Intergenerational transmission of parental education in Malawi

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Abstract

.

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1. Introduction

Over the past 50 years, primary school enrollment has increased dramatically in most developing countries (Glewwe and Muralidharan, 2016). The most significant increase in primary schooling is observed among countries in Sub-Saharan Africa, where primary enrollment rate in 1960 was 54 percent on average which has increased to 108 percent in 2010 (Glewwe and Muralidharan, 2016). This dramatic increase in primary schooling attainment is mostly driven by a universal primary education program implemented since the mid-1990s. Using the policy induced variation in access to education, many studies have so far documented the impact of education on benefitted women's outcomes such as fertility and age at marriage (Osili and Long, 2008; Adu Boahen and Yamauch, 2018; Moussa and Omoeva, 2020).

However, education has far-reaching intergenerational consequences that goes beyond the impact on the affected women and men, such as its effect on child's welfare and human capital. Parental education could have positive impact on children's health or human capital in two ways. First, education renders parents to be a better caregiver, and to provide better/efficient health related care to children (Grossman, 2006). Second, parents with more education invest more in children's schooling, in which case children's health could be improved further through the impact of their own education. Regarding the first implication on health, Keats (2018) found the positive causal impact of mother's education on children's health in Uganda. Several papers also showed that schooling has been causally associated with a decline in child mortality in sub-Saharan Africa (Andriano and Monden, 2019; Makate and Makate, 2016; Gepin and Bharadwaj, 2015).

In this paper, we investigate the latter channel, i.e., intergenerational effect of parental education on children's education in Malawi using free primary education (FPE) reform implemented in 1994 that induced exogenous increase in education among affected women

and men for identification. While there is a large literature in developed countries that document the positive impact of parent education on children's schooling (i.e., Oreopoulos, et al., 2006 for U.S., Tsou et al, 2012 for Taiwan, Björklund et al., 2006 for Sweden), causal evidence on the existence of such effect in developing countries is yet sparse. The notable exception is Agüero and Ramachandran (2020), which provided causal estimates of the intergenerational effect of education among black Zimbabweans. Leveraging the variation induced by the reform in 1980 which ensured automatic promotion from primary to secondary school for blacks, they found that an extra year of schooling of the mother increased the schooling of her child (ages 6-15 years) by 0.073 years and for fathers about 0.092 years of child schooling. Our paper complements Agüero and Ramachandran (2020) by providing evidence from a broader reform that affected primary schooling nationally rather than sub-group within the country. Also, our paper departs from Agüero and Ramachandran (2020) in that the reform of interest concerns primary schooling rather than secondary schooling.

Our study contributes to several strands of the literature. First, we add evidence on the existing body of literature that examines the effect of expanding primary schooling in sub-Saharan Africa. While education access expansion policies shortly after independence in African countries benefited both male and female students, most of the studies have focused on impact of female education on own outcomes and children's health[1]. Our paper contributes to this literature by providing causal estimates of the first-stage effect of the schooling reform on both women's and men's schooling effect, as well as examining the intergenerational effects of both maternal and paternal education. Breierova and Duflo (2004) found that although female education has a stronger effect on age at marriage and early fertility than male's

1 For instance, Osili and Long (2008) finds universal primary education to have induced lower fertility in Nigeria among affected women. Keats (2018) finds universal primary education expansion in Uganda to have improved early health investments and health outcomes of the first-born children of the affected mothers.

education, both female and male education are found to be important in reducing child mortality. Our study further provides evidence that father's education also matters for children's education.

Second, our paper is related to the literature that studies the intergenerational transmission of education, especially in a developing country context. There is a large literature documenting the causal effect of parental education on child's schooling in a developed country setting (Oreopoulos et al., 2006; Black and Devereux, 2010; Black et al., 2020) In a developing country setting, several studies that investigated intergenerational consequences of education have mainly focused on child's health outcomes (Keats, 2018; Bharadwaj and Grepin, 2015). Our paper is one of very rare studies in developing countries that examine the intergenerational effect of parental schooling on child's education.[2]

Finally, our work relates to the studies that find that transmission of intergenerational resources may depend on the gender of the giver or the recipient. Duflo (2003) finds that grandmothers invest more in granddaughters using South African pension reform, which suggests that the efficiency of public transfer programs may vary by the gender of the recipient. Qian (2008) shows that while increase in relative adult female income increases the survival rate of girls, that of male income has the opposite effect on girls. Barcellos et al (2014) focus on families with boys and girls between zero to 15 months of age (so that their observable characteristics are all the same except for the gender of the newborn) in India. They find that boys are more favorably treated than girls at early age; boys are breastfed longer and get more vitamin supplementation than girls. Boys also have a greater advantage in height and weight outcomes than girls. We add to this literature by investigating the differential effect of mother's

2 While it is beyond the scope of our paper, if intergenerational transmission of education indeed improves health outcomes of children, public provision of education could further be supported.

and father's education, on son and daughters, respectively.

Using the Census of Malawi, we find that the FPE has a strong positive effect on educational attainment of men and women. Using the sample of mothers and fathers of primary school-aged children, our first-stage estimates indicate that FPE increased educational attainment of mothers by 0.54 years and fathers by 0.30 years. The second-stage results state that an extra year of maternal education increases education years of primary schooling-aged children by 0.14 years, while that of paternal schooling increases education years of children by 0.24 years. An extra year of maternal schooling increase child's likelihood of schooling attendance by 4.1 percentage points while paternal schooling increases the likelihood of schooling by a similar magnitude at 5.3 percentage points. We also show that mother's education has a significant and positive effect on both girls and boys, whereas the father's education seems to have a positive and significant effect on girls' education only. Further investigation of the results reveals that the effect of parental education on child's education is higher in rural areas than urban areas, and also the effect was stronger in households with low level of observed wealth. Children with more educated mothers are less likely to engage in domestic work, whereas we do not find such evidence for children with more educated fathers.

