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Article

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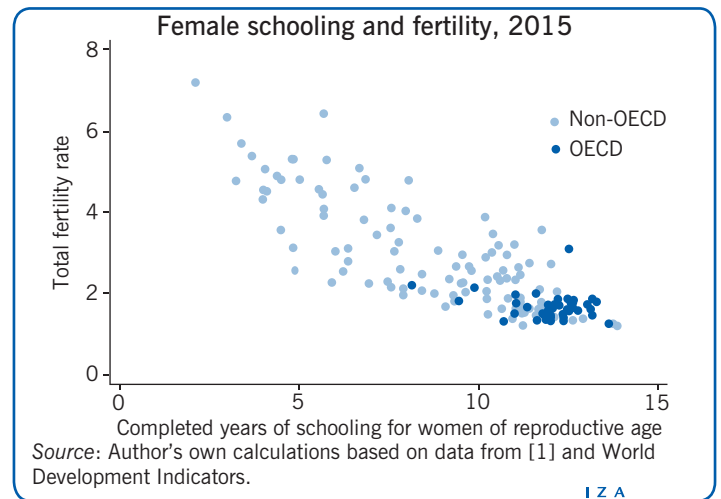
Female education and its impact on fertility

Additional female educational attainment generally lowers fertility, but the relationship is complex

Keywords: female education, fertility, demand for children, fertility control costs, returns to education, family planning

ELEVATOR PITCH

The negative correlation between women’s education and fertility has been observed across regions and time, although it is now weaker among high-income countries. Women’s education level could affect fertility through its impact on women’s health and their physical capacity to give birth, children’s health, the number of children desired, and women’s ability to control birth and knowledge of different birth control methods. Each of these mechanisms depends on the individual, institutional, and country circumstances experienced. Their relative importance may change along a country’s economic development process.



KEY FINDINGS

Pros

- ⊕ The fertility gap between women with primary versus no education widens as incomes increase, but decreases at higher (secondary versus primary) education levels.
- ⊕ Educated women are more physically capable of giving birth than uneducated women; but want fewer children and control birth better.
- ⊕ Educated women provide better care at home, thus increasing the value of their children’s human capital and reducing the need for more children.
- ⊕ At relatively early stages of a country’s development, educated women adopt modern birth control methods more often than uneducated women.

