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The Relationship between Female Education and Total Fertility Rate, and the Role of Paid Leave Entitlements Available to Mothers

Eun Jung Kim[1*]

Abstract

The present study examined the relationship between women's education and the total fertility rate from 1995 to 2010, based on data obtained from 140 countries, and how paid leave entitlements available to mothers moderate this relationship. Two-way fixed effects modeling was used. The findings revealed that there was a negative relationship between average years of female schooling and total fertility rates, however the relationship was significantly moderated if the country had generous paid leave. Results showed that if a country had 26 or more weeks of paid leave, the negative relationship between female education and the total fertility rate disappeared while controlling for GDP per capita, under-five mortality, and female employment. Findings from this study provide valuable information for policymakers concerned with decreasing fertility, and development of policies that support mothers who want to continue their careers while taking care for their children.

Keywords

Female education; total fertility rate; paid leave; two-way fixed effects modeling

Introduction

The negative correlation between women's education and fertility has been observed in numerous studies (Jejeenhoy, 1995; Martin, 1995). However, recent studies report that the negative relationship between women's education and fertility may not be as strong as it was in the past (Anderson et al., 2009; Kravdal & Rindfuss, 2008) and that in countries such as France, Germany, and Sweden, women with higher education are now having more children than women with less education (Lutz et al., 2017a; Takayama & Werding, 2011).

[1] Institute Asian Demographic Research Institute, Shanghai University, China
* Eun Jung Kim, corresponding author. Email address: uwcsea0620@hotmail.com

Changes in the relationship between female education and fertility may been related to the expansion of family policies in the above mentioned countries (Lutz et al., 2017a; Takayama & Werding, 2011). Family policies such as paid maternity leave and parental leave help reduce the opportunity costs of childbearing and allow women to take time off from work while retaining their source of income. As more women participate in the labor market and dual-earner families become more common, more countries have introduced and expanded paid leave to help working women (and men) better balance work and child-care responsibilities (Robila, 2014; Thévenon, 2010). The expansion of family policies has been attributed to the rise of birth rates even amidst the increase in women's education, especially in Nordic and Western European countries (Lutz et al., 2017; Takayama & Werding, 2011). For example, France experienced a steep decline in fertility during the 1970s and 1980s, but fertility started to increase in the mid-1990s, simultaneously with the introduction of the 1994 parental leave reform, which extended parental leave provisions to parents with two children (previously the provisions were only available for parents with three or more children). France's total fertility rate has consistently remained at around 1.8-2.0 children per woman, even amidst increased women's education.

However, to my knowledge, there have been no empirical analyses that has specifically examined how paid leave entitlements available to mothers moderate the negative relationship between female education and fertility. The goal of this paper is to address these gaps and to examine the relationship between female education and fertility, and whether paid leave for mothers has a significant moderating effect on attenuating the negative relationship between the two variables using cross-national macro-data for 140 countries between 1995 and 2010. Findings from the study provide empirical evidence to policymakers concerned with decreasing fertility to expand paid policies that support mothers who want to continue their careers while also taking care of their children.

Literature review

In his theory of the determinants of fertility, Bongaarts (1987) maintained that a country's fertility level is influenced by two types of variables: (1) proximate variables, and (2) socioeconomic and environmental background variables. Proximate variables are biological and behavioral variables that directly influence fertility, such as the use of contraception, timing of marriage, frequency of intercourse, abortion, and intrauterine mortality. Socioeconomic and environmental background variables are social, cultural, economic, institutional, and environmental variables, such as education, women's movement, unemployment, and economic growth, which influence fertility through proximate variables (i.e., socioeconomic variables → proximate variables → fertility). Female education (socioeconomic variable) is known to affect fertility by limiting fertility desires (Gustafson, 2001; Jejeenhoy, 1995; Kravdal, 2002).

According to economic theories, two types of mechanisms have roles in determining the relationship between female education and fertility: the "income effect" and the "price effect" (Becker, 1981; Cigno, 1991). The "income effect" explains the positive relationship between female education and fertility. Well educated women tend to have a higher income and can more easily afford the costs of having children, and are thus better able to have more children. On the other hand, the "price effect" explains the negative effect of education on fertility. For more-educated women, the opportunity costs of devoting time to non-paid activities such as childrearing are higher than they are for less-educated women, and as a result, more-educated women are less inclined to have children. Higher education entails enhanced human capital and higher earning potential, which women may very well want to capitalize on in the labor market. More educated women may face greater lose (i.e., opportunity cost) by staying at home to provide childcare. Given the increase in the earning potential associated with higher educational attainment, women are encouraged to invest more time in labor market participation than in caring for children. For educated women, the negative price effect of having children has been considered a greater influence on fertility than the positive income effect. Thus, these women are less likely to have children. Several studies have examined the relationship between female education and corroborated the association (Jejeebhoy, 1995; Martin & Juarez, 1995; Rindfuss & John, 1983). Martin and Juarez (1995) examined the affect of women's education on fertility in nine Latin American countries, and found that while women with no education had large families of six to seven children, better-educated women had family sizes of two to three children. Also, McClamroch (1996), using cross-national data from 72 countries between 1980 and 1993, discovered that the level of women's education was significantly negatively correlated with the total fertility rate.

Theoretically, leave policies may help moderate the negative price effect of female education on fertility by decreasing the opportunity costs of having (additional) children (Luci-Greulich & Thevenon, 2013). Paid parental leave and maternity leave help protect employees and prevent income loss during absence from work so that mothers can take care of newborns or young children. Expansion of leave policies has been cited as one of the critical factors in the recent rise in fertility rates among educated women in Western European and Nordic countries (Lutz et al., 2017). Research has found that increases in fertility rates have been steeper in countries where paid leave for mothers was generous and women have more opportunities to combine work and childbearing (e.g., Sweden, France) (Lutz et al., 2017). Also, a study by Bassford and Fisher (2016), which examined the effects of Australia's Paid Parental Leave (PPL) on women's fertility intentions, found that the introduction of PPL increased the desired number of children by 13% (conditional on women who intend to have at least one child), and what was particularly notable was that this was primarily driven by highly educated women with no children. Also, Lalive and Zweimuller (2009) found that an increase in leave duration from one to two years in Austria caused a 15% increase in fertility, and Malkova (2018) found that the introduction of one year of paid maternity leave in Russia led to a 5% increase in total

fertility rates.

However, despite the changing nature of education and fertility, there are very few studies that have empirically examined the changing relationship between education and fertility, especially in relation to the role of paid leave entitlements available for mothers. The present study therefore empirically explored the relationship between female education and fertility, and whether paid leave entitlements for mothers help moderate the negative relationship as hypothesized.