Finally, we find that lowered level of fertility, delayed age at first marriage and birth, better spousal quality and higher level of wealth are possible channels that are consistent with our results.

The rest of the paper is organized as follows. We describe the background on Malawi's education system and the Free Primary Education program in Section 2. Sections 3 and 4 describe our data and empirical strategy. Section 5 presents our results and Section 6 concludes.

2. Background

Malawi is a land-locked country in south central Africa, bordered by three countries

Mozambique, Tanzania, and Zambia. It is among the least developed countries in the world, with its GDP per capita (PPP) in 2019 is estimated to be 1,234 USD[3]. Official language is English although Chewa is used commonly. Prominent industry is Agriculture, where about 77 percent of the workforce engage in occupations related to agriculture. Accordingly, about 85% of the population lives in rural areas[4].

Malawi's education follows the 8-4-4 system: the first 8 years of primary schooling (Standards 1-8) are compulsory, followed by 4 years of secondary school (Forms 1 to 4)[5]. University and college education are available to students who pass the Malawi School Certificate of Education Examination upon graduating secondary school. However, less than one percent of students actually enter university and continue their studies beyond the secondary level (The World Bank, 2011).

In 1994, Malawi ended its one-party rule system, and brought up the first administration through multi-party democratic election since its independence in 1964. The new government introduced an ambitious Free Primary Education program (henceforth FPE), which abolished all school-related fees to improve access to education and reduce the education inequality. Figure 1 shows that indeed FPE was successful at getting both boys and girls to school. Primary enrollment has expanded from 1.73 million pupils in 1994 to 2.7 million in 2000. Notably, the gender gap in primary enrolment existed prior to 1994 has been greatly reduced and gender gap in primary enrolment has almost disappeared since early 2000.

[Figure 1] Gross primary school enrollment

[3]Source: https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases#sort=%40imfdate%20descending

4 Source: The World Fact Book (https://www.cia.gov/the-world-factbook/countries/malawi/) and 2018 Malawi Population and Housing Census Main Report

[5] Since January 2019, secondary schooling became tuition-free.

As the FPE was introduced in 1994 school year, individuals who graduated from primary school before 1994 were not exposed to the program. The oldest treated cohort is those who entered the last grade of primary school (Standard 8) in 1994. Since the official the official recommended age for primary school entry is age 6 in Malawi, under the assumption that students did not repeat their grades, children born in 1978 were eligible for the FPE for at least one year.

However, due to the prevalence of delayed school entry and grade repetition, age-grade mismatch is commonly observed in Malawi (Castro-Leal, 1996). Because our empirical identification relies on age-specific exposure level due to the introduction of Free Primary Education (FPE) policy, age-grade mismatch becomes an important empirical issue to consider when defining the treated cohorts, which we discuss in more detail in Section 4.

3. Data

For the main analysis, we use 2008 Malawi Population and Housing Census (henceforth Census). This is the earliest yet most recent wave of the Malawi Census that is available to study the completed education attainment of the treated cohort[6]. This dataset is a nationally representative household survey that collects information on individual's schooling years, completion of each level of school, literacy, employment as well as fertility, marriage outcomes and asset ownership. It samples 10 percent of the population.

Our analysis sample is restricted to individuals born five years before and after cutoff

[6] Since treated individuals are aged 24-29 in 2008, and almost no women attend school after the age of 22 (ADD *Fig. 3 – to be updated*), we are able to study the first stage effect of FPE on completed years of schooling and marriage and fertility outcomes using 2008 Census, which can be potential mechanisms for the improved child's education. The earlier Census rounds in 1987 and 1998 are too early, given the introduction of the FPE in 1994, although we use Census 1987 for balance tests.

(i.e. individuals born between 1974 and 1983). The construction of the treated cohort will be described in detail in Section 4. We measure own education using completed years of schooling, literacy and binary indicators for whether or not an individual had some primary education, graduated primary school and had some secondary education.

We also collected data on fertility, marital outcomes, as increased female education could change women's fertility and marriage choices. While both men and women have education records, fertility outcomes are collected only for women. We study the impact on the total number of children ever born to mother, child mortality ratio and mother's age at first birth. We construct the child mortality ratio based on total number of children ever born to mother, and the number of currently surviving children. Summary statistics are reported in Table 1.

[Table1] Summary Statistics

4. Empirical Strategy

Using the across-birth cohort differences in the exposure to the FPE program, we apply a regression discontinuity design (RDD) to estimate the causal effect of parental education on their children's schooling. Based on the official education guidelines in Malawi, the FPE treated cohort are those who were between ages 6 to 13 in 1994. However, due to prevalent grade repetition, actual data shows a wide range of ages for those who have completed 7 years of schooling and about to enter Standard 8, the last grade to be affected by FPE. Therefore, to define the actual treated cohort, ideally we would like to know the age - grade distribution in 1994. We use instead Census 1987 and 1998, which are available survey years close to 1994. In both survey years, we find that the most common age for seven years of completed schooling is age 15. Based on this information, we set the cutoff birth year to define the treatment group to be 1979 (= 1994-15).

In other words, students 15 years old or younger at the onset of the FPE policy benefits from the reduction in schooling costs, whereas students over 15 were not granted such opportunity. By setting the cutoff of the discontinuity at the birth year of 1979, RDD can identify the causal effect of the increased education induced by the FPE. The main identifying assumption for the RDD is that there were no policy changes that sharply affect education and related behavior of the birth cohort of 1979 and beyond.