Cons

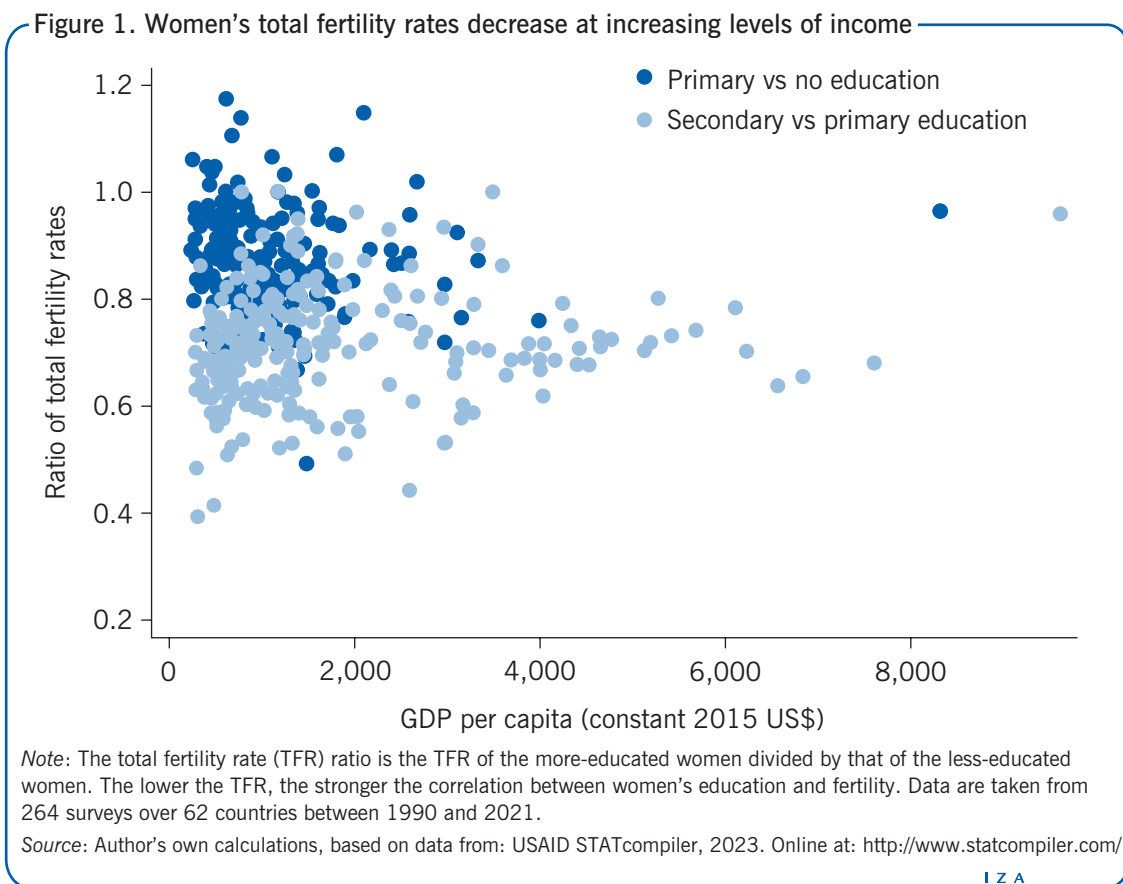
- ⊖ The negative correlation between female schooling and fertility is strong, but it varies at different levels of women’s education and stages of a country’s development.
- ⊖ With paid childcare or cooperative husbands, educated women may want to work more and have more children than uneducated women.
- ⊖ Parents’ ability to generate wealth may be transferred to their children through investment in children’s human capital.
- ⊖ It is unclear whether education increases women’s access to new information or their ability to adopt new birth control technology.

AUTHOR’S MAIN MESSAGE

Three mechanisms influence the fertility decision of educated women: (i) the relatively higher incomes and thus higher income forgone due to childbearing leads them to want fewer children. The better care these women give increases their children’s human capital and reduces the economic need for more children; (ii) the positive health impacts of education, on both women and their children, mean women are better able to give birth and children’s higher survival rate reduces the desire for more; and (iii) the knowledge impact of education means women are better at using contraceptives. For developing population policies, it is thus important to understand these impacts on income, health, and knowledge, and their influence on fertility decisions in the specific country context.

MOTIVATION

Educated women generally have fewer children than uneducated women. This negative relationship is strong and varies across both developed and developing countries (measured by GDP per capita) and among women of different education levels. This is not surprising, since countries differ in their various institutional aspects, including education quality. Further, different education levels can generate different kinds of incentives. For example, better-educated women tend to have better jobs and earn higher incomes, thus the forgone earnings from taking care of children would be higher for these women. Thus, women with primary education tend to have up to 30% fewer children than uneducated women (ratio of total fertility rate of 1.0 to 0.7). The differential, if any, tends to widen as income increases. Further, women with secondary education tend to have 10–50% fewer children than those with primary education (ratio of total fertility rate of 0.9 to 0.5), with gaps narrowing as income increases (Figure 1). It would be useful for policymakers to understand the mechanisms through which female education affects fertility in the contexts in which these outcomes are observed.



DISCUSSION OF PROS AND CONS

What is the causal effect of education on fertility?

In principle, women who attend school may have different ideas on family size than those who do not attend school. Hence, economists have questioned whether the observed

correlation between women's education and fertility is causal. The Illustration on p. 1 shows that countries with a higher share of better-educated women tend to have lower fertility rates. However, even at similar levels of schooling, fertility rates differ across countries, suggesting that other factors might also influence fertility.

