objective function. We can think of this decision maker as representing either a woman who decides on fertility on her own, or a couple who share the same objectives and agree on fertility decisions. In reality, fertility is often a joint decision taken by the mother and the father, and discord can arise. Indeed, as we document in Section 3.4, disagreement between partners over whether to have a (or another) child is widespread in high-income countries, and is predictive of low fertility rates. These observations raise the question whether disagreement over fertility and the need to bargain account in part for the new facts concerning fertility choice.

Disagreement over fertility can be observed at any stage of development. Nevertheless, bargaining frictions are likely to have particularly large effects on fertility rates in high-income countries. The reason is that agreement on having another baby matters more where women's and men's preferences are equally important in the fertility decision-making process. In this regard, Doepke and Kindermann (2019) show that in high-income countries, the mapping from partners' fertility preferences to outcomes is well described by a veto model: children are likely to be born only if both partners desire to have a baby, implying that a "veto" from one of the potential parents is sufficient to block the decision. More generally, bargaining over fertility is likely to be important if women and men have similar power in relationships, which is more probable in high-income economies with more gender-equal laws and higher participation of women in the labor market. In contrast, fertility decisions in patriarchal societies may be better approximated by a dictator model of fertility choice, where only the man's preferences matter.[32]

In the broader family economics literature, the need to take bargaining and outside options into account has been recognized for some time. Prominent examples include the explicit bargaining models of marriage proposed by Manser and Brown (1980), McElroy and Horney (1981), and Lundberg and Pollak (1993), and the collective model proposed by Chiappori (1988, 1992) and Apps and Rees (1988).[33] In these static models, the two spouses have different preferences, and the bargaining process determines the influence that each spouse has in the decision-making process. Doepke and Kindermann (2019) argue that to account for the empirical observation that each spouse has veto power over fertility decisions, an explicitly dynamic framework is needed in which the ability to commit takes center stage.[34] Commitment matters because having children implies caring for them over many years, and how this childcare is shared between the two parents has implications for their future career opportunities. Fertility decision-making therefore depends on whether the parents can commit to a specific allocation of future childcare.

We illustrate the role of commitment and bargaining over fertility with a simplified version of the model in Doepke and Kindermann (2019). There are two partners f and m deciding whether to have a single child n, i.e., $n \in \{0, 1\}$. The preferences of partner $g \in \{f, m\}$ over individual consumption c_g and fertility n are given by the linear utility function:

$$u_g(c_g, n) = c_g + \nu_g n \quad \text{with } g \in \{f, m\}.$$

Partners can have a different preference ν_g for having a child.

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32 Examples of such models include Tertilt (2005) and Doepke and Tertilt (2009).

33 These models rely on cooperation between the partners and efficient outcomes are achieved. An alternative modeling approach is to use noncooperative game theory and assume that partners play best responses, as outlined, for example, in Lundberg and Pollak (1994). Gobbi (2018) and Doepke and Tertilt (2019) show that such models can account for empirical patterns related to childcare and expenditure on children. Doepke and Kindermann (2017) survey different models of the household decision-making process with a special focus on fertility decisions.

34 Issues related to the role of commitment in explaining intra-family resource allocations are studied in Mazzocco (2007), Rasul (2008), Voena (2015), Lise and Yamada (2019), and Foerster (2020).

Partners earn wages w_g and raise their child if they have one. Raising children requires a time investment ϕ. We assume that the cost of raising children is split between partners according to shares χ_f and χ_m with $\chi_f + \chi_m = 1$. In this simplified setup, we interpret the χ_g as fixed parameters, and we do not take a stand on how these shares are determined. In reality, they might be shaped by nature (e.g., breastfeeding provided by mothers), legislation, or social norms, an issue we discuss in more detail in the next section. The cost shares might also be endogenous and depend on factors such as a couple's childcare arrangement or the availability of informal childcare.[35] Given the fixed cost shares assumed here, we can define the unit cost of time investment in children as $\hat{w} = \chi_f w_f + \chi_m w_m$.

The household's budget constraint is:

$$\underbrace{c_f + \chi_f w_f \phi n}_{\text{expenditure partner } f} + \underbrace{c_m + \chi_m w_m \phi n}_{\text{expenditure partner } m} = (1+\alpha)\big(w_m + w_f\big). \tag{16}$$

Here α denotes the surplus of cooperation within the family, e.g., economies of scale in consumption.

The timing of the model is such that the decision to have a child $n \in \{0, 1\}$ comes first, and then childcare expenses are incurred later on, at the same time that consumption c_f, c_m takes place. This timing reflects the fact that having a baby translates into many years of childcare.

Let us first consider a situation where both partners can fully commit to any consumption plans they make prior to the arrival of a child. They can accordingly decide jointly about fertility and consumption before the potential child is born. The couple bargains cooperatively subject to an outside option where the couple coexists uncooperatively, no child is born, and each partner consumes only her or his wage. The utility derived from this outside option, where no agreement is reached, is:

$$\bar{u}_g(0) = w_g.$$

The partners bargain over how to split the potential surplus of child birth and cooperation. We denote by $u_g(n)$ the utility that each partner derives in the bargaining solution. Assuming equal bargaining power, the joint optimization problem solved by the bargaining process is:

$$\max_{c_m, c_f, n} \; [u_m(n) - \bar{u}_m(0)]^{0.5} \left[u_f(n) - \bar{u}_f(0)\right]^{0.5}$$

[35] Doepke and Kindermann (2019) investigate the case of partial commitment where a decision on childcare arrangements affects cost shares.

subject to (16). Taking the fertility choice n as given for now, the solution to this problem is:

$$u_g(n) = \underbrace{w_g}_{\text{outside option}} + \underbrace{\frac{\alpha}{2}\left(w_m + w_f\right)}_{\text{cooperation surplus}} + \underbrace{\frac{1}{2}\left(\nu_m + \nu_f - \hat{w}\phi n\right)}_{\text{fertility surplus}}. \tag{17}$$

Neither of the partners can have a child without the cooperation of the other; hence a child will only be born if both partners derive a higher utility from $n = 1$ as opposed to $n = 0$. In the above solution, n enters only in the shared surplus, which is the same for both partners. The two partners are in favor of having children whenever

$$\nu_m + \nu_f \geq \hat{w}\phi, \tag{18}$$

that is, when the total utility the partners derive from having a child is greater than the total cost. In this setting with commitment, there is no possibility of the partners disagreeing over the fertility decision, because having a child affects both partners' utility in the same way.

To see the role that the assumption of commitment plays in generating agreement, consider the case of a couple who would derive different enjoyment from having a child. For example, he may very much want to have a child, $\nu_m > \hat{w}\phi$, while she does not care about children per se, $\nu_f = 0$. The condition (18) is fulfilled here, such that under commitment the couple will decide to have the child, $n = 1$. Moreover, (17) implies that under the bargaining solution each partner gains the same amount from having the child, even though only he derives a direct utility benefit. This is possible because she can be compensated by getting a higher level of consumption c_f compared to her outside option. In other words, at the time the decision is taken, he promises to transfer consumption to her later on, and if commitment is possible this promise will convince her to agree to having a child.

The same argument applies to the situation in which both partners have the same preference for children $\nu_f = \nu_m = \nu$, but the distribution of childcare costs is unbalanced. Consider, for instance, the case where $2\nu > \hat{w}\phi$ but $\nu > \chi_m w_m \phi$ and $\nu < \chi_f w_f \phi$. Again, condition (18) is fulfilled under commitment, such that the couple will have a child. On an individual basis, however, the childcare cost borne by the mother exceeds the individual utility she derives from the presence of the child. Again, she will be compensated for this higher cost by a promise of a later transfer, giving her a higher level of consumption c_f.

The issue with such promises is that they may not be credible. In either case, what stops him from reneging on the promise and consuming all of his wage income, in addition to enjoying having a child? Let us next consider what happens if the couple is unable to commit to a future consumption plan.

Assume that the couple first decides on whether or not to have a child and, after a baby has either been born or not, they renegotiate their consumption plans. When deciding on whether to have a child, the partners will anticipate that the birth of a child might alter both of their outside options. Consequently, the outside option now depends on the prior fertility decision of the couple. If no child is born, the outside options are the same as in the case of commitment. In contrast, if the couple decides to have a baby, who bears the cost of raising the child determines the outside options in the noncooperation stage. Given the cost shares χ_g, the outside options are:

$$\bar{u}_g(n) = w_g - \chi_g w_g \phi n + n\nu_g.$$

Note that upon noncooperation both partners still enjoy their children. Hence, we interpret the outside option as a state of noncooperation within a continuing partnership, similar to Lundberg and Pollak (1993). In this state, couples still live together and enjoy their children, but bargaining breaks down and the surplus from cooperation disappears.

The distribution of utility that arises from ex-post bargaining now reads:

$$u_g(n) = \underbrace{w_g - \chi_g w_g \phi n + n\nu_g}_{\text{outside option}} + \underbrace{\frac{\alpha}{2}\left(w_m + w_f\right)}_{\text{cooperation surplus}}.$$

Unlike in Eq. (17), the partners do not share the potential surplus from having a child, because the decision to have a child is sunk when ex-post bargaining takes place. The only surplus that is bargained over arises from increasing returns to scale from joint consumption. A partner now would opt for a child only if the utility derived from the child exceeds his or her own cost share:

$$\nu_g \geq \chi_g w_g \phi.$$

The intention to have children now differs across partners. In particular, the desire to have children varies both with the individual fertility preference, ν_g, and the share χ_g each partner has to take in raising them if bargaining breaks down. In the case of full commitment, the distribution of childcare burdens did not play a role in the fertility decision, as the couple could always undo a lopsided distribution of the costs or benefits of children through monetary transfers. The lack of commitment hinders partners from doing so, and hence both the individual preference and the cost partly determine each partner's fertility intention. As a result, disagreement between partners on whether to have children may arise.

Doepke and Kindermann (2019) estimate a dynamic model of fertility that combines the bargaining framework outlined above with features of the life-cycle models of family and career choices described in Section 4.3. The model allows for partial commitment and a choice between parent-provided or purchased childcare. They argue that differences in cost shares of the childcare burden can explain cross-country differences in agreement between partners on whether or not to have a (or another) child, as displayed in Fig. 16. This is true for both the division of childcare costs during usual labor hours as measured by the female labor force participation rate, as well as the sharing of childcare burdens during usual leisure time. A lopsided distribution of childcare burdens to the disadvantage of women creates more disagreement within couples and therefore lowers the total fertility rate of a country.

In their model, disagreement is especially likely to arise if mothers have to considerably reduce their labor supply to care for children, which lowers their outside option in bargaining. This feature explains how bargaining frictions can contribute to the reversal in the relationship between women's labor supply and fertility. Consider three scenarios relative to the relationship between motherhood and labor supply. In the first scenario, women's labor force participation is low independently of having children. In this case, having a child has a limited effect on outside options, and bargaining frictions do not matter much for fertility decisions. In the second scenario, women want to work but having children requires them to temporarily step back from their careers, implying a deterioration of their outside option. It is this scenario where bargaining frictions significantly matter and disagreement over fertility is likely to arise. In the third and final scenario, women work and pursue careers even while raising children, which happens when women's wages are high and market-based childcare is available and widely used. Here, the impact of bargaining frictions is again limited because having children does not imply a worsening of the mother's bargaining position.

We can interpret the era when fertility was declining in women's labor force participation as a time when most countries were characterized by one of the first two scenarios. There is little conflict over childbearing in countries with low female labor force participation, and more conflict, and hence lower fertility, in those where women want to work, but have to compromise if they have many children. Today, in contrast, most countries are in either the second or the third scenario. In countries where having children and careers are more compatible, women don't have to give up as much to have children, which lowers disagreement over fertility and results in higher fertility rates.

In explaining the reversal of the female labor force participation-fertility relationship, the bargaining channel is closely linked to the previously discussed issues of careers, public provision of childcare, and the marketization of childcare. The new angle here is that these forces matter not just because they determine the overall cost of children, but also because they affect how the cost of children is shared between mothers and fathers, which is a key driver of fertility decisions in a bargaining model of fertility.

Doepke and Kindermann (2019) use their model to compare the effects of different policies aimed at increasing fertility rates. They find the introduction or expansion of publicly subsidized childcare to be the most cost-effective method in raising the total fertility of a country, as it does the most to rebalance the costs of raising children between mothers and fathers. Tax credits and parental leave policies are less effective in creating a higher number of births, in line with the evidence presented in Section 5.1.

Empirical studies using recent data from industrialized countries support the view that agreement is a powerful predictor of subsequent fertility choices; see, for example, Testa et al. (2014) for Italy, Thomson (1997) for the United States, Thomson and Hoem (1998) for Sweden, and Hener (2014) for Germany. In studies using US data for earlier time periods characterized by lower female labor force participation (between the 1950s and 1970s), disagreement has a smaller effect on fertility (Beckman, 1984; Thomson et al., 1990). This finding is consistent with the notion that bargaining frictions play a minor role in determining fertility when few married women work, regardless of their number of children.

The importance of fathers' involvement in childcare has also been emphasized in the sociological literature. Brodmann et al. (2007), investigate why Denmark has a substantially higher fertility rate than Spain. They find that the reconciliation of career and motherhood is easier in Denmark in part due to greater father-provided childcare. Other contributions that highlight the link between fertility and a high female childcare burden include Feyrer et al. (2008), De Laat and Sevilla-Sanz (2006, 2011), and Fanelli and Profeta (2021). Certainly, both mothers and fathers matter in bargaining over fertility, and it is possible that shifting more of the childcare burden to fathers could reduce men's desire to have children. To this regard, Farré and González (2019) show that the introduction of two weeks of paternity leave in Spain led to delays in subsequent births and a reduced likelihood of higher-order births for older parents. They identify two channels for this effect. First, fathers' involvement in childcare may facilitate a faster return for women to the labor market, thereby raising the opportunity cost of having another child. Second, the cost associated with raising children might become more salient to fathers, leading to a reduction in their individual desire to have another child. González and Zoabi (2021) meanwhile examine the effects of paternity leave with a formal bargaining model. The model predicts that bargaining frictions are especially prominent among couples with an intermediate within-couple wage gap. Using Spanish data, they find that paternity leave leads intermediate wage-gap couples to specialize less, have fewer children, and divorce more.

