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LIU, Yang
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U-shaped Association between Education and Fertility among Married Women: Evidence from Japan*

Yang LIU

Research Institute of Economy, Trade and Industry

Abstract

Contrary to conventional views, evidence from several countries shows that fertility does not always decline with women's education due to the recent marketization of childcare, which may enable a positive relationship between women's labor supply and childcare. Using the most recent individual-level data, this study provides the first evidence of a U-shaped relationship between education and fertility among married Japanese women, focusing on the period 2015-2020, during which market-based childcare expanded substantially in Japan. Compared to low-educated women, highly educated women exhibit both higher fertility and greater labor supply. In contrast, medium-educated women supply more labor than low-educated women but exhibit lower fertility. Unlike the U-shaped education–fertility pattern observed in the United States, labor supply continues to substantially reduce fertility among highly educated women in Japan, as well as among women with medium and low levels of education. Based on standard economic theory of fertility, the U-shaped association could be driven by differences in the relative sizes of the income and substitution effects across education groups. In addition, the U-shaped pattern is not observed for permanent immigrant women living in Japan; instead, their fertility increases with education, likely reflecting a slower pace of economic and social integration. Overall, the results suggest that policies promoting women's human capital development may enhance both their fertility and labor supply in Japan, while obstacles for women balancing work and child-rearing still exist broadly in the country and more serious attention should be employed in tackling this issue.

Keywords: education, fertility, U-shaped relationship, labor supply, income effect, substitution effect

JEL classification: J13, J22, I24

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1. Introduction

The negative relationship between education and women's fertility has long been documented (Cygan-Rehm 2013). In recent years, however, several studies have provided new perspectives by showing that this correlation turns positive for highly educated women in the U.S. (Hazan and Zoabi 2015; Bar et al. 2018 (Fig. 1)) and in several European countries (Doepke 2023, Fig. 15). This change has been attributed to the expansion of market childcare, which enables a positive relationship between women's labor supply and fertility in those countries (e.g. Hazan and Zoabi 2015). Using recent large-scale individual data from Japan—a developed country with persistently low fertility and a challenging work environment for women—this study revisits this issue. Building on economic theories of fertility, the study contributes to the literature by providing empirical evidence that even if the association between the labor supply and fertility of highly educated women is negative, they can still exhibit both higher fertility and higher labor supply than low-educated women.

Following the economic theory of fertility, the relationship between women's education and fertility reflects the total education effect of the income effect and the labor-supply effect on fertility. According to conventional economic theory (Doepke 2023), in which all the childcare are conducted within the household, husbands' education generally affects fertility through the income effect, whereas wives' education affects fertility through both the income effect and the substitution effect associated with labor supply. Because women typically earn lower wages than men, the household's optimal labor allocation historically placed most childcare responsibilities on women, who therefore face a tradeoff between labor supply and childrearing, while men specialize in market work (Doepke 2023, p.165). The income effect is positive: higher education raises wages, enabling households to afford more children. By contrast, the substitution effect arises because education increases women's labor supply, reducing the time available for childcare and, in conventional models, lowering fertility. Given the husband's higher wage, "the substitution effect dominates, and a rise in women's wages lowers fertility" (Doepke 2023, p.165), implying a negative relationship between women's education and fertility.

More recently, several studies have shown that the substitution effect has weakened with the growth of market childcare. "When childcare can be marketized, the cost of raising children can be converted from opportunity costs into pure monetary costs" (Doepke 2023, p.183). Cross-country evidence suggests that the relationship between fertility and female labor supply has shifted from negative to positive in most developed countries (e.g. Hwang 2018, Oshio 2019). A U-shaped relationship between women's education and fertility has been documented in the U.S. (Hazan and Zoabi 2015; Bar et al. 2018 (Fig. 1)), with a "positive correlation between fertility and labor supply for highly educated women. (Hazan and Zoabi 2015)." Hwang et al. (2018) further show that greater substitutability between maternal time and market childcare "allows working women to have more children but it also attracts less productive women to enter the labor force, who trade childbirths for labor supply."

Despite these findings, it remains unclear whether a U-shaped relationship between education and fertility can arise even when the correlation between women's fertility and labor supply remains negative. This is theoretically possible because the U-shaped pattern reflects the total effect of education on fertility, which combines the positive income effect and the labor-supply effect of education. The income effect is positive, as women's higher education raises their wages and increases the ability to afford children. The labor-supply effect may be negative, as in conventional models (Doepke 2023), or may weaken or even turn positive in the presence of market childcare (Hazan and Zoabi 2015). Thus, the labor-supply effect may be negative, positive, or negligible. Because the total effect is the sum of the two components, a positive association between education and fertility does not necessarily imply a positive labor-supply effect. Even when the labor-supply effect remains negative, the total effect can be positive if the income effect is sufficiently large. Accordingly, unlike previous studies, this study examines whether a positive relationship between education and fertility can coexist with a negative relationship between labor supply and fertility.