Researchers have observed women's access to education in order to determine whether this has an impact on fertility. A US study compares areas by number of colleges present, and finds that female college graduates have 20% fewer children, on average, than high-school graduates [2]. In contrast, another study examines women born before and immediately after the school entry date, in the US, concluding that education does not have a significant impact on fertility [3]. These different results may be because the researchers investigated different populations, in different regions and time periods. The former examines a sample of child births between 1970 and 1999, whereas the latter deals with a sample between 1989 and 2002. More importantly, the former focuses on women who would be expected to change their decision to go to college, depending on the availability of colleges close by, whereas the latter analyzes women whose educational outcomes would potentially be affected by school entry date.

Sudden changes in legislation offer a chance to verify the causal effect of women's education on fertility. Between 1960 and 1972 the Norwegian government implemented an educational reform that extended compulsory schooling from seven to nine years. This reform was gradually introduced, with each municipality deciding when to adopt it. One study compares female students who were born in the same year but in areas that differed by reform status [4]. It finds that the reform increased female schooling by an average of 0.1 years. However, total fertility did not change, possibly because Norwegian women already tended to postpone childbearing until their 20s or 30s.

Israel offers another example of the education–fertility nexus. In 1948, Israel's military government placed a restriction on its Arab population traveling within the country. In 1963, it lifted the restriction due to growing public opinion in favor of democracy. Arab children could freely move across localities to attend school if there was no school nearby. Observing the same areas before and after the change reveals that Arab girls' schooling increased by one year and their fertility declined by 0.6 children, on average, after the travel restriction was removed [5].

As for developing countries, a study on Nigeria investigates a universal primary education program that took place between 1976 and 1981, and finds that it also influenced fertility behavior [6]. Accordingly, women with an additional year of schooling had, on average, 0.26 fewer children before the age of 25 than they would otherwise have had. This study compares students from the same area before and after the education programs were introduced. Findings show innate differences in the preference for children between educated and uneducated women. However, they do not explain why better-educated women have fewer children nor do they determine which mechanisms (associated with education) are involved.

Mechanisms for the relationship between female education and fertility

Women's education may have different effects on fertility through various mechanisms. Fertility can be considered as the maximum number of children a couple could have

(supply) minus the number it deliberately avoids having (fertility control). Alternatively, it may be viewed as the sum of the number of desired (demand) and unplanned children. Improvements in women's education affect fertility through the number of children a couple can have, the number of children it wants, and the ability to control birth through the availability of modern contraceptives and the knowledge of how to use them. A woman's actual number of children falls somewhere between the number she desires and her natural fertility level. The influencing factors are age and fertility control.

Supply of children

The supply of children is the number of children a woman is physically capable of bearing. This can be measured by the maximum number of surviving children a couple would have if they did not intentionally attempt to control family size. When better-educated women have more maternal knowledge than less-educated women, for example, with regard to prenatal care and child nutrition, they can be expected to have higher fertility and infants with better survival prospects.

Recent studies generally support this. For example, the study on the availability of colleges in the US also finds that an additional year of maternal education reduces the incidence of low birth weights by about 10% and premature births by 6% [2]. On the other hand, the US study on school entry date suggests that the effect of an increase in maternal education on infant health is only small [3]. One study examines Taiwan, where in 1968 the government extended compulsory education from six to nine years [7]. An increase in maternal education by one year led to a reduction in infant mortality by between 7% and 9%.

The maximum number of children a couple can have also depends on how long they have been in a relationship. If higher-educated women delay marriage or cohabitation, due to opportunities in the labor market, then education reduces their fertility due to age. Education may also have an effect on fertility through breastfeeding. Although breastfeeding results in temporary infertility due to lactational amenorrhea, its birth-control effect is less than perfect. As better-educated women generally breastfeed their babies for shorter periods, they face the risk of an earlier subsequent pregnancy than less-educated women.