To test the validity of our assumption, we show that parents who gave birth around 1979, i.e., grandparents of the children with affected mothers and fathers, did not experience any particular shocks such that their characteristics are smooth around the cutoff. Since the analysis sample is born between 1974 and 1983, if we use the Census 2008 to test smoothness in parental characteristics, sample individuals are likely to be married and living apart from their parents. Therefore, we use Census 1987 for the balance check of parental characteristics. In Table A1, we show that parental education and household assets are mostly well balanced for female and male analysis cohort. When there is imbalance, the coefficient estimates are extremely small compared to the mean of the dependent variable. In addition, given that the reform took place long after birth, it is highly unlikely that parents planned the year of the birth for our analysis sample in advance. We also confirm this in Figure A2 that there is no sorting around 1979.

Because of the prevalent repetition of grades and varying primary school entry ages, some students may have benefited from the FPE despite being born before 1979, and some students born after 1979 who are already out of school due to child labor may not comply. Therefore, a fuzzy regression discontinuity design with a local 2SLS regression model is more suitable in our setting, which can be formalized in the following functional form:

$$\tau_{FRD} = \frac{lim_{x\downarrow c}E[Y|Birthyear = x] - lim_{x\uparrow c}E[Y|Birthyear = x]}{lim_{x\downarrow c}E[Educ|Birthyear = x] - lim_{x\uparrow c}E[Educ|Birthyear = x]} \qquad (1)$$

The intended magnitude of the treatment effect τ_{FRD} can be estimated equivalently using the following system of equations:

$$1st\ Stage: Educyrs = \gamma + \delta Treat + g(Birthyear - 1979) + \sigma X + \nu \quad (2)$$

$$2nd\ Stage: Y = \alpha + \beta_{FRD}\left(\widehat{Educyrs}\right) + f(Birthyear - 1979) + \theta X + \varepsilon \quad (3)$$

where $Educyrs$ refers to the total completed years of education. *Treat* is a binary indicator variable, which takes a value of one if the respondent was born in or after 1979 and equals to 0 otherwise. To control for smooth changes in birth year, *f* and *g* takes the form of linear spline. In equation (2), δ captures the first stage effect of FPE on years of schooling. The control variable vector X includes region fixed effects, dummies for religion[7], dummies for ethnicity[8] and survey year and month fixed effects. For child outcomes, child's age dummy is further controlled for. For second stage equation (3), Y includes child's years of schooling, a binary indicator of school attendance, and child labor status. For exploring possible mechanisms for intergenerational transmission of education, *Y* includes fertility, spouse quality, household asset and labor market status. The 2SLS estimator β_{FRD} is systematically the same as τ_{FRD} in the functional form (Hahn et al., 2001). The standard errors are clustered at the birth year and birth region level.

We select a bandwidth of 5 years before and after the cutoff, which was selected by using the data-driven RDD estimation package in STATA rdrobust. We show that our results are robust to across various bandwidths and non-parametric functional form in Appendix Table A2.

[7] Religion in Malawi is classified into four categories; Christian, Muslim, Roman Catholic, and others.

[8] The ethnicity is classified into five most common ethnicities in Malawi and others (Update here).

5. Results

5.1. The Effects of the FPE on female education

Table 2 shows the first stage results of the effect of the FPE on mothers' and fathers' education, which is based on the size of the jump in educational attainment right around the birth year threshold of 1979.[9]

[Table 2]

The first-stage results by gender and mean dependent variable of the control group are reported in Panel A and B. The results indicate that the reform increased overall schooling years roughly by 0.54 years for mothers and 0.30 years for fathers, with the graphical representation presented in Figure 2. The graph shows a discontinuous increase in average years of education right around the cut-off birth year of 1979.

[Figure 2]

The reform increased the probability of graduating from primary school for women by 4.4 percentage points and for men by 2.6 percentage points (Column 3). While the first-stage coefficient estimate on mothers is higher than that on father, the impact of the FPE on women is even higher in terms of the percent of the mean (women: 0.044/0.255=17.3 percent; men: 0.026/0.413=6.3 percent). Although the reform mainly targets primary schooling enrollment by removing tuitions and fees, it also impacted the secondary schooling enrollment and graduation. Considering that the average education years among the control cohorts (measured at age 30 to 35) is 4.6 years for mothers and 6.2 years for fathers, the reform induced some

[9] As the optimal bandwidth suggested by Calonico et al. (2020) varies between 3 to 8 depending on the dependent variable and the sample, for consistency we apply the bandwidth of 5 throughout the analysis while reporting the robustness of the results with varying bandwidths. Table A2 shows that the estimates are robust with a wide range of bandwidth choices between 3 to 8.

affected students to gain the higher level of education than before by increasing the likelihood of graduating from secondary schooling by 2.2 percentage points for both mothers and fathers. The effect on literacy is much greater for women than for men. The FPE increased the literacy rate for women by 6.4 percentage points, which is a sizable improvement from the control mean of 68 percent. The FPE increased the literacy rate for men by 3.1 percentage points, from the control mean of 82.1 percent. Although we do not have the information on the quality of education, the positive impact on literacy indicates that the FPE increased the basic reading and writing skills for the affected cohorts, not merely increasing the quantity of education.[10]

The positive effect of the reform on educational attainment is similar to the other country settings. For comparison, Boahen and Yamauchi (2018) document that Free Compulsory Universal Basic Education in Ghana increased the schooling for affected women roughly by 0.9 years, from the average control mean of 6.02 years. Similarly, Keats (2018) examines the Uganda's Universal Primary Education program and finds that the reform increased schooling by 0.72 years, from the mean of 5.82 years for affected women. Aguero and Ramachandran (2020)'s first stage results show slightly higher than our estimates; they report an increase in mothers' education by 0.82 years and fathers' education by 0.68 years as a result of Zimbabwe reform which increased access to secondary schooling. However, the effect in terms of the percent of the average schooling is more comparable to our estimates, since the average schooling year for the mothers and fathers in Aguero and Ramachandran (2020) sample were 8.1 and 9.7 years, respectively whereas the average schooling in our sample was 5 years for mothers and 6.2 years for fathers.

[need to add a result by parent's grade level].