Methodology

Data

For this study, three macro-level datasets were merged. First, female education data were collected from the Barro and Lee Educational Attainment Data version 2.2 (Barro & Lee, 2013). Barro and Lee Data provide educational attainment data for 146 countries (and regions) in 5-year intervals for 1950-2010, and include information about the distribution (%) of educational attainment over age 15 by average years of schooling years and by gender. Second, total fertility rate, GDP per capita, under-five child mortality rate, and female labor force participation rate (age 15 and over) were collected from the World Bank Database (World Bank, 2019). Lastly, information about paid leave for mothers was collected from the WORLD Policy Analysis Center Database (WORLD Policy Analysis Center, 2020). The World Policy Analysis provides information about leave entitlements (including both maternity leave and parental leave) for mothers available in weeks and by wage replacement rates for 197 US-recognized countries from 1995 to 2013 annually. The World Policy Analysis Data does not include Réunion, Maldives, Republic of Moldova, Serbia, Macao (China), and Kyrgyzstan, which are included in the Barro and Lee Data and the World Bank Data.

In this study, I merged the three datasets and matched countries and years. First, only countries that were included in all three datasets were selected. Second, I selected information for 1995, 2000, 2005, and 2010 that were included in all three datasets. In the final dataset, a total of 140 countries that were commonly identified in all three datasets were included for the 1995-2010 period in 5-year intervals. A total of 560 observations (140 countries × 4 waves) were analyzed in this study.

Measures

Female education (independent variable) was measured using weighted average years of female schooling for the population 15-49 years old. Weights were allocated based on the population size of the age groups that composed this population. The population of 15-49 years old was selected because this age range is considered the

reproductive age for women.

Fertility (dependent variable) was measured using total fertility rate (TFR), which is the average number of children a woman would have if current age-specific birth rates remained constant throughout her childbearing years (15-49 years old).

Paid leave entitlements available to mothers (moderating variable) was measured as the total duration of paid leave available to mothers with infants or young children. The total length of paid leave was obtained by the sum of paid maternity leave and parental leave. The present study included both maternity leave and parental leave because in most countries, although not in all countries, maternity leave is often relatively short, and parental leave usually follows the period of maternity leave and serves as a supplement to maternity leave. Also, the present study included both leaves since the total period a mother can leave work is likely a more accurate proxy for analyzing the influence of paid leave on fertility. Further, in this study, paid leave was defined as leave during which mothers were guaranteed at least one-fifth of their previous earnings. The International Labor Organization (ILO) (2018) standards recommend that women be guaranteed at least two-thirds of their previous earning during leave in order to ensure a suitable standard of living; in reality, most countries fail to meet this requirement. Although many countries provide maternity leave above two-thirds of mothers' previous earnings, very few countries meet this standard during parental leave. The countries that did meet the standard were Austria, Iceland, Czech Republic, Lithuania, Luxembourg, Poland, and Slovenia. Very few countries (approximately 10% of the sample) were able to meet the ILO standards when both maternity leave and parental leave were combined. Hence, in order to avoid losing a large number of cases, the present study defined paid leave more generously. The possibility of wide variations in wage-replacement rates among countries and how this may modulate the effects of paid leave is considered further in the discussion section. In the present study, paid leave was defined as the total length of maternity leave and parental leave, during which mothers were guaranteed at least one-fifth of their previous earnings. I have divided the paid leave entitlements available to mothers as a four-mutually-exclusive-category variable (1=no paid leave or less than 14 weeks, 2=14-25.9 weeks, 3=26-51.9 weeks, 4=52 weeks, or more). In this study, no paid leave and less than 14 weeks were combined for two reasons: first, the ILO standards denote that mothers should be guaranteed at least 14 weeks of leave (ILO, 2018) and, second, only approximately 4% of the study observations (n=23) reported no paid leave (See Table 1). Due to data limitations, the present study could not distinguish between prenatal and postnatal leave.

GDP per capita (control variable) was measured using a per capita constant to the year 2010 US dollar to adjust for inflation. GDP per capita is GDP divided by the size of the nation's overall population and hence is considered to provide a better determination of living standards than GDP (Amadeo, 2019). The "fertility rebound and economic growth" model is based on the observation that fertility decreases as GDP per capita

increases but rebounds as GDP per capita further increases (Luci-Greulich & Thévenon, 2010). Weil and Sharma (2016) claimed that as countries get richer, people value children as 'normal goods' on which they need to spend money, and in high-income countries, the cost of raising children increases as parents have fewer children and focus more on the "quality" of the children, and improving the children's prospects in life. However, a series of recent empirical studies have identified changing relationships between economic growth and fertility rates (Dominiak, Lechman, & Okonowicz, 2015; Luci-Greulich & Thévenon, 2010; Myrskylä, Kohler, & Billari, 2009;). Myrskylä et al. (2009) found that in highly developed countries, further development halted the declining fertility rates, which means that the previously negative development-fertility association was reversed, and the graph became U-shaped. Based on Myrskylä et al. (2009), in the present study, GDP per capita was included as an inverted U-shape quadratic curve.

Under-five mortality (control variable) was measured using death under age five per 1,000 live births. Extensive empirical literature establishes a positive relationship between reductions in child mortality and declines in fertility (Boldrein & Jones, 2002; Galor & Weil, 1999; Kalemli-Ozcan, 2003). In an environment with high child mortality – particularly at a young age – individuals will give birth to more children than they want to insure against the loss of children (Kalemli-Ozcan, 2003). In countries that are notably lacking in public and private forms of social security, children are a major source of financial support for later years, and parents aim to maximize their return on investment (Montgomery & Cohen, 1998). If child mortality is high, then parents continue to invest in the number of children in favor of focusing on one or two children, and their "quality" through investments such as a good education. Hence, based on existing literature, I decided to control for under-five mortality in this study.

The female employment rate (control variable) was measured using the female labor force participation rate (% of female population ages 15 and above) modeled based on the International Labor Organization (ILO) estimations. Female employment and fertility have long been closely linked (Emara, 2016; McClamroch, 1996; Oshio, 2019; Rindfuss, Guzzo, & Morgan, 2003). Becker (1981) argued that the increasing role of women in the labor market is expected to raise the opportunity cost of childbearing and thereby reduce fertility; hence, a negative relationship exists between female employment and fertility, which is corroborated in Kögel's (2004) study, which examined fertility and female employment in OECD countries for 1960-2000. On the other hand, some researchers have argued that high unemployment (including female employment) induces women to postpone and space births, which in turn, reduces total fertility, thereby giving rise to a positive association between female employment and fertility (Rocha & Fuster, 20006). However, Oshio (2019) found that while the relationship between female employment and total fertility rate was negative in OECD countries during the years 1970-2004, the data reversed and started to show a positive relationship during 2005-2017.

