Development Policies when Accounting for the Extensive Margin of Fertility

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Abstract

Beyond natural sterility, there are two main types of childlessness: one driven by poverty and another by the high opportunity cost to child-rearing. We argue that taking childlessness and its causes into account matters for assessing the impact of development policies on fertility. We measure the importance of the components of childlessness with a structural model of fertility and marriage. Deep parameters are identified using census data from 36 developing countries. In poor countries, one more year of education decreases poverty-driven childlessness by 0.75 percentage points, but increases opportunity-cost-driven childlessness by 0.57 percentage points from the 9th year of schooling onwards. Neglecting the endogenous response of marriage and childlessness leads to overestimating the effectiveness of imposing universal primary education. The same holds for family planning policies, except where highly educated mothers are also heavily affected by unwanted births, and to underestimating the effect of promoting gender equality on fertility, except in countries where poverty-driven childlessness is high.

Keywords: Poverty, Childlessness, Marriage, Education, Inequality, Fertility, Unwanted Births, Structural Estimation.
JEL Classification Numbers: J11; O11; O40.

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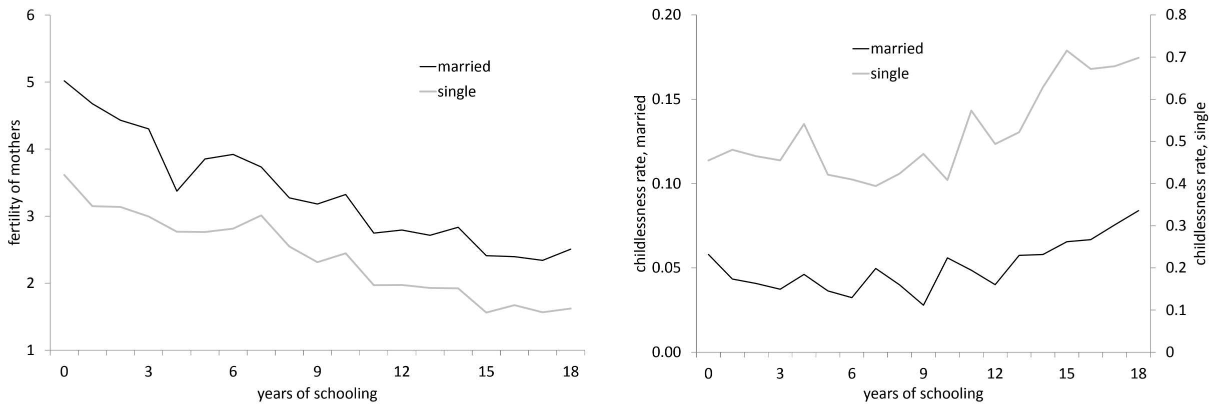
1 Introduction

Maternity and fertility in emerging countries are commonly thought of as high. This might explain why there is little research on childlessness in these countries. This is however surprising as childlessness is very much caused by poverty. When a country takes-off, poverty recedes, and a smaller share of its inhabitants is affected by subfecundity factors. When it develops further, more of its citizens seem to make the deliberate choice of not having children. Understanding the complex relationship between childlessness, i.e. the extensive margin of fertility, and development is the first objective of this paper. It is important for our second objective: evaluating the demographic impact of development policies when variations in the extensive margin of fertility are taken into account. We focus on four types of development policies: fighting gender inequalities, imposing universal primary education, reducing child mortality and promoting family planning.

An important feature of the extensive and intensive margins of fertility is that they do not display a similar pattern with respect to the education of women (Figure 4). Childlessness first decreases and then increases with education, for both single and married women. Using Census data for 36 countries we observe that, in average, childlessness attains a minimum at 6 years of schooling for married women and at 5 years of schooling for single women.[1] On the contrary, the fertility of mothers decreases monotonically with education. On average, fertility decreases by 0.13 children for an additional year of mothers' education and by 0.11 for singles. This shows that there is something crucial to understand by distinguishing these two margins.

