How Education Empowers Women in Developing Countries

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Abstract

This paper evaluates the impacts of education on women's relational empowerment, within a context of 70 developing countries across the world. Exploiting the variation in educational attainment between biological sisters, we find that education is positively associated with women's intra-household decision making authority in both financial and non-financial domains. Moreover, education reduces relational friction, especially women's exposure to psychological abuse. Our mechanism analyses provide suggestive evidence that these improvements could be attributed to increased access to information, assortative matching, and better labor market outcome.

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1 Introduction

Empowering women is one of the key themes in the Agenda for Sustainable Development adopted by the United Nations in 2015 (UN Women, 2018). Women's empowerment is a multi-faceted concept which refers to a process of change where women gain the freedom to control their own lives in a way that improves their well-being. In a comprehensive review, Huis et al. (2017) integrate previous findings and classifies women's empowerment into three dimensions, namely, personal, relational, and societal empowerment. In this paper, we focus on relational empowerment which refers to women's position in relation to partner, family, or social networks, such as intra-household decision making and experiences of intimate partner violence (Rahman, 1999; Banerjee et al., 2015; Huis et al., 2019).[1] The relational dimension is of interest because women continue to lag behind men in personal autonomy in both developed and developing countries. The poorer the countries, the less likely the women are to influence household decisions, and the more likely they are to face domestic violence (Jayachandran, 2015).

In this paper, we investigate the extent to which education improves women's relational empowerment. The contribution of our study is threefold. First, we analyze the non-pecuniary effects of education on an important yet understudied aspect in economic development (women's empowerment), while the majority of existing studies tend to focus on the returns of education in financial or human capital domains. In particular, we comprehensively evaluate the impacts of education on women's empowerment in the relational dimension indicated by intra-household decision making power and relational friction. Second, instead of concentrating on one individual country, we study the relationship of interest for a wide coverage of 70 developing countries from 1992 to 2018. The wide coverage across time and space lends external validity to our estimates. In other words, the results of our study could be generalized to many countries. Third, we rigorously examine potential mechanisms through which education empowers women. Understanding the pathways is important to devise policies to improve the well-being of women.

Employing the Demographic and Health Surveys, we uncover the positive impacts of education

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[1] Personal empowerment is related to self-esteem, control beliefs, self-confidence, and self-efficacy (Basargekar, 2009; Kato and Kratzer, 2013; Hansen, 2015). Societal empowerment reflects women's position in society on a macro level, for instance, the proportion of female leadership or the percentage of parliamentary seats held by women (Strøm et al., 2014; Huis et al., 2017).

on women's empowerment along the line of intra-household decision making authority. Specifically, an additional year of education is associated with an increase in the composite decision indices (both Financial Decisions and Non-financial Decisions) by approximately 0.01 points. We also find some evidence that a one-year increase in female education reduces relational friction, particularly women's exposure to psychological abuse by the husband/partner by 0.01 points. To put the numbers into perspective, a woman with a college degree is likely to have higher intra-household decision making authority and less relational friction by 16 percentage points than a woman without education (corresponding to 30% and 87% of the means, respectively). Our mechanism analysis provides suggestive evidence that the empowerment effects of female education could be, at least in part, attributed to increased access to information, assortative matching, and better labor market outcome. Given the integral role of women in the Sustainable Development Goals (UN Women, 2018), our findings call for expanding access to education for women as part of the solution.

The paper proceeds as follows. Section 2 reviews related literature. Section 3 presents the empirical methodology. Section 4 describes the data. Section 5 provides the results, robustness checks, and heterogeneity analyses. Section 6 concludes our paper.

2 Literature Review

Conceptually, our study on the link between education and women's relational empowerment can be related to the bargaining theories of distribution within the household, such as the works of Manser and Brown (1980), McElroy and Horney (1981), and Lundberg and Pollak (1993). These models treat household decision as a cooperative game in which a woman and her partner resolve their differences by the bargaining solution (e.g. Nash). Unlike the unitary model where decisions are made by perfectly aligned preferences, these bargaining models focus on household demand behavior that depends on the resources controlled by each partner both individually and jointly. By raising women's knowledge and economic resources, education serves as a *"threat"* option to a non-cooperative equilibrium that increases women's bargaining power within households. Here, the *"threat"* option reflects the outcome that would be obtained in the absence of agreement. In other words, it captures the individuals' maximal levels of utility outside the household. The more attractive a woman's opportunities outside the household, the more power the woman will have in the intra-household decision making. Simply put, education could empower women by raising their welfare/gains in a non-cooperative scenario with their partners, thus allowing them to bargain with their

2

partners on household resource allocation. Therefore, education is regarded by UNESCO (2014) as an important instrument to empower women worldwide.

Empirically, our paper is closely related to studies on the empowerment effects of female education. Particularly, within the context of Kenya, Friedman et al. (2016) show that increased secondary school enrollment decreases women's acceptance of the right of men to beat their wives and reduces the likelihood of parents choosing husbands for their daughters. The authors conclude that education fosters a desire for autonomy and empowerment. In the same vein, Cannonier and Mocan (2018) find that education makes Sierra Leonean women more likely to declare that a wife is justified in refusing sex when she is tired or when the husband has a sexually transmitted disease. Educated women also tend to assert that the violent practice of female genital mutilation should be stopped. While an increase in educational accumulation makes women less likely to be tolerant of intimate partner violence as well as other harmful practices conflicting with their welfare, Samarakoon and Parinduri (2015) does not detect any effect of education on women's decision-making power within households in Indonesia.

Our study also fits into the literature on the determinants of women's relational empowerment. For example, incomes and ownership of land are positively linked with female autonomy within the household proxied by a woman's say in household decision making (Panda and Agarwal, 2005; Allendorf, 2007; Harari, 2019; Heath and Tan, 2019). Moreover, access to microfinance services empowers women through raising their decision making power (Pitt et al., 2006; Ashraf et al., 2010; Li et al., 2011; Alam, 2012) as well as reducing domestic violence (Hashemi et al., 1996; Panda and Agarwal, 2005; Arora and Arora, 2012).