In Japan, previous studies have documented a negative relationship between women's education and fertility using data from periods before the 2010s (e.g., Retherford, 2004). However, more recent studies suggest that this negative association has weakened in recent years. One important background factor is the substantial expansion of market-based childcare, driven by policies promoting the marketization of childcare services. In particular, the "New System for Children and Child-rearing Support," which was launched in April 2015, greatly increased the capacity of childcare facilities (Cabinet Office, 2015; Children and Families Agency, 2025). Yamaguchi and Kambayashi (2025) and Unayama (2023) further show that recent expansions in childcare provision have contributed significantly to fertility in Japan. However, traditional employment practices—particularly long working hours—continue to make it difficult for women to balance work and family responsibilities. This situation differs from the U.S., where highly educated women's likelihood of combining childrearing with continuous employment has increased among recent cohorts (Brinton and Oh 2019). In Japan, the proportion of women who remain employed after childbirth has remained low for decades, despite aggressive government efforts to encourage maternal employment (Brinton and Oh 2019). Based on interviews with highly educated Japanese men and women of childbearing age, Brinton and Oh (2019) argue that labor market structures and workplace norms create a highly gendered division of labor within households, leading "many married women to either forsake employment or to consider having only one child."

The remainder of this manuscript is structured as follows. Section 2 reviews the related literature. Section 3 describes the data. Section 4 presents the main estimates of the association between education and fertility. Section 5 examines whether the higher fertility of highly educated women in Japan is accompanied by reduced labor supply, and whether high-educated women no longer trade labor supply for fertility. Section 6 discusses the findings. Section 7 concludes.

2. Literature

For many years, negative relationships between women's education and fertility have been widely documented in the literature (e.g., Cygan-Rehm 2013). However, in recent years, several studies have noted that the negative relationship between education and fertility has weakened (Fort et al. 2016) or even turned positive (Doepke 2023). Hazan and Zoabi (2015) found that during 2001–2011, highly educated women had more children and worked more hours than low-educated women in the U.S. The declining or positive relationship between education and fertility has been widely attributed to the marketization of childcare in developed countries (Hwang et al. 2018; Hazan and Zoabi 2015). In a study of China, a developing country context, Chen (2022) explained their finding of a positive effect of women's education on fertility during 2010–2012 as: "first, education does not cause an increase in the mean age at first marriage; second, among ever-married women, education increases their demand for children."

In Japan, earlier studies have found a negative relationship between education and fertility using pre-2010 data, including Retherford (2004; data from 1966–2000), Shirahase (2000; data from 1995), and Nozaki (2017; Japanese General Social Survey 2005 and 2006). Although no study has found a positive relationship between women's education and fertility in Japan, several recent studies have observed that the negative relationship has weakened or even disappeared. Ghaznavi et al(2022) suggests that "higher education was associated with lower fertility, although this pattern was no longer observed among those born in 1971–1975." Zhang (2025) compares trends in women's education and fertility between Japan and China, finding that "Japan shows a weakening negative association between higher education and fertility over time," based on data from the Japan Panel Survey of Consumers (JPSC) conducted by Keio University from 1993 to 2021. Kondo (2024a) finds that among women in their late 30s, "for cohorts born in the late 1970s, college-educated women have more children than high school–educated women," in contrast to cohorts born between 1965 and 1975 (Kondo, 2024a, p. 8 and Figure 5), based on data from the Labour Force Survey. This result also suggests that the previously negative relationship between women's education and fertility has disappeared for these younger cohorts; however, it does not imply either a positive monotonic relationship or a U-shaped relationship between education and fertility, because the same figure (Kondo, 2024a, Figure 5) also shows that women with junior college education have more children than both college-educated and high-school-educated women within the same cohort. Moreover, this evidence is based on descriptive statistics of group averages and does not control for individual characteristics, regional factors, or spousal attributes.[2]. In addition, Okui (2024) concluded that

[2] Figure 4 in Kondo (2024a) and Figure 2-1 in Kondo(2024b, p.55) show a U-shaped relationship between women's birth year and average number of children. This is conceptually different from the focus of our study, which examines the relationship between women's education and fertility.

"persons with higher educational attainment tended to have a relatively favorable trend in the birth rate compared with persons with lower educational attainment in recent decades," while the study did not identify whether this effect arises from wives or husbands[3]. In contrast to these studies, the present study focuses on women's fertility during the period 2015–2020 and controls for individual characteristics, spousal attributes, and regional factors in the empirical analysis.