Bargaining frictions may also be an important determinant of fertility rates in low-income countries, where there are often large gaps between the desired fertility of husbands and wives (see references in Section 3.4). Rasul (2008) develops a model of fertility with lack of commitment, and argues that household data from the Malaysian Family Life Survey supports this model of an alternative setup without bargaining frictions. Ashraf et al. (2014) examine the fertility decisions of women in Zambia who were given access to concealable contraceptives either in a meeting that also included their husbands, or in a private meeting enabling them to control fertility without their husband's knowledge. They find that women that were given access without their husbands present were much less likely to give birth, suggesting disagreement over fertility decisions.[36] Ashraf et al. (2020b) argue that disagreement can partly stem from information asymmetries. In an intervention that randomly varies the exposure to information about maternal health, these scholars observe that wives of treated men experience a sizeable reduction in the probability of being pregnant. This finding points to the importance of information asymmetries

[36] Similarly, in a study exploiting variation across US states in expansions of women's economic rights before 1920, Hazan et al. (2021b) find that granting women greater economic rights, and thus increased household bargaining power, decreased fertility, especially in areas with high maternal mortality risk.

in determining fertility decisions, an issue that has thus far seen only limited formal treatment in the family economics literature.

5.3 Social norms

The bargaining model in the previous section and the evidence presented in Section 3.4 suggest that the division of childcare tasks between mothers and fathers has a substantial impact on fertility rates. We have already highlighted marketization and the public provision of childcare as factors that determine the amount of childcare provided by mothers. An additional determinant of childcare arrangements that varies widely across countries consists of attitudes or social norms regarding women's and men's roles in raising children and providing financially for their families.[37]

Both low female labor force participation and low fertility can result from social norms that create an implicit penalty for mothers who want to combine family and career. Kleven et al. (2019) provide suggestive evidence for the importance of social norms for women's career choices. Fig. 22 displays a scatter plot of a social norm concerning women's labor market participation and the motherhood penalty (or child penalty) in earnings across countries. The social norm is measured by the fraction of people who agree with the statement that mothers of children of school age or younger should stay home to care for them. The motherhood penalty is an empirical measure of the reduction in women's earnings relative to men after giving birth to a child. It reflects both lower labor market participation and lower earnings growth conditional on continued employment, and can be interpreted as a summary measure of women's career costs of having children in a given country. The figure shows that countries with stronger social norms against mothers' employment also have larger motherhood penalties. Given that lower labor market participation tends to go hand in hand with more time spent on childcare, this correlation is consistent with the notion that social norms are a key determinant of childcare arrangements.

To illustrate how social norms on the role of mothers can affect fertility decisions, we build on the model of Section 4.2 where childcare can either be provided by the mother or purchased in the market.[38] As in Section 4.3, we simplify the analysis by considering a discrete fertility choice where couples either have a baby or not, $n \in \{0, 1\}$. As before, s is the share of childcare purchased in the market. The social norm is represented as a level s^* of purchased childcare that represents "what people typically do," i.e., a reflection of society's expectations of women's proper role in childcare. The couple suffers a utility loss when deviating from this social norm.

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[37] While not the focus of this section, social norms about the intensity of parenting may also be relevant for fertility decisions; see Section 8.1.

[38] Our model considers social norms in favor of maternal over external childcare. Alternatively, social norms may influence the division of childcare between mothers and fathers. See De Laat and Sevilla-Sanz (2006) for a formal model.

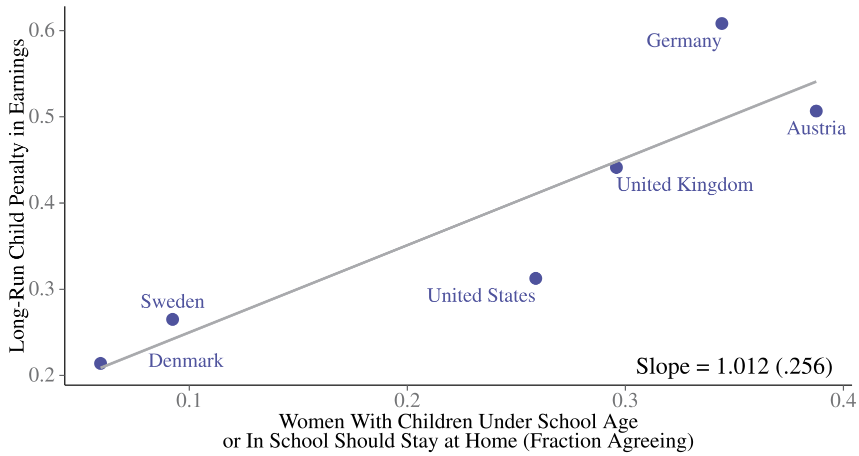

FIGURE 22 Elicited gender norms and child penalties.

Source: Kleven et al. (2019), Figure 4.

Specifically, the couple's preferences are represented by the utility function:

$$u(c, n, s) = c + \nu n - n \cdot \frac{\tau\,(s - s^*)^2}{2}.$$

Here c is consumption, $n \in \{0, 1\}$ is fertility, and s is purchased childcare. The utility derived from a child ν varies across couples; hence, as in the model of Section 4.3, the fertility rate depends on how many couples care sufficiently about children to decide to have one. The couple maximizes their utility subject to the budget constraint:

$$c + s p_s \phi n = w_m + w_f\,[1 - (1 - s)n\phi]\,.$$

As before, ϕ represents the time cost of children and p_s is the price of market-based childcare. For simplicity and as in Section 5.1, we assume that nonmarket childcare is entirely provided by the mother.

If the couple decides to have a child, $n = 1$, the optimal choice of market-provided childcare s is:

$$s = \begin{cases} 0 & \text{if } w_f < p_s - \frac{\tau s^*}{\phi}, \\ s^* + \frac{[w_f - p_s]\phi}{\tau} & \text{if } p_s - \frac{\tau s^*}{\phi} \leq w_f \leq p_s + \frac{\tau(1-s^*)}{\phi}, \text{ and} \\ 1 & \text{if } w_f \geq p_s + \frac{\tau(1-s^*)}{\phi}. \end{cases}$$

The household's utility as a function of the fertility decision can be written as:

$$u(n) = \begin{cases} w_m + w_f - w_f n\phi + n\nu - nI_{low}(w_f) & \text{if } w_f < p_s \\ w_m + w_f - p_s n\phi + n\nu - nI_{high}(w_f) & \text{if } w_f \geq p_s. \end{cases}$$

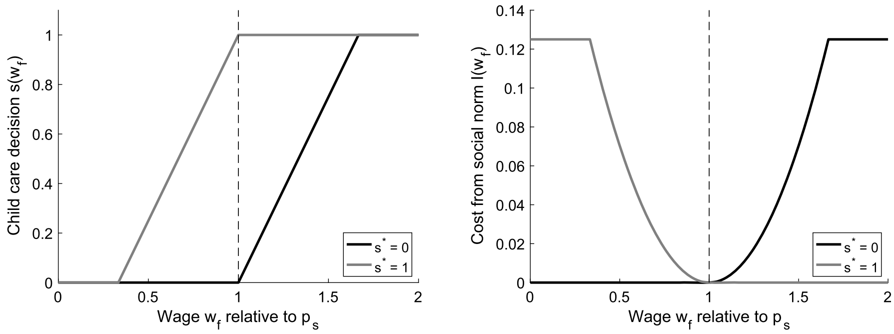

FIGURE 23 Social norms and childcare decisions.

Notes: We set $p_s = 1.5$, $\phi = 0.25$, and $\tau = 0.25$ for this graph.

Here $I_{low}(w_f)$ and $I_{high}(w_f)$ denote the utility cost induced by the social norm on low-wage and high-wage couples. In the absence of a social norm, as in Section 4.2 the couple would choose to purchase the maximum possible amount of childcare from the market if the mother's wage w_f is greater than the price of childcare, and otherwise the mother would provide all childcare. In either case, the utility cost would be zero. With the social norm, a cost arises because couples at least partly follow the social norm and therefore deviate from what would otherwise be their optimal strategy. The cost induced by the social norm is:

$$I_{low}(w_f) = \begin{cases} \frac{[s^* - s][p_s - w_f]}{2}\phi & \text{if } w_f \geq p_s - \frac{\tau s^*}{\phi} \text{ and} \\ \frac{\tau (s^*)^2}{2} & \text{otherwise} \end{cases}$$

for low-wage couples and:

$$I_{high}(w_f) = \begin{cases} \frac{[1 - s^* - (1-s)][w_f - p_s]}{2}\phi & \text{if } w_f < p_s + \frac{\tau (1 - s^*)}{\phi} \text{ and} \\ \frac{\tau (1 - s^*)^2}{2} & \text{otherwise} \end{cases}$$

for high-wage couples.

Fig. 23 illustrates the impact of a social norm on the couple's choices. The left panel depicts the childcare decisions made by a couple under two forms of the social norm s^* as a function of $\frac{w_f}{p_s}$. The black line shows the case of a traditional social norm $s^* = 0$, whereby mothers are to care for their children at home and not use market childcare.[39] The gray line instead shows the opposite extreme, where the social norm is that everybody should purchase childcare on the market, $s^* = 1$. The dashed

[39] See Bettio and Villa (1998) for an earlier version of this idea, where Mediterranean family norms are shown to inhibit the outsourcing of female services.

vertical line indicates the switching point for the optimal childcare decision of a couple if social norms were absent. Without social norms, all couples with a wage w_f smaller than the childcare cost, $w_f < p_s$, would choose $s = 0$, whereas high-wage couples with $w_f \geq p_s$ would purchase all childcare on the market, $s = 1$.

A social norm alters behavior around the switching point $w_f = p_s$. Consider first the traditional social norm, $s^* = 0$. In this case, all couples with a low wage comply with the social norm by choosing $s = 0$ and do not incur an additional utility cost. As the wage cost of caring for children at home increases above p_s, the couple engages in a tradeoff between choosing what would minimize the cost of childcare (i.e., $s = 1$) and complying with the social norm. The higher the couple's wage, the more costly it is to comply with the social norm and, hence, the more childcare the couple will purchase on the market. As a result, the utility cost from the social norm is greater for high-wage couples, and having children becomes less attractive for them.

In the opposite case of a social norm that favors mothers' employment and the use of market childcare, $s^* = 1$, it is high wage couples with $w_f > p_s$ who implement their preferred choice of $s = 1$ without incurring a cost from the social norm. Meanwhile, low-wage couples who otherwise would like to raise their children at home do incur a utility cost and their benefit of having children is reduced.

When the traditional social norm ($s^* = 0$) is prevalent in most countries, we would observe a negative relationship between women's labor supply and fertility. This is true both within and across countries, for example as a result of cross-country variation in women's potential wages w_f. The negative cross-country relationship would revert when traditional norms are eroded in a subset of countries, such that social norms do not influence fertility and labor supply decisions in either direction. Among otherwise identical countries, those without traditional social norms would have both higher female labor supply and higher fertility. If, in a given country, a norm in favor of market-based childcare develops ($s^* = 1$), the within-country relationship between potential wages and fertility will flatten or even revert.

Social norms also matter when it comes to the efficacy of pro-natal policies. Consider a country that has a traditional social norm of $s^* = 0$. If this country wants to lower the cost of childcare by providing additional public childcare facilities, the positive effect on fertility will be diminished by the additional costs induced by the social norm. Consequently, the social norm will dampen the reaction of total fertility to the pro-natal policy. Conversely, population control policies can lower fertility not just through their direct impact on the costs of children, but also by shifting social norms. De Silva and Tenreyro (2020) develop a quantitative model of fertility choice that allows for endogenously evolving social norms, and argue that policies aimed at changing family-size norms have contributed to accelerating fertility decline in middle- and low-income countries in recent decades.

A number of recent papers suggest that social norms may play a particularly important role in explaining low fertility rates in high-income countries in Asia. In 2019, South Korea was the only country in the world with a fertility rate below one child per woman, at 0.92. Hong Kong and Singapore also have extraordinarily low fertility rates at just above 1.0, and Japan is not far behind at 1.37.[40] Focusing on the case of South Korea, Anderson and Kohler (2013) argue that a high social status conferred by success in education contributes to low fertility rates. They argue that the so-called "education fever" predominant in South Korea has once again made the quantity-quality tradeoff salient, leading many families to have only one child. Kim et al. (2021) formalize this idea in a quantitative model with status externalities and study the policy implications. Beyond a high direct cost of having children in terms of education investment, the low fertility rates in high-income Asian countries may also be due to the persistence of traditional norms regarding gender roles and new family forms (Gauthier, 2015). Myong et al. (2021) explore this idea in a quantitative model.

Fernández and Fogli (2006, 2009) point to the role of culture in the labor force participation and fertility decisions of US women. They proxy culture by past female labor force participation and total fertility rates in a woman's country of ancestry and show that these variables have predictive power for her labor supply and fertility decisions today. Boelmann et al. (2021) use cultural differences among East and West German women to study the impact of norms on women's labor market decisions after giving birth to a child. They document a stark difference in the persistence of culturally based norms. Looking specifically at women who migrated between East and West Germany after reunification, they show that East German women who are living in the West still return to work much faster after the arrival of a child compared to their West German counterparts. The labor market behavior of West German women who migrated to the East, however, is almost indistinguishable from their East German peers.