There remain three gaps in the literature. First, despite being regarded as one of the Sustainable Development Goals (SDG) by the United Nations, women's empowerment has received insufficient attention, and the role of education in empowering women has been understudied. Second, among the few studies on the empowering effects of education, the evidence is conflicting as some studies document positive impacts (Cannonier and Mocan, 2018; Friedman et al., 2016) while others point to the non-existence of such a relationship (Samarakoon and Parinduri., 2015). To fill these two gaps, this paper aims to investigate the impacts of education and women's empowerment measured by women's intra-household decision making power and relational friction. In terms of identification, we establish a causal link on the relationship of interest by exploiting the variation in education among

biological sisters within a fixed effects framework. Finally, prior studies only consider the role of education in empowering women for one single country, thus making it hard to interpret the results as externally valid. To this end, we employ a global sample of 70 developing countries spanning from 1992 to 2018 to estimate the empowering effects of education. The wide coverage across time and space lend external validity to our results.

3 Empirical Methodology

The relationship between education and women's empowerment can be expressed by the following model,

$$Y_{ict} = \beta_0 + \beta_1 Education_{ict} + X'_{ict}\Omega + \epsilon_{ict} \tag{1}$$

where the subscripts i, c, and t refer to woman, country, and survey year, respectively. Y_{ict} represents different measures of relational empowerment (described in details in Section 4). $Education_{ict}$ is the educational attainment of the woman. X'_{ict} is a covariate vector including age, place of residence, ethnicity as well as the country-specific birth cohort trend. We denote by ϵ_{ict} the error term. Standard errors are clustered at the country level.

The coefficient of interest is β_1, which summarizes the empowering effects of female education. In this model, we compare the empowerment measures of women randomly drawn from the population who attain different levels of education. Estimates from equation (1) are plagued with heterogeneity bias since there are unobserved family characteristics that jointly determine educational attainment and empowerment measures. For example, a high socioeconomic status family might adopt a liberal view and instill the value of women's empowerment to their daughter. That family is also more likely to invest in the schooling of their child. In other words, unobserved family traits may simultaneously influence both educational attainment and women's empowerment, confounding the causal relationship of interest.

We attempt to control for unobserved heterogeneity in family characteristics by comparing the empowerment outcomes of two biological sisters. As the sister comparison will better capture the effects of unobserved family traits than other comparison groups (Geronimus and Korenman, 1992), the method is widely adopted in prior studies to account for unobserved heterogeneity in family background (Altonji and Dunn, 1996; Aaronson, 1997; Currie and Stabile, 2006; Fletcher and Wolfe, 2008; Fletcher, 2010; Le and Nguyen, 2020a). In our

4

context, the between-sister comparison is given in the sister fixed effects model as follows,

$$Y_{isct} = \beta_0 + \beta_1 Education_{isct} + \lambda_s + X'_{isct}\Omega + \epsilon_{isct} \tag{2}$$

where the subscript s refers to the sister group. A woman and her biological sister(s) together form a unique set s. The term λ_s stands for sister fixed effects which can remove confounding unobserved endowments common to biological sisters. Factors such as unmeasured family traits that could potentially affect both empowerment outcomes and education are now accounted for in the sister fixed effects model. The covariate X'_{isct} now consists of age and the age difference between the woman and her sister.[2]

The coefficient of interest is β_1, which captures the weighted average of the differences in empowerment measures of two biological sisters where the woman attains one more educational year than her sister. Our identification of the impacts of education on women's empowerment hinges upon the variation in educational attainment between sisters. The underlying identifying assumption is that the educational differences between sisters are as good as random. To provide suggestive evidence on the plausibility of this assumption, we test whether the educational differences between sisters are correlated with other characteristics. Following Altonji and Dunn (1996), we regress the deviation from (sister) pair mean of the woman's years of education on the deviation from (sister) pair mean of the woman's prior characteristics. These characteristics include birth order, childhood place of residence (an indicator for a city), and the time interval between marriage and first birth. The results presented in Table A1 suggest that the educational differences between sisters are uncorrelated with other characteristics, thus further strengthening our empirical strategy.

4 Data

The data used in this paper comes from the Woman File of the Demographic and Health Surveys (DHS). Respondents are women aged 15-49. The DHS Woman includes information on demographics, education, and employment, among others. Especially, there are various questions which can be used to assess women's empowerment in the DHS, making it ideal for the purpose of this study. We pool the data and impose several restrictions to construct the analysis sample. First, we only utilize countries and data waves with available women

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[2] As we later show in Section 4, since our identification comes from the between-sister variation in educational attainment, our sample consists of sisters who live together. Therefore, the inclusion of sister fixed effects will absorb the place of residence of the woman.

empowerment measures. Second, we further limit ourselves to women aged 18 and older to confine the effects of education at completed schooling (McCrary and Royer, 2011). Finally, because our identification comes from the comparison between sisters with different years of education, we construct a sample made up of sister groups. Specifically, the biological daughters of the household head constitute the first group of sisters. The second group of sisters consists of women who are biological sisters of the household head and the head herself. These restrictions leave us with over 23,000 women in 70 developing countries. The list of countries is provided in Table B1 in appendix B. Table B1 also provides the survey year and wave, average educational attainment, and age for each country in our sample.