Analytical Strategy

A two-way fixed effects (FE) model was used to estimate the relation between female education and total fertility rate, and how paid parental leave moderates this relation, while controlling for GDP per capita and under-five mortality. If the present study were to run a pooled ordinary least square regression model, the results would be biased because of repeated measures and unobserved heterogeneity. The present study applied a series of panel data methods to reduce the risk of biased estimators.

First, we distinguished within-country and between-country variations in order to identify a causal effect of education on fertility. Between-country variations were identified using a Between Effects (BE) model, which is based on a time average of each variable for each country, and within-country variations were identified by using a simple one-way FE model. The coefficients in the BE model for average female schooling and paid leave were not statistically significant, indicating that between-country variation was primarily driven by within-country variation. FE modeling eliminates unobserved country-specific variables that are constant over time and therefore reduces the risk of obtaining an omitted variable bias (i.e., unobserved country-heterogeneity). The present study also conducted Random Effects (RE) modeling, which captures both within- and between-country variations. While a fixed-effects model uses only time-series information and measures the expected changes within a country when an independent variable changes by one unit (i.e., causal relationship), a random-effects model measures both changes between and within units (Wooldridge, 2008). In random-effects modeling, a one-unit increase in "X" may have two meanings: (1) differences between countries when there is a unit difference in "X" between them; and (2) differences within a country when "X" increases by one. Random-effects modeling averages the two effects (Woodridge, 2008). Like the FE model, the RE model can also control for unobserved country heterogeneity; however, it can only be used on the assumption that the unobserved effects are not correlated with the error term. The present study conducted a Hausman test to compare FE and RE estimators, and results confirmed that the FE specification is a better fit than the RE specification in controlling for unobserved country-heterogeneity ($x2 = 79.19^{***}$).

Further, the present study used two-way FE modeling that combines country-specific dummy variables with time dummies in order to control for not only country-fixed-effects but also time shocks. This further reduces the risk of obtaining biased estimates due to unobserved variables. To confirm two-way FE modeling with time dummies is needed, I conducted a joint test to see if the time dummies are not equal to zero. Results confirmed that they are not, and thus, two-way FE modeling was required ($F=18.60^{***}$). Hence, the final model for this study was as follows:

$$LogTFRi,t=\beta 0i + + \beta 2Feamle\ educationit + \beta 3Parental\ leaveit + \beta 4Parental\ leavei,t*Female\ Educationit + \beta 5log(GDP\ per\ capitait) + \beta 6log(GDP\ per\ capitait)2 + \beta 9log(Under\ five\ mortalityit) + \beta 6log(Female\ employmentit) + \beta 7Timet + \mu i + eit$$

(here, i=country, t=time, μi=country-fixed effects, eit=country and time-specific random shocks)

Results

Table 1 presents the descriptive analysis of the total fertility rate, average female years of schooling, paid parental leave, GDP per capita, under-five mortality rate, and female employment rate over time. Results showed that the total fertility rate decreased consistently between 1995 and 2010 from 3.41 to 2.85 live births per woman (17% decrease). At the same time, the average years of schooling for females increased from 7.35 to 8.80 (20% increase). GDP per capita (constant to 2010 USD) increased from USD 11,982 to USD 15,169 (35% increase), under-five mortality decreased from 60 to 36 deaths per 1,000 births (66% decrease), and female employment increased from 45% to 49% (8% increase) between 1995 and 2010. Regarding paid leave entitlements available to mothers, in 1995, approximately 57% of the surveyed countries provided less than 14 weeks of paid leave or no paid leave for mothers, and less than 10% of countries provided more than 52 weeks of paid leave. In 2010, approximately 46% of countries provided less than 14 weeks of paid leave or no paid leave for mothers, and approximately 17% of countries provided more than 52 weeks of paid leave. Overall, between 1995 and 2010, an average of 4% provided no paid leave, 48% provided less than 14 weeks, 27% provided 14 to 25.9 weeks, 7% provided 2 to 51.9 weeks, and 14% provided more than 52 weeks or more.

Table 1: Description of variables, 1995-2010 (N=140 Countries)

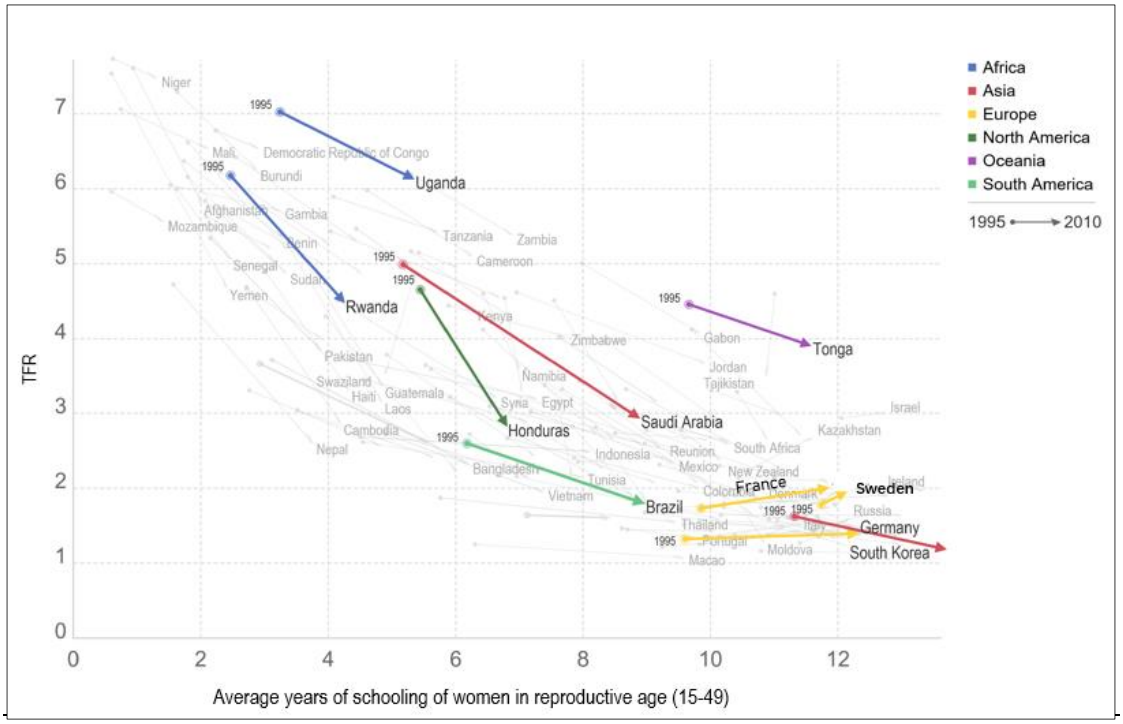
Year	Total Fertility Rate	Average female years of schooling (aged 15-49)	GDP per capita, constant to 2010 USD	Under-five mortality (deaths under age 5 per 1000 live births)	Female employment rate
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
1995	3.41 (1.79)	7.35 (3.35)	11,982.19 (16,445.59)	60.57 (63.29)	45.47 (11.87)
2000	3.16 (1.69)	7.81 (3.35)	13,844.13 (19,090.26)	54.15 (56.73)	47.61 (12.89)
2005	2.96 (1.58)	8.32 (3.28)	15,087.50 (20,313.34)	43.95 (45.83)	47.69 (12.79)
2010	2.85 (1.43)	8.80 (3.15)	15,169.35 (20,113.88)	36.124 (39.44)	49.29 (13.13)
Average	3.09 (1.63)	8.08 (3.31)	14,047.02 (19,066.35)	48.62 (52.74)	47.71 (12.75)