A key issue for understanding the changing relationship between women's labor supply and fertility is the evolution of social norms over time. Changing norms have been examined in different fields of research, including linguistics (Amato et al., 2018), evolutionary biology (Ehrlich and Levin, 2005), psychology (Miller and Prentice, 2016), and sociology (Cislaghi et al., 2019). In economics, the evolution of norms has been studied using tools from Bayesian learning and evolutionary game theory; see, for example, Bicchieri et al. (2009) and Bicchieri and Sontuoso (2020). A learning mechanism is emphasized as a source of changing norms in the context of the increasing female labor force participation rate by Fogli and Veldkamp (2011) and Fernández (2013).[41]

Learning could contribute to the reversal in the female labor supply-fertility relationship observed in the cross-country data. Countries where women's labor force participation rises first would also see the fastest erosion of social norms that discourage mothers from working. This would reinforce the trend towards higher partic-

[40] Data from World Bank Development Indicators.

[41] Danzer et al. (2021) study the evolution of gender role attitudes towards maternal employment during the Covid-19 epidemic in Germany. They find that fathers' support for maternal employment dropped substantially in 2021 after a series of daycare and school closures. Women's attitudes, however, were not affected. Boring and Moroni (2021) document similar findings for the lockdown measures in France.

ipation while also encouraging fertility. Fernández et al. (2004) investigate a similar mechanism. They propose a model in which sons of working mothers are more likely to be in a marriage with a working wife, either because they developed a preference for a working spouse or because they have a higher productivity at home. De Laat and Sevilla-Sanz (2006) provide a formal model of the reversal in the relationship between fertility and female labor force participation based on social norms about paternal childcare. A key aspect of their model is a social externality: attitudes about a fathers' involvement in childcare are in part shaped by the behavior of other fathers. As female wages rise, men's contribution in the household rises, allowing the social externality to dominate. At sufficiently high wages, more egalitarian countries have both higher fertility and higher female labor force participation. At the same time, the social externality does not negate the negative correlation between women's labor supply and fertility within countries. Arpino et al. (2015) study the link between attitudes to women's employment and fertility empirically, and document a U-shaped relationship between more gender-equal norms and fertility. The positive effect of gender-equal attitudes at the higher end of this relationship is stronger if there is more agreement between women and men.

Beyond the specific issue of the compatibility of women's career and family goals, which is our focus here, there is an extensive literature on the role of social norms for fertility choice spanning economics, sociology, and demography. In economics, Leibenstein (1974) provides an early discussion of the idea that social norms and interactions are important determinants of fertility, and a formalization is provided by Crook (1978) and Easterlin et al. (1980). This work mostly looks at social norms on the optimal number of children. The role of societal interaction as a vehicle in spreading new norms and attitudes towards fertility during the demographic transition has been emphasized in the context of the Princeton European Fertility Project (Coale and Watkins, 1986), for the United States (Rindfuss et al., 1996), for other English-speaking countries (Preston, 1986), and for developing countries (Bongaarts and Watkins, 1996). Spolaore and Wacziarg (2022) use a data set on linguistic distances in Europe to demonstrate the spread of low fertility from France, the first major country to enter the demographic transition. They argue that both economic and cultural factors drive behavior; regions that were culturally close to France entered fertility decline earlier than those at the periphery. Palivos (2001), Bhattacharya and Chakraborty (2012), and Dzhumashev and Tursunalieva (2023) provide quantitative analyses of the role social norms play in shaping the fertility transition.

Other recent work exploring social influences on fertility choice includes Ciliberto et al. (2016), who estimate the importance of peer effects in family planning among coworkers, friends, or siblings. Using data from Denmark, the authors find strong workplace peer effects, which shift fertility rates by around five percentage points. In the developing-country context, Munshi and Myaux (2006) provide a social-norms based explanation for two widely recognized phenomena regarding the fertility transition: a slow response to external interventions and wide variation in the response to the same intervention across countries and population groups. They apply their concept to fertility interventions in rural Bangladesh, where norms are typically organized at the religious-group level. Mishra and Parasnis (2017) meanwhile estimate the impact of religious and neighborhood peers on women's fertility preferences in India, and Iftikhar (2021) uses a quantitative model to investigate the extent to which social norms influence the quantity and quality of children in Pakistan. She shows that norms explain about 50 percent of the within-country variation in the number of children and 30 percent of the variation in education investment.

5.4 Labor market frictions

Another potential source of children-career incompatibility can arise from frictions in the labor market. When unemployment is high, temporary jobs common, and permanent jobs hard to obtain, even a temporary leave to start a family can have long-term repercussions for labor market prospects. Fertility rates may consequently be lower than in a setting where secure, long-term jobs are easy to find.

When pointing out the beginnings of the reversal of the cross-country relationship between women's labor force participation and fertility, Ahn and Mira (2002) already note that this coincided with the emergence of high unemployment rates in many high-income countries. They also show that the rise in unemployment was particularly sharp in countries that belong to the low-fertility group. Labor market frictions are most pronounced in parts of Southern Europe. Del Boca (2002) highlights inflexibilities in the labor market and the childcare system as important factors underlying low fertility in Italy. The Italian labor market is characterized by rigid working hours with few part-time opportunities. At the same time, the public childcare system offers hours that are largely incompatible with full-time work, and slots for the youngest children are severely rationed.

Da Rocha and Fuster (2006) focus on a different labor market friction, namely women's concerns over obtaining employment in countries with inflexible labor markets. The analysis looks specifically at Italy and Spain, two countries with high female unemployment and low fertility. In a quantitative labor search model, they show that women delay fertility if they are worried about not finding a job. Their theory highlights two mechanisms. First, upon childbirth women typically interrupt careers. When finding a job is difficult, this interruption becomes longer than desired, increasing the career cost of children. Second, children are expensive, and women with poorly paid temporary jobs may simply find children too costly.

Del Boca and Sauer (2009) analyze fertility and employment decisions in a structurally estimated model of married women in Spain, Italy, and France. They find that in addition to childcare policies, labor market flexibility is an important aspect underlying cross-country differences in labor force participation. That said, in their analysis, the impact of labor market conditions on fertility is small. Del Bono et al. (2012) and Del Bono et al. (2015) consider empirical evidence from Austria, and find that job displacement due to a firm closure reduces subsequent births. It is not, however, the unemployment itself that lowers fertility, but rather the displacement from a career-oriented job. Sommer (2016) and Santos and Weiss (2016) formalize the idea of marriage and children as consumption commitments. Both papers use quantitative models to show how increases in earnings risk lead to reductions in family size and delayed childbearing. This mechanism can account for a significant portion of demographic change in the United States from the 1970s to the 2000s, a period of sharply rising income uncertainty.

Another type of labor market friction relates to different sorts of job inflexibility. Many jobs come with long hour requirements, others have fixed schedules, and being present at work is often obliged by management even if not strictly necessary for the required task. Goldin (2014) sees the lack of work flexibility as central to the final chapter of the "grand gender convergence." Guner et al. (2020) explore the effect of job inflexibility on fertility in Spain in a quantitative model. They find that labor market reforms that would eliminate split-shift schedules would substantially increase completed fertility. Lopes (2020) studies the importance of job insecurity, in the form of fixed-term contracts, for fertility decisions in a quantitative model calibrated to Portugal. She finds that job insecurity reduces fertility at both the extensive and intensive margin, i.e., more women remain childless, and fewer women decide to have multiple children. The importance of job security is also emphasized in the empirical study of Adserà (2004), who finds that in OECD countries with high unemployment and insecure employment more women postpone fertility or remain childless.

All of the labor market frictions explored in this literature have become more pronounced in recent decades compared to the 1950s and 1960s, when most high-income countries were characterized by low unemployment and tight labor markets during the postwar economic boom. Hence, changing labor market frictions have plausibly contributed to the reverting relationship between women's employment and fertility observed in the cross-country data.

6 More new directions in modeling fertility choice

There are other recent developments in the economic modeling of fertility that go beyond the theme of combining families and careers. In discussing these new directions, we first highlight models with discrete fertility choice that account for the determinants of childlessness, and then turn to the growing incidence of nonmarital childbearing.

6.1 Childlessness and discrete fertility choice

Variation in fertility choice over time and space can occur on the extensive and the intensive margin. For example, fertility in a given country can decline because all women decide to have fewer children, or because a growing fraction of women decide to have no children at all. Demographers have long documented the importance of each margin by, for example, distinguishing marital fertility from total fertility in times where remaining unmarried usually also meant remaining childless. In contrast, baseline economic models of fertility typically abstract from both the extensive mar-

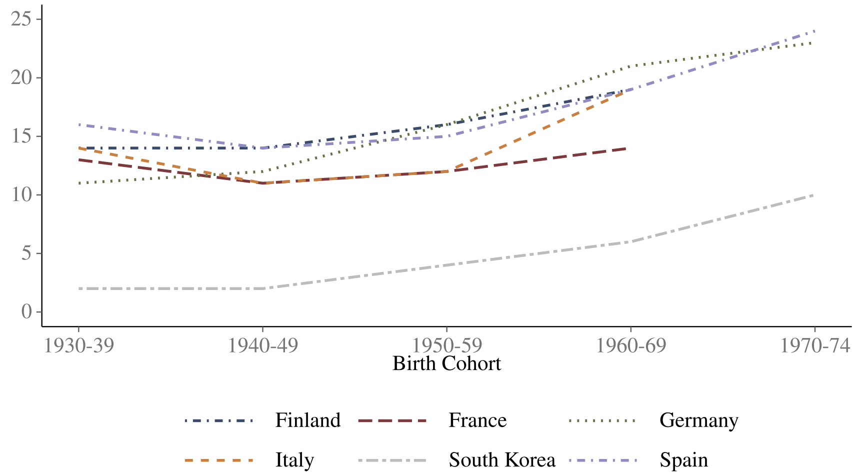

FIGURE 24 Cohort childlessness.

Notes: Data from the Cohort Fertility and Education (CFE) database. This database combines information from censuses and large-scale surveys and covers women and men ages 40 to 80 who have completed or almost completed their fertility. See Zeman et al. (2017) for further details.

gin and the discrete nature of childbirth, and focus on a representative family making a continuous fertility choice instead.[42]

When fertility levels are high and most women have children, representative-family models with continuous fertility choice can provide a good approximation of reality. However, when fertility rates are low, the discrete nature of children becomes more important. Since it is not possible to have half a child, some families may opt for none, even if in principle they do desire children. Indeed, childlessness has been increasing over time in many high-income countries. Fig. 24 shows the fraction of women without children for five birth cohorts in six countries. The figure starts with women born between 1930 and 1939 and ends with the cohort born between 1970 and 1974.[43] In the most recent birth cohorts in Germany and Spain, almost a quarter of all women remain childless. Childlessness is much lower in South Korea, though a pronounced increase over time is nonetheless evident.

Historically, childlessness was positively related to women's education. The most educated women were the least likely to marry and hence were also more likely to remain childless.[44] In some countries, this pattern has begun to change. Fig. 25

[42] Discrete fertility choice does appear in models of the impact of child mortality on fertility, such as Sah (1991), Wolpin (1997), Kalemli-Ozcan (2002), and Doepke (2005), but these studies do not attempt to match data on childlessness, and stochastic survival of children is the primary source of heterogeneity.
[43] The last cohort includes only five birth years, as some women born later may not yet have completed their fertility.
[44] See Torr (2011) for details on the changing relationship between education and marriage in the United States.

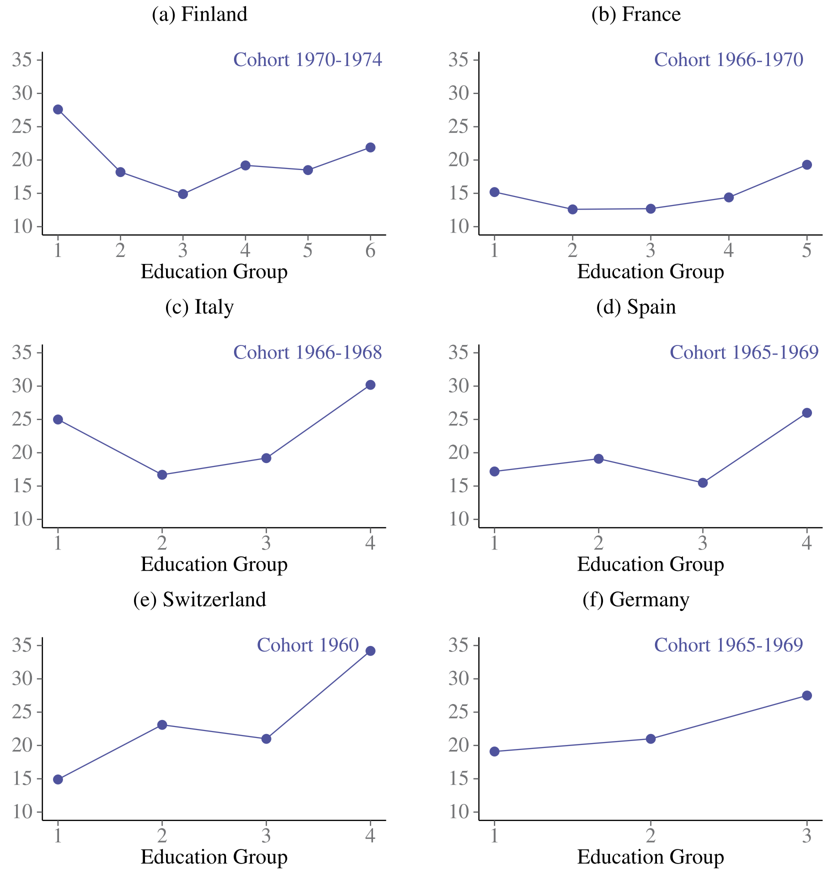

FIGURE 25 U-shape in cohort childlessness by education in Europe.