3. Data

This study uses the individual-level 10% random-sample data of the 2020 Population Census provided by the Ministry of Internal Affairs and Communications. City-level dummies (*Shikuchoson* in Japanese) are included to control for detailed regional factors such as local labor market conditions and the availability of childcare services. As the number of non-marital births is very small in Japan (Iwasawa 2004), we examine marital fertility, focusing on households consisting of married couples[4]. Couples living with their parents are excluded because the effects of co-residing parents are ambiguous: while some parents may provide help with housework and childcare, others may require care from the couple, thereby reducing the time available for housework or childcare. We also exclude individuals who are currently enrolled in school and special households, such as those in nursing homes or military facilities. Females are restricted to those aged 15–49.

Among the variables, fertility probability is defined as whether a woman gave birth in the past five years, controlling for her history of past births. This definition follows Hazan and Zoabi (2015), who examine women's fertility probability during 2001–2011. We limit the period to the five years closest to the census year—2015–2020—to examine recent fertility behavior under similar social and institutional environments. We do not use the lifetime number of births, as this measure captures fertility behavior over several decades under varying social and institutional conditions.

Education levels include university and junior college (defined as high-educated), high school (defined as medium-educated), and basic education (primary and lower-secondary school; defined as low-educated). Birth history is measured by the numbers of births in the past 5–11 years, 12–14 years, and 15–18 years. Age dummies include 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, and 45–49. Employment status includes non-participants, permanently employed, temporarily employed, self-employed, temporarily absent workers, and unemployed/job seekers. As income information is unavailable in the census, the husband's income is proxied by a high-income indicator, defined as 1 if the husband holds a highly skilled occupation (managerial or highly specialized/skilled jobs) and 0

[3] This finding in Okui (2024) is based on "Birth rate (estimated number of births per 1,000 persons) by gender, year, and educational attainment for each age group" (p. 6). However, the reported results show both increasing and decreasing relationships between education and the "birth rate," which therefore does not fully support the study's conclusion.

[4] Households with divorced mothers are excluded as non-marital births are very small in Japan, and fathers' information is unavailable in the data.

otherwise.

Population size refers to the population of the municipality in which the household is located and includes 20 categories: Population size = 1 if fewer than 3,000 persons; = 2 if 3,000–4,999 persons; = 3 if 5,000–9,999 persons; = 4 if 10,000–19,999 persons; = 5 if 20,000–29,999 persons; …; = 18 if 500,000–599,999 persons; = 19 if 600,000–999,000 persons; and = 20 if 1,000,000 persons or more.

Finally, permanent immigrants are defined as individuals who have lived in Japan for five years or more, including those who have obtained the right to stay indefinitely and those "admitted with a permit of limited duration that is more or less indefinitely renewable," following the OECD definition (OECD 2008). As Japanese policies do not allow temporary immigrants, such as those with statuses "Specified Skilled Worker (i)" or "Technical Intern", to remain in Japan for more than five years, restricting the sample to individuals with at least five years of residence effectively excludes all temporary immigrants.

4. The relationship between education and fertility

4.1 Stylized facts

Figure 1 shows that among all education and age groups, low-educated women aged 20–24 have the highest fertility rate. However, the rate declines sharply after age 25–29, and from age 30 onward, low-educated women experience the lowest fertility rate among all education groups. In contrast, high-educated women—including university and junior-college graduates—although they have the lowest fertility rate at ages 20–24, experience rising fertility thereafter, peaking at ages 30–34. Their fertility rates exceed those of medium- and low-educated women at ages 30–34, and the subsequent decline is more gradual, with their rates remaining higher than those of medium- and low-educated women up to ages 45–49. In addition, the fertility curve of medium-educated women lies between those of high- and low-educated women: it peaks at ages 25–29, after which the rate remains between the high- and low-educated groups.

Overall, Figure 1 indicates that high-educated women—who leave school the latest among all education groups—experience the lowest fertility in their twenties; however, their fertility rates peak at ages 30–34 and remain the highest among all education groups through ages 45–49. In contrast, low-educated women—who leave school the earliest—although they have the highest fertility rate at ages 20–24, experience a sharp decline thereafter.

(Figure 1)

Figure 2 presents the total fertility rates (ages 15–49) for each education group. Compared with basic-educated women, fertility is lower among high-school graduates. The rate increases among junior-college graduates, although it remains below that of basic-educated women, and reaches its highest level among university graduates. In other words, as education increases, fertility initially declines, remains low for a period, and then rises to the highest level among all education groups, forming a U-shaped relationship between education and fertility.

Note that in Figure 2, differences in fertility levels across education groups are influenced not only by women's education but also by their husbands' wages, husbands' education and employment, women's past childbirth history and age, household economic conditions, and regional factors. Therefore, in the subsequent section, this study estimates the association between women's fertility and women's education level while controlling for these factors.