[10] We refrain from analyzing the effect of the FPE on tertiary education because less than 1 percent of the sample within our bandwidth completed university (and less than 0.5 percent of women).

5.2. Child education outcomes

Next, to examine the intergenerational effects of FPE, we focus on child education. We restrict the sample of children based on primary schooling age of 6 to 13, as the affected mothers and fathers are relatively young to have secondary schooling age children (age 14-17) and above[11]. We examine three educational outcomes of the children; years of schooling, school attendance, and literacy[12]. Given that these children have not yet completed schooling, the years of schooling can be indicative of whether the child progresses at a normal level, rather than repeating or delaying school entry date[13].

Table 3 provides a separate estimate for mother's education and father's education. The reduced form estimates showing the long-term impact of the FPE are reported in the first row in each panel. The mothers affected by FPE increased their child's education years by 6.9 percentage points and the likelihood of currently attending school by 2.2 percentage points. The impact on literacy is positive, but it is statistically significant only in the OLS estimates. Similarly, the fathers affected by FPE increased their child's education years by 7.1 percentage points, the likelihood of attending school by 1.6 percentage points, and literacy by 1.9 percentage points.

Next rows show the OLS and 2SLS effect of mothers' education and fathers' education. We discuss our results based on 2SLS estimates. For a given age of a child, the extra year of

[11] Appendix Figure A1 shows the distribution of the age of child among the parents within our sample.

[12] We also examine the outcome variable indicating whether a child had ever been enrolled in primary schools and find the results are very similar to the effect on school attendance.

[13] Since education years differ by children's age and parent's education can affect the age composition of children, we control for fixed effects for child's age in our estimation.

mother's schooling increase the years of schooling by 0.14 years and the child's likelihood of school attendance by 4.1 percentage points. The effect of father's education on education years and school attendance is positive at 0.24 years and 5.3 percentage points respectively. Father's education also increases schooling years of the child, but the estimate is marginally significant at the 10 percent.

As discussed, causal evidence on intergenerational effects of education is quite limited in the developing country context with the only exception of Aguero and Ramachandran (2020) in Zimbabwe. They find that an extra year of mothers' and fathers' schooling increase average schooling of child by 0.073 years and 0.092 years respectively. Our estimates are slightly larger, although the estimates may not be directly comparable to Aguero and Ramachandran (2020) who use Zimbabwe Census 2002 as baseline mean schooling and school attendance rate is much higher at both parents and children level in Aguero and Ramachandran (2020). For instance, despite that we use more recent year of Malawi Census of 2008, only 75 percent of our sample children currently attend school in contrast to the fact that almost all children (97 percent of children) currently attend school in Aguero ad Ramachandran (2020).

In developed country context, Oreopolulos et al. (2006) leverage historical changes in compulsory schooling laws in the United States to identify the causal effect of parent education on a child's schooling outcomes. Since most students are attending school, their outcome of interest is whether the child repeats a grade or not. They find that a one-year increase in parental education reduces the child's likelihood of repeating a grade by about 2 to 4 percentage points among the sample of children ages 7-15.

Finally, our results are robust to alternative specifications using the various bandwidths and non-parametric functional form. The results are reported in Appendix Table A2.

5.3. Heterogeneous effect of parent's education

This section explores heterogeneous effect of parent's education in two dimensions; by gender and by rural and urban status. The literature suggests the transmission of intergenerational resources may depend on the gender of the giver or the recipient (Duflo, 2003; Barcellos, 2014; Breierova, 2004; Qian 2008). We estimate the intergenerational effects for mothers and fathers on sons and daughters separately in Table 4.

[Table 4]

The results show that while mother's education appears to have significant effect on both sons and daughters, father's education has significant effect only for daughters. Our finding is different from previous papers finding larger intergenerational effect of female resources on female recipients (if there is any recipient's gender based difference), which is possibility due to the fact that gender gap in primary education has essentially disappeared around year 2005.

Also, we find the effect of parental education to be stronger and more precisely estimated for the rural children than urban children[14]. For urban children, although the estimates are all positive, they are not statistically significant at the conventional level. One potential reason for stronger effect among rural children is a low baseline schooling level compared to urban counterpart so there is more likely to be a room for improvement. Another possibility is that rural households are more likely to be credit constrained, due to lack of formal

[14] Although we do not report separately, we also find that children with lower than median observed wealth level show a higher impact than the children with higher than median wealth level, where summary measure of wealth measure is estimated by factor analysis using the reported assets such as possession of TV or radio and access to infrastructure such as electricity and clean water.

financial institutions or higher variability in income relative to urban households. *[ADD citation and discussion why rural may have stronger effect based on other literature as well]*

5.4. Child's labor market outcomes

Table 5 indicates that children with more educated mothers are less likely to engage in domestic work, whereas we do not find such evidence for children with more educated fathers. **[To be updated]**

[Table 5]

5.5. Mechanisms

Evidence so far suggests that increased parental education improves child's schooling years and increases likelihood of school-age children to stay in schools. Also, the increased mother's schooling decreases incidence of child's domestic labor. In this section, we discuss several channels that may explain this pattern.

The literature suggests that the First, the individuals with higher level of education are likely to have higher earnings and household wealth. increased education is likely to h may lead to better Given the fertility and investment in children is a joint decision between the couple, the fertility is likely to be reduced further under assortative matching. If the extra year of schooling merely delays fertility, it would not decrease number of children ever born at a later age.

5.5.1. Birth and marital outcomes

Our first-stage results suggest that the FPE reform has increased schooling among affected mothers and father. In this section, we examine whether the extra years of schooling affects the birth and marital outcomes such as age at marriage and birth. Column (1) in Table 6 indicates that an extra year of schooling reduces the number of children ever born by 0.4, which is about 10 percent of the baseline mean. The estimate is slightly higher than Osili and Long (2008), who show that an extra year of schooling reduces fertility before age 25 by 0.26 births. The result in column (2) indicates that there is also a small reduction in child mortality, suggesting that if mother's education allow marginal children to survive, our estimates on the effect of mother's schooling is likely to be underestimated.