A 1986 study on Côte d'Ivoire supports the above findings [8]. The study shows that women aged 55 who achieved lower-secondary education reduced their fertility by an average of 0.6 children (by the end of their childbearing years), through an increase in their age at cohabitation; shortened breastfeeding increased their fertility by an average of 1.8 children. Hence, the total effect of education was an increase in fertility by an average of 1.2 children (1.8–0.6). For women aged 35, the effect of achieving lower-secondary education was a slightly lower decrease in fertility by an average of 0.5 children through an increase in age at cohabitation. (The breastfeeding effect for this group was not detected, possibly due to the offsetting effects of more of these women using contraceptives.) These results are based on a country with a total fertility rate of seven children and GDP per capita of US\$1,258 (in constant 2005 US dollars). However, in countries where the average number of children is one or two, education's effect on fertility, through the timing of cohabitation and the duration of breastfeeding, is likely to be smaller.

The possibility that education may limit women's exposure to pregnancy could be more relevant to teenage girls. In school, girls have fewer opportunities to become pregnant than if they are not in school. In this context, an extension of mandatory education may generate an "incarceration effect" for teenage girls. The study on Norway's education reform finds that one additional year of schooling reduces the chance of teenage pregnancy by 8 percentage points [4]. Hence, number of years of education can impact the timing of childbearing. Since entering motherhood at a young age may hamper career development, the reduction of teenage pregnancy, alone, is an important policy objective.

Demand for children

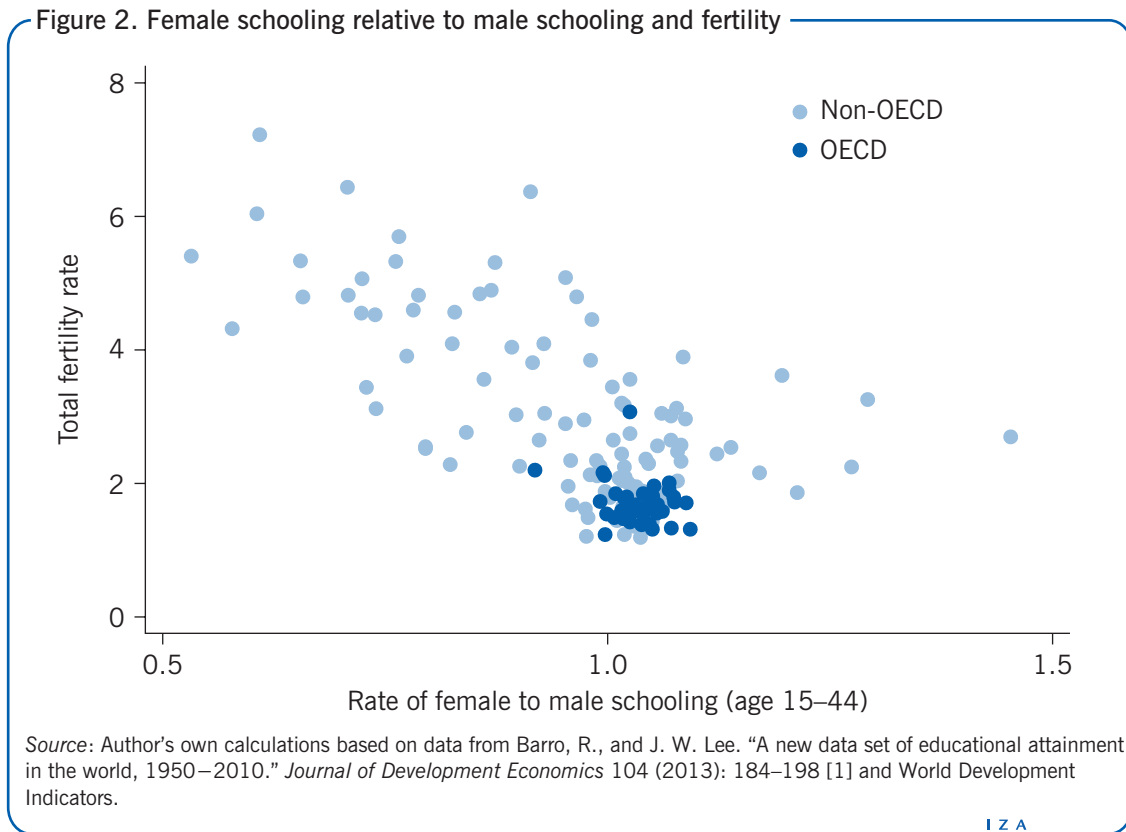
The demand for children can be described as the number of children a couple would like to have if they are free to choose. Most theories predict that better-educated women desire fewer children than less-educated women.