(Figure 2)

4.2 Model

Following previous studies (e.g., Hazan and Zoabi 2015), the fertility outcome is estimated using the following specification:

$$y_{ij} = e'_{ij}\alpha + b'_{ij}\beta + X_{ij}\gamma + \delta_j + \epsilon_{ij} \tag{1}$$

In equation (1), y_{ij} is a binary indicator equal to 1 if woman i residing in city j gave birth within the past five years, controlling for her birth history prior to the past five years, denoted by b'_{ij}.[5] The vector b'_{ij} includes the number (zero or more) of previous children for each age category, thereby accounting for whether the observed birth corresponds to a first, second, or higher-order birth in the estimation. The vector e'_{ij} contains education-category dummies. The vector X_{ij} includes additional demographic and socioeconomic controls, such as the woman's age category, her own employment status, her husband's income proxy, her husband's education and employment status, household homeownership, and local population size. City fixed effects δ_j are included to absorb regional heterogeneity, such as differences in childcare availability and local labor market conditions. The disturbance term ϵ_{ij} represents unobserved individual-level determinants of fertility. Probit-model estimation is employed, and marginal effects are reported for the main results.

4.3 Estimation results

The results are reported in Table 1. Figure 3 summarizes the estimated marginal effects of education for the baseline model and the three comparison specifications. As shown in Table 1 and Figure 3, starting from the right-hand side of the education–fertility curve, university-educated women have a fertility probability that is 3.0 percentage points higher than that of high-school–educated women

[5] We do not use the total fertility rate (TFR) because it reflects women's fertility over several decades, making it unsuitable for capturing fertility behavior in a particular period.

(calculated as 0.0074* – (–0.0221***)). This is followed by junior-college graduates, whose fertility probability is 2.2 percentage points higher than that of high-school–educated women (calculated as 0 – (–0.0221*)). However, moving further to the left-hand side of the education–fertility curve, the fertility probability of high-school–educated women is significantly 2.2 percentage points lower than that of their lower-educated counterparts (low-educated women).

Overall, at the lower end of the education distribution, fertility decreases as education increases, while at the higher end, fertility increases with education. This pattern yields the U-shaped relationship between fertility and education.

A similar U-shaped association is also observed in Comparisons 2–4 (Figure 3). However, in detail, omitting husbands' characteristics leads to an overestimation of the association between women's education and fertility (Comparison 4). This upward bias may reflect educational assortative mating, which was estimated to be around 50% in Japan in 2010 (Fukuda et al. 2021). This issue arises in studies that combine married and unmarried women, where husband-level variables are unavailable for unmarried women and therefore omitted from the estimation. This is one of the reasons why the present study focuses exclusively on married women rather than pooling married and unmarried women together.

In addition, excluding detailed regional and population variables leads to an underestimation of the education–fertility association (Comparisons 2 and 3), confirming the importance of controlling for regional characteristics. The result of control variable of birth history indicates that having given birth more than five years ago is associated with a lower probability of having a birth in the past five years, and this pattern is consistent across all specifications. In particular, relative to women without such prior births, the probability of a birth in the past five years is on average 5.2, 16.9, and 19.9 percentage points lower for women who had a birth in the past 6–11 years, 12–14 years, and 15–18 years, respectively (Model).

(Table 1)

(Figure 3)

5. Labor supply, education, and fertility

To better understand the U-shaped association between education and fertility, this section examines how labor supply relates to both education and fertility, as labor supply is a key factor influencing women's fertility decisions. Conventional views predict a negative association between women's fertility and labor supply. Therefore, this section first tests whether highly educated women—who exhibit higher fertility—actually supply less labor. The empirical results show the opposite: higher fertility among highly educated women is accompanied by higher labor supply.

In the U.S. context, this pattern has been interpreted as evidence that highly educated women may no longer face a trade-off between fertility and labor supply. Thus, the next step is to examine whether the same holds in Japan—namely, whether Japanese women no longer trade labor supply for fertility. The analysis shows that, in contrast to the U.S. case, the association between labor supply and fertility remains negative among Japanese women.

Finally, these findings can be understood through the mechanism that the total effect of education on fertility is the sum of the income effect and the labor-supply (substitution) effect. Education may raise fertility if the income effect dominates, even though the labor-supply effect remains negative. This framework reconciles the coexistence of higher fertility and higher labor supply among highly educated women in Japan.

5.1 Are higher fertility levels among highly educated women accompanied by lower labor supply?

If fertility and labor supply were negatively correlated as in the conventional view, highly educated women—who have higher fertility rates—would be expected to work less. To test this, labor supply is estimated using the following specification:

$$l_{ij} = e'_{ij}\alpha + n'_{ij}\beta + X_{ij}\gamma + \delta_j + \epsilon^{l}_{ij}, \tag{2}$$

Here, l_{ij} denotes either labor force participation or permanent employment. The vector n_{ij}contains indicators for the number of children in age ranges 0–5, 6–11, 12–15, and 16–18.

All remaining controls follow the definitions in equation (1).