[Table 6]

The next outcome of interest is age gap (spouse age-own age) between spouses and age at marriage and birth. Following the literature on early marriage and fertility, which are mostly focused on women, we discuss women's outcomes mainly although we include men's outcomes for comparison. Field and Ambrus (2008) examine the causal effect of marriage timing using age of menarche as an instrumental variable. Delaying marriage is associated with a higher level of schooling and with an increase in use of preventive health services for women. While some boys marry young, the practice of child marriage mostly affects girls (Parsons et. al, 2015).

Each year of extra schooling reduces age gap by 1.93 years from the average age gap of 6.2 years and the effect is statistically significant at the 5 percent (Column 3). To see whether the extra schooling reduces extreme age gap between husband and wife, we construct a binary variable indicating if the age gap between spouses is greater than 10, the value of which represents a 75 percentile of the age gap distribution. The result in column (4) indicates that the education reduces the likelihood of marrying a much older partner by 7.8 percentage points.

Marrying a much older partner happens not so rarely at 14 percent among married women in the control group, and this incidence decreases as women obtain more education.

Column (5) and (6) show that while the extra year of schooling induced by the FPE does not necessarily delays overall age at first marriage, it decreases early marriage by 1.8 percentage points. Child marriage, or early marriage refers to any marriage or union involving a person under the age of 18. The female education also delays the age at first birth by 0.59 years (column 7), suggesting that the delayed age at birth is likely due to postponing a birth after getting married rather than the delayed marriage timing. However, education does play a role in reducing marriage at early age, suggesting that the effect of education may not be constant across age.

5.5.2. Labor market and household wealth

In this section, we explore whether the extra years of schooling affect own labor market outcomes and asset score.

[Table 7]

In Table 7, columns (1) and (5) shows that the likelihood that the individual is employed is unaffected by an increase in schooling for both men and women. Among the employed, the likelihood that the individual works in agriculture while negative, is insignificant for both men and women in columns (2) and (6), respectively. We do not observe any significant effect on the probability of being a wage worker among the employed, for both men and women. To measure household wealth, we construct an asset score using the principle component analysis method. We find that for women, an extra year of schooling increases asset score by 0.091 points from the mean wealth score of 0.29 in column (4). The effect on asset

score is slightly more pronounced for men. In column (8), from the mean wealth score of 0.24 points, an extra year of schooling is found to increase asset score by 0.201 points.

5.5.3. Spousal quality

We next investigate the impact of schooling on spousal quality and examine whether there is any evidence indicating assortative mating in Table 8. Marrying or living with educated partners can be a possible mean through which women's education induces a trade-off between the quantity and quality of their children. In column (1), we find that an extra year of own schooling for mother is associated with an increase of 0.79 years of husband's schooling. This implies that women marrying better educated husbands may be one of the channels leading to the decrease and delay of the child fertility. For spouse's labor market outcomes, while increase schooling of mothers has no effect on husband's employment and likelihood of being a wage worker, the likelihood that the husband works in agricultural industry is reduced by 3.3 percentage points in column (3). This suggests that both education and job quality of spouse may increase with increases in female's schooling.

For men, an extra year of schooling increases wife's years of schooling by 1.16 years in column (5). This is likely to be a combined effect of assortative matching and a result of increased female schooling. For labor market outcomes of spouse, an extra year of schooling for men lowers wife's employment likelihood by 7.3 percentage points while increasing the likelihood that wife is a wage worker by 8.9 percentage points in columns (6) and (8), respectively. We find no significant effect on the probability that wife works in the agriculture industry.

6. Conclusion

Using the introduction of the Free Primary Education program in Malawi, aimed to achieve the universal primary education, we estimate the causal impact of parent's schooling on children's education. We find mother's education to have positive association with both son's and daughter's education, while father's education increases only daughter's education. We also find that children are less likely to engage in child labor, with more education parents. The findings are robust to various specification checks.

As a possible mechanism for this intergenerational transmission of education, we investigate fertility and quantity-quality tradeoff as one possible channel. Indeed, we find permanent reduction in fertility, smaller age gap between husband and wife, as well as delayed age at birth for mothers. Furthermore, we find evidence of assortative mating for both treated men and women in that they are more likely to match with spouse with more years of schooling. Finally, own asset score increases with increased years of schooling for both men and women.

Our results show that reducing costs of schooling in developing countries have intergenerational spillovers, even at the primary school level. It is possible that increasing access to schooling at higher levels of education may have even larger effects. While our results suggest that there could be gender-specific differences in intergenerational transmission of human capital, given that by the time that the children of the FPE affected cohort are observed in data, gender gap in primary education was essentially eliminated, it is probably difficult to generalize our findings to countries where there still is a gender gap in education.

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Table 1: Summary Statistics

Parent's Outcomes	Mothers	Fathers
Age at cutoff (1979)	29	29
Included ages (± 5 years)	25-34	25-34
Schooling years	4.625	6.219
	[3.887]	[4.027]
Enrolled in primary school	0.7	0.828
Graduated from primary school	0.258	0.416
Enrolled in secondary school	0.145	0.268
Graduated from secondary school	0.06	0.139
Literacy	0.682	0.822
Number of Obs.	63,018	31,590

Child's Outcomes	Female Child	Male Child
Child's year of schooling	2.394	2.263
Currently attending school	0.724	0.715
Ever attended primary school	0.835	0.825
Literacy	0.497	0.47
Domestic Work	0.045	0.043
Market Work	0.17	0.172
Domestic & Market Work	0.213	0.215
Number of Obs. (Mother within household)	55,201	54,278
Number of Obs. (Father within household)	24,193	23,674

Note: Samples are restricted to mothers and fathers with children of age between 6 to 13.