Intra-household Decision Making − Women's intra-household decision making power measures are drawn from seven item questions where women were asked to specify the decision-maker(s) in the following categories: spending of their own earnings, spending of their husband/partner's earnings, making large household purchases, making household purchases for daily needs, their own health care, visits to family/relatives, and foods to be cooked each day. Based on women's responses, those decisions can be made alone or jointly by the women and their husbands/partners. To capture women's decision power in the household, we construct a composite index as follows. We first assign 0, 0.5, and 1 point for each domain if the woman has no say in the decision, if she is partially involved in the decision, and if she is the sole decision-maker, respectively.[3] Then we take the average of the underlying items.

Using this method, we construct two female decision-making power indices. First, the Financial Decisions index is based on four items, namely, spending of own earnings, spending of husband/partner's earnings, making large household purchases, and making household purchases for daily needs. Second, the Non-financial Decisions index is constructed from the three remaining items, including the woman's health care, visits to family/relatives, and everyday cooking. Our measures of female intra-household decision making power have Cronbach's alpha greater than 0.7, suggesting that the items underlying the indices are measuring a single concept.

Relational Friction − Relational friction is measured by women's experience of two types of domestic violence: physical violence and psychological abuse. Accordingly, we construct

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[3] This choice of assignment is adopted in Huis et al. (2019).

two indices to measure women's exposure to relational friction. For each item, we assign the value of 1 if the woman ever experiences the incident and 0 otherwise. We respectively compute a composite index by averaging across the underlying items under each measure (Physical Violence and Psychological Abuse).

To reflect women's experience with physical violence, we draw from women-reported frequency of facing these six incidents: being pushed, shook, or had something thrown at, being slapped, being punched with fists or something harmful, being kicked or dragged, being strangled or burned, having arm twisted or hair pulled, all by the husband/partner. To assess women's exposure to psychological abuse, we utilize three items on the frequency of being humiliated, being threatened with harm, and being insulted/felt bad by the husband/partner. The internal reliability of the two relational friction indices is high evidenced by a large Cronbach's alpha.

Table 1: Summary Statistics

	Mean	SD	Observations
Panel A: Controls			
Education	7.533	4.640	23,894
Age	27.829	7.099	23,894
Age Differential	6.309	4.720	23,894
Panel B: Outcomes			
Financial Decisions	0.541	0.361	23,894
Non-financial Decisions	0.542	0.336	20,037
Physical Violence	0.146	0.255	6,052
Psychological Abuse	0.183	0.336	5,119

Panel A of Table 1 provides the descriptive statistics of control variables used in this analysis. On average, a woman completes 7.5 years of education. The mean values of the woman's age and the age differences between the woman and her sister are 27.8 and 6.3 years, respectively. Panel B of Table 1 presents the mean and standard deviation of different measures of women's empowerment. Regarding intra-household decision making power, the Financial Decisions and Non-financial Decisions indices take the mean values of 0.54. In terms of relational friction, on average, Physical Violence and Psychological Abuse indices lie at 0.15 and 0.18 points, respectively. Summary statistics of the underlying items are provided in Table B2 in the Appendix.

5 Results

5.1 Main Results

Intra-household Decision Making − We provide the estimates for the impacts of education on women's intra-household decision making authority in Table 2. It is evident from Panel A that education makes women more likely to be involved in household decisions. Specifically, an additional year of education raises women's decision making authority in financial and non-financial domains (proxied by the Financial Decisions and Non-financial Decisions indices, respectively) by approximately 0.01 points.

Table 2: The Impacts of Female Education on Intra-household Decision Making

	(1)	(2)	(3)	(4)
Panel A: Decision Indices				
	Financial Decisions	Non-financial Decisions		
Female Education	0.009***	0.009***		
	(0.003)	(0.002)		
Observations	23,894	20,037		
Panel B: Financial Decision Items				
	Large Purchases	Daily Purchases	Own Earnings	Husband/Partner Earnings
Female Education	0.011***	0.012***	0.001	0.003
	(0.003)	(0.004)	(0.002)	(0.003)
Observations	20,004	12,723	13,417	10,068
Panel C: Non-financial Decision Items				
	Women's Health Care	Food Cooked	Family Visits	
Female Education	0.013***	0.003*	0.008***	
	(0.002)	(0.002)	(0.002)	
Observations	19,927	10,720	19,924	

NOTE: Each cell reports the coefficient β_1 in equation (2). All regressions control for age, the age difference between the woman and her sister, sister fixed effects, as well as the country-specific birth cohort trend. Standard errors are provided in the parentheses. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

It is suggested that women's bargaining power in male-dominated domains that involves major financial decisions differs from the engagement of women in traditionally female-dominated domains (Dutt et al., 2016; Johnson, 2017). To shed additional light on the source of the increase in women's decision making authority, we separately estimate the effects of education

on each of the item decisions that constitute the decision making indices.[4] As shown in Panel B of Table 2, education increases women's decision making on both large household purchases and household purchases for daily needs. Moreover, education is positively associated with women's decision making authority in their own health care as well as other traditionally female-dominated domains such as everyday cooking and visits to family/relatives. However, there is not enough statistical evidence for the effects of education on the spending of own earnings and husband/partner's earnings.[5] Overall, the improvements in decision making authority within the households come from women's increased involvements in decisions on large and daily household purchases, decisions regarding their own health care as well as other traditionally female-dominated categories.

Taken together, the results in Table 2 suggest that education empowers women in terms of their intra-household decision making power. Our findings are consistent with the bargaining theory proposed by Manser and Brown (1980) where education allows women to enjoy higher bargaining power within households. Particularly, the more educated women command more knowledge and make more financial contributions to the family, thus are more likely to have a say in household decisions regarding resource allocation (Lundberg and Pollak, 1993; Chiappori et al., 2009; Duflo, 2012). However, our results differ from those in Samarakoon and Parinduri (2015) which document that education does not have any effect on women's decision making authority.