Table 2 shows that highly educated women—who also exhibit the highest fertility (Table 1)—have the highest labor supply. Both labor force participation and permanent employment increase monotonically with education. Controlling for observed characteristics, university-educated women have labor force participation and permanent employment probabilities that are 16.3 and 34.7 percentage points higher, respectively, than those of low-educated women. For junior-college graduates, the corresponding increases are 12.1 and 20.2 percentage points.

Thus, despite the conventional expectation of a negative relationship between fertility and labor supply, highly educated married women in Japan exhibit both higher fertility and higher labor supply relative to medium- and low-educated women.

(Table 2)

5.2 Do highly educated women no longer trade labor supply for fertility?

The U.S. evidence in Hazan and Zoabi (2015) suggests that highly educated women may no longer face a trade-off between fertility and labor supply. However, a positive total effect of education on fertility does not imply that the marginal effect of labor supply is no longer negative. It remains possible that highly educated women have higher fertility and higher labor supply on average, while within the group of highly educated women, greater labor supply still reduces fertility.

To examine this hypothesis, fertility is estimated as:

$$y_{ij} = s'_{ij}\theta + b'_{ij}\beta + X_{ij}\gamma + \delta_j + \epsilon^{s}_{ij} \quad (3)$$

Here, y_{ij} indicates whether woman i gave birth in the past five years. The vector s'_{ij} includes detailed labor supply categories: permanent employment, temporary employment (part-time or informal employment), employer, self-employed or family worker, and job search (unemployed), with non-participation as the reference group. A work-break indicator, capturing periods during which women are temporarily out of work (e.g., maternity leave), is included as a separate category.

The results, reported in Table 3, show that coefficients on labor supply variables are significantly negative across all education groups, indicating that fertility is negatively associated with women's labor supply in Japan. In particular, permanent employment is associated with an 18.3–percentage-point decrease in fertility for university-educated women, a 15.0–percentage-point decrease for junior-college graduates, a 13.5–percentage-point decrease for high-school graduates, and an 11.1–percentage-point decrease for basic-educated women. This pattern indicates that the negative association between fertility and labor supply is stronger among higher-educated women, suggesting a larger substitution effect of labor supply for these women. One possible explanation is that higher-educated women are more likely to work in high-skilled occupations that entail greater responsibility, requiring a stronger focus on work and thereby reducing fertility.

Thus, unlike the U.S. case, highly educated women in Japan still face a trade-off between fertility and labor supply, even though both fertility and labor supply are higher for this group on average. This is consistent with the view that the U-shaped relationship reflects the total effect of education: the income effect may be sufficiently strong to offset the negative labor-supply effect, even though the substitution effect itself remains negative.

(Table 3)

6. Discussion

As reviewed in the Introduction, the observed association between women's education and fertility reflects the total effect of education, which consists of the income effect and the labor-supply (substitution) effect. On the one hand, Table 3 shows that labor supply reduces fertility for all education groups, and the magnitude of this negative effect is larger for higher-educated women. Because higher-educated women also supply more labor (Table 2), the labor-supply effect of education contributes to a negative association between education and fertility. On the other hand, higher-educated women tend to have higher expected wages, implying a larger income effect, which contributes to a positive association between education and fertility. This income effect refers to the economic ability to afford childrearing, as well as the costs of assisted reproductive technologies (ART) when such treatments are necessary to achieve childbirth. The overall association between education and fertility depends on the relative strength of these opposing components.

The U-shaped association can therefore be interpreted as follows. Compared with low-educated women, the higher fertility probability of university-educated women suggests that their income effect exceeds their labor-supply effect. For junior-college graduates, a roughly offsetting relationship—where the income effect counterbalances the negative labor-supply effect—leads to fertility levels similar to those of low-educated women. In contrast, the lower fertility probability of medium-educated women arises because their income effect is smaller than their labor-supply effect. These patterns are consistent with the well-established fact that higher education leads to higher wage rates, and therefore, larger income effects among higher-educated women.

7. Conclusion

This study examines the association between women's education and fertility using Japanese data, focusing on the period 2015-2020, during which market-based childcare expanded rapidly. Compared with low- and medium-educated women, highly educated women exhibit both higher fertility probabilities and higher labor supply. This pattern may reflect the expansion of market-based childcare services in Japan, which enables higher-educated women—who typically hold higher-paying jobs—to purchase more childcare services.

However, within each education group, fertility is significantly negatively associated with labor supply, and this negative association is larger among higher-educated women. In particular, the estimation results indicate that the fertility reduction associated with permanent or temporary employment for university-educated women is nearly twice as large as that for low-educated women, suggesting a stronger substitution effect among highly educated women. Although market childcare has expanded substantially in Japan—potentially mitigating the substitution effect of labor supply on fertility—traditional employment practices, including limited work–life balance, may continue to reinforce this strong negative labor-supply effect. Furthermore, the stronger substitution effect observed among higher-educated women may be due to the fact that they tend to hold higher-skilled jobs with greater responsibility, which require a stronger focus on work and therefore lead to a larger reduction in fertility per unit of labor supply.