The job of raising children at home is usually more time-intensive than working in the labor market. As better-educated women earn higher incomes, they may feel that raising children is the more expensive option because of the income forgone. In this case, wages are not only a measure of the value of the mother's time, they also contribute to family income. If educated women tend to marry educated men, then the income effect would suggest that these women would be expected to have more children because they can afford to. However, this is a theoretical concept and the actual income effect is often small. On the contrary, empirical findings show that as women's incomes increase, they tend to have fewer children. And since the number of years of schooling is an important determinant of earnings, it follows that female education indirectly reduces fertility through their earnings.

When this mechanism is at work, it would be expected that women's wage relative to men's would explain the differences in their fertility rates. Using schooling as a proxy for wage, Figure 2 shows that the fertility rate declines across countries as women's education increases relative to men's. The correlation is strong and indicates that an increase in women's schooling from 50% to 100% of men's is associated with a decline of the fertility rate from six children per woman to two.

Women's potential opportunities in the labor market do not need to coincide with their actual engagement in employment. Jobs for educated women may not be available in their local labor market, or they may choose to stay at home. This suggests that mechanisms other than women's employment can also have an impact on fertility.

The study on Israel's travel restrictions on the Arab population offers evidence on increased education having no impact on women's employment, as measured by their labor force participation (LFP) rate [5]. The LFP rate is the percentage of the working-age population that is either employed (part- or full-time) or actively seeking work. Findings show that an increase in Arab women's education led to a decline in fertility but did not affect their or their husbands' LFP. The LFP rate for this group of women was low, at around 15%, and that of their husbands was between 70% and 90%, before and after the travel reform. One plausible reason for these women's low LFP rate is that education may generate other forms of returns at home. For example, parents with more education may be better able to guide their children's studies, thus preparing them for post-secondary education, better jobs, and higher incomes, or the family may have more financial resources for a



parent (usually the mother) to remain at home to raise the children, than those less-educated. In this case, parents with more education would want to have fewer children and invest more in their care. Recent literature supports this.

A study on the impact of women's education in India points out that, during that country's "green revolution," a time of rapid growth in agricultural production during the 1960s and 1970s, literate women commanded a premium dowry in the marriage market even when the return to female education in the labor market was not observed [9]. Educated men sought to marry educated women because of the higher quality care such wives would provide to any future children. Findings show that children with literate mothers studied for more hours than those whose mothers were illiterate. The authors conclude that the demand for schooled wives, during that period, was mainly due to the potential returns to these women raising better-educated children at home rather than returns to their employment in the labor market.

Other arguments for the impact of women's education on fertility are the role these women's incomes play in improving their families' economic prospects, and the improved social status that comes with higher education. Both mechanisms reduce the need for more children. For a household in a traditional agricultural economy, children are an important source of labor. They are also a source of support during parents' old age. However, as households of women with more education tend to earn higher incomes, they would have less need to rely on children financially. Also, in patriarchal societies, sons are valued more than daughters because they bring their parents a higher social status and

are often responsible for taking care of them. In the absence of technology that screens fetuses, the preference for sons often leads to an increase in fertility. However, women with higher education tend to exhibit a weaker preference for sons than less-educated women, due to their financial independence and awareness of gender equality.