Table 2: First-stage outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
	Schooling Years	Enrolled in Primary	Graduated Primary	Enrolled in Secondary	Graduated Secondary	Literacy
A. Mothers						
Treat	0.537***	0.059***	0.044***	0.022***	0.002	0.064***
	(0.074)	(0.009)	(0.007)	(0.005)	(0.004)	(0.009)
Mean Dep. Var.	4.598	0.699	0.255	0.143	0.058	0.680
Obs.	61854	62617	62617	62617	62617	62030
B. Fathers						
Treat	0.296***	0.030***	0.026***	0.022***	0.001	0.031***
	(0.088)	(0.009)	(0.010)	(0.008)	(0.007)	(0.009)
Mean Dep. Var.	6.193	0.827	0.413	0.265	0.137	0.821
Obs.	31191	31391	31391	31391	31391	31311

Note: The birth year has been re-centered at the cutoff year (1979). Robust standard errors, clustered at the birth year and region are given in parentheses. Controls in each specification include: linear slopes on either side of the cutoff birthyear, religion and ethnicity fixed effects, and region fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Effect of parent education on child education

		Schooling Years	School Attendance	Literacy
		(1)	(2)	(3)
A. Mothers				
Reduced Form	Treat	0.069***	0.022***	0.011
		(0.026)	(0.007)	(0.008)
		2.107	0.746	0.431
		108104	109479	10866
OLS	Parent's education	0.104***	0.014***	0.027***
		(0.002)	(0.001)	(<0.001)
	Mean Dep. Var.	2.105	0.749	0.430
	Obs.	107450	108330	107983
IV	Parent's education	0.138***	0.041***	0.021
		(0.040)	(0.013)	(0.013)
	Mean Dep. Var.	2.105	0.749	0.430
	Obs.	107450	108330	107983
B. Fathers				
Reduced Form	Treat	0.071***	0.016*	0.019**
		(0.026)	(0.009)	(0.010)
	Mean Dep. Var.	1.781	0.726	0.351
	Obs.	47313	47867	47612
OLS	Parent's education	0.074***	0.014***	0.021***
		(0.002)	(0.001)	(0.001)
	Mean Dep. Var.	1.781	0.727	0.351
	Obs.	47068	47567	47359
IV	Parent's education	0.239***	0.053*	0.069*
		(0.092)	(0.032)	(0.036)
	Mean Dep. Var.	1.781	0.727	0.351
	Obs.	47068	47567	47359

Table 4: Heterogeneous effect of parent education on child education (2SLS)

	A. Mothers			B. Fathers		
	Schooling Years	School Attendance	Literacy	Schooling Years	School Attendance	Literacy
	(1)	(2)	(3)	(4)	(5)	(6)
Daughters						
Treat	0.104**	0.057***	0.016	0.227***	0.091**	0.058*
	(0.047)	(0.019)	(0.015)	(0.086)	(0.038)	(0.032)
Mean Dep. Var.	2.167	0.754	0.443	1.834	0.731	0.365
Obs.	54149	54587	54412	23794	24055	23937
Sons						
Parent's education	0.173***	0.026*	0.027*	0.261	-0.028	0.094
	(0.048)	(0.013)	(0.016)	(0.187)	(0.070)	(0.081)
Mean Dep. Var.	2.043	0.744	0.418	1.725	0.723	0.337
Obs.	53301	53743	53571	23274	23512	23422
Rural						
Parent's education	0.109***	0.038***	0.014	0.278**	0.049	0.069
	(0.041)	(0.014)	(0.013)	(0.130)	(0.039)	(0.048)
Mean Dep. Var.	1.969	0.735	0.390	1.666	0.713	0.311
Obs.	91331	92113	91812	39749	40173	40002
Urban						
	0.435	0.144	0.106	0.052	0.050	0.035
Parent's education	(0.602)	(0.268)	(0.143)	(0.192)	(0.076)	(0.069)
Mean Dep. Var.	2.868	0.828	0.655	2.388	0.804	0.559
Obs.	15498	15594	15549	7041	7115	7078

Table 5: Child labor outcomes (2SLS)

		Domestic Work	Market Work	Market & Domestic Work
		(1)	(2)	(3)
A. Mothers				
OLS	Parent's education	-0.004***	-0.004***	-0.008***
		(0.000)	(0.000)	(0.000)
IV	Parent's education	-0.016**	-0.012	-0.028**
		(0.006)	(0.010)	(0.013)
	Mean Dep. Var.	0.041	0.151	0.192
	Obs.	107983	108330	108330
B. Fathers				
OLS	Parent's education	-0.004***	-0.004***	-0.008***
		(0.000)	(0.001)	(0.001)
IV	Parent's education	0.010	-0.049	-0.039
		(0.017)	(0.031)	(0.030)
	Mean Dep. Var.	0.043	0.169	0.212
	Obs.	47359	47567	47567

Table 6. Fertility and marital outcomes (2SLS)

	Outcome variables						
	Children ever born	% children died	Age gap	Extreme age gap	Age at marr	Married age <=18	Age at birth
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mother's education	-0.386***	-0.017***	-1.929***	-0.078***	-0.005	-0.018*	0.586***
	(0.067)	(0.005)	(0.350)	(0.017)	(0.072)	(0.011)	(0.125)
Mean Dep. Var.	3.984	0.110	6.220	0.144	18.356	0.581	18.751
Obs.	62252	61398	50425	50425	61600	62253	61397
Father's education	NA	NA	-0.561*	0.010	-0.380*	0.009	0.600***
	NA	NA	(0.316)	(0.008)	(0.206)	(0.022)	(0.203)
Mean Dep. Var.	NA	NA	-3.391	0.025	21.212	0.147	21.309
Obs.	NA	NA	30039	30039	31336	31389	31165