Relational Friction − Table 3 presents the estimated impacts of education on relational friction. Relational friction is measured by the extent to which women are exposed to physical and psychological aggression by their husbands/partners, proxied by the Physical Violence and the Psychological Abuse indices. As shown in Column 1 of Panel A, there is a negative association between female education and the incidence of physical violence. The estimated effect is marginally significant with p-value equal to 0.11. In terms of psychological abuse (Column 2 of Panel A), we detect a negative association between female education and the Psychological Abuse index. The estimate is statistically distinguishable from zero.

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[4] The seven items include Large Purchases, Daily Purchases, Own Earnings, Husband/Partner Earnings, Women's Health Care, Food Cooked, Family Visits. Each takes the value of 1 if the woman is the sole decision maker, 0.5 if she is partially involved in the decision, 0 if she has no say in the decision.

[5] Splitting the samples by continent, place of residence, marital status, employment status leaves the results unchanged (Table A2). Specifically, we continue to find no effect of women's education on decisions regarding own earnings and husband/partner's earnings for African and non-African women, rural and urban women, married and unmarried women, as well as employed and unemployed women.

In Panel B, we look at the six items that constitute the Physical Violence index, including Being Pushed, Being Slapped, Being Punched, Being Kicked, Being Strangled, and Being Twisted. These are dummy variables indicating whether the husband/partner ever uses a particular type of violence against his wife. As evident from Panel B of Table 3, an additional year of education decreases the incidence of the woman being slapped, punched, and strangled by her husband/partner by 0.8, 0.8, and 0.5 percentage points, respectively. For other types of domestic violence, the coefficient estimates are statistically insignificant.

In Panel C of Table 3, we further break down the Psychological Abuse index by looking at the three underlying items (Being Humiliated, Being Threatened with Harm, and Being Insulted). We find that more educated women are less likely to be insulted by their spouses (Column 3). Education does not seem to affect the incidence of being humiliated and being threatened. Overall, Table 3 suggests that education decreases relational friction in terms of psychological abuse but leaves no effect on the incidence of physical violence. This finding is in line with the literature on the inverse relationship between female education and domestic violence (Eswaran and Malhotra, 2011; Anderberg et al., 2016).

Table 3: The Impacts of Female Education on Relational Friction

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Relational Friction Indices						
	Physical Violence	Psychological Abuse				
Female Education	-0.004	-0.009***				
	(0.002)	(0.003)				
Observations	6,052	5,119				
Panel B: Physical Violence Items						
	Being Pushed	Being Slapped	Being Punched	Being Kicked	Being Strangled	Being Twisted
Female Education	0.001	-0.008***	-0.008***	0.001	-0.005***	0.002
	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.007)
Observations	6,051	5,721	5,720	5,808	5,867	3,777
Panel C: Psychological Abuse Items						
	Being Humiliated	Being Threatened	Being Insulted			
Female Education	0.000	-0.089	-0.008***			
	(0.012)	(0.057)	(0.001)			
Observations	4,128	3,945	4,380			

NOTE: Each cell reports the coefficient β_1 in equation (2). All regressions control for age, the age difference between the woman and her sister, sister fixed effects, as well as the country-specific birth cohort trend. Standard errors are provided in the parentheses. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

5.2 Robustness Checks

In this section, we conduct three sets of exercises to test for the robustness of our results. In the first set of exercises, we re-estimate our main model for samples of sisters with various age gaps. Recall that our estimated effects of female education come from the comparison of empowerment measures of biological sisters who attain different numbers of educational years. The rationale behind the first set of robustness exercises is that the closer in ages are the sisters, the more comparable they are. If the results for sisters close in age are similar to the results in Tables 2 and 3, then our estimated impacts of education on women's relational empowerment are reliable. In the second set of exercises, we alter our measure of decision making power indices. In the third set of exercises, we test for the robustness of our results to different specifications. Particularly, we utilize survey weight, control for different additional variables that could affect women's empowerment, exclude all control variables. The preservation of the estimates in both statistical and economic senses will strengthen our results.

Table 4: Robustness Checks 1: Sisters with Different Age Gaps

	(1)	(2)	(3)	(4)
	Financial Decisions	Non-financial Decisions	Physical Violence	Psychological Abuse
Panel A: Age difference $\leq$ 10 years				
Female Education	0.009***	0.008***	-0.006	-0.009
	(0.001)	(0.001)	(0.006)	(0.013)
Observations	19,651	16,427	4,864	4,094
Panel B: Age difference $\leq$ 5 years				
Female Education	0.007***	0.006***	-0.006	-0.013
	(0.002)	(0.002)	(0.008)	(0.018)
Observations	12,456	10,380	3,019	2,530
Panel C: Age difference $\leq$ 3 years				
Female Education	0.006**	0.007***	-0.010	-0.004
	(0.002)	(0.002)	(0.012)	(0.028)
Observations	7,658	6,334	1,869	1,563

NOTE: Each cell reports the coefficient β_1 in equation (2). All regressions control for age, the age difference between the woman and her sister, sister fixed effects, as well as the country-specific birth cohort trend. Standard errors are provided in the parentheses. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Robustness Checks 1: Sisters with Different Age Gaps $-$ In this first set of exercises, we re-estimate the impacts of education for samples of sisters with small age gaps and report the estimating results in Table 4. Although the estimates are more internally valid when

we narrow the age gaps between sisters, there is a loss of efficiency since we lose a lot of observations. We look at sisters born up to 10, 5, and 3 years apart in Panel A, B, and C, respectively.[6] Female schooling has positive and significant impacts on decision making authority in both financial and non-financial domains. The magnitudes of the impacts are similar and somewhat larger than those in the main results. Female education is negatively associated with both Physical Violence and Psychological Abuse indices. Despite the lack of statistical power, the results do not indicate the absence of an actual effect (Amrheim et al., 2019). Collectively, these robustness exercises lend some support to our estimated impacts of education on women's empowerment along the dimension of intra-household decision making power.