There are two main types of childlessness which have already been discussed in the literature: involuntary and voluntary. By definition, voluntary childlessness results from unconstrained decision making and does not necessarily call for public intervention. Involuntary childlessness corresponds to the inability for women or couples to give birth. This situation arises partly as a consequence of poverty through different channels: more risky behavior leading to infertility, malnutrition, lower chances of finding a stable partner, and higher mortality of children. Following the theory of capabilities by Sen and Nussbaum (1993), involuntary childlessness deteriorates poor people's capability sets. To eradicate this kind of childlessness should then be on policy makers' agendas. Moreover, the presence of involuntary childlessness may make total fertility increase with the standard of living (as found by Vogl (2015)

[1] This feature does not relies on aggregation over countries. The U-shaped pattern of fertility with respect to female education for married women is present for 19 of the 36 countries that we consider. For single women, the U-shape appears in 19 over 32 countries (data on fertility of single women is not available everywhere).



Note: Single and married women aged 40-54 from 36 developing countries. Censuses from various years (1991-2010).

Figure 1: Extensive and intensive margins of fertility, by years of education

for some poor countries), hence making the demographic transition happen only once a relatively high income or education threshold is reached.[2] However, before any policy design, one should clearly identify its relevance. Belsey (1976) shows that childlessness can be as high as 40% in a given cohort of women in some regions or tribes of Sub-Saharan Africa. The presence of high levels of childlessness among the poor has also been evidenced in other studies such as Romaniuk (1980), Retel-Laurentin (1974), Poston et al. (1985), Ombelet et al. (2008), Wolowyna (1977) and McFalls (1979). Venereal diseases and pregnancy-related infections are the most common cause of infertility in developing countries. Frank (1983) estimates that in Africa, 60% of the variation in total fertility was due to infertility and that a disappearance of pathological infertility could make total fertility increase significantly.[3]

One major limit of existing studies on childlessness resides in the impossibility of distinguishing involuntary childlessness from voluntary childlessness in the data.[4] In this paper, we propose to estimate the composition of childlessness using quantitative theory, extending the methodology of Baudin, de la Croix, and Gobbi (2015) to allow for unwanted births and

[2]This type of childlessness is a Malthusian check, not mentioned in Malthus (1798).

[3]Baudin, de la Croix, and Gobbi (2015) show that, even in the United States, part of childlessness is driven by poverty, in particular among single women; this is what they call social sterility.

[4]Censuses never ask childless people why they are childless. Alternative datasets, like the National Survey for Family Growth in the United States, provide details on people's reproductive behavior and motivation. However, these datasets contain a limited number of observations and a significant number of people provide contradictory answers, preventing the analyst from determining the voluntary or involuntary nature of childlessness. Demographic and Health Surveys ask women about the ideal number of children they would have liked to have in their lifetime irrespective of their actual number. One could imagine considering that childless women who answer a positive number are involuntarily childless. However, nothing ensures that the absence of children in their lifetime is not the result of a rational decision due to career perspectives, matrimonial decisions, etc. Furthermore, even if we considered these women as involuntarily childless, we would not have information about the causes that made them involuntarily childless women.

child mortality. We provide a unified model of marriage, childlessness and fertility whose deep parameters are identified using Census data from 36 developing countries, from IPUMS International.

As childlessness interacts with marriage, it is important to model both as endogenous phenomena. We therefore develop a two stage marriage game. During the first stage, people are matched randomly with a partner of the opposite sex from their own country. For simplicity, this match happens only once in a lifetime and no divorce is allowed. Then, people discover, at no cost, if they are naturally sterile or not, and in case they married, if they can control their fertility. In the last stage, singles and couples decide how much to consume and, eventually, how many children to have. Couples' decision making is assumed to follow a collective negotiation process. As shown by Chiappori (1988), this framework has considerable empirical support. The game is solved backward: people have to anticipate what their optimal decisions will be in different marital scenarios depending on their fecundity status, and then to compare their expected utilities to decide whether to marry or not. Marriage entails costs and benefits. For men, it opens the possibility of having children. As a counterpart, some of their time will be allocated to child-rearing. For women, a husband alleviates the time cost of raising children. Marriage also generates economies of scale both in terms of time and goods; indeed, spouses share expenses on household public goods and the time needed to run a household. We accordingly assume that an individual has a lower time endowment when single than when married. Time endowment among singles may differ across genders. These economies of scale within marriage shape marriage rates.