It is notable that in Figure 2 women's higher schooling relative to men's is no longer associated with a lower fertility rate among OECD countries where women often gain more education than men on average. In fact, the negative correlation between women's education and fertility is weak among high-income countries and is even reversed for the highly educated in some countries. This implies that the mechanism of demand for children may be different for high-income countries.

A US study reports that the relationship between women's schooling and fertility has a U-shape in the US for the period 2001–2011 [10]. That is, while the relationship is found to be negative for women up to them having a college education, those with advanced degrees have more children than college graduates. The study attributes the change in the relationship to the availability of paid childcare based on two pieces of evidence. First, the cost of childcare relative to earnings decreased more for highly educated women than for the less educated. Second, the chance of giving birth is lower in states where the relative cost of childcare is higher. It further presents evidence against alternative explanations, including childcare provided by a spouse, marriage rates, and improvements in reproductive technology. Among women with a college degree or more, higher education is not associated with husbands' longer provision of childcare or higher marriage rates. The birth rate of those with an advanced degree is no higher than historical birth rates, even if they are likely to be able to afford assisted reproductive technology.

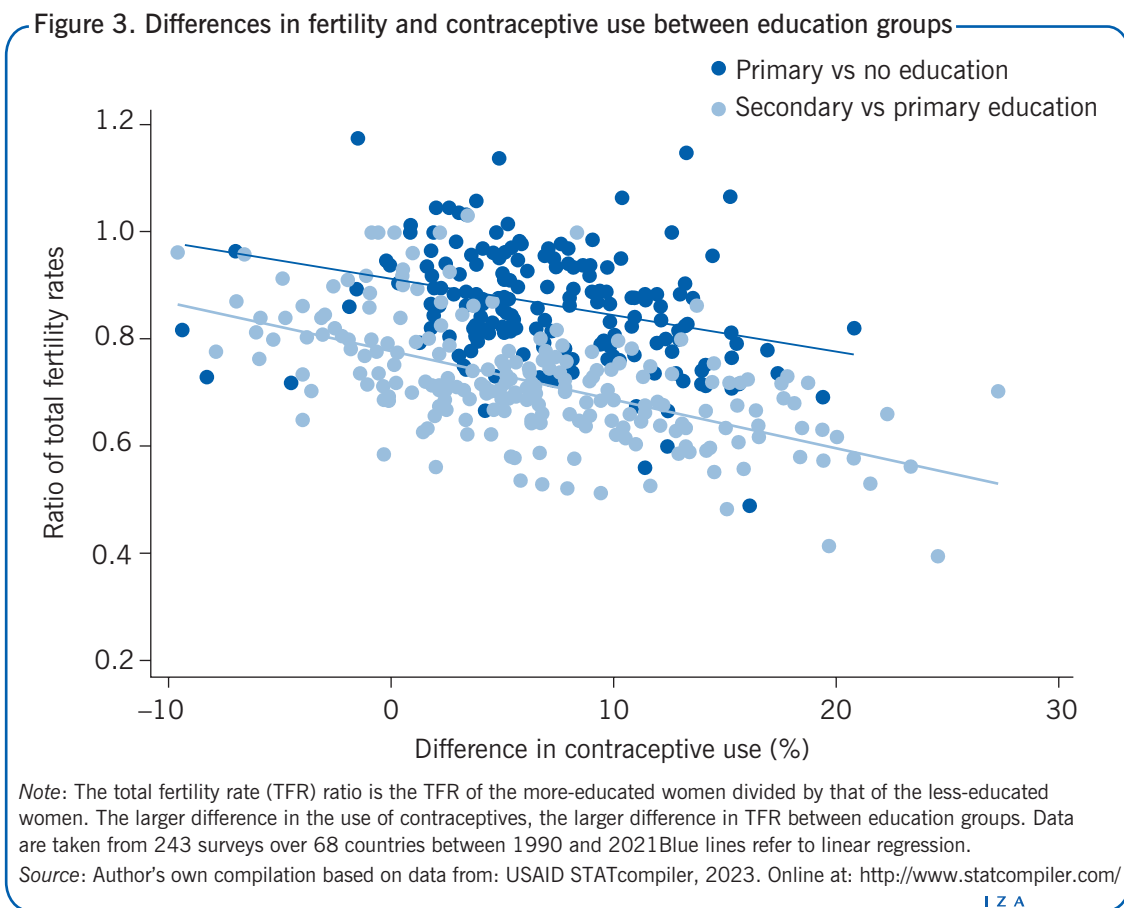
The U-shaped pattern is also observed in some western European countries. The weakened relationship between female schooling and fertility in developed countries can be understood as the overall social change having improved the compatibility of career and family for women. A few mechanisms have been discussed in recent studies. The public provision of childcare or the entitlement to take paid parental leave directly lowers the cost of raising children for working parents. In addition, the burden of childcare may be more equally shared by a mother and a father than previously as women's earnings are getting close to men's. The traditional social norm of strict gender roles in a household is in transition to a new norm of gender equality with economic development. Jobs characterized by long work hours and fixed schedules make it difficult for women to reconcile work and childcare, and the introduction of flexible arrangements is likely to ease the tradeoff. These changes are in progress to varying degrees across countries.