Table 5: Robustness Checks 2: Different Measures of Intra-household Decision Making

	(1)	(2)	(3)	(4)
Panel A: Decision Indices				
	Financial Decisions	Non-financial Decisions		
Female Education	0.008***	0.009***		
	(0.003)	(0.002)		
Observations	23,894	20,037		
Panel B: Financial Decision Items				
	Large Purchases	Daily Purchases	Own Earnings	Husband Earnings
Female Education	0.009***	0.011***	0.001	-0.000
	(0.003)	(0.004)	(0.002)	(0.003)
Observations	20,004	12,723	13,417	10,068
Panel C: Non-financial Decision Items				
	Women's Health Care	Food Cooked	Family Visits	
Female Education	0.014***	0.003	0.007***	
	(0.003)	(0.002)	(0.003)	
Observations	19,927	10,720	19,924	

NOTE: Each cell reports the coefficient β_1 in equation (2). All regressions control for age, the age difference between the woman and her sister, sister fixed effects, as well as the country-specific birth cohort trend. Standard errors are provided in the parentheses. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Robustness Checks 2: Different Measure of Intra-household Decision Making – Recall that the items underlying the decision indices take the value of 0, 0.5, and 1 if the woman has no say, has partial say, and is the sole decision maker (Section 4). One might

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[6] Ideally, we would re-estimate the effects for twin sisters. However, doing so reduces the sample size significantly to less than 50 observations.

concern that this type of construction entails the measurement error problem since these variables do not account for the issue that the interpretation of partial involvement varies across and within countries with different degrees of gender preferences (Acosta et al., 2020). For instance, while some women actually make the final decision with their husbands/partners, other women might only have some say but the final decision is left to men.

To address this issue, we recode our decision items by assigning the value of 1 if the woman is the sole decision maker and 0 otherwise. The results are reported in Table 5. We still find positive and statistically significant impacts of education on women's intra-household decision making. In other words, the estimates in Table 5 are close to those in Table 2 in both economic and statistical sense, lending further support to our estimated impacts of education on women's intra-household decision making.

Robustness Checks 3: Different Specifications − In the third set of exercises, we re-estimate the impacts of education using different specifications. The results are provided in Table 6. As shown in Panel A, using sample weight leaves our main results unchanged. Particularly, an additional year of education increases women's intra-household decision making power in both financial and non-financial dimensions. While more educated women are no less likely to suffer from physical violence, they tend to experience less psychological abuse. In Panel B, excluding all control variables leaves our estimates intact. In Panel C, we control for birth order of the woman because birth order is a good proxy for parental investment which could potentially affect education and empowerment measures (Price, 2008; Lehmann et al., 2016; Le and Nguyen, 2020b). With the inclusion of birth order, we still uncover positive impacts of education on women's intra-household decision making power and negative impacts on the incidence of psychological abuse.

From Panels D through F, we control for husband/partner's education, women's marital status, and women's religion.[7] It is possible that these factors might exert some degree of influence on women's relational empowerment. As shown in Columns 1 and 2 of these panels, the effects of education on women's intra-household decision making power are preserved in both economic and statistical sense. There is still a lack of evidence for the effects of female education on the incidence of physical violence. As for psychological abuse, the impacts of female education are insensitive to the inclusion of marital status and religion. However,

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[7] We do not include these variables as regressors in our main model because they could be affected by female education, which makes them potentially endogenous.

the point estimate becomes statistically indistinguishable from zero once husband/partner's education is accounted for. As the educational level of the woman affects the education of her husband/partner (i.e. assortative matching, Section 5.3), the impacts of education on the experience of psychological abuse could potentially be transmitted through her husband/partner's education.

Taken together, the results of the robustness exercises further support the internal validity of our estimated impacts of education on women's relational empowerment.

Table 6: Robustness Checks 3: Different Specifications

	(1)	(2)	(3)	(4)
	Financial Decisions	Non-financial Decisions	Physical Violence	Psychological Abuse
Panel A: Using Sample Weight				
Female Education	0.009***	0.009***	-0.000	-0.014***
	(0.003)	(0.002)	(0.001)	(0.002)
Observations	23,889	20,032	6,050	5,117
Panel B: No Control Variables				
Female Education	0.009***	0.009***	-0.004	-0.008**
	(0.003)	(0.002)	(0.003)	(0.003)
Observations	23,894	20,037	6,052	5,119
Panel C: Control for Birth Order				
Female Education	0.009***	0.009***	-0.004	-0.009***
	(0.003)	(0.002)	(0.002)	(0.003)
Observations	23,894	20,037	6,052	5,119
Panel D: Control for Husband/Partner's Education				
Female Education	0.007***	0.008***	-0.001	0.004
	(0.002)	(0.002)	(0.003)	(0.006)
Observations	16,745	14,449	4,869	3,963
Panel E: Control for Marital Status				
Female Education	0.009***	0.009***	-0.004	-0.009**
	(0.003)	(0.002)	(0.003)	(0.004)
Observations	23,894	20,037	6,052	5,119
Panel F: Control for Religion				
Female Education	0.006***	0.010***	-0.001	-0.107***
	(0.002)	(0.002)	(0.002)	(0.000)
Observations	14,675	12,063	3,069	2,980

NOTE: Each cell reports the coefficient β_1 in equation (2). All regressions except those in Panel B control for age, the age difference between the woman and her sister, sister fixed effects, as well as the country-specific birth cohort trend. The panel headings indicate the types of robustness exercises. Standard errors are provided in the parentheses. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

5.3 Potential Mechanisms

In this section, we provide some suggestive evidence on the potential pathways to the effects of female education. We focus on three main groups of mechanisms through which female schooling could potentially empower women: (i) access to information, (ii) assortative matching, and (iii) labor market outcome. First, education equips women with a new stock of knowledge, which enables them to process information and formulates their behaviors in interacting with others (Duflo, 2012; Samarakoon and Parinduri, 2015). As a result, access to information can empower women by increasing their role in household decision making and reducing the acceptance of domestic violence (Mahmud et al., 2012; Friedman et al., 2016). Second, as better-educated women tend to marry better-educated men (Siow, 2015) and well-educated men are less likely to exercise violence against their wives (Simister and Makowiec, 2008), assortative matching could be another channel transmitting the effects of female education.