Paid Parental leave for mothers	1995	2000	2005	2010	Average
No paid leave	5.93%	5.84%	2.88%	2.16%	4.18%
Less than 14 weeks	51.11%	49.64%	48.20%	43.88%	48.18%
14-25.9 weeks	28.89%	27.01%	25.90%	27.34%	27.27%
26-51.9 weeks	4.44%	5.84%	6.47%	9.35%	6.55%
52 weeks or more	9.63%	11.68%	16.55%	17.27%	13.82%

Note: A Paid leave for mothers includes both paid maternity leave, which is leave reserved for mothers of infants, and paid parental leave, which is leave available to either parent. Paid leave here refers to when mothers are guaranteed at least one-fifth of their previous earnings during the entire leave period.

Figure 1 presents a visual view of how the relationship between total fertility rate and average female years of schooling changed from 1995 to 2010 by country. Overall, in most countries, total fertility rates declined when countries' average female years of schooling increased. However, in some developed countries, such as France, Sweden, Netherlands, and Finland, total fertility rates increased while the average female years of schooling also increased.

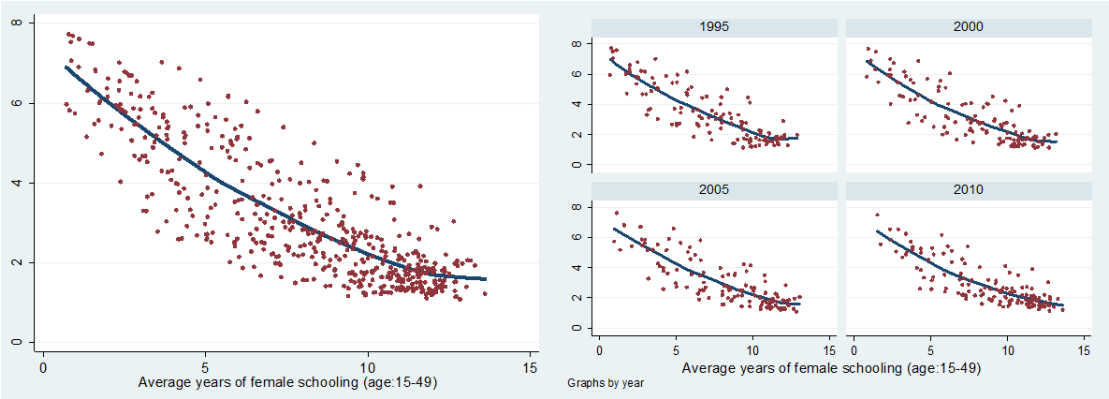
Figure 1: Average years of female schooling and TFR between 1995-2010 for selected countries



Source: Max Roser (2018) "Fertility Rate." Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/fertility-rate'. The data used by Max Roser corresponds with the data used in this study. Max Roser developed a graphical animated figure, which illustrates a country's TFR and average years of female schooling between 1995-2010. Here, I present his figure.

The Locally Estimated Scatterplot Smoothing (LOWESS) graphs is a statistical method that creates a smooth line through scatterplots to help researchers understand the general relationship between variables or trends. Figure 2 represents the LOWESS graphs between countries' average years of female schooling and TFR by years. The graphs overall indicate a decreasing logged-shaped relationship (i.e., the slope becomes gradual as the predictor variable increases) between total fertility rate and average female years of schooling. The decreasing logged-shaped relationship between total fertility rate and average female years of schooling was consistently shown over time between 1995 and 2010.

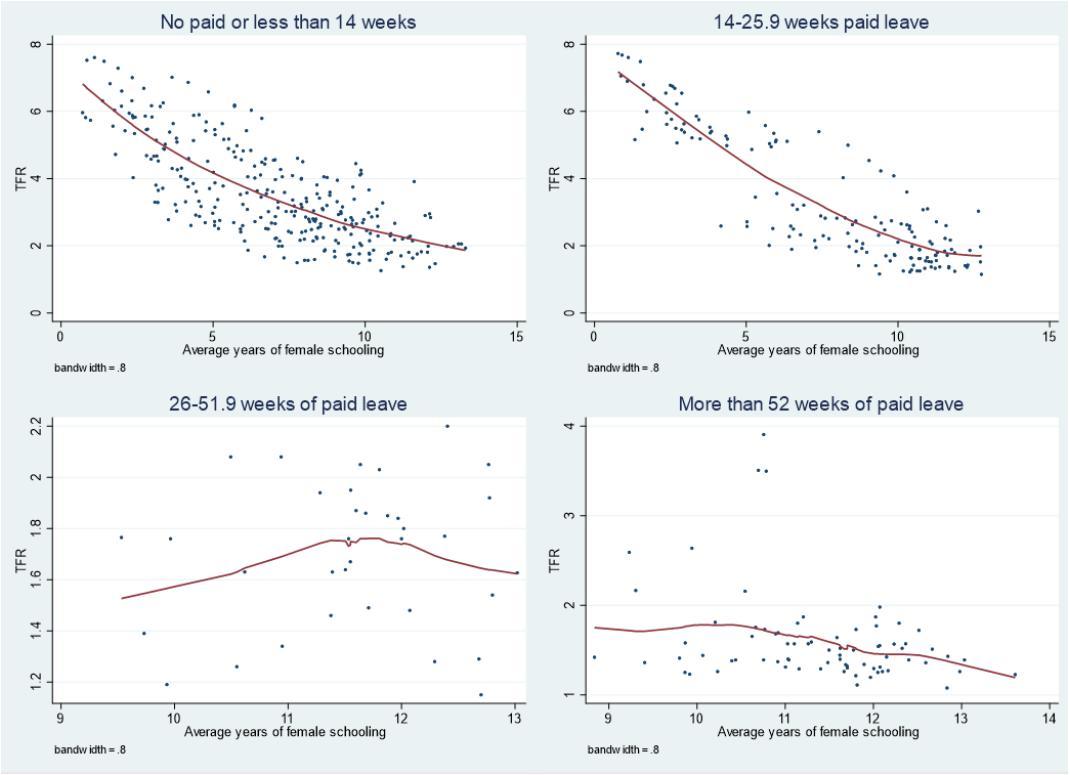
Figure 2: LOWESS graphs of average years of female schooling and TFR by year



Source: Author's calculation.