Cost of birth control

As long as there is a gap between the maximum number of achievable births and the desired number of children, a couple has an incentive to control birth. Better-educated women are more likely to be aware of modern contraceptives and to adopt new birth-control methods; their education may also help to improve their bargaining power with their husbands, thereby earning them consent to use contraception in the context of developing countries.

Evidence shows that the differences in fertility between women’s education groups, across developed and developing countries, are indeed strongly correlated with differences in contraceptive use. Figure 3 compares two education groups and shows that an increase in the use of modern contraceptives by 20 percentage points is associated with a decrease in fertility by the same amount. This observation does not confirm the importance of obstacles to birth control, such as a lack of access to a family planning clinic, since women’s education both increases the incentive to use contraception and improves knowledge on where to get it and how to use it. However, birth control is far from perfect, even in developed countries. In the US, for example, 2.3% of women who used a typical contraceptive implant in 1995 had an unintended pregnancy; male condoms failed 8.7% of the time; and spermicides showed an even higher failure rate at 15.3%.

The case of Indonesia, from the 1970s to the 1990s, offers additional evidence for the role of education in the adoption of contraceptives [11]. While fertility declined among



women of all education levels, it fell much faster among better-educated women. It is possible that these women benefited more from a family planning program that was implemented in 1971 and extended to villages, nationally, over the following decade. One issue was that women’s fertility behavior may have been related to the location of a family planning clinic. To address this problem, the fertility rates of women in the same

village were compared before and after the family planning clinic was set up. It was found that when women had post-primary education and a family planning clinic nearby, the probability of having a second birth was reduced by 12.4 percentage points. With no family planning clinic nearby, the effect was close to zero. These results imply that the effect of education through a family planning program explains three-quarters of the total change in the fertility of women with post-primary education, over time. Primary level education helped these women lower their fertility, mainly through increasing their knowledge of contraceptive availability. However, it is unclear whether education enabled these women to have better access to new information, enhanced their ability to learn new technology, or improved their bargaining power in the household. The results suggest, though, that the role of a family planning program in fertility decline may be larger than previously thought when its indirect effect through female education is considered.

Contrary to the above finding, one study presents a case wherein access to birth control benefited uneducated women more than educated women [12]. In 1966, the Romanian government banned abortion and family planning. In 1989, after the fall of communism, it legalized both. The study compares fertility behavior immediately before and after the liberalization, and finds that fertility decreased by 30% within six months of the policy change. Further, the fertility differential between women with more than primary education and relatively less-educated women decreased by an average of 0.03 births per year, or more than half the differential. The lifting of the ban on birth control implies that all Romanian women had access to family planning. In other words, modern birth control was not new information, therefore the role of education in the adoption of contraceptives and abortion would be limited. In fact, it is reported that after the 1989 change in legislation uneducated women had, on average, 0.03 abortions per year more than educated women. This may be viewed as uneducated women failing in family planning more often than educated women.