Table 7: Potential Mechanisms

	(1)	(2)	(3)
Panel A: Access to Information			
	Watch Television	Read Magazines	Listen to Radio
Female Education	0.021***	0.084***	0.023***
	(0.004)	(0.005)	(0.004)
Observations	17,443	17,423	17,432
Panel B: Assortative Matching			
	Husband/Partner Education		
Female Education	0.349***		
	(0.023)		
Observations	16,746		
Panel C: Labor Market Outcome			
	Currently Working	Worked in the Last 12 Months	Earnings
Female Education	0.015***	0.013***	0.018***
	(0.004)	(0.003)	(0.004)
Observations	23,787	23,795	2,253

NOTE: Each cell reports the coefficient β_1 in equation (2). All regressions control for age, the age difference between the woman and her sister, sister fixed effects, as well as the country-specific birth cohort trend. Standard errors are provided in the parentheses. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Third, previous studies suggest that education improves women's labor market outcome (Cameron et al., 2001; Aslam et al., 2008; Chamlou et al., 2016). The resulting improvements in women's economic status can exert positive influence on their intra-household decision

making authority (Attanasio and Lechene, 2002; Morozumi, 2012; Antman, 2014; Heath and Tan, 2019). Specifically, engagement in market work makes women more likely to be involved in household decisions (Antman, 2014). Furthermore, as women's relative income share is positively correlated with their intra-household bargaining power, higher earnings induce women to have a say in important decisions within the households (Attanasio and Lechene, 2002; Iyigun and Walsh, 2007). Besides, better employment opportunities and higher incomes tend to decrease women's exposure to intimate partner violence (Aizer, 2010; Hidrobo and Fernald, 2013). Thus, labor market outcome could be one channel through which education empowers women.

We measure access to information by three variables indicating the frequency of women watching television (Watch Television), reading magazines (Read Magazines), and listening to the radio (Listen to Radio).[8] Assortative matching is captured by the educational attainment of the husband/partner. Female labor market outcome is proxied by a dummy variable that takes the value of 1 if the woman is currently working and 0 otherwise (Currently Working), a dummy that takes the value of 1 if the woman worked in the last 12 months and 0 otherwise (Worked in the Last 12 Months), and her annual labor earnings (Earnings). We estimate the same specification as in equation (2) but replace empowerment measures with potential mechanism variables.

The estimating results are provided in Table 7. It is evident from Panel A that education makes it more likely for women to get access to information by raising the frequency of watching television, reading magazines, and listening to the radio. From Panel B, there is evidence that female education is positively related to husband/partner education. As shown in Panel C, there is a positive association between education and women's probability of participating in the labor market, both at the time being and within the last 12 months. The effect on earnings is also positive and statistically significant. Collectively, the impacts of education on women's empowerment in terms of higher intra-household decision making power and less relational friction could be, at least in part, attributed to the increased access to information, assortative matching, and the improvements in labor market outcome.

Table 8: Heterogeneity Analyses

	(1)	(2)	(3)	(4)
	Financial Decisions	Non-financial Decisions	Physical Violence	Psychological Abuse
Panel A: African Women				
Female Education	0.009***	0.010***	0.003	-0.001
	(0.002)	(0.003)	(0.079)	(0.261)
Observations	11,677	9,523	2,147	2,064
Panel B: Non-African Women				
Female Education	0.010***	0.008***	-0.003	-0.009
	(0.002)	(0.002)	(0.009)	(0.024)
Observations	12,217	10,514	3,905	3,055
Panel C: Rural Women				
Female Education	0.008**	0.009***	0.000	0.010
	(0.003)	(0.003)	(0.007)	(0.099)
Observations	8,859	7,668	2,111	1,896
Panel D: Urban Women				
Female Education	0.010***	0.010***	-0.004	-0.012***
	(0.003)	(0.002)	(0.002)	(0.004)
Observations	13,618	11,374	3,721	3,017
Panel E: Married Women				
Female Education	0.005**	0.008***	-0.009	-0.058
	(0.002)	(0.003)	(0.024)	(0.064)
Observations	9,434	8,663	1,687	1,579
Panel F: Unmarried Women				
Female Education	0.012***	0.011***	-0.000	-0.003
	(0.004)	(0.002)	(0.002)	(0.002)
Observations	14,460	11,374	4,365	3,540

NOTE: Each cell reports the coefficient β_1 in equation (2). The panel headings indicate dimensions of heterogeneity. All regressions control for age, the age difference between the woman and her sister, sister fixed effects, as well as the country-specific birth cohort trend. Standard errors are provided in the parentheses. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

5.4 Heterogeneity Analyses

In this section, we proceed to test for the heterogeneous impacts of female education along the lines of continent, place of residence, and marital status. The results are reported in Table 8. In Panels A and B, we examine if the effects differ between African and non-African women. The results point to similar returns to education in terms of relational empowerment measures for both African and non-African women. In Panels C and D, we explore the

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[8] The range of these variables is as follows: 0-"not at all", 1-"less than once a week", 2-"at least once a week", 3-"almost every day".

heterogeneity along the place of residence dimension. Regarding intra-household decision making power, we detect similar estimates for rural and urban women. While urban women experience improvements in relational friction, rural women do not. Particularly, education has a negative and statistically significant effect on the psychological abuse index for urban women whereas the point estimate for rural women is statistically indistinguishable from zero.