Because we deal with developing countries, child mortality and unwanted births are essential ingredients of our theory. As shown in Section 2, survival rates are heterogenous across countries but also across maternal education levels within countries. We assume that each newborn has a probability of surviving to adulthood, which is country and education specific. In line with Sah (1991), Kalemli-Ozcan (2003) and Baudin (2012), the number of children who survive to adulthood within a family is a random variable drawn from a binomial distribution. This implies that single women and couples have to maximize their expected utility facing a given mortality law. To model unwanted births, we assume there are two types of couples. Those who can control their fertility (say, Beckerian couples), and those who cannot (say, Instinctive couples). The latter have the maximum number of children given their time and resource constraint.[5] The share of each type of couple is inferred from

[5]This way of modeling unwanted births is analogous to the spender-saver model in which some households are maximizing agents and are therefore subject to a Euler condition, while others spend their income as they earn it. An alternative way to model unwanted births is proposed by Bhattacharya and Chakraborty (2013) who assume that parents have to invest in a contraception technology, and, depending on their choice, they

the Demographic and Health Surveys (DHS), which ask questions on desired and actual fertility. We assume that, contrary to couples, single women always control their fertility, as they can more easily walk away from their partner.

The theory produces four types of childlessness. First, *voluntary childlessness* is driven by the opportunity cost of having children: a highly educated woman earns high wages and then faces a high opportunity cost (see also Gobbi (2013) and Aaronson, Lange, and Mazumder (2014) on this type of childlessness). Above an education threshold that depends on the non labor income and on the time needed to raise a child, some women rationally decide to specialize in labor market activities and have no children. The three remaining types of childlessness are involuntary. *Natural sterility* refers to the innate biological impossibility of having children, which does not depend on the level of education or wealth. The two remaining types of childlessness are driven either by poverty or by mortality. *Social sterility* concerns low-educated women and more specifically singles for whom the poverty burden is the heaviest. For some couples, even if becoming parents is economically feasible, it can be done only at the cost of impoverishing the couple too much. Finally, *mortality driven childlessness* arises when none of the newborn children survived. In the data, child mortality decreases with the mother's education, thus it is also correlated with poverty.

When average education is low, one-year increase in school-life expectancy reduces social sterility by 0.75 percentage points. The prevalence of voluntary childlessness is also correlated with the level of development: voluntary childlessness emerges along with economic development. A one-year rise in school life expectancy increases voluntary childlessness by 0.57 percentage points, when average education is above 9 years. By better understanding the relationship between childlessness and development, we can also shed new light on the old debate about the sustainability of population growth in developing countries. Indeed, population growth rates are intimately linked to parenthood rates. The decreasing involuntary childlessness rates due to economic development seem to delay the demographic transition that is predicted from a model in which only the intensive margin of fertility is taken into account. Our results suggest that there is a threshold above which both the fertility of mothers and motherhood rates will decline with development, leading to a fast drop in population growth.

Our second contribution is to assess whether endogenous childlessness and marriage are important when one wants to measure the impact of development policies on fertility in the long run. The policies we study are: primary education for all, no child mortality, perfect

have a given probability of giving birth, even if that would not be their choice if the contraception technology was costless.

family planning and gender equality on the labor market. Unlike the existing economic literature, our framework allows us to analyze the impact of each policy on the two (intensive and extensive) margins of fertility.