Further, I have created the LOWESS graphs by countries' weeks of paid parental leave to understand how the relationship between female education and total fertility rate may change according to countries' provision of paid leave for mothers (Figure 3). The LOWESS graphs indicated a decreasing logged-shaped relationship between average years of female schooling and the total fertility rate for countries that provided less than 26 weeks of paid leave for mothers. However, this negative relationship was no longer salient among countries that provided more than 26 weeks of paid leave. In countries that provided mothers with 26 to 51.9 weeks of paid leave, the relationship between female years of schooling and TFR showed a weak inverse U-shaped relationship (TFR increased as female years of schooling increased, but when countries' average female years of schooling exceeded 12 years TFR started to decrease gradually). For countries that provided more than 52 weeks of paid leave for mothers, the relationship between average female years of schooling and TFR seemed to flatten out.

Figure 3: LOWESS graphs of average years of female schooling and TFR by weeks of paid leave for mothers.



Source: Author's calculation.

Table 2 presents the regression results for the OLS, between effects (BE), country-fixed effects, country-random effects, and country & time two-way fixed effects estimation models while controlling for GDP per capita, under-five mortality, and female employment. In contrast to Pooled OLS and BE results, which estimate between-country differences, the FE and RE results showed that when countries' average female years of schooling increased, total fertility rate decreased significantly, which suggests that fertility variation was mainly due to changes in female schooling over time (i.e., within-country variation).

Our final country-FE & time-FE results, which controlled for any periodic and country-specific events, indicated that if a country had no paid leave or less than 14 weeks of paid leave entitlements available to mothers, each additional year of average female schooling decreased a country's total fertility rate by 5% (p<0.01) while controlling for GDP per capita, under-five mortality, and female employment rate. If a country had 14 to 25.9 weeks of paid leave, each additional year of average female schooling decreased a country's total fertility rate by 4% (= –0.06+0.02, p<0.1). If a country had 26 to 51.9 weeks of paid leave, each additional year of average female schooling increased a country's total fertility rate by 3% (= –0.06+0.09, p<0.01) and if a country had 52 weeks or more paid leave then each additional year of average female years of

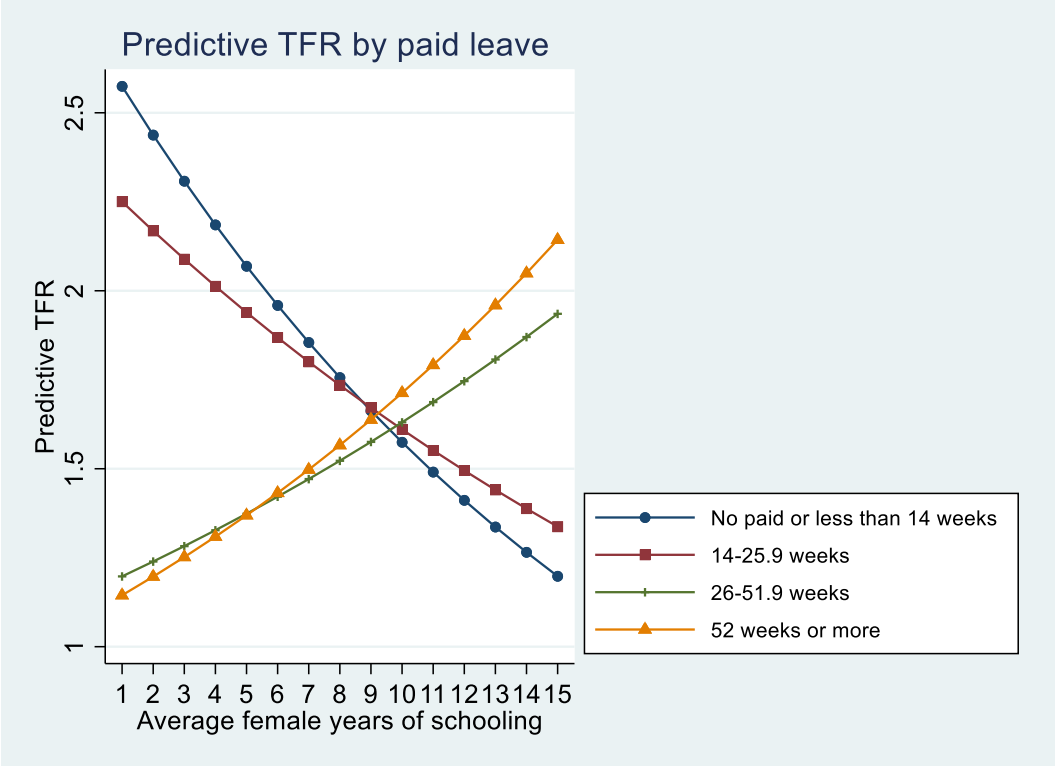
schooling was reported to increase the total fertility rate by 4% (=–0.06+0.10, p<0.01). In Figure 4, I have exponentiated the coefficients from the final model and presented the predicted total fertility rate as a function of years of female schooling by paid leave weeks. It is clear from the graph that if a country provided longer periods of paid leave, the negative relationship between total fertility rate and average years of female schooling attenuated. There was a clear negative relationship between women's education and total fertility rate for countries that provided fewer than 25.9 weeks of paid leave; however, the negative slope was not as steep when a country provided 14 to 25.9 weeks than when it offered less than 14 weeks or no paid leave. The relationship between female education and total fertility rate changed to a positive relationship when countries provided more than 26 weeks of paid leave, and the positive relationship was stronger when countries had a more extensive period of paid leave after controlling for GDP, under-five mortality, and female employment. These results support the idea that paid leave helps moderate the negative effect of female education on fertility by decreasing the opportunity costs of having (additional) children, allowing educated mothers to retain their employment and preserving their income loss during absence from work to take care of newborns or young children.