Note: The birth year has been re-centered at the cutoff year of 1979. Robust standard errors, clustered at the birth year and region, are given in parentheses. Controls dummies for religion and ethnicity fixed effects, and region fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Labor market outcomes and wealth

	Mothers				Fathers			
	Employed	Agri.	Wage worker	Asset score	Employed	Agri.	Wage worker	Asset score
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Parent's education	0.004	-0.008	0.011	0.091**	-0.011	-0.056	0.046	0.201**
	(0.015)	(0.016)	(0.011)	(0.038)	(0.024)	(0.035)	(0.028)	(0.075)
Mean Dep. Var.	0.577	0.712	0.134	0.285	0.832	0.515	0.270	0.237
Obs.	62253	36065	34032	62253	31389	26162	24421	31389

Table 8 Spouse quality

	Mothers				Fathers			
	Schooling Years	employed	Ind_agri	Wage worker	Schooling Years	employed	Ind_agri	Wage worker
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Parent's educ	0.786***	-0.003	-0.033**	0.023	1.185***	-0.073*	0.016	0.089**
	(0.098)	(0.011)	(0.015)	(0.015)	(0.230)	(0.042)	(0.042)	(0.041)
Mean Dep. Var.	6.173	0.839	0.506	0.300	4.754	0.543	0.757	0.109
Obs.	50137	50317	42310	39714	29958	30026	16392	15489

Note: The birth year has been re-centered at the cutoff year (1977/78) so that the estimate of the discontinuity may be interpreted directly. All DHS statistics adjusted for sampling weights. Robust standard errors, clustered at the birth year and survey cluster, are given in parentheses. Controls in each specification include: linear slopes on either side of the cutoff birthyear, religion and ethnicity fixed effects, region fixed effects, survey year and month fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Appendix

Table A1: Using Census 1987, check parents of the affected cohort's education, work status, etc.

	A. Females born 1974-1983				B. Males born 1974-1983			
	Treat coef.	SE	MDV	N	Treat coef.	SE	MDV	N
Parent edu (mother+father)	0.096	(0.122)	5.688	61195	0.088	(0.085)	5.595	63813
Schooling Years (mother)	0.059	(0.047)	1.842	92780	0.011	(0.040)	1.831	93782
Schooling Years (father)	0.070	(0.066)	3.870	63689	0.102**	(0.051)	3.798	66818
Rural (mother)	-0.004	(0.006)	0.897	92881	-0.007**	(0.003)	0.899	93897
Rural (father)	0	(0.007)	0.873	64065	-0.005	(0.004)	0.877	67278
Has a radio (mother)	0.010*	(0.005)	0.228	92881	0.003	(0.005)	0.228	93897
Has a radio (father)	0.008	(0.007)	0.266	64065	-0	(0.006)	0.261	67278
Has a toilet (mother)	0.010	(0.006)	0.675	92881	0.008	(0.006)	0.674	93897
Has a toilet (father)	0.005	(0.008)	0.705	64065	0.012*	(0.006)	0.702	67278
Has a piped water (mother)	0.003	(0.005)	0.202	92881	0.009**	(0.004)	0.203	93897
Has a piped water (father)	0.001	(0.006)	0.210	64065	0.008	(0.006)	0.210	67278

Table A2: Robustness checks with varying bandwidth and using alternative specification

[To be updated]