Imposing primary education generally reduces average fertility of mothers automatically, as fertility is a decreasing function of education for both single and married. This mechanical effect is however either partly compensated or can even be reversed by the marriage and childlessness margins. A first effect on childlessness is achieved by cutting poverty and the related poverty-driven part of childlessness. This goes against the initial dampening effect on fertility. Moreover, this policy improves the average quality of matches on the marriage market. More people accept to marry the person they meet. Partners being richer on average, an income effect makes them less likely to be voluntary childless. On the whole, the drop in childlessness makes education policy less fertility-reducing as one might think on the basis of the intensive margin only.

A reduction in mortality rates has an ambiguous effect on childlessness. A lower mortality has a direct negative impact on childlessness among married women, but a positive effect on childlessness among single women. This latter effect arises through adjustments on the marriage market. Lower mortality rates increase the probability of having unwanted (surviving) births which is a risk in terms of potential consumption loss for poor individuals, and marriage rates decrease as a result. This implies that low-educated women are more likely to be single and hence involuntarily childless. This highlights a Malthusian type of mechanism on how mortality allows regulating fertility. On the whole, we find that improving child survival is generally neutral for net fertility in our model. These results are in line with Doepke (2005) for whom a lower child mortality did contribute to the decline of the total fertility rates, but not to the decline in net fertility.

Together with health policies, family planning is often seen as the workhorse of development policies; May (2012) estimates that giving access to contraceptives reduces fertility by between 0.5 and 1.5 children. In our framework, when married women have full control over their fertility, there is less uncertainty concerning the outcome of the marriage and this affects marriage rates positively especially among low-educated women. Childlessness rates are therefore lowered among low-educated women. As married women can now control their fertility, they are also more often childless. We predict that the overall effect on childlessness is negative. This is interesting as both the completed fertility of mothers and childlessness decrease after a shock that leads women to fully control their fertility. The conclusion we draw from this policy analysis is that, generally, neglecting the endogenous response of marriage and childlessness leads to overestimate the effectiveness of family planning policies.

We predict that, accounting for the effect on marriage and childlessness, this policy reduces fertility by half a child.

Female empowerment, modeled as closing the gender wage gap and hence increasing women's bargaining power within couples, also affects the prevalence and composition of childlessness. The effectiveness of promoting gender equality in lowering fertility rates is generally amplified, in particular when voluntary childlessness is high. On average, closing the gender wage gap increases total childlessness, due to an increase in voluntary childlessness. For the poorest countries, however, which are more concerned with the type of childlessness that is driven by poverty, the effect goes in the other direction: closing the gender wage gap decreases total childlessness, due to its negative effect on social sterility. In these countries, the overall effect on fertility is then weakened when the extensive margin of fertility is accounted for.

The rest of the paper is organized as follows. The theoretical model is described in Section 3. Section 2 describes our database while Section 4 displays the identification strategy for the parameters of the model. In Section 5 we analyze the effect of education, mortality, family planning and gender parity on childlessness and fertility. Section 6 concludes.

2 Data and Measurement

Women from developing countries are too often thought as mothers having many kids, reality is definitely much more complex. In the 36 countries we will describe within the next paragraphs, we find that 9.5% of women are childless and half of them are married, half are single (never married). Among married women, childlessness hits "only" 5% of the population while around 50% of single women are childless. Our theory will predict that the main driving force of childlessness within the married population is natural sterility and child mortality while it is poverty and child opportunity costs among singles. Understanding the determinants of childlessness within both populations is then crucial but cannot be done without understanding the determinants of marriage decisions which, clearly, are not exogenous. The following data are indicative that the nature of the relationship between fertility and childlessness is not necessarily the same among married and single women.

Data selection

For establishing stylized facts about fertility, childlessness and marriage in developing countries, we use the Census data from developing countries as harmonized by IPUMS International.[6] We also use these data to measure educational homogamy and child mortality. Because our theory uses the concept of unwanted births, we need to measure their prevalence what cannot be done with census data, we then use Demographic and Health Surveys (DHS) for this part.[7]

From IPUMS, we select the Censuses, listed in Table 1, for which the variables "years of schooling" and both "children ever born" and "children surviving" are available.[8] As we are interested in completed fertility, we accordingly sample women aged 40-54.[9] We fix the age range of men in accordance with the age of the male partner of the women in the sample, dropping the lowest and highest 5% of the distribution. This age range varies across countries as shown in Table 8 (Appendix A.1).