Nevertheless, the study finds a U-shaped relationship between education and fertility: fertility is highest among university-educated women, lowest among medium-educated women, and intermediate among low-educated women. This pattern reflects the total effect of education, which is the sum of the positive income effect and the negative labor-supply effect. Because higher-educated women have higher expected income, the income effect exceeds the labor-supply effect for university-educated women, leading to higher fertility. In contrast, for medium-educated women, the income effect is smaller than the labor-supply effect, generating lower fertility relative to low-educated women.

The policy implications are as follows. First, the government has made substantial efforts to expand market childcare services—particularly between 2014 and 2020, when childcare capacity increased significantly and waiting lists declined. These policies likely enabled highly educated women to achieve both higher fertility and greater labor supply. Second, policies promoting women’s human capital development, such as leadership development and digital and technical skills programs for women promoted by the Ministry of Economy, Trade and Industry, as well as science and engineering education and advanced training initiatives promoted by the Ministry of Education, Culture, Sports, Science and Technology, may simultaneously increase fertility and labor supply. Such policies may contribute to addressing Japan’s dual challenges of low fertility and labor shortages. Third, labor supply continues to substantially reduce women’s fertility, reflecting persistent difficulties in achieving work–life balance under Japanese employment practices. Policies aimed at improving work–life balance—such as legal reforms, workplace regulations, and targeted subsidies—remain essential for enabling women to maintain both employment and childbearing.

Appendix.

Education and Fertility Among Permanent Immigrants in Japan

Different from natives, this study finds that permanent immigrants in Japan exhibit a consistently positive association between education and fertility across all educational groups. This pattern suggests that the income effect exceeds the labor-supply effect at every level of education for immigrants. Importantly, this does not imply that immigrants have higher incomes than natives; in fact, average wages among immigrants tend to be lower.

The likely explanation lies in the effect of education on labor supply. Immigrants in Japan often face disadvantages in the labor market—such as incomplete information, limited social networks, and slower or incomplete economic and social integration—which attenuate the extent to which education increases their labor supply. For example, the estimated marginal effect of university education on labor-force participation is 0.058* for immigrants, substantially smaller than 0.163* for natives.

Because education raises labor supply less for immigrants than for natives, the negative labor-supply effect of education on fertility is correspondingly smaller. As a result, the income effect dominates the labor-supply effect, generating a positive overall association between education and fertility among permanent immigrants.

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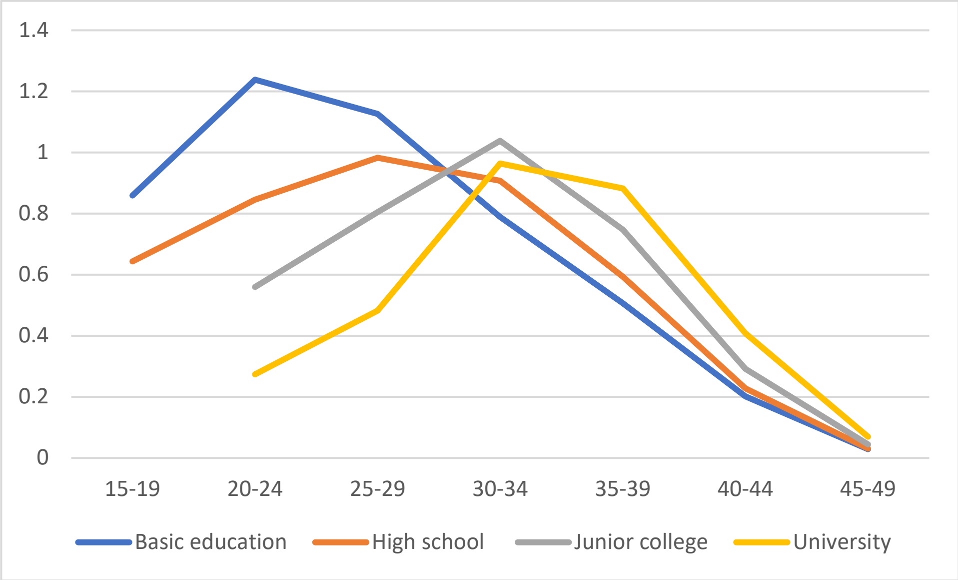
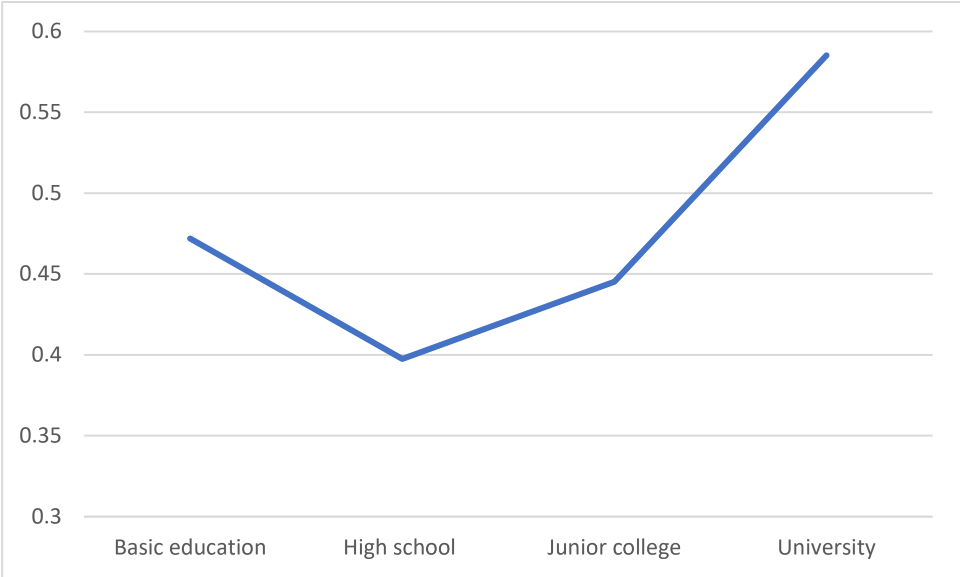
Figure 1. Fertility Rates by Age Group and Educational Attainment