Notes: Data comes from the CFE database, which focuses on women ages 40 to 80. We plot the fraction of women who do not have children for every available education group. For each country, we use the most detailed education levels available coded according to the ISCED97. Refer to Zeman et al. (2017) for the definitions of these groups. For Finland, the six education groups are 1 - ISCED0-2A, 2 - ISCED3A, 3 - ISCED4B-A, 4 - ISCED5A, 5 - ISCED5B, and 6 - ISCED6. For France, the education groups are 1 - ISCED0, 2 - ISCED1-2A, 3 - ISCED3C-A, 4 - ISCED4B-5B, and 5 - ISCED5A-6. For Italy, Spain, and Switzerland, the four education groups are 1 - lowest compulsory education (ISCED 0, 1, and 2), 2 - secondary education (ISCED 3C), 3 - upper and postsecondary education (ISCED 3B, 3A, and 4), and 4 - tertiary or university education (ISCED 5 and 6). For Germany, secondary and upper and postsecondary education are collapsed into one group.

displays a U-shape in childlessness by education in Finland, France, Italy, and Spain for the most recent cohort for which data is available. Baudin et al. (2015) similarly document a U-shape for the United States. There exist, however, large cross-country

Table 1 The distribution of number of children across countries and time.

Country	Cohort	Fraction of Women with Number of Children				
		0	1	2	3	4+
Austria	1920-1929	17.1%	24.8%	26.1%	14.9%	17.2%
Austria	1960-1961	16.8%	23.3%	38.3%	15.3%	6.3%
	Δ	-0.3%	-1.5%	12.2%	0.4%	-10.9%
Finland	1930-1939	13.7%	16.6%	34.7%	20.8%	14.1%
Finland	1970-1975	20.3%	16.8%	35.4%	18.3%	9.2%
	Δ	6.5%	0.2%	0.7%	-2.5%	-4.9%
France	1930-1939	13.1%	17.1%	26.6%	19.3%	23.8%
France	1960-1969	13.6%	18.2%	38.9%	20.2%	9.2%
	Δ	0.5%	1.1%	12.3%	0.8%	-14.6%
Italy	1930-1939	14.0%	19.8%	33.1%	18.8%	14.2%
Italy	1960-1968	18.7%	24.5%	43.3%	10.6%	2.8%
	Δ	4.7%	4.7%	10.3%	-8.1%	-11.4%

Notes: Data comes from the Cohort Fertility and Education (CFE) Database, which focuses on women ages 40 to 80. We tabulate the fraction of women by number of children. The last category includes 4 or more children.

differences. In Switzerland and Germany, the shape has remained quite constant over time, where even the most recent cohorts see the least educated women having the lowest childlessness rate and the most educated the highest.

While demographers and sociologists have for some time now examined the causes of childlessness (e.g., Hakim, 2003), the economic literature on fertility has only recently recognized childlessness as a distinct phenomenon from low fertility. Three notable contributions include Gobbi (2013), Aaronson et al. (2014), and Baudin et al. (2015). Aaronson et al. empirically investigate the importance of childlessness among Southern Black women during the US fertility transition. Gobbi (2013) develops a model of endogenous fertility choice that distinguishes between voluntary and involuntary childlessness and incorporates a theory of intergenerational preference transmission. Individuals with a stronger child preference are more likely to have children and pass on their preferences, creating a force that counteracts a trend towards lower fertility. Baudin et al. (2015) distinguish three different types of childlessness in their model: natural sterility, social sterility (i.e., not having enough income to support a family), and opportunity-cost-driven childlessness (i.e., a high opportunity cost of time resulting from good labor market opportunities). The authors show that this theory can reproduce the U-shape in childlessness across the education distribution observed in the data, where childlessness among less-educated individuals is driven by social sterility and among the most-educated individuals by opportunity-cost-driven childlessness.

Modeling fertility as a discrete choice matters beyond childlessness, as the mechanisms that drive childlessness can also lead families to have one rather than two children, or stop at two instead of three, and so on. In high-income countries, a large majority of families chooses just one of four options, ranging from zero to three children. Few women today have four or more children. Table 1 summarizes the distribution of the number children in four countries: Austria, Finland, France, and Italy. For each country, data for the oldest and youngest cohorts of women available in the CFE database is displayed. The fraction having four or more children has declined in all countries, while the share of women who do not have any children has instead increased in all countries except Austria. At the same time, the portion of women who have two children has also risen everywhere. Given that the discreteness of fertility matters more when most families choose zero to three children rather than having large families, an increasing number of recent papers model fertility decisions as a discrete and sequential choice over a limited number of fertility options (e.g., Doepke and Kindermann, 2019, Daruich and Kozlowski, 2020, Kim et al., 2021). This approach is particularly important when endeavoring to understand the timing of births in life cycle models (e.g., Hotz and Miller, 1988, Caucutt et al., 2002, Sommer, 2016, Guner et al., 2020). Finally, allowing for discrete births will likely be an important dimension in models that aim to account for the extremely low fertility rates in Western Europe and parts of Asia today, where having just one child is becoming the most popular choice.

6.2 Nonmarital childbearing and cohabitation

Early research in family economics reflected a reality where fertility was closely linked to marriage. Since the 1960s, however, a rising fraction of births is accounted for by single parents and cohabiting couples, suggesting that models that solely consider marital fertility are no longer sufficient.[45] Fig. 26 displays the share of births outside marriage for nine countries. In 1960, these rates ranged from close to zero for Japan to about 15 percent in Austria. Nonmarital childbearing subsequently started to increase in most countries, albeit at different speeds. Today, the share of nonmarital births differs widely across countries, from more than 50 percent in some of the Scandinavian countries, 40 percent in the United States, about 30 percent in Switzerland, to still close to zero in Japan. Nonmarital childbearing is, more generally, low in East Asia (Raymo et al., 2015; Sassler and Lichter, 2020).

Nonmarital childbearing is a combination of two distinct phenomena: (i) childbearing in cohabiting unions and (ii) rising single parenthood. This section focuses on cohabitation, while the subsequent section discusses single parenthood and marital stability.

Though marriage rates have declined since the 1970s, couples continue to form unions at about the same rate as in previous decades. In the United States, over half of first unions formed in the early 1990s began with cohabitation (Bumpass and Lu, 2000), and the majority of nonmarital births today are to cohabiting rather than single women (Lundberg and Pollak, 2014; Lundberg et al., 2016). In many Western and Northern European countries, cohabitation has become a relevant alternative to marriage (Adamopoulou, 2010).

45 In demography, the trend towards childbearing in a wider range of living arrangements together with low fertility rates is sometimes referred to as the second demographic transition; see Lesthaeghe (2010).

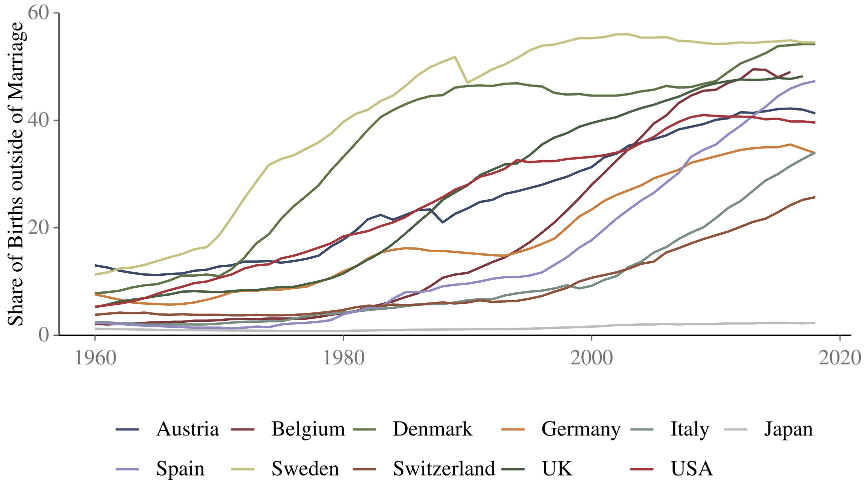

FIGURE 26 Nonmarital childbearing.

Notes: Data comes from the OECD Family Database, "Share of births outside of marriage (% of all births)," https://stats.oecd.org/Index.aspx?DataSetCode=FAMILY&_ga=2.159675577.501745241.1620823942-831612256.1620823942# (accessed on 08 February 2022).

Fig. 27 plots the living arrangements of households with young children in a number of countries. While the majority of these households consist of married couples raising their children together, cohabitation is increasingly common. In fact, in France, cohabitation has overtaken marriage as the most common living arrangement for raising children. Cohabitation is also more common than single parenthood in all countries except the United States, where 21 percent of households with small children consist of single mothers and almost four percent single fathers. The degree of informality of a cohabiting union varies across countries; while cohabitors in France can enter a registered partnership, in other countries no special regulations or protections apply to cohabitation.

Cohabitation interacts with fertility through at least two channels: the risk of breakup and the impact on parental investments. Cohabiting women are much more likely to experience a separation from their partner after childbirth compared to married women (Manning et al., 2004). This is especially true for cohabiting women in the United States (Liefbroer and Dourleijn, 2006). Not surprisingly, the fraction of cohabiting couples that have children is significantly lower compared to married couples (Gemici and Laufer, 2012). Moreover, births to cohabiting couples are more likely to be unintended and disagreed upon (Guzzo and Hayford, 2014), suggesting that the fertility decisions of cohabiting couples should be modeled differently than those of married couples. Cohabitation also correlates with parental investments. Adamopoulou et al. (2022) show that cohabiting couples in the United States invest less time and money in their children compared to married couples. Consistent with

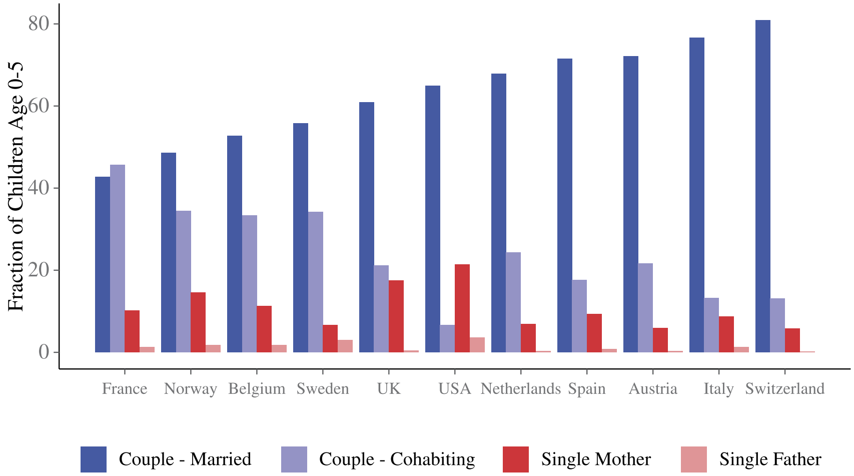

FIGURE 27 Living arrangements of young children.

Notes: We plot the fraction of households with children ages 0 to 5 by type of living arrangement: married couple, cohabiting couple, single mother, or single father. Data refers to 2016 or latest available and comes from the OECD Family Database, Indicator SF1.3.A: "Living arrangements of children by age," https://www.oecd.org/els/family/database.htm. Children living with married parents are defined as those living in the same household as a mother and a father who both report their marital status as "married" and identify each other as their spouse or partner. Children living with cohabiting parents are defined as those living in the same household as a mother and a father who do not both report their marital status as married and/or identify each other as their spouse or partner.

this fact, children of cohabiting couples have a 10 percentage point lower probability of completing college if the parents do not hold a college degree and a 40 percentage point lower college completion probability if the parents do have a college degree. Lundberg et al. (2016) argue that differential investments in children are not just a consequence but also a cause of marriage decisions. The increased commitment and relationship stability of marital unions facilitates investment in children. Since child quality and fertility decisions are linked, the choice to marry or cohabit also interacts with fertility choices.

The rising importance of cohabitation in many countries around the world has complicated the study of marriage, divorce, and fertility, and has challenged existing economic models of the family. Brien et al. (2006) and Adamopoulou (2010) provide early models of cohabitation. More recently, Lafortune and Low (2023), Blasutto and Kozlov (2021), Blasutto (2021), and Adamopoulou et al. (2022) develop structural models of the choice between cohabitation and marriage and the implications for child investments. Such models have yet, however, to be applied to the determination of fertility. The only exception we are aware of is Gemici and Laufer (2012), who study the choices to cohabit or marry and to have children jointly in a structurally estimated model. Since marriages are more stable and children make break-ups more costly, married couples choose to have children at higher rates than cohabiting couples. Greater exploration along these lines would be a fruitful direction for future research.

6.3 Single parenthood and divorce

Single parenthood has become more common over time, though trends differ widely across countries. For example, the fraction of children growing up with a single parent amounts to only 12 percent in Switzerland but to 27 percent in the United States.[46] Single parenthood is more common among less educated parents. Fig. 28 shows that in a number of countries, the share of children aged 0 to 17 living with a single mother is usually highest among mothers who do not have a high school degree. The educational gradient in single motherhood is particularly strong in Norway, Sweden, and the United Kingdom, where the difference in single motherhood between the lowest and highest education group is more than 20 percentage points. In contrast, we do not observe an educational gradient in Italy and the pattern in Switzerland is even slightly inverted.