Table 2: Multilevel mixed-effects model for 140 countries (560 observations)

Logged TFR	Pooled OLS (robust SE)	Between Effects	Country Random Effects	County Fixed Effects	Country & Time Fixed Effects
Year (ref: year 1995)					
2000					-0.08 (0.02)**
2005					-0.12 (0.04)**
2010					-0.11 (0.06)†
Average female years of schooling	-0.01 (0.01)	-2.39e-4 (0.02)	-0.04 (0.01)**	-0.07 (0.02)***	-0.05 (0.02)**
Paid leave (ref: no paid leave or less than 14 weeks)					
14-25.9 weeks	0.22 (0.13)	0.36 (0.19)†	-0.04 (0.08)	-0.19 (0.09)*	-0.15 (0.09)
26-51.9 weeks	-0.80 (0.49)	-1.28 (1.42)	-0.795 (0.34)*	-0.88 (0.25)**	-0.85 (0.27)**
52 weeks or more	-0.57 (0.25)*	-0.06 (0.69)	-1.35 (0.34)***	-0.99 (0.39)*	-0.91 (0.33)**
Average years of schooling × Paid leave (ref: no paid leave or less than 14 weeks)					
14-25.9 weeks	-0.03 (0.01)*	-0.04 (0.02)*	1.46e-3 (0.01)	0.02 (0.01)*	0.02 (0.01)†
26-51.9 weeks	0.06 (0.04)	0.10 (0.13)	0.07 (0.03)*	0.09 (0.02)***	0.09 (0.02)**
52 weeks or more	0.03 (0.03)	-0.01 (0.07)	0.12 (0.03)***	0.10 (0.03)**	0.10 (0.03)**
Log GDP per capita	-0.77 (0.15)***	-0.63 (0.22)**	-0.73 (0.21)**	-0.76 (0.42)†	-1.29 (0.44)**
Log GDP per capita^2	0.04 (0.01)***	0.04 (0.01)**	0.04 (0.01)**	0.04 (0.02)†	0.08 (0.02)**
Log Under five mortality	0.22 (0.04)***	0.27 (0.05)***	0.16 (0.43)***	0.11 (0.05)*	0.03 (0.06)
Log Female employment	-0.04 (0.05)	-4.27e-3 (0.07)	-0.04 (0.06)	-0.08 (0.07)	-0.07 (0.07)
Constant	3.81 (0.77)***	2.76 (1.11)*	4.22 (1.07)***	4.53 (2.02)*	6.56 (2.10)**
Sigma_u			0.19	0.29	0.44
Sigma_e			0.08	0.08	0.08
rho			0.85	0.92	0.97

*Note: †p < 0.1, *p < 0.05, **p< 0.01, ***p <0.001*

Figure 4: Predicted TFR by average years of female schooling by paid leave based on Model 5



Note: GDP, under-five mortality, and female employment are fixed at mean value.

Discussion

The present study examined the relationship between women's education and total fertility rate between 1995 and 2010 based on 140 countries, and how paid leave entitlement available to mothers moderates the relationship between women's education and total fertility rate. The findings revealed that (1) overall, there was a negative-logged relationship between total fertility rate and average female years of schooling (i.e., the negative relationship between total fertility rate and female years of schooling attenuates as average female years of schooling increases); and (2) paid leave significantly moderated the negative relationship between female years of schooling and total fertility rate even after controlling for GDP per capita, under-five mortality, and female employment. Results showed that the negative effect of female years of schooling on total fertility rate diminished if a country had 26 weeks or more paid leave available for mothers, corroborating the notion that paid leave helps mitigate the opportunity costs of childbearing and allows women to take time off from work while retaining their source of income.

Limitations

Before discussing the implications of this study, I must consider its limitations. First, the study used macro country-level data to analyze the relationship between female education, fertility and paid leave. Macro country-level data rely on aggregated information and cannot tell us how fertility behaviors differ among individuals. In this study, I focused on country-level characteristics. The present study did not analyze how fertility behaviors differed by socioeconomic group. Second, due to data limitations, other country-level variables such as social norms, gender values, and policy idiosyncrasies could not be included as control variables. Most datasets for these variables are only available for OECD or European Union countries. Third, the present study examined fertility based on total fertility rates, which is the number of live births a hypothetical woman would have if she passed through her childbearing years conforming to the age-specific fertility rate of the current year. One weakness of the total fertility rate is that it overlooks the fact that age-specific fertility rates may change over time (i.e., "tempo effect"). With the mean age of marriage and first births being postponed, it is important to investigate the tempo effect of total fertility. Tempo-adjusted total fertility rates have been developed and used in some countries (Bongaarts & Sobotka, 2012). However, due to data limitations, tempo-adjusted total fertility rates are currently not available for many countries, especially developing countries. The present study considered using cohort fertility rate (i.e., the total number of children women from a specific birth year give birth to throughout their childbearing years) in order to take tempo effects into account; however, paid parental leave, GPD per capita, under-five mortality, and female employment rate are difficult to compute in accordance with cohort fertility rate. Also, data was only available for cohorts born between 1948-1963, and thus, these cohorts would not have reflected the latest education and fertility trends.

Further, the complexities of measuring paid leave should be considered. First, there is a potential issue of accessibility: even though leave policies are available, some mothers may not be able to utilize the policies. However, according to an OECD survey that appraised the take-up rate of parental leave by gender across OECD countries, parental leave take-up by mothers was reported to be quite high (OECD, 2018). In 2016, in half of all OECD countries with available data, female recipient rates were around or above 100 per 100 live births – that is, at least one-woman user/recipient for every child born. In Estonia and the Czech Republic, more than 200 women were claiming publicly administered parental benefits or using publicly administered parental leave for every 100 live births. In Sweden, the rate was as high as 380 recipients per 100 live births. This phenomenon may not apply to non-OECD countries, and country-specific idiosyncrasies may exist. Due to data limitations, the present study could not include measurements related to the take-up rate in non-OECD countries, but future studies may usefully explore this issue. In this study, I examined the relationship between female education, fertility, and paid leave, treating

leave policies as if they were available and accessible to all mothers.

Second, as mentioned above, the present study defined paid leave as when mothers were guaranteed at least one-fifth of their previous earnings, which is far below the ILO standard (i.e., two-thirds of previous earnings). Very few countries meet the ILO standard. Koslowski, Blum, Dobrotić, Macht, and Moss (2019) published an annual review of 43 cross-countries' leave policies, and categorized countries that provided more the two-thirds of previous earnings as "well paid" and others as "paid." There are wide variations in the wage-replacement rate among different countries, and it is difficult to say that leave policies with two-thirds of previous salaries for 14 weeks are better or worse than leave policies with one-fifth of previous salaries for 52 weeks. The data used in the present study provides wage-replacement rates by category (i.e., 20-65%, 66-79%, and 80-100%) and more than 90% of the countries fall under the '20-65%' category; hence, to avoid losing a considerable number of observations, the present study defined 'paid' leave generously, as at least one-fifth of previous earnings. A recent 2019 OECD report acknowledged the issue of comparing countries' paid leave by simply length and developed a "full-rate equivalent rate (FRE)', which is the length of paid leave in weeks if it were paid at 100% of previous earnings (OECD, 2019). This is a more advanced measurement that encompasses both the length of paid leave and the payment rate of a county and standardizes how many weeks a recipient can take leave when they are paid 100% of their previous earnings, allowing more robust comparison between countries possible. However, as of now, there is only data available for 2018 for OECD countries.