In Panels E and F, we explore if there is any heterogeneity in the effects of education among married and unmarried women. While there is not enough evidence for the impacts on relational friction, education does raise the intra-household decision making authority for both married and unmarried women. In terms of magnitude, we detect slightly larger effects among unmarried women.

6   Conclusion

In this paper, we estimate the impacts of education on women's relational empowerment depicted by intra-household decision making and relational friction for a sample covering 70 developing countries. Drawing from the Demographic and Health Surveys, we identify the effects of interest by comparing the empowerment measures of biological sisters who differ in educational attainment, within a sister fixed effects framework.

We find that education improves women's decision making authority within the households in both financial and non-financial domains. The findings are in line with Manser and Brown (1980)'s bargaining theory, supported by several subsequent studies (Lundberg and Pollak, 1993; Chiappori et al., 2009; Duflo, 2012). Moreover, our results point to the negative impacts of female education on relational friction measured by women's exposure to psychological abuse. Our findings complement the literature on the relationship between female education and domestic violence (Eswaran and Malhotra, 2011; Anderberg et al., 2016; Erten and Keskin, 2018). We further explore the pathways to the impacts of female education. Education empowers women through increased access to information, assortative matching, and improved labor market outcome. Given the integral role of women in all 17 SDGs (UN Women, 2018), our results highlight the importance of female education in achieving sustainable development. Expanding access to education for women not only help materialize SDG-5 (Gender Equality) but also contribute to the progress in other goals.

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Appendix A

Table A1: Correlation Test

	(1)	(2)	(3)
	Deviation of Female Education from Pair Mean		
Birth Order	-0.250		
	(0.394)		
City as Childhood Place of Residence		-0.380	
		(0.674)	
Marriage to First Birth of Interval (months)			-0.005
			(0.006)
Observations	23,901	23,901	16,933

NOTE: Dependent variable is the deviation from (sister) pair mean of the woman's years of education. Explanatory variables are the deviation from (sister) pair mean of the woman's prior characteristics. These characteristics include birth order, childhood place of residence (an indicator for a city), and the time interval between marriage and first birth. All regressions control for statistical area-by-wave-by-birth year fixed effects. Standard errors are provided in the parentheses. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A2: Additional Heterogeneity Analyses

	(1)	(2)
	Own Earnings	Husband/Partner Earnings
Panel A: African Women		
Female Education	0.003	0.006
	(0.003)	(0.005)
Observations	6,594	4,567
Panel B: Non-African Women		
Female Education	-0.001	-0.004
	(0.003)	(0.006)
Observations	6,823	5,501
Panel C: Rural Women		
Female Education	0.002	0.001
	(0.006)	(0.006)
Observations	4,360	4,446
Panel D: Urban Women		
Female Education	0.002	0.000
	(0.002)	(0.007)
Observations	8,211	4,953
Panel E: Married Women		
Female Education	0.004	0.003
	(0.004)	(0.002)
Observations	5,038	6,714
Panel F: Unmarried Women		
Female Education	0.001	0.004
	(0.002)	(0.007)
Observations	8,379	3,354
Panel G: Employed Women		
Female Education	0.002	0.002
	(0.002)	(0.005)
Observations	11,365	5,283
Panel H: Unemployed Women		
Female Education	0.006	-0.001
	(0.005)	(0.009)
Observations	1,978	4,768

NOTE: Each cell reports the coefficient β_1 in equation (2). The panel headings indicate dimensions of heterogeneity. All regressions control for age, the age difference between the woman and her sister, sister fixed effects, as well as the country-specific birth cohort trend. Standard errors are provided in the parentheses. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Appendix B

Table B1: The List of Countries

Code	Name	Survey Year and Wave	Avg. Education	Avg. Age
AL	Albania	[09][5], [17][7]	11.3	27.8
AO	Angola	[15,16][7]	6.7	25.433
AM	Armenia	[00, 05][4], [10][6], [16][7]	10.593	30.093
AZ	Azerbaijan	[06][5]	10.0	27.963
BD	Bangladesh	[93, 94, 96, 97][3], [04][4], [07][5], [11, 14][6]	5.2	27.056
BJ	Benin	[96][3], [01][4], [06][5], [11, 12][6], [17, 18][7]	4.920	27.095
BO	Bolivia	[93, 94, 98][3], [03, 04][4], [08][5]	10.441	25.471
BR	Brazil	[96][3]	6.635	25.442
BF	Burkina Faso	[03][4], [10][6]	5.558	26.236
BU	Burundi	[10, 11][6], [16, 17][6]	5.354	25.539
KH	Cambodia	[00][4], [05, 06, 10, 11][5], [14][6]	5.503	27.716
CM	Cameroon	[04][4], [11][6]	7.590	28.536
CF	Central African Republic	[94, 95][3]	3.610	27.992
TD	Chad	[96, 97][3], [04][4], [14, 15][6]	2.145	28.443
CO	Colombia	[95][3], [00, 04, 05][4], [09, 10][5], [15, 16][7]	9.245	26.958
KM	Comoros	[96][3], [12][6]	6.364	25.921
CG	Congo	[05][5], [11, 12][6]	7.537	27.983
CD	Congo Democratic Republic	[07][5], [13, 14][6]	7.743	27.595
CI	Cote d'Ivoire	[11, 12][6]	4.100	28.866
DR	Dominican Republic	[96, 99][3], [02][4], [07][5], [13][6]	9.783	26.926
EG	Egypt	[95][3], [00, 05][4], [08][5], [14][6]	6.624	31
ET	Ethiopia	[92, 97][4], [03][6], [08][7]	5.353	25.460
GA	Gabon	00, 01, 12	7.533	27.459
GM	Gambia	[13][6]	7.989	27.240
GH	Ghana	[93, 98][3], [03][4], [08][5], [14][6]	7.574	25.896
GU	Guatemala	[95, 98, 99][3], [14, 15][6]	6.564	25.794
GN	Guinea	[05][4], [12][6]	5.246	27.616
GY	Guyana	[09][5]	10.905	27.551
HT	Haiti	[00][4], [05, 06][5], [12][6], [16, 17][7]	6.378	27.248
HN	Honduras	[05, 06][5], [11, 12][6]	7.735	25.813
IA	India	[98, 99][3], [05, 06][5], [15, 16][6]	7.677	26.569
ID	Indonesia	[94, 97][3], [02, 03][4], [07][5], [12][6], [17][7]	10.152	29.693
JO	Jordan	[02][4], [07][5], [12][6], [17, 18][7]	9.7	31.44
KK	Kazakhstan	[95, 99][3]	10.5	25.214
KE	Kenya	[98][3], [03][4], [08, 09][5], [14][6]	8.427	25.509
KY	Kyrgyz Republic	[97][3], [12][6]	11.7	27.234