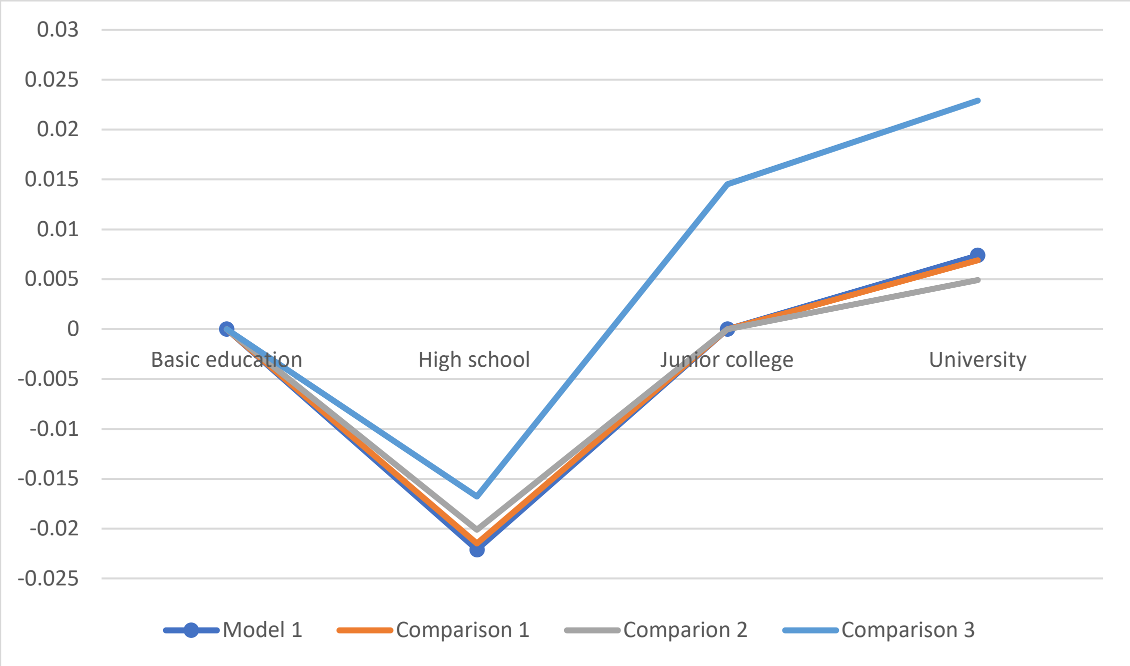
Source: Author’s calculations based on the 2020 Population Census.

Figure 2. U-Shaped Relationship Between Educational Attainment and Total Fertility (Ages 15–49)



Source: Author’s calculations based on the 2020 Population Census.

Figure 3. Estimated U-Shaped Relationship Between Educational Attainment and Fertility



Notes: marginal effects reported in Table 1.