A sizeable fraction of single parenthood in the United States is accounted for by teenage childbearing, in part explained by a lack of access to or information about birth control.[47] In other cases, single parenthood can be a deliberate choice. Some women purposely choose to have a child by themselves if they have not found a suitable partner and are approaching the end of their fertile years. This may happen through in-vitro-fertilization or through casual relationships that were not meant to last. The increase in cohabitation may also underlie single parenthood. A looser relationship with the father of a child may weaken his sense of responsibility and lead to the dissolution of the partnership upon birth.

Willis (1999) provides an early theoretical analysis of single parenthood. In his model, fathers face a choice between getting married to the mother, which allows for higher and more efficient investment in children, or to shirk on their responsibilities. Men are especially likely to shirk if they have the opportunity to father children with multiple single mothers. This depends, among other factors, on the gender ratio in the marriage market. Akerlof et al. (1996), in contrast, argue that the spread of reliable birth control and the legalization of abortion played a major role in the rise of single parenthood. Greenwood et al. (2019) further explore this idea in a model where people search for partners and choose between abstinence, a premarital sexual relationship, and marriage. Guner and Knowles (2009) develop a model of marriage, fertility, and child investment in order to compare targeted and universal welfare policies. They conclude that the high rate of single parenthood in the United States can be explained by welfare policies that target single parents. Keane and Wolpin (2010) and Eckstein et al. (2019) build life-cycle models of women's decisions on marriage,

46 Based on data from the OECD Family Database.

47 Lundberg and Plotnick (1995) provide an early analysis of adolescents' premarital childbearing, emphasizing both the role of welfare policy as well as access to contraception and abortion.

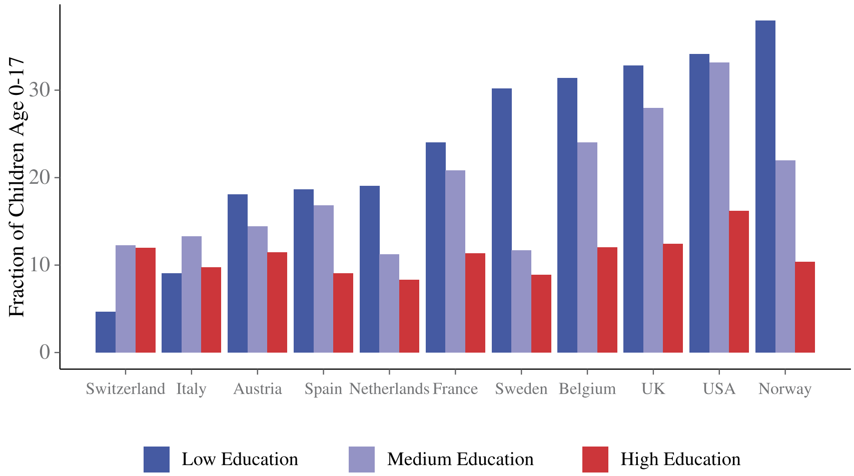

FIGURE 28 Fraction of children ages 0–17 living with single mothers by education.

Notes: We plot the fraction of children ages 0 to 17 living with single mothers of a given education level. Data refers to 2016 or latest available and comes from the OECD Family Database, Indicator SF1.3.C: "Living arrangements of children by mother's level of educational attainment." Educational categories are defined as follows: "Low Education" corresponds to a highest level of educational attainment at ISCED 2011 levels 0-2 (early-childhood education, primary, or lower secondary education); "Medium Education" reflects a highest level of educational attainment at ISCED 2011 levels 3-4 (upper secondary and postsecondary nontertiary education); and "High Education" is the highest level of educational attainment at ISCED 2011 levels 5-8 (short-cycle tertiary education, bachelor, master, doctoral degree or equivalent).

fertility, and labor supply that quantify the contributions of policy and labor market conditions to differences in the work and family decisions of women over time and across different racial and socio-economic groups.

An empirical literature studies the determinants of single motherhood. The impact of tax policies and welfare benefits on the incidence of single motherhood is contested, mainly because it remains unclear whether the incentives implied by welfare programs are large enough to account for the trends in single parenthood across countries. Whittington et al. (1990) argue that personal tax exemptions in the United States affect family birth decisions. Similarly, Moffitt (1997) concludes that welfare is likely to affect family structure. Blau et al. (2004) use US Census data and find no effect of welfare benefits on single motherhood for white or Black women.

A major demographic trend that relates to the rise in single parenthood concerns the increase in divorce rates in many countries. The link between divorce rates and fertility decisions is subtle, as this can be a two-way relationship. Lower fertility may decrease the cost of divorce, especially for the partner who receives custody, such that the number of children can be a predictor of a couple's likelihood to dissolve (Becker et al., 1977, Waite and Lillard, 1991). In turn, a higher threat of divorce might lead partners to have fewer children in the first place (Lillard and Waite, 1993). Furthermore, the cross-country relationship between fertility and divorce has not been stable over time: the correlation between the two was negative until the early 1990s, and has turned positive since then (Billari and Kohler, 2004). At the individual level, Bavel et al. (2012) show that having experienced divorce is generally associated with lower levels of children ever born.

The relationship between fertility and divorce is also shaped by the policy environment. Bellido and Marcén (2014) document that fertility declined with reforms towards more liberal divorce laws in a sample of European countries. Alesina and Giuliano (2006) find the same relationship for US states that introduced unilateral divorce law. They also argue that the shift in the legal environment led to a decrease in the relative number of children born outside of marriage: more liberal divorce laws pushed women with a high preference for children to marry, which in turn increased fertility in the first years of marriage. Aizer and McLanahan (2006) point to the importance of child support payments for fertility decisions, arguing that a stronger enforcement of child support payments led men to have fewer nonmarital births. Tannenbaum (2020) studies the effects of an expansion in child support payments on fertility behavior in a theoretical model. Higher child support payments reduce the likelihood of shot-gun marriage but also diminish abortion of unplanned pregnancies, as this provides single mothers with more resources.

Relatively little work uses quantitative models to assess fertility and marital stability. Greenwood et al. (2003) study the decisions to marry, have children, and possibly divorce, though their focus is predominantly on the distribution of income across families. Sheran (2007) estimates a discrete choice model with marriage, fertility, and education as endogenous choice variables. Brown and Flinn (2011) develop and estimate a model of marriage, fertility, and parenting to quantify the role of regulations regarding divorced parenting on child welfare. They find that divorce, fertility, children's test scores, and parents' welfare all increase with a move toward shared physical placement. Beyond these contributions, substantial gaps remain in this literature. For instance, models of single parenthood have thus far focused almost exclusively on single mothers, even though the share of single fathers has become nonnegligible in some countries, as reflected in Fig. 27.

7 Recent developments in the normative analysis of fertility

The close link between fertility choice and macroeconomic outcomes raises a host of policy questions. Should developing countries with high fertility rates invest in family planning and other policies to reduce fertility, in order to receive a "demographic dividend" of lower dependency ratios and faster growth in income per capita? Should low-fertility, high-income countries implement pro-fertility policies to push back against population aging and help support social insurance and pension systems? These are not just theoretical questions. Many countries have implemented a range of either pro- or antinatalist policies, ranging from child subsidies or penalties to various family-planning programs. Some policy interventions have placed considerable burdens on the population, such as the forced sterilizations in India in the 1970s or the at times draconian implementation of the one-child policy in China starting in the 1980s. Assessing the desirability of such policies and the tradeoffs involved represents an important challenge.

In principle, quantitative models of fertility choices are well-equipped to answer these questions. Models that incorporate different policy options can be calibrated or estimated to match empirical evidence for a specific country, and counterfactual policy simulations can be used to assess the effects of reforms. However, comparing the welfare implications of different scenarios is far from straightforward when fertility behavior is affected by policy. The allocations to be compared have different population levels. Even for a fixed population, there may be differences in terms of exactly who gets born, e.g., a tradeoff between children born to one group of parents versus another. Standard concepts from welfare economics do not apply in this case; for example, Pareto optimality is not defined if the allocations to be compared involve different sets of people, some of whom are alive only under one policy but not another.

In addition to the ethical issue of how to evaluate the welfare of people who may be born only under some scenarios, seemingly simple solutions to this issue often turn out to have unattractive properties. For example, one could aim to maximize per-capita welfare, a concept known as average utilitarianism. In settings with finite resources and decreasing returns to scale, it then often turns out to be optimal to have a minuscule population, with each of the few people alive consuming huge resources. It is difficult to recommend such outcomes as optimal without a convincing argument as to why the potential welfare of the many other people who could be born should be ignored. Conversely, the concept of total utilitarianism prescribes to maximize the sum of the utilities of everyone alive (Dasgupta, 1969). However, such criteria frequently imply the "repugnant conclusion" (Parfit, 1984): welfare can always be improved by adding more people, even if these people have lives barely worth living. Thus, maximizing average or total utility leads to opposite extremes in terms of how the welfare of a given person should be traded off against the number of people alive.

In this section, we focus on recent developments in the normative analysis of fertility. We start with new concepts for evaluating population policies and then discuss how the literature using quantitative models of fertility choice has proceeded to assess policy options.

7.1 Efficiency criteria for population economics

To make headway on this issue, one part of the literature focuses on developing efficiency criteria for environments with endogenous population. By ruling out inefficient allocations, efficiency criteria provide a partial ordering of possible allocations, but refrain from settling on an overall social optimum.

In environments with a fixed population, Pareto efficiency is the standard efficiency concept employed in economics. An allocation is considered Pareto efficient if it is feasible (i.e., it can be achieved given technological and resource constraints), and if there is no other feasible allocation that makes at least one person better off and no person worse off. Pareto efficiency is not directly applicable to models with fertility choice, since here evaluating efficiency involves comparing allocations with different numbers of people, so that one has to take a stand on how to deal with the utility of people who are alive in one allocation, but not another.

Michel and Wigniolle (2007) define Pareto efficiency at the level of a representative consumer in each generation, and show conditions under which competitive equilibria in overlapping generations models with endogenous fertility are efficient. The applicability of such a criterion is limited, as it does not deal with potential heterogeneity within a generation and the tradeoff between the size and the welfare of a generation.

Golosov et al. (2007) apply two possible generalizations of Pareto efficiency to settings with endogenous population. $\mathcal{A}$-efficiency applies Pareto efficiency only to those people who are alive in both allocations that are being compared.[48] In dynastic models where the current generation is altruistic to their future descendants, allocations that maximize the weighted sum of utilities of the initial generation are generally $\mathcal{A}$-efficient. Further, as long as there are no frictions such as taxes, public goods, or consumption externalities, equilibrium allocations are generally $\mathcal{A}$-efficient. The $\mathcal{A}$-efficiency concept circumvents the ethical question of how to think about the welfare of people who are born only in some allocations by delegating this question to the parents in the model. Models with endogenous fertility choice naturally include some concern for the next generation, either through altruism or some other benefit from having descendants. These preferences are then used to evaluate whether smaller or larger future populations are preferred. The drawback of the concept is that it is not straightforward to find the $\mathcal{A}$-efficient allocations in a given model. There is no planning problem that delivers all $\mathcal{A}$-efficient allocations, and it is possible to construct examples where the set of $\mathcal{A}$-efficient allocations is empty.

As an alternative, Golosov et al. (2007) propose the concept of $\mathcal{P}$-efficiency, which applies Pareto efficiency to everyone, including those born only in some allocations. As in the case of $\mathcal{A}$-efficiency, equilibria in fertility models with altruism and without distortions are generally $\mathcal{P}$-efficient. A drawback is that the set of $\mathcal{P}$-efficient allocations is generally large. Moreover, the concept requires specifying a welfare level for those not being born. Without guidance on how this can be done, $\mathcal{P}$-efficiency lacks clear-cut implications for population policy.

7.2 The socially optimal level of population

As the discussion of efficiency criteria with variable population makes clear, only limited progress can be made without taking a stand on the utility of not being born. This is especially true in the literature on the socially optimal level of population,

[48] Conde-Ruiz et al. (2010) develop a related concept for overlapping-generations models, which they refer to as Millian efficiency.

which aims to provide a full ordering of the desirability of allocations with different population levels, rather than the partial ordering that efficiency criteria provide. Here the issue of the utility of the unborn is impossible to avoid. Even naive criteria implicitly set such a utility level; for example, total utilitarianism amounts to assuming that never being born gives a utility of zero.

Addressing the challenge head-on, Blackorby et al. (1995) propose the social welfare concept of critical-level utilitarianism, whereby adding a person to a given allocation is considered welfare-improving if this person's utility is above a specific critical level. If the critical level is zero, this amounts to total utilitarianism. By specifying a positive critical level, this criterion can avoid the extremes of total and average utilitarianism. The resulting criterion also satisfies a number of desirable axioms for social welfare evaluation.[49] However, we are still left without clear guidance on how the critical level should be set.

de la Croix and Doepke (2021) argue that settling on a utility of not being born is difficult because the usual "veil of ignorance" arguments do not apply. A popular approach in fixed-population welfare economics envisions welfare calculations that take place at an initial stage before people know whose life they are going to live. We are asked to imagine the life of each person who will live, and then to choose the allocation that we would prefer ex-ante (behind the veil of ignorance) if we had an equal probability of living each person's life. Here, welfare judgments arise from people's ability to imagine the circumstances of others, that is, to put oneself in someone else's shoes and to imagine what their life would be like.[50]

de la Croix and Doepke (2021) show that similar comparisons can be made under a variable population if we take the perspective of reincarnation, i.e., we posit that future lives are additional reincarnations of people already alive today. While this is only a thought experiment (just like the original veil of ignorance), it does reduce the question of the utility of never being born to something more tangible, namely the question of whether one would prefer to live more lives at a relatively low utility, or fewer lives where each incarnation is highly enjoyable. de la Croix and Doepke (2021) show that the resulting concept of soul-based utilitarianism is similar to critical level utilitarianism, but with an implicit critical level that depends on resources and the level of technology. In settings where critical-level utilitarianism would prescribe that technological progress should be absorbed by higher population levels, holding individual welfare constant, the soul-based alternative allows both population size and individual welfare to rise when overall productivity improves.