Despite these limitations, the present study has important strengths. It is the first empirical study to examine the relationship between female education, total fertility, and paid leave using a large panel survey of 140 countries. The study is also the first study to empirically examine how paid leave for mothers moderates the relationship between female education and total fertility rates. Findings from this study provide potentially valuable information to researchers and policymakers concerned with decreasing fertility and provide empirical evidence to support policies that help mothers to keep their careers while also taking care of their newborns or young children.

Implications

The LOWESS findings indicated a negative correlation between countries' average years of female education and total fertility rate, corroborating the argument that a rise in women's education contributes to reduced fertility. However, further breakdown of the LOWESS graphs by weeks of paid leave for mothers showed that countries with more generous paid leave had a weaker negative relationship between female education and total fertility rate than countries with relatively meager paid leaves. Further, multivariate results reported that after controlling for GDP, under-five mortality, and female employment rate, the relationship between female education

and total fertility rate changed to a positive relationship when countries provided more than 26 weeks of paid leave and the positive relationship was stronger when countries had a more extensive period of paid leaves, which suggests that paid leave for mothers has a significant moderating effect, attenuating the negative relationship between female education and total fertility rate. This result confirms the idea that paid leave for mothers helps to decrease the opportunity cost of having children.

Also, multivariate results indicated that wealth (measured here as GDP per capita) had a significant relationship to the total fertility rate. In the present study, total fertility rate and GDP per capita were reported to show a significant quadratic U-shaped relationship: fertility dropped as GDP per capita increased, but then rose again. The result is in line with the "fertility rebound" theory put forth by Myrskylä et al. (2009), Dominiak et al. (2015), and Luci-Greulich and Thevenon (2010). Economic growth has been found to significantly contribute to the decline of total fertility rates in many countries. However, recently, in high-income economies, a 'fertility rebound' has emerged and, according to Dominiak et al. (2015), once a country passed the threshold level of GDP per capita 32,208 (in 2005 constant USD), fertility decline stopped and, in some cases, rose.

Although it is beyond the scope of this paper, it is also important to note that factors other than the expansion of paid leave may also have contributed to the attenuation of the negative relationship between female education and fertility. Recent literature notes that labor market inequality (Hanzan & Zoabi, 2015), especially in the US, high university enrollment rates, especially in South Korea (OECD, 2009; OECD, 2016; Yoo, 2014), and family planning, especially in developing countries (Lutz et al., 2017b; Roser, 2017) may have contributed to decreasing the negative effect of female education on total fertility rates. Hanzan and Zoabi (2015) found that fertility among highly educated women was rising in the US and this was because of growing inequality in the labor market which created both a group of women who can afford to buy services that help them raise their children and run household chores and a group of women who are willing to supply these services cheaply. In South Korea, fertility rates are low at all educational levels, and the educational differentials in fertility in Korea are minimal (Yoo, 2014), hence the negative relationship between female education and fertility is less steep. Education now has less leverage in the labor market, especially when approximately 70% of younger (aged 25-34) Koreans have more than tertiary education (compared to OECD average 42%, OECD, 2009). Lastly, in developing African and Asian countries, recently, low-cost and safe methods of contraception have become more widely available to the public, which has had the effect of lowering fertility rates among less-educated women and decreasing the educational fertility gap (Lutz et al., 2017b). In sum, many factors may have contributed to the decreasing negative relationship between female education and fertility, and it is important to consider contextual differences when applying the conclusions of the present study to specific populations.

In conclusion, the present study examined the relationship between average years of female schooling and total fertility rates, and whether and how paid leave for mothers moderate this relationship using large panel data from 140 countries. The present study highlights that paid leave for mothers had a significant moderating effect on attenuating the negative relationship between female education and fertility. The negative relationship between female education and total fertility rate was weaker in countries with more generous paid leave than countries with relatively meager paid leaves, and the relationship turned positive when countries provided more than 26 weeks of paid leave after controlling for GDP, under-five mortality, and female employment. The study results provide empirical evidence to policymakers to expand paid leave entitlement for mothers in order to help mitigate the opportunity cost of childbirth and to support work and child care.

References

Amadeo, K. (2020, April 14). GDP: *Understanding a country's gross domestic product*. https://www.thebalance.com/what-is-gdp-definition-of-gross-domestic-product-3306038.

Andersson, G., Rønsen, M., Knudsen, L. B., Lappegård, T., Neyer, G., Skrede, K., Teschner, K., & Vikat, A. (2009). Cohort fertility patterns in the nordic countries. *Demographic Research*, 20, 313–352. https://doi.org/10.4054/demres.2009.20.14

Barro, R. J., & Lee, J. W. (2013). A new data set of educational attainment in the world, 1950–2010. *Journal of Development Economics*, 104, 184–198. https://doi.org/10.1016/j.jdeveco.2012.10.001

Bassford, M., & Fisher, H. (2016). (working paper). *Bonus babies? The impact of paid parental leave on fertility intentions*. Retrieved from http://econ-wpseries.com/2016/201604.pdf

Becker, G. S. (1981). *A treatise on the family*. Harvard University Press.

Boldrin, M., & Jones, L. E. (2002). Mortality, fertility, and saving in a Malthusian economy. *Review of Economic Dynamics*, 5(4), 775–814. https://doi.org/10.1006/redy.2002.0186

Bongaarts, J. (1987). The proximate determinants of fertility. *Technology in Society*, 9(3-4), 243–260. https://doi.org/10.1016/0160-791x(87)90003-0

Bongaarts, J., & Sobotka, T. (2012). A demographic explanation for the recent rise in European fertility. *Population and Development Review*, 38(1), 83–120. https://doi.org/10.1111/j.1728-4457.2012.00473.x

Cigno, A. (1994). *Economics of the family*. Clarendon Press.

Dominiak, P., Lechman, E., & Okonowicz, A. (2015). Fertility rebound and economic growth. New evidence for 18 countries over the period 1970–2011. *Equilibrium*, 10(1), 91. https://doi.org/10.12775/equil.2015.005

Emara, N. (2016). Fertility and female employment: A panel study on developing countries. *Applied Economics and Finance*, 3(2). https://doi.org/10.11114/aef.v3i2.1381

Galor, O., & Weil, D. N. (1999). From Malthusian stagnation to modern growth. *American Economic Review*, 89(2), 150–154. https://doi.org/10.1257/aer.89.2.150

Goldscheider, F., Bernhardt, E., & Lappegård, T. (2015). The gender revolution: A framework for understanding changing family and demographic behavior. *Population and Development Review*, 41(2), 207–239. https://doi.org/10.1111/j.1728-4457.2015.00045.x

Gustafsson, S. (2001). Optimal age at motherhood. Theoretical and empirical considerations on postponement of maternity in Europe. *Journal of Population Economics*, 14(2), 225–247. https://doi.org/10.1007/s001480000051

Hazan, M., & Zoabi, H. (2014). Do highly educated women choose smaller families? *The Economic Journal,* 125(587), 1191–1226. https://doi.org/10.1111/ecoj.12148

International Labour Organization. (2018). *C183 - Maternity Protection Convention, 2000* (No. 183). Convention C183 - Maternity Protection Convention, 2000 (No. 183). https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB%3A12100%3A0%3A%3ANO%3A%3AP12100_ILO_CODE%3AC183.