Table 1. Association Between Educational Attainment and Fertility (Marginal Effects)

	Model 1	Comparison 1	Comparion 2	Comparison 3
Education level				
Reference: Low-educated(basic education)				
Medium-educated				
High school	-0.0221***	-0.0215***	-0.0201***	-0.0168***
	(0.00267)	(0.00267)	(0.00267)	(0.00259)
High-educated				
Junior college	0.00202	0.00261	0.00248	0.0145***
	(0.00271)	(0.00271)	(0.00272)	(0.00260)
University	0.00738***	0.00689**	0.00490*	0.0229***
	(0.00279)	(0.00279)	(0.00279)	(0.00263)
Husband's income	0.00556***	0.00530***	0.00415***	
	(0.00116)	(0.00116)	(0.00116)	
Homeowner	0.0749***	0.0742***	0.0739***	0.0706***
	(0.00105)	(0.00105)	(0.00104)	(0.00104)
Birth history				
Births in the past 5–11 years	-0.0523***	-0.0515***	-0.0504***	-0.0457***
	(0.000675)	(0.000675)	(0.000674)	(0.000670)
Births in the past 12–14 years	-0.169***	-0.168***	-0.167***	-0.170***
	(0.00136)	(0.00136)	(0.00136)	(0.00136)
Births in the past 15–18 years	-0.199***	-0.199***	-0.197***	-0.204***
	(0.00201)	(0.00201)	(0.00201)	(0.00200)
Age category dummy	Yes	Yes	Yes	Yes
Husband's education dummy	Yes	Yes	Yes	No
Husband's employment dummy	Yes	Yes	Yes	No
Local population dummy	Yes	Yes	No	Yes
City dummy	Yes	No	No	No
Observations	750,848	750,848	750,848	769,709
Pseudo R-squared	0.294	0.293	0.292	0.281
Log likelihood	-344308	-344911	-345350	-358980

Notes: The dependent variable is an indicator for having given birth in the past five years. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 2. Association Between Labor Supply and Educational Attainment (Marginal Effects)

	Labor force participation		Permanent Employment	
	Model	Comparison	Model	Comparison
Education level				
Reference: Low-educated(basic education)				
Medium-educated				
High school	0.0901***	0.0890***	0.124***	0.132***
	(0.00272)	(0.00275)	(0.00468)	(0.00473)
High-educated				
Junior college	0.121***	0.115***	0.202***	0.207***
	(0.00277)	(0.00280)	(0.00472)	(0.00477)
University	0.163***	0.152***	0.347***	0.359***
	(0.00286)	(0.00290)	(0.00480)	(0.00484)
Children by age category	Yes	No	Yes	No
Age category dummy	Yes	Yes	Yes	Yes
Husband's income	Yes	Yes	Yes	Yes
Husband's education dummy	Yes	Yes	Yes	Yes
Husband's employment dummy	Yes	Yes	Yes	Yes
Husband's age category dummy	Yes	Yes	Yes	Yes
Homeowner	Yes	Yes	Yes	Yes
Local population dummy	Yes	Yes	Yes	Yes
City dummy	Yes	Yes	Yes	Yes
Observations	750,846	750,849	492,910	492,910
Pseudo R-squared	0.0613	0.0298	0.0589	0.0483
Log likelihood	-392548	-405751	-320284	-323883

Notes: Labor supply is measured by labor-force participation and permanent employment. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 3. Association Between Labor Supply and Fertility (Marginal Effects)

	High educated		Medium educated	Low educated
	University	Junior college	High school	Basic education
Reference: non-participants				
Permanently employed	-0.183***	-0.150***	-0.135***	-0.111***
	(0.00210)	(0.00190)	(0.00192)	(0.00825)
Temporarily employed	-0.201***	-0.148***	-0.129***	-0.108***
	(0.00247)	(0.00184)	(0.00170)	(0.00561)
Self-employed	-0.134***	-0.0952***	-0.0690***	-0.0434***
	(0.00488)	(0.00406)	(0.00357)	(0.0109)
Unemployed/Job seekers	-0.270***	-0.211***	-0.168***	-0.131***
	(0.00994)	(0.00757)	(0.00666)	(0.0214)
Temporarily absent	0.141***	0.0713***	0.0585***	0.0375**
workers(controlled)	(0.00454)	(0.00425)	(0.00419)	(0.0171)
Birth history	Yes	Yes	Yes	Yes
Husband's income	Yes	Yes	Yes	Yes
Homeowner	Yes	Yes	Yes	Yes
Age category dummy	Yes	Yes	Yes	Yes
Husband's education dummy	Yes	Yes	Yes	Yes
Husband's employment dummy	Yes	Yes	Yes	Yes
Husband's age category dummy	Yes	Yes	Yes	Yes
Local population dummy	Yes	Yes	Yes	Yes
City dummy	Yes	Yes	Yes	Yes
Observations	207,301	251,788	266,529	23,930
Pseudo R-squared	0.301	0.354	0.344	0.310
Log likelihood	-99548	-103920	-106928	-10670

Note: Labor supply categories include permanent employment, temporary employment, self-employment, temporarily absent workers, and unemployment/job search, with non-participation as the reference category. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1