Figures

Figure 1

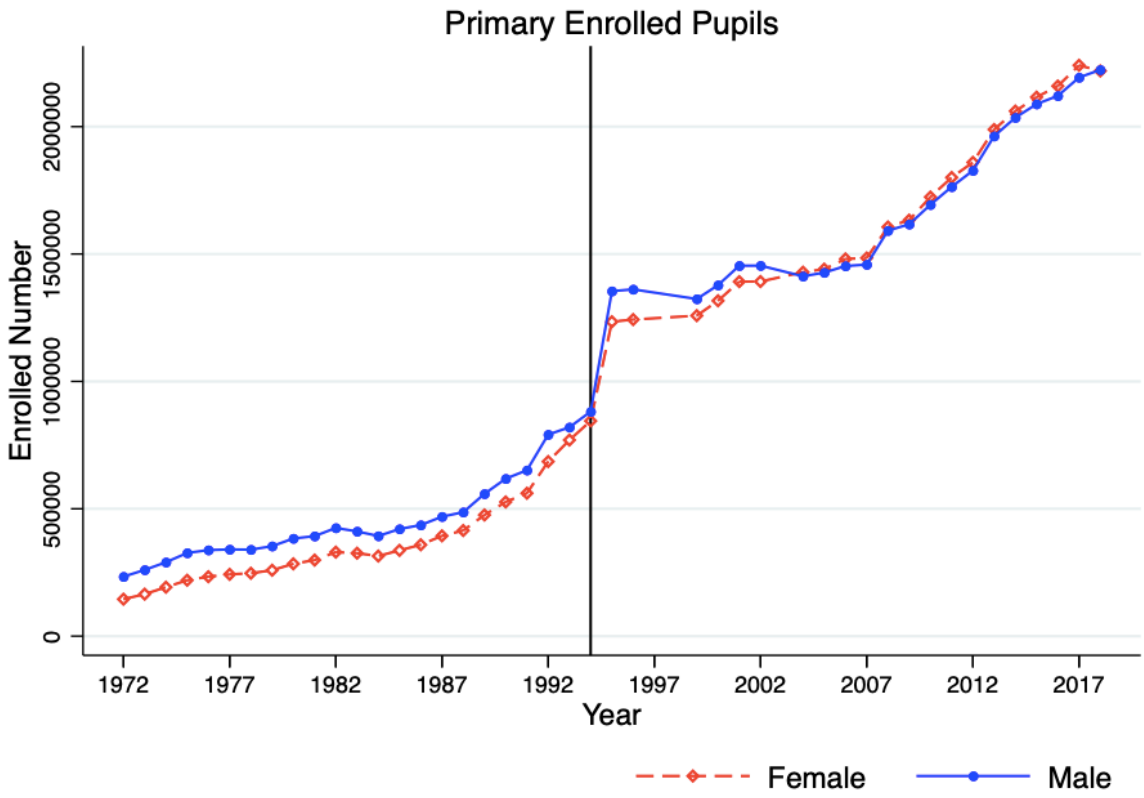


Figure 2: The effect of the FPE policy on schooling years

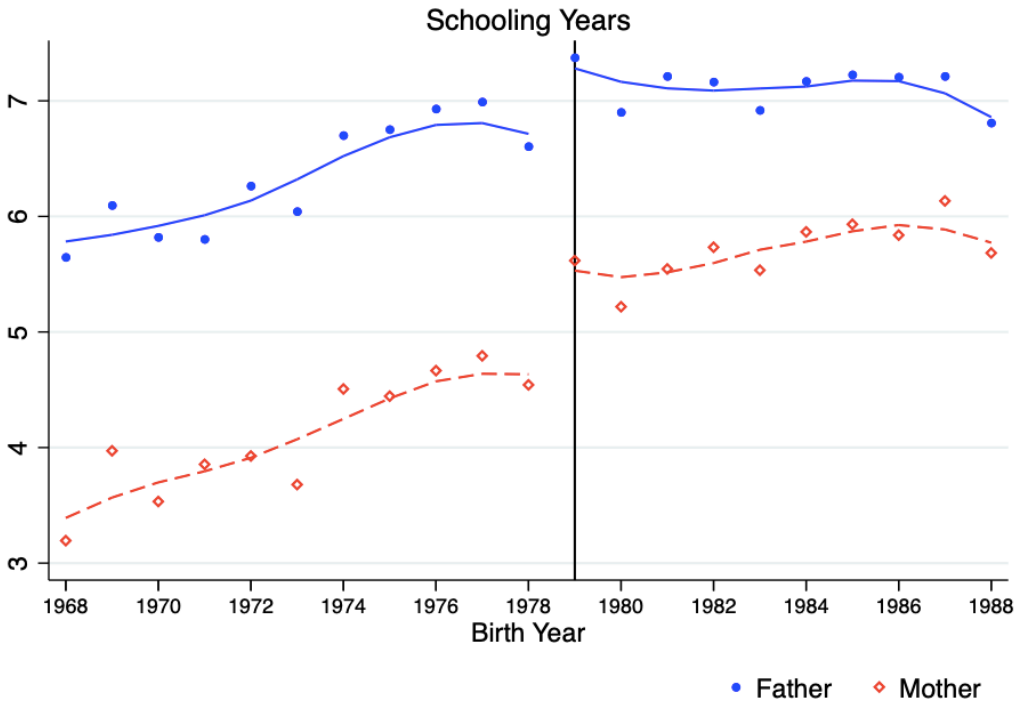


Figure 3: The first-stage effect of FPE by grade level

[To be updated]

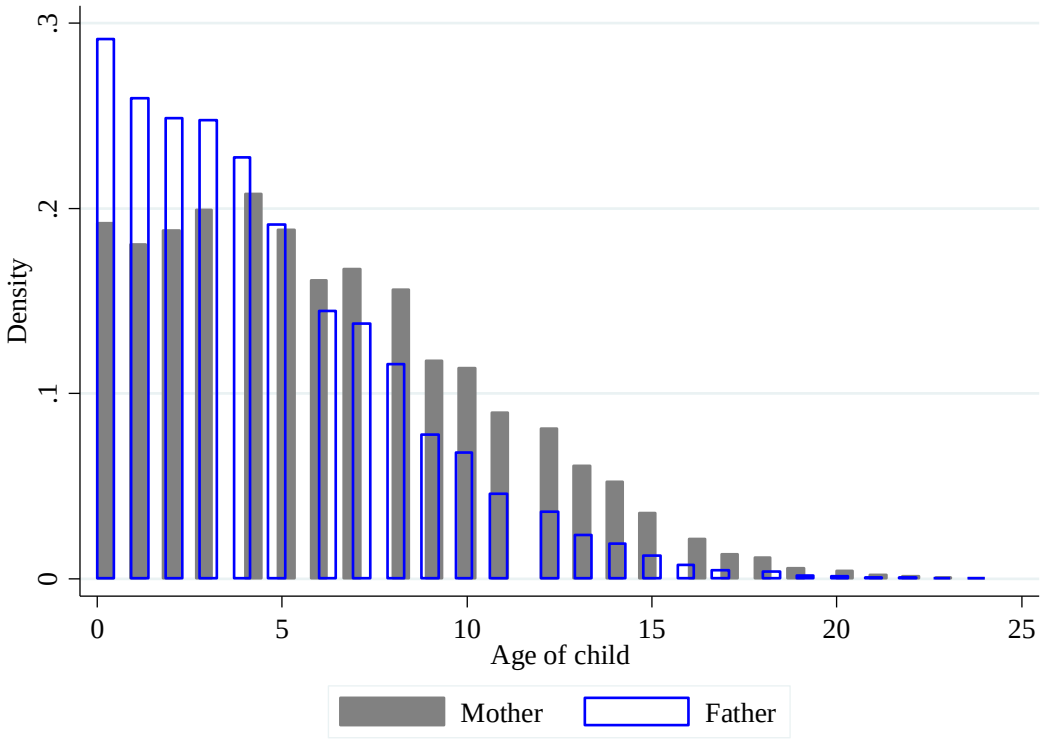
Figure 4: The effect of education on child's education years by child's age

[To be updated]

Figure 5: The effect of education on child's school attendance by child's age

[To be updated]

Appendix Figure A1:



Appendix Figure A2: Density of population in Census 87 (Female: Left, Male: Right)