Jejeebhoy, S. J. (1998). *Women's education, autonomy, and reproductive behaviour: experience from developing countries*. Clarendon Press.

Kalemli-Ozcan, S. (2003). A stochastic model of mortality, fertility, and human capital investment. *Journal of Development Economics*, 70(1), 103–118. https://doi.org/10.1016/s0304-3878(02)00089-5

Koslowski, A., Blum, S., Dobrotić, I., Macht, A., & Moss, P. (2019). *15th International review of leave policies and related research 2019*. s. n.

Kravdal, O. (2002). Education and fertility in Sub-Saharan Africa: Individual and community effects. *Demography*, 39(2), 233. https://doi.org/10.2307/3088337

Kravdal, Ø., & Rindfuss, R. R. (2008). Changing relationships between education and fertility: A study of women and men born 1940 to 1964. *American Sociological Review*, 73(5), 854–873. https://doi.org/10.1177/000312240807300508

KöGel, T. (2004). Did the association between fertility and female employment within OECD countries really change its sign? *Journal of Population Economics*, 17(1), 45–65. https://doi.org/10.1007/s00148-003-0180-z

Lalive, R., & Zweimüller, J. (2009). How does parental leave affect fertility and return to work? Evidence from two natural experiments. *Quarterly Journal of Economics*, 124(3), 1363–1402. https://doi.org/10.1162/qjec.2009.124.3.1363

Luci-Greulich, A., & Thévenon, O. (2010). (working paper). *Does economic development drive the fertility rebound in oecd countries?* Institut National d'Etudes Démographiques. Retrieved from https://www.ined.fr/en/publications/editions/document-travail/does-economic-development-drive-the-fertility-rebound-in-oecd-countries-en/

Luci-Greulich, A., & Thévenon, O. (2013). The impact of family policies on fertility trends in developed countries. *European Journal of Population / Revue Européenne De Démographie*, 29(4), 387–416. https://doi.org/10.1007/s10680-013-9295-4

Lutz, W., Butz, W. P., KC, S., Gietel-Basten, S., Sobotka, T., & Zeman, K. (2017a). Future fertility in low fertility countries. In *World population and human capital in the twenty-first century: An overview* (pp. 39–146). essay, Oxford University Press.

Lutz, W., Butz, W. P., KC, S., Fuchs, R., & Goujon, A. (2017b). Future fertility in high fertility countries. In *World population and human capital in the twenty-first century: An overview* (pp. 147–225). essay, Oxford University Press.

Malkova, O. (2018). Can maternity benefits have long-term effects on childbearing? Evidence from Soviet Russia. *The Review of Economics and Statistics*, 100(4), 691–703. https://doi.org/10.1162/rest_a_00713

Martin, T. C. (1995). Women's education and fertility: Results from 26 demographic and health surveys. *Studies in Family Planning*, 26(4), 187–202. https://doi.org/10.2307/2137845

Martin, T. C., & Juarez, F. (1995). The impact of women's education on fertility in Latin America: Searching for explanations. *International Family Planning Perspectives*, 21(2), 52. https://doi.org/10.2307/2133523

Mcclamroch, K. (1996). Total fertility rate, women's education, and women's work: What are the relationships? *Population and Environment*, 18(2), 175–186. https://doi.org/10.1007/bf02208410

Montgomery, M., & Cohen, B. (1998). *From death to birth: mortality decline and reproductive change*. National Academy Press.

Myrskylä, M., Kohler, H.-P., & Billari, F. C. (2009). Advances in development reverse fertility declines. *Nature*, 460(7256), 741–743. https://doi.org/10.1038/nature08230

Organisation for Economic Co-operation and Development. (2009). *OECD Reviews of Tertiary Education: Korea 2009*. OECD Publishing.

Organisation for Economic Co-operation and Development. (2016). (rep.). *Education Policy Outlook: Korea*. Retrieved from http://www.oecd.org/education/Education-Policy-Outlook-Korea.pdf

Organisation for Economic Co-operation and Development. (2018). *PF2.2 Use of childbirth-related leave benefits*. http://www.oecd.org/els/family/database.htm.

Organisation for Economic Co-operation and Development. (2019). *PF2.1 Key characteristics of parental leave systems.* https://www.oecd.org/els/soc/PF2_1_Parental_leave_systems.pdf.

Oshio, T. (2019). Is a positive association between female employment and fertility still spurious in developed countries? *Demographic Research*, 41, 1277–1288. https://doi.org/10.4054/demres.2019.41.45

Rindfuss, R. R., & John, C. S. (1983). Social determinants of age at first birth. *Journal of Marriage and the Family*, 45(3), 553. https://doi.org/10.2307/351660

Robila, M. (2014). *Handbook of family policies across the globe*. Springer.

Rocha, J. M. D., & Fuster, L. (2006). Why are fertility rates and female employment ratios positively correlated across OECD countries? *International Economic Review*, 47(4), 1187–1222. https://doi.org/10.1111/j.1468-2354.2006.00410.x

Roser, M. (2014, February 19). *Fertility Rate. Our World in Data*. https://ourworldindata.org/fertility-rate.

Takayama, N., & Werding, M. (2011). *Fertility and public policy: how to reverse the trend of declining birth rates*. MIT Press.

Weil, D. N., & Sharma, A. (2016). *Economic growth*. Pearson Education.

Wood, J., Neels, K., & Kil, T. (2014). The educational gradient of childlessness and cohort parity progression in 14 low fertility countries. *Demographic Research*, 31, 1365–1416. https://doi.org/10.4054/demres.2014.31.46

Wooldridge, J. M. (2008). *Introductory econometrics: a modern approach*. South-Western College Pub.

World Bank. (2019). *Indicators*. Data. https://data.worldbank.org/indicator/

World Policy Analysis Center. (2020). *Is paid leave available to mothers and fathers of infants?* World Policy Analysis Center. https://www.worldpolicycenter.org/policies/is-paid-leave-available-to-mothers-and-fathers-of-infants/is-paid-leave-available-for-mothers-of-infants.

Yoo, S. H. (2014). Educational differentials in cohort fertility during the fertility transition in South Korea. *Demographic Research*, 30, 1463–1494. https://doi.org/10.4054/demres.2014.30.53