Another argument is that women's higher education empowers them to make decisions on their fertility. In fact, women's empowerment could be the driving force for the effect of education on fertility [13]. An example of this can be seen in Kenya. In 1974, the Kenyan government introduced a family planning program; by the mid-1980s, knowledge of modern contraceptives was widespread. In 1985 the length of primary education was extended by one year. This reform increased women's schooling by 0.74 years and reduced fertility, at age 25, by an average of 0.3 children. Evidence shows that the education reform increased the use of birth control. This increase was due to the improved autonomy of women on two grounds. First, the reform narrowed the difference in educational attainment between women and their husbands, thereby increasing their bargaining power. Second, the reform also increased the prevalence of HIV/AIDS testing for women, another sign of their increased empowerment.

The negative correlation between female schooling and fertility may be flattened in high-income countries also through the cost of birth control. As the overall level of women's education increases, the gap in access to contraceptives or knowledge on how to use them across different education groups may diminish. A US study estimates that about one-third of the decline in fertility in the US for the period 2007–2016 is due to the decline in unintended births [14]. In addition, the availability of assisted reproductive technology (ART) may benefit highly educated women who postpone childbearing. Given that the

share of births using ART is less than 5% in high-income countries, this possibility is not quantitatively significant yet but is likely to be realized in the future.

LIMITATIONS AND GAPS

Progress has been made in estimating the causal effect of women's education on fertility. However, study results may not be easily generalized since they are based on subpopulations affected by certain policy changes, in certain countries, in certain time periods. For a complete picture, more evidence is needed on the impacts on fertility of different education levels and institutional settings across countries.

So far, less attention has been paid to the mechanisms through which female schooling affects fertility. Theoretical predictions have been in place for years. Yet, the literature has not verified whether female education affects fertility because education generates some forms of return; because it brings home more resources; or because it improves women's bargaining power. Furthermore, the effectiveness of these mechanism depends on social institutions including norms, family policies, and job flexibility. Answers to these questions will help predict which subpopulations would benefit more from a particular population policy and program design.

SUMMARY AND POLICY ADVICE

In developing countries, better-educated women have fewer children than less-educated women. However, the reasons for this are less clear, since the benefits of education extend beyond the value of women's time. Education can reduce fertility because better-educated women earn more and may raise their children more effectively. Education also improves maternal and child health, thereby increasing a woman's physical capacity to give birth and reducing the (economic) necessity for more children. However, the fact that educated women tend to breastfeed for shorter periods lengthens their exposure to (a new) pregnancy. Nevertheless, understanding modern contraception helps women control birth. Finally, higher education empowers women and includes them in household decision-making on family planning.

The once strong relationship between women's education and fertility is flattened in developed countries. The compatibility of work and childrearing for women used to be low but has been raised by family policy, balance of bargaining power in a household, social norms, flexible working conditions in labor markets, and overall improvement of knowledge on birth control. Each mechanism is significant, depending on the individual and institutional context, but there is limited evidence on the relative importance of each one.

The return to women's education as caregivers at home suggests family-friendly policies may allow for a parent to remain at home with their children and invest time in nurturing the next generation. While these policies improve the welfare of both parents and children, they are likely to increase the private transfer of knowledge between generations and, thereby, increase the value of the next generation's human capital. Hence, in the interests of both efficiency and equity, policies should be balanced by strengthening education for the disadvantaged/less-educated, which could improve their children's long-term prospects in terms of education, employment, and earnings. The returns to education in

contraceptive use in both developed and developing countries implies that policies that promote female education complement family planning. However, policymakers should always measure a particular program's cost-effectiveness against the alternatives.

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Competing interests

The IZA World of Labor project is committed to the IZA Code of Conduct. The author declares to have observed the principles outlined in the code.

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Further reading

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