Code	Name	Survey Year and Wave	Avg. Education	Avg. Age
LS	Lesotho	[04, 05]^4, [09, 10]^5, [14]^6	8.442	25.79
LB	Liberia	[06, 07]^5, [13]^6	5.531	27.609
MD	Madagascar	[97]^3, [03, 04]^4, [08, 09]^5	5.237	26.065
MW	Malawi	[00, 04, 05]^4, [10]^5, [15, 16]^7	7.1	25.706
MV	Maldives	[09]^5, [16, 17]^7	8.851	29.089
ML	Mali	[95, 96]^3, [01]^4, [06]^5, [12, 13]^6, [18]^7	3.261	27.389
MB	Moldova	[05]^4	10.846	22.577
MA	Morocco	[03, 04]^4	5.133	28.523
MZ	Mozambique	[97]^3, [03]^4, [11, 15]^6	5.902	26.595
MM	Myanmar	[15, 16]^7	6.255	32.26
NM	Namibia	[00]^4, [06, 07]^5, [13]^6	8.215	27.817
NP	Nepal	[96]^3, [01]^4, [06]^5, [11]^6, [16]^7	6.004	25.140
NC	Nicaragua	[97, 98]^3, [01]^4	7.381	26.129
NI	Niger	[98]^3, [06]^5, [12]^6	3.755	27.545
NG	Nigeria	[03]^4, [08]^5, [13]^6	9.482	26.168
PK	Pakistan	[12, 13]^6, [17, 18]^7	3.417	29.667
PE	Peru	[96]^3, [00]^4, [03-12]^5 [09-12]^6	10.703	26.921
PH	Philippines	[98]^3, [03]^4, [08]^5, [13]^6, [17]^7	11.351	27.593
RW	Rwanda	[00, 05]^4, [10, 11, 14, 15]^6	5.061	26.98
ST	Sao Tome and Principe	[08]^5	6.186	26.644
SN	Senegal	[05]^4, [10-13, 15]^6, [17]^7	4.70	28.576
SL	Sierra Leone	[08]^5, [13]^6	5.36	27.771
ZA	South Africa	[98]^3, [16]^7	9.789	27.420
SZ	Swaziland	[06, 07]^5	9.014	24.958
TJ	Tajikistan	[12]^6, [17]^7	9.595	27.812
TZ	Tanzania	[96]^3, [04, 05]^4, [09, 10]^5, [15, 16]^7	6.743	26.962
TL	Timor-Leste	[09, 10]^5, [16]^{1}7	9.468	26.268
TG	Togo	[98]^3, [13, 14]^6	5.994	26.959
TR	Turkey	[98]^3, [03, 04]^4	5.176	26.235
UG	Uganda	[95]^3, [00, 01]^4, [06]^5, [11]^5, [16]^7	7.144	26.852
UA	Ukraine	[07]^5	12.706	25.647
UZ	Yemen	[96]^3	10.632	27.211
ZM	Zambia	[96]^3, [01, 02]^4, [07]^5, [13, 14]^6	7.471	26.701
ZW	Zimbabwe	[94]^3, [99]^4, [05, 06]^5, [10, 11]^6, [15]^7	9.336	26.425

NOTE: Column 1 and 2 display country code and name. Column 3 shows [survey year]$^{\text{survey wave}}$. For example, [99, 01-0.3]^4 means that the respondents of survey wave 4 in the sample are interviewed in 1999, 2001, 2002, and 2003. Besides, Columns 4 and 5 also provide the average years of education and age for the sampled women.

Table B2: Additional Summary Statistics

Intra-household Decision Making	Mean (SD)	Relational Friction	Mean (SD)
Large Purchases	0.411 (0.404)	Being Pushed	0.241 (0.428)
Daily Purchases	0.454 (0.444)	Being Slapped	0.257 (0.437)
Own Earnings	0.861 (0.286)	Being Punched	0.118 (0.323)
Husband/Partner Earnings	0.411 (0.360)	Being Kicked	0.123 (0.328)
Women's Health Care	0.584 (0.431)	Being Strangled	0.052 (0.221)
Food Cooked	0.455 (0.444)	Being Twisted	0.091 (0.287)
Family Visits	0.546 (0.407)	Being Humiliated	0.17 (0.383)
		Being Threatened with Harm	0.110 (0.313)
		Being Insulted	0.226 (0.418)

NOTE: The seven items that constitute the intra-household decision making indices include Large Purchases, Daily Purchases, Own Earnings, Husband/Partner Earnings, Women's Health Care, Food Cooked, Family Visits. Each takes the value of 1 if the woman is the sole decision maker, 0.5 if she is partially involved in the decision, 0 if she has no say in the decision. The items that form the relational friction indices include Being Pushed, Being Slapped, Being Punched, Being Kicked, Being Strangled, Being Twisted Being Humiliated, Being Threatened with Harm, and Being Insulted. Each is a dummy indicating whether the husband/partner ever uses a particular type of violence against his wife.