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49 See Blackorby et al. (2005) for a comprehensive overview of the axiomatic approach to population ethics.

50 Veil-of-ignorance arguments were introduced by Harsanyi (1953, 1955) and later popularized by Rawls (1971).

7.3 Quantitative research on population policies

Even without definitive answers on which welfare criteria are to be preferred, much can be done to assess potential inefficiencies arising from endogenous fertility choice and to examine the effects of various policies. Some of the unattractive properties of average and total utilitarianism are less relevant in models with endogenous fertility choice when the costs and benefits of having children are explicitly modeled. Nerlove et al. (1985, 1986) are early contributions that compare how laissez-faire equilibria in models with endogenous fertility relate to the prescriptions of average and total utilitarianism. Eckstein and Wolpin (1985) also rely on average utilitarianism and show that when parents derive utility from their children's consumption but not their utility, then there is no equivalence between the competitive equilibrium and per-capita utility maximization, leaving room for policy intervention. de la Croix and Gosseries (2009) consider whether externalities arising from fertility choice can be internalized through tradeable procreation rights.

Several quantitative papers focus on positive implications of fertility control policies without confronting welfare issues. For example, Liao (2013) studies the Chinese one-child policy in a quantitative model. She concludes that the one-child policy accelerated the accumulation of human capital and increased income per capita, but also created winners and losers. The paper circumvents statements about overall optimality and instead computes welfare changes for each generation and skill type. In a similar vein, Choukhmane et al. (2014) and Banerjee et al. (2014) analyze the impact of the Chinese one-child policy on aggregate savings, while Coeurdacier et al. (2014) investigate how fertility policy impacts the sustainability of the pension system in China. De Silva and Tenreyro (2017, 2020) consider the impact of fertility control and family planning policies across a large set of countries, and argue that such policies have played a major role in the acceleration of fertility decline in developing countries in recent decades.

Other papers consider welfare implications from the perspective of average utilitarianism. For example, Cavalcanti et al. (2021) analyze family planning policies in a quantitative model calibrated to Kenya. They argue that government subsidies on contraception or abortion are welfare-improving and more effective than education subsidies, conclusions reached by comparing average welfare across policies. In contrast, Zhou (2021) finds that subsidizing births would improve welfare in a quantitative model calibrated to the United States. Once again, the welfare concept used is average utilitarianism, although in this case the focus is on welfare in the long run: the cohorts that had already passed childbearing age at the time of the policy change may be hurt. The opposing results of these papers on whether births should be encouraged or discouraged are related to the baseline level of population growth and the resulting age structure. In particular, while in both Cavalcanti et al. (2021) and Zhou (2021) higher population growth implies less human capital accumulation through the quantity-quality tradeoff, in Zhou (2021) the dominant effect is that higher population growth reduces the old-age dependency ratio in a cost-effective way.

Schoonbroodt and Tertilt (2014) argue that private fertility decisions may be inefficiently low because of misaligned property rights. It is parents who choose fertility but children who reap most of the benefits (e.g., in form of future labor income). This discrepancy can lead to inefficiently low fertility outcomes and hence provides a rationale for pro-natal policies. Kim et al. (2021) propose another reason for equilibrium fertility being below what is socially optimal: status externalities. If parents care about their children's education relative to others, they may overinvest in the quality of children. This in turn makes children costly and can lead to underinvestment in the number of children. These conclusions are based on the $\mathcal{A}$-efficiency concept of Golosov et al. (2007).

8 The road ahead for the economics of fertility

In this survey, we have laid out new facts about fertility behavior and we have described the mechanisms that we believe have the greatest promise in explaining these facts. A central task for future research on the economics of fertility will be to improve our understanding of these mechanisms and to connect them to more empirical evidence.

But there is a lot more to be done. It is impossible to do full justice to all ongoing developments in fertility research in a single survey. For example, while we focus on the economics of fertility in high-income countries, much exciting research seeks to understand fertility behavior in middle- and low-income countries, where additional mechanisms come into play.[51]

Our survey moreover looks predominantly at economic models of fertility behavior, with less emphasis on purely empirical research. Yet, as the examples of the career-family conflict and of childlessness show, empirical research on new topics often starts long before formal models that account for a new aspect of the evidence are developed. Some future advances in the economic modeling of fertility are likely to rely on empirical evidence that already exists today. It is from this perspective that we now discuss a number of additional directions for further research that we expect to be fruitful.

8.1 Parental time use and the intensity of parenting

The concept of investments in child quality, as introduced by Becker is, in principle, quite general. In practice, the literature on the quantity-quality tradeoff has focused on education as the primary form of investing in children, usually measured by educational attainment. As we argue above, this specific form of the quantity-quality tradeoff has become less relevant over time in high-income economies: few parents now move along the margin of how many children to have versus how many years these children should attend school.

[51] For example, women's rights are less advanced in lower-income countries (Doepke et al., 2012; Tertilt et al., 2022), child marriage and bride price payments are common (Corno et al., 2020; Ashraf et al., 2020a), and in some places, polygyny continues to be prevalent (Tertilt, 2005).

Nevertheless, investments in children may vary at a finer level than years of schooling, and this variation could continue to be relevant for fertility choice. For instance, one might consider what Doepke and Zilibotti (2019) refer to as the "intensity of parenting," namely the overall time and effort that parents invest in raising their children. The wider availability of time use data in recent years has uncovered new facts about the intensity of parenting that may be linked to fertility choice. While we are not aware of economic models that directly address this time use data and relate it to fertility, this is an area that offers much possibility for future research.

There is a now sizeable literature that summarizes evidence on parents' time use for childcare, including Bianchi (2000), Guryan et al. (2008), Ramey and Ramey (2010), Dotti Sani and Treas (2016), Gobbi (2018), and Cardia and Gomme (2018). In what follows, we summarize the most important empirical findings and discuss implications for modeling fertility choice. We focus on time used for primary childcare; that is, the amount of time parents report being engaged in childcare as a primary activity. Childcare can also be a secondary activity when, for example, a parent is simultaneously carrying out another activity, like cooking or watching TV, while also minding children.[52]

The evidence on parental time use in high-income economies can be summarized in four basic facts. First, mothers spend more time on childcare than fathers. Some of this gap arises naturally from the spousal division of labor: in many families, fathers spend more time on market work and mothers more time on childcare. However, the gender gap in childcare time persists even conditional on labor market status. To illustrate this fact, Fig. 29 displays childcare time for mothers and fathers in the United States, distinguishing between parents who work full-time, part-time, or are out of the labor force. In each category, there is a large gap between mothers and fathers. For example, nonemployed mothers spend more than an additional hour a day on childcare compared to nonemployed fathers. The more parents work, the less time they spend on childcare. The gradient is steeper for mothers than fathers: full-time working mothers spend 84 minutes per day on childcare, compared to about double that among nonemployed mothers (162 minutes per day). Among men, full-time working fathers spend 57 minutes versus 94 minutes among nonemployed fathers, which is a much smaller ratio. Nonemployed fathers spend only about 10 minutes more on childcare each day than mothers who work full time.

Second, childcare time increases in education, for both mothers and fathers. Fig. 30 documents this fact for a number of countries. While the difference between the childcare time of more- and less-educated parents in the figure might not seem large in some cases, educated mothers are also more likely to be working and to have fewer children. All else equal, one would therefore have expected them to spend less—not more—time on childcare than less-educated mothers. Indeed, Guryan et

52 Secondary childcare is still of interest for theories of fertility choice as, for instance, the need to supervise children may prevent a parent from being at work. Parents spent about three to four times as much time on secondary compared to primary childcare (Guryan et al., 2008; Cardia and Gomme, 2018).

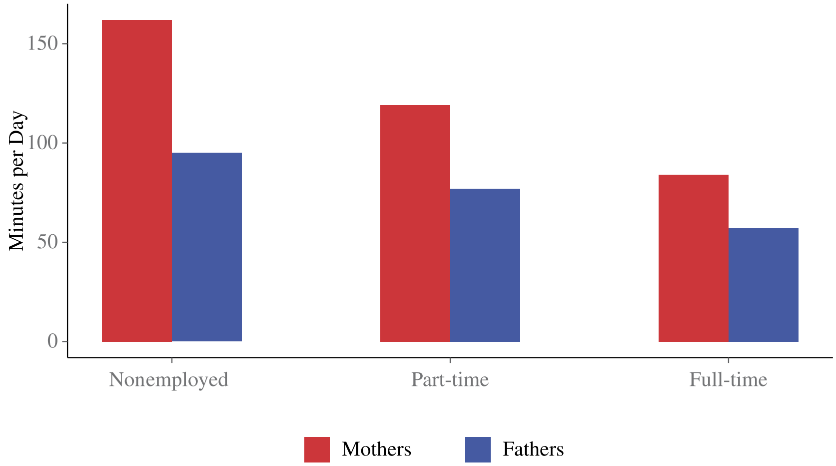

FIGURE 29 Childcare by employment status: US mothers vs. fathers, 2003-2019.

Source: Data from the American Time Use Survey (ATUS) and the Current Population Survey (CPS) for the years 2003 to 2019. Childcare time includes: (i) caring for and helping children, (ii) activities related to children's education, and (iii) activities related to children's health. We follow Gobbi (2018) and include all men and women between the ages of 25 and 55 in the sample, who live with their spouse or an unmarried partner and have at least one child under 18 years of age in the household. In addition, there is no other adult living in the household and the partner's highest completed level of education is known.

al. (2008) show for the United States that conditioning on labor market participation, the education gap in time spent with children is much larger than in the raw data. Gobbi (2018) further documents that time spent caring for children increases not only in own education, but also in the partner's education (holding own education constant). This is true for both genders, with the exception of the most educated men with postgraduate degrees.

Third, parental time with children has increased over time, both for mothers and fathers (see Fig. 31). This finding is perhaps surprising given that the labor market participation of women in general, and of mothers in particular, has also risen over time. Nonetheless, this is a robust finding across many countries. Bianchi (2000) further documents that among married parents in the United States, time use on childcare has increased comparatively more for fathers than for mothers, resulting in a narrowing of the gender gap in childcare over time. Feyrer et al. (2008) show that the gender childcare gap has diminished in other countries as well.

Fourth, the increase in childcare over time has been particularly pronounced among educated parents. Fig. 32 displays trends in time use for childcare in the United States separately for college-educated and less-educated parents.[53] From the

[53] The figure is reproduced from Doepke and Zilibotti (2017) and is based on the analysis of Ramey and Ramey (2010), who first pointed out the widening gap in childcare time by education in the United States.

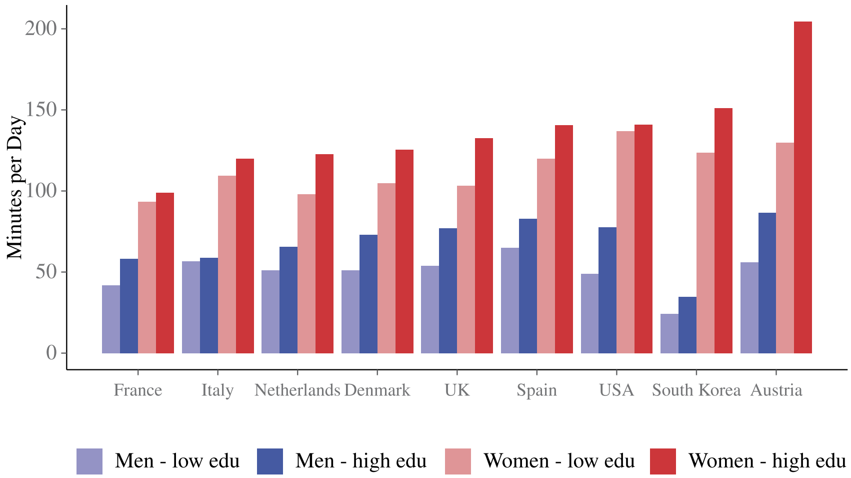

FIGURE 30 Childcare by parental education.

Source: Data from Multinational Time Use Study. We use the most recent available survey wave in each country: USA (2018), UK (2015), Austria (2009), France (2010), Netherlands (2005), Denmark (2001), Italy (2009), Spain (2010), South Korea (2009). We restrict the sample to parents between the ages of 18 and 45 with children less than age 13 in the household. We use total time spent with children (including physical, medical, routine childcare, playing sports, reading, teaching) and only consider countries that record all childcare categories in their time use diaries. We use the highest education level harmonized across countries to define education groups. "Low edu" stands for low education and includes completed secondary education (ISCED level 3 and attendance at level 4) and below. "High edu" stands for high education and includes all education levels above secondary education (ISCED level 5 and above).

1970s to about 1990, educated parents spent only slightly more time on childcare compared to less-educated parents. The difference between these two groups subsequently started to grow, and by the mid-2000s mothers with a college degree were spending four hours more on childcare per week compared to mothers with a high school degree. The difference in childcare time between more- and less-educated fathers is somewhat smaller, but has also grown over time. Dotti Sani and Treas (2016) show that in many countries, childcare time has increased more among the educated than among the less educated.

One might ask how total time use adds up. In particular, where is all the extra time that educated parents spend with their children coming from? Furthermore, how have women managed to simultaneously increase both childcare hours and labor market hours? In the United States, most of the rise in childcare over time is matched by declines in two other categories: housework other than childcare and leisure time (Guryan et al., 2008; Ramey and Ramey, 2010). Employed women in particular now spend much less time on housework compared to a few decades ago (Bianchi, 2000).

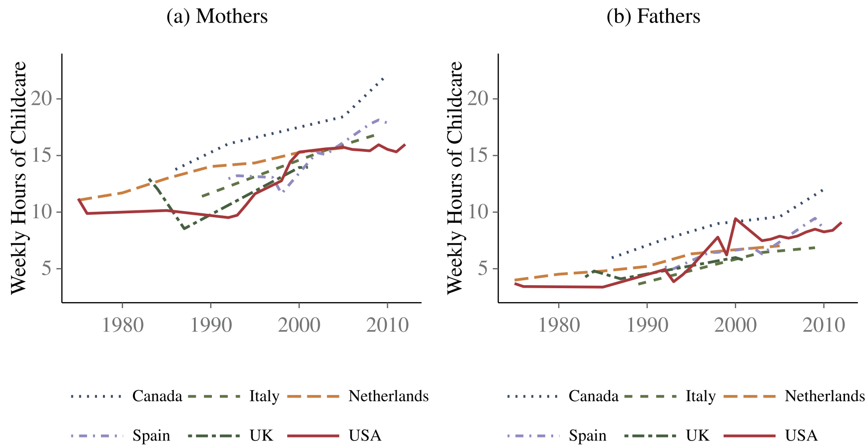

FIGURE 31 Parental childcare over time.

Source: Doepke and Zilibotti (2019), Figure 2.1. Hours per week spent on child-rearing in six OECD countries.

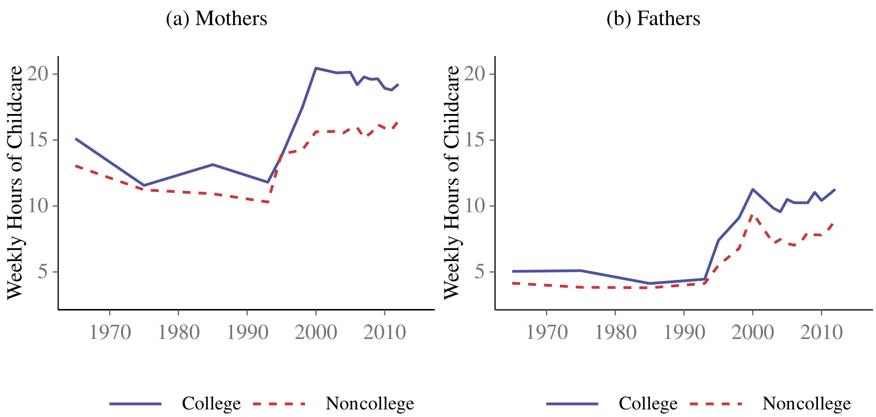

FIGURE 32 Childcare of mothers and fathers in the United States, by education.

Source: Doepke and Zilibotti (2019), Figure 4.1. Time spent on childcare by mothers and fathers in the United States, by education (hours per week). Data comes from the American Time Use Survey. Childcare time comprises the same categories used in Ramey and Ramey (2010). Average time use is computed by regressing individual time use on interacted dummy variables for gender, survey year, education category, and age category. Plotted results are average time use for parents in the 25–34-year-old age group.

Some of these changes can be accounted for by wider use of household technologies such as dishwashers or pressure cookers (Greenwood et al., 2005b), and the marketization forces discussed in Section 4.2 also play a role.[54]

The above facts cannot be explained by classic fertility models, which assume that raising a child either involves a fixed time cost or a time cost that increases linearly with the child's educational attainment. Instead, the data shows wide variation in time use on childcare over time, by labor market status, by gender, and by education of the parent. Accordingly, future fertility theories should more explicitly model the choice of parental childcare time.

At least two issues would particularly benefit from greater consideration of time-use data. The first concerns the main theme of our survey; namely, the importance of the career-family conflict for fertility choices today. Time use data makes this conflict explicit, both in terms of the tradeoff between childcare, other home production, and market work, and the distribution of childcare between two parents, a key dimension in our discussion of household bargaining in Section 5.2.

The second issue that time use data can speak to is the role of a rising intensity of parenting, which is observed in many countries, for fertility choice. Time use for investing in children's skills is a major focus of the economic literature on child development and parenting (see, e.g., Cunha et al., 2010 and Doepke et al., 2019). Doepke and Zilibotti (2019) link the rising intensity in parenting to growing economic inequality and higher returns to education. They argue that many parents today feel that the stakes in pushing their children to educational achievement have risen, and consequently they redouble their efforts in this respect. In a similar vein, Ramey and Ramey (2010) connect the increase in childcare time among educated parents in the United States to higher competition for admission slots at top colleges. Though these trends have yet to be taken into account in the economic literature on fertility choice, it is notable that some of the countries with the most intense parenting cultures, such as China and South Korea, also have extremely low fertility rates. Kearney et al. (2022) hypothesize that changes in social norms on the intensity of parenting may be the main driver of declining birth rates in the United States since the Great Recession. As pointed out by Guryan et al. (2008), it could prove fruitful to distinguish between basic childcare and education time with children in future models, as the latter has increased particularly quickly over time. The distinction may also help explain why highly educated couples do not outsource more childcare: while it might be easy to outsource basic care, parents may feel that they should provide educational activities themselves. We expect that greater engagement with the time-use evidence will be a major feature of the next generation of economic models of fertility.

[54] Cardia and Gomme (2018) make the interesting point that housework and leisure are both complementary to childcare. As time spent in these two activities has fallen over time, it seems possible that unlike primary childcare, total childcare time (including secondary childcare, such as cooking while also looking after children) has actually declined. This hypothesis is difficult to verify in the data, since only the most recent time use surveys distinguish between primary and secondary activities.

8.2 The extended family and heterogeneity in family types

The economic models of fertility choice considered thus far either abstract from multiple caregivers entirely or are limited to families consisting of a mother and father with their children. In reality, family types range beyond either single parents or the traditional nuclear family. Economic modeling of fertility could benefit from explicitly accounting for the role of extended families and other family types.[55]

An example to this regard is the role of grandparents, and in particular grandmothers, as childcare providers. Though average age at first birth has risen, so too has life expectancy, such that grandparents are often able to help with caring for children. García-Morán and Kuehn (2017) model access to grandmother care as a close substitute for institutionalized childcare if grandparents live close by and the grandmother is not working. Having more access to grandmother care raises fertility, but also comes with career costs because geographic mobility is limited by the need to live close to family. Childcare provided by grandmothers was moreover important for the first generation of women to enter the labor force in large numbers, as little formal childcare was available. Many of these women turned to their mothers, who were usually not working, for help watching their children. This is less feasible for many women with young children today in that their own mothers are often still active in the labor force. As Backhaus and Barslund (2021) document, having a grandchild reduces the labor supply of grandmothers, often in the form of dropping out of the labor market early. As women are bearing children at later ages, greater care assistance may once again become available as grandmothers are more likely to be retired. At the same time, geographic mobility has risen in many countries, reducing access to care provided by grandmothers who now might live far away.

The availability of childcare provision on the part of the extended family also responds to fertility itself. In China, for example, after two generations under the one-child policy there are now many children who are the only grandchild of their four grandparents—a phenomenon referred to as "4-2-1" families (four grandparents, two parents, one child). It does not come as a surprise that under these circumstances, the importance of grandparent-provided childcare has risen (Chen et al., 2011). As fertility rates have fallen to well under two children per family in many high-income countries, we can expect similar trends to take hold elsewhere.

Beyond the extended family, there are other family types that have become more common recently, such as patchwork families and same-sex couples raising children.[56] Single parenting and marital instability raises the likelihood of parents having children with multiple partners over time (Guzzo, 2014), and there

[55] Cohabiting couples with children is another family type that has become prevalent in many countries in recent decades, as discussed in Section 6.2.

[56] For a discussion on the rise of same-sex couples see the chapter by Bau and Fernández (2023) in this volume.

are more families that combine children from partners' earlier relationships. These step-families tend to be less stable and the birth of a shared child is often unintended (Guzzo, 2017a). The childcare arrangements of couples raising children in same-sex relationships have also been the subject of an increasing amount of empirical research. Comparing same-sex and opposite-sex couples can be informative about the role of gender norms in childcare arrangements. For example, Perlesz et al. (2010) document that same-sex couples divide home work and childcare tasks more equally and that their division of labor is more responsive to preferences and economic circumstances compared to opposite-gender couples. Using Norwegian data, Andresen and Nix (2022) show that mothers in same-sex relationships experience a substantially smaller motherhood penalty (i.e., the decline in labor market earnings in the years following a birth) than mothers in opposite-gender relationships. This evidence suggests that neither the health impact of giving birth nor relative wages account for a large part of the motherhood penalty, and that the key drivers are instead gender norms and possibly preferences. Overall, these findings are enlightening not only in terms of understanding the decisions of same-sex couples, but also to better distinguish the roles of the efficient division of labor, preferences, and social norms in family decision-making more broadly.

8.3 The macroeconomic consequences of ultra-low fertility

The literature on the macroeconomic consequences of fertility decisions has long emphasized the beneficial effects of fertility decline for economic development, including reduced pressure on finite resources and faster accumulation of human capital through the quantity-quality tradeoff. Recently, a new issue has drawn attention; namely, the repercussions of ultra-low fertility and population decline.

As documented above, many countries are currently experiencing fertility rates well below replacement levels. While population projections used to be based on the assumption that fertility rates will ultimately converge to about two children per woman in all countries, the evidence from recent decades suggests that low fertility may persist and ultimately result in shrinking populations. In fact, places where fertility has been below replacement for a long time (such as Japan), already see their population declining today. In some cases, such diminution may be severe. In South Korea, for example, the total fertility rate in 2019 was only 0.92, which if sustained would imply that each successive generation is less than half the size of the preceding one.

Research on the wider implications of such population decline is in the early stages. Fertility decline raises questions as to how social insurance systems can be sustained as the population ages, the baby boom generation retires, and the dependency ratio rises. De Nardi et al. (1999) and Attanasio et al. (2007) use macroeconomic models with changing population structure in closed and open economy settings, respectively, to study the fiscal, macroeconomic, and welfare consequences of reforms that aim to make social security sustainable. Storesletten (2000) assesses the role that increased immigration could play in supporting public pensions in the United States. Population aging and slowing population growth has also been linked to declining real interest rates (Carvalho et al., 2016), changes in the transmission of monetary policy to consumption (Wong, 2021), declining labor market dynamism (Karahan et al., 2019; Peters and Walsh, 2021; Hopenhayn et al., 2022), and the phenomenon of "secular stagnation" (Eggertsson et al., 2019).

How declining populations and population aging will affect productivity growth is another important question. Acemoglu and Restrepo (2017) argue that population aging can spur automation to make up for a declining labor force, which will ultimately raise productivity. Jones (2022), in contrast, takes a global perspective and contends that a declining world population will ultimately generate fewer ideas, leading to a gradual return to stagnation in living standards.

Fertility decisions also matter for the transmission of inequality across generations, an issue that has been highlighted by de la Croix and Doepke (2003), Vogl (2016), Cordoba et al. (2016), and Daruich and Kozlowski (2020), among others. Children born to groups with a high fertility rate are overrepresented in the next generation, and if high fertility goes hand in hand with low investments in children, persistent poverty can result (Moav, 2005). These forces gain strength as fertility falls below replacement; groups whose fertility consistently remains below replacement are bound to vanish. Meanwhile, those that manage to maintain high fertility would ultimately come to dominate. When fertility differentials are large, the composition of a population undergoes substantial change within decades. The rising share of the ultra-orthodox in Israel is one example of such a phenomenon (see Berman, 2000 for an economic analysis of this case).

Concern over ultra-low fertility has further intensified with the Covid-19 pandemic and the resulting global recession. An unusual characteristic of this recession is the widespread school closures causing a sudden increase in childcare needs. Especially if childcare continues to be unreliable due to further local Covid-19 outbreaks, parents may adjust their expectations about the cost of children, potentially reducing the desire for further children. School closures have also resulted in a sizeable drop in female employment in many countries, in contrast to other recent economic downturns that were largely mancessions (Alon et al., 2022). These resulting losses in female human capital could diminish the opportunity cost of time for some women, which, down the road, may increase the number of higher order births. The pandemic has furthermore seen a lesser availability of birth control and abortion services, which may increase fertility particularly among low-income women (Bailey et al., 2022). Finally, changes in employment flexibility may also emerge (such as working from home options) as well as a shift in social norms regarding the division of childcare between mothers and fathers. Both of these matters are central to the issue of female career-family compatibility discussed above. Thus far, the available data seems to point towards a baby bust, at least in the short run (Wilde et al., 2020; Aassve et al., 2021). Measuring and analyzing the medium- and long-run effects of the pandemic on fertility will be an important topic for future research.

9 Conclusion

With this survey, we aim to assess the state of the economic theory of fertility as applied to high-income economies at the beginning of the 21st century. We argue that research in this area is currently undergoing a major shift. Past fertility research largely focused on understanding fertility decline over time and the negative cross-country relationship between income and fertility. The most important mechanism in explaining these patterns was the quantity-quality tradeoff. However, much has changed over the last few decades. In particular, fertility is no longer negatively related to income across high-income countries. Instead, family policy, cooperative fathers, favorable social norms, and flexible labor markets have become key determinants of fertility choice. Thus, a new era of fertility research has begun.

We are optimistic that much more progress can be made in research addressing the causes and consequences of fertility in the near future. Notably, a number of the new developments in the economic modeling of fertility choice build on long-standing discussions and research in demography and sociology. Further integration of the different social science fields analyzing fertility behavior offers a source for additional advancement. New research also benefits from the availability of more data. In our view, information on couple's fertility intentions and detailed time use data will be especially useful for disciplining future economic models of fertility choice. Lastly, computational and theoretical advances allow today's modelers to construct theories at a much more fine-grained level than a few decades ago, including models with a detailed life cycle, different family types, and multiple sources of heterogeneity. This is an exciting moment in the economics of fertility, and we look forward to learning about the new insights which will likely emerge in the coming years.

Appendix

A.1 Data definitions and sources

Detailed sources for the data displayed in Fig. 1 are given in Table A1.

Table A1 Data sources for Fig. 1: total fertility rates since 1850.

Country	Years	Source
Austria	1871-1939	Rothenbacher (2002)
	1945	Sardon (1991), Table 2.
	1950-1990	Human Fertility Database
	1991-2018	World Development Indicator Database
Belgium	1853-1889	Chesnais (1992)
	1930-1949	Sardon (1991)
	1950-1989	United Nations, World Population Prospects (2013)
	1990-2018	World Development Indicator Database
Denmark	1851-1899	Chesnais (1992)
	1900-1993	Statistics Denmark
	1994-2018	World Development Indicator Database
Finland	1851-1995	Statistics Finland
	1996-2018	World Development Indicator Database
France	1850-1900	Chesnais (1992)
	1901-1949	Insee
	1950-2004	United Nations, World Population Prospects (2013)
	2005-2018	World Development Indicator Database
Germany	1850-1923	Chesnais (1992)
	1925-1949	Sardon (1991)
	1950-2001	United Nations, World Population Prospects (2013)
	2002-2018	World Development Indicator Database
Italy	1863-1898	Chesnais (1992)
	1903-1949	Sardon (1991)
	1950-1997	United Nations, World Population Prospects (2013)
	1998-2018	World Development Indicator Database
Japan	1800-1919	Chesnais (1992) and Mitchell (1998)
	1920-1949	Sardon (1991)
	1950-2018	United Nations, World Population Prospects (2013)
Spain	1858-1900	Chesnais (1992)
	1859	Rothenbacher (2002)
	1901-1949	Sardon (1991)
	1950-1988	United Nations, World Population Prospects (2013)
	1989-2018	World Development Indicator Database
Sweden	1850-1890	Festy (1979)
	1891-1996	Human Fertility Database
	1997-2018	World Development Indicator Database
Switzerland	1852-1870	Rothenbacher (2002)
	1872-1919	Statistics Switzerland
	1913, 1918, 1928	Chesnais (1992)
	1932-1949	Calot (1998)
	1950-1997	United Nations, World Population Prospects (2013)
	1998-2018	World Development Indicator Database
UK	1850-1871	Wrigley and Schofield (1989), Table A3.3.
	1973-1908	Chesnais (1992)
	1911-1949	Festy (1979)
	1950-1998	United Nations, World Population Prospects (2013)
	1999-2018	World Development Indicator Database
USA	1860-1949	US Statistical Office
	1950-1990	Human Fertility Database
	1991-2018	World Development Indicator Database

A.2 Additional figures and tables

Table A2 Average children ever born by women's education in the US, Several cross-sections, by race.

All						White					
year	**< 12**	**12**	**13-15**	**16**	**> 16**	**year**	**< 12**	**12**	**13-15**	**16**	**> 16**
1980	2.48	1.90	1.56	1.43	1.24	1980	2.23	1.83	1.52	1.40	1.21
1990	2.30	1.80	1.53	1.28	1.29	1990	2.06	1.74	1.50	1.31	1.30
2000	2.58	2.08	1.84	1.60	1.64	2000	2.25	2.01	1.83	1.64	1.68
2010	2.54	1.93	1.73	1.53	1.68	2010	2.12	1.83	1.73	1.59	1.77
2019	2.15	1.65	1.53	1.32	1.46	2019	2.02	1.55	1.55	1.38	1.59
Nonwhite						**Black**					
year	**< 12**	**12**	**13-15**	**16**	**> 16**	**year**	**< 12**	**12**	**13-15**	**16**	**> 16**
1980	2.88	2.21	1.74	1.57	1.39	1980	2.69	2.14	1.74	1.35	1.22
1990	2.54	1.97	1.59	1.17	1.25	1990	2.40	1.94	1.59	1.04	1.32
2000	2.77	2.21	1.86	1.48	1.51	2000	2.53	2.14	1.84	1.38	1.35
2010	2.72	2.06	1.73	1.39	1.49	2010	2.50	1.90	1.68	1.29	1.22
2019	2.20	1.75	1.50	1.20	1.24	2019	2.05	1.63	1.48	1.14	1.09

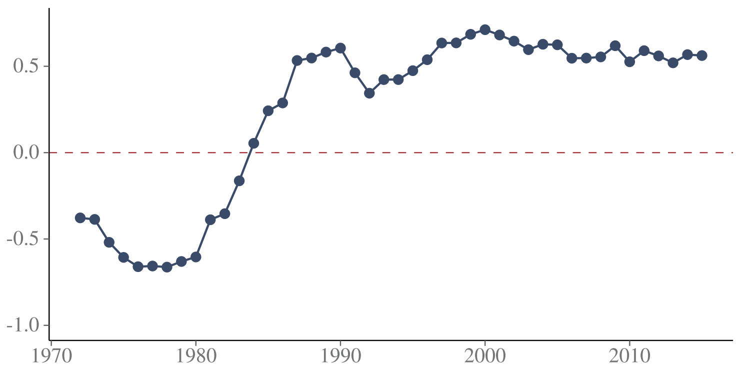

FIGURE A1 Cross-country correlation between total fertility rate and per capita GDP—fixed sample over time.

Notes: The figure plots the correlation coefficients between the total fertility rate and income per capita across OECD countries in a given year. Data for the total fertility rate and income per capita comes from the OECD Statistical Database. We keep the underlying sample fixed and include the following 10 countries: Australia, Finland, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, and the United States. See Fig. 8 for details on the data sources.

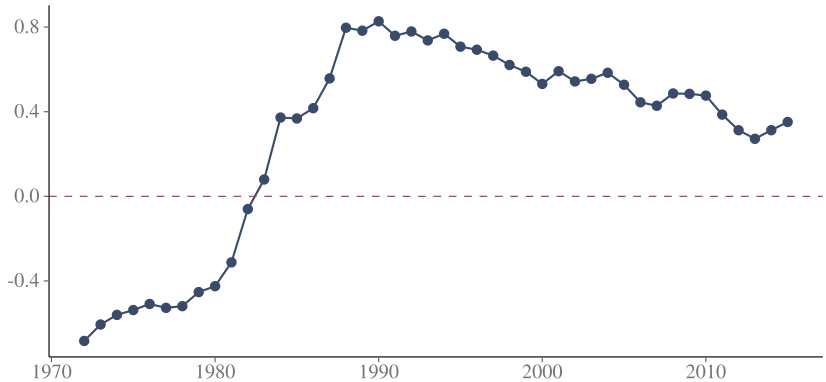

FIGURE A2 Cross-country correlation between total fertility rate and female labor force participation rate—fixed sample over time.

Notes: The figure plots the correlation coefficients between the total fertility rate and the female labor force participation rate across OECD countries in a given year. Data for the total fertility rate and female labor force participation rate (25-54-year-old age group) comes from the OECD Statistical Database. We keep the underlying sample fixed and include the following 10 countries: Australia, Finland, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, and the United States. See Fig. 12 for details on the data sources.

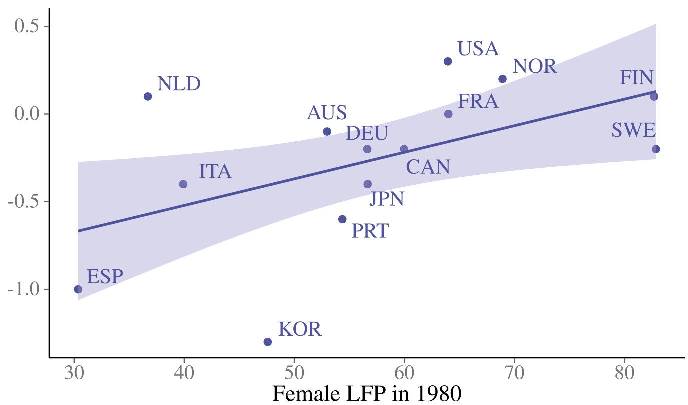

FIGURE A3 Female labor force participation in 1980 and changes in total fertility rate (2000-1980).

Notes: We plot changes in the total fertility rates against the female labor force participation rate for the 25-54-year-old age group in 1980 and 2000. We include a linear regression of changes in the total fertility rate on female labor force participation and show 90% confidence intervals. Data on total fertility rates comes from OECD (2021), "Fertility rates" (indicator), https://doi.org/10.1787/8272fb01-en (accessed on 30 June 2021). Data on female labor force participation comes from OECD (2021), "LFS by sex and age," https://stats.oecd.org/ (accessed on 30 June 2021).

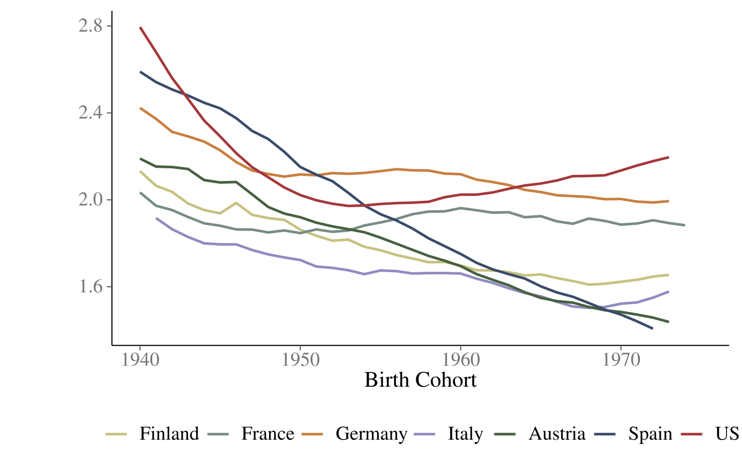

FIGURE A4 Children ever born in high-income countries.

Notes: Data comes from Human Fertility Database. Children ever born is the average number of children born alive to women in a given birth cohort who reached at least age 44.

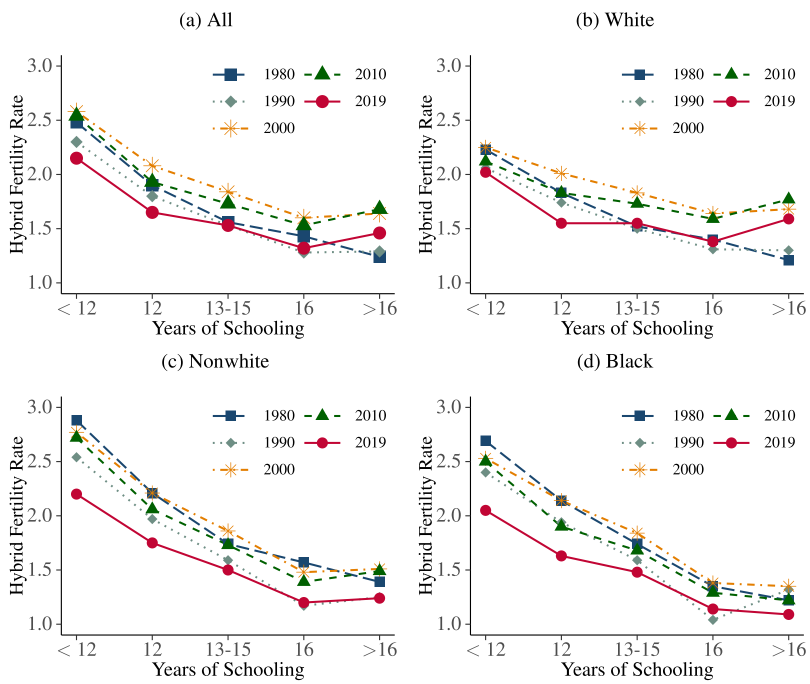

FIGURE A5 Fertility by women's education in the US, several cross-sections, by race.

Notes: Figure is based on Bar et al. (2018) Figure 1, with additional years added and for different subsamples. Data comes from the Census accessed through IPUMS.

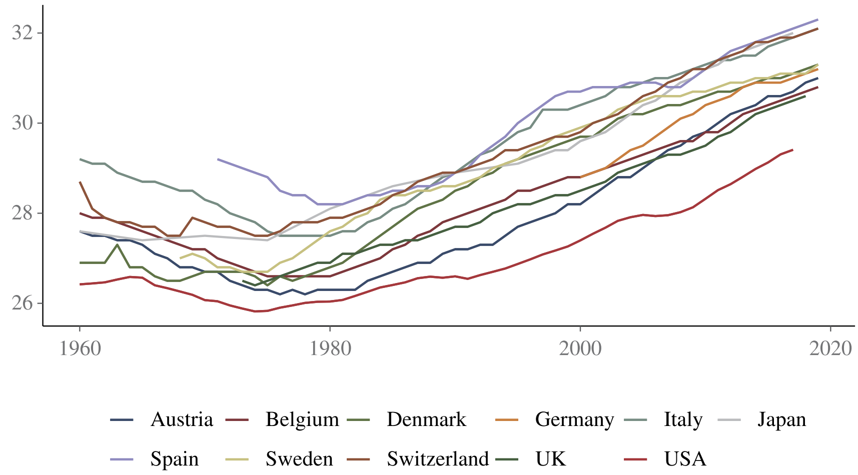

FIGURE A6 Average age at birth.

Notes: We plot the evolution of women's average age at birth over time and across a selection of OECD countries. The data comes from OECD Family Database, "Fertility indicators - SF2.3 Age of mothers at childbirth and age-specific fertility," https://www.oecd.org/els/family/database.htm (accessed on 08 February 2022).

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