In the data, individuals can be married (legally or consensually), monogamously for most, single, divorced, separated or windowed.[10] Our theory focuses on two margins: marrying versus staying single, and having children versus staying childless. We abstracts from additional margins, such as staying married versus divorcing, having more than one wife versus being monogamous, and remarrying after widowhood versus staying single once windowed. We therefore adjust the sample to reflect the concepts of the model. We accordingly remove polygynous, divorced, separated and widowed men and women from the sample. Polygynous couples face a different problem than monogamous ones, while divorced and widowed women experienced a change in family status during their reproductive life time, which likely affected their fertility decision. By not accounting for these categories, we neglect the possible interactions between all these different marital statuses.[11] Cohabitation is very common in the English-speaking Caribbean.[12] We thus treat single women who are in a consensual

[6] These "data are especially valuable for studying trends and differentials in the core demographic processes and have become a major source for the reports of the U.N. Population Division" (Ruggles et al. 2015). More details about data selection are provided in Appendix A.1.

[7] DHS samples offer data on the number of children ever born and children who survived. We nevertheless decided not to use this data source to construct our main dataset as the age range of women is rather limited, the literature has reported errors in the declaration of births Schoumaker (2009) and the number of observations is rather limited.

[8] In Appendix A.1, we provide Table 9 where the population of each country is divided by gender and marital status. Censuses from developed countries that are present in IPUMS International have at least one of these three variables missing. Moreover, the major interest of the paper is on how development policies affect fertility. Developed countries are not likely to be the recipients of such policies.

[9] In Jamaica, Mali and Vietnam, women over 49 are not asked the question relative to childbirth. In South Africa women over 50 are not asked the question. So we respectively limit the sample to 40-49 and 40-50 in these countries.

[10] The proportion of men and women in each type of marital status, by country, is shown in Table 7 (Appendix A.1). Appendix A.1 also discusses marriage regimes and the likelihood to be in multifamily households for some particular countries.

[11] de la Croix and Mariani (2015) show how the intensity of polygyny depends on within and across gender inequality in a given society. Any policy is expected to affect marriage rates through this margin.

[12] In Jamaica, many women who are coded as singles are in fact in a consensual union (only those who

Country Code and Name	**Census Year**	**Mothers Fertility**		**Childlessness**		**Marriage**		**N.Obs**
		Married	Single	Married	Single	Women	Men	
ARG - Argentina	1991	3.18	2.3	0.07	0.74	0.90	0.90	285,621
BOL - Bolivia	2001	4.70	3.0	0.03	0.30	0.88	0.89	42,659
BRA - Brazil	2000	3.49	1.7	0.05	0.78	0.91	0.92	621,313
CHL - Chile	2002	2.96	2.0	0.03	0.37	0.82	0.85	118,660
COL - Colombia	2005	3.34	2.4	0.06	0.39	0.78	0.84	248,780
CRI - Costa-Rica	2000	3.75	2.91	0.03	0.33	0.84	0.88	23,608
DOM - Dominican Rep.	2010	3.39	2.66	0.04	0.57	0.95	0.89	50,491
ECU - Ecuador	2010	3.68	2.49	0.05	0.42	0.85	0.88	86,974
HTI - Haiti	2003	4.77	3.38	0.07	0.44	0.92	0.90	41,598
JAM - Jamaica	2001	3.78	3.39	0.05	0.14	0.61	0.65	8,639
MEX - Mexico	2010	3.51	2.17	0.03	0.53	0.88	0.91	764,469
NIC - Nicaragua	2005	5.02	3.61	0.02	0.28	0.87	0.88	23,886
PAN - Panama	2010	3.44	2.53	0.04	0.48	0.87	0.82	22,376
PER - Peru	2007	3.87	1.82	0.03	0.36	0.90	0.88	176,570
SAL - Salvador	2007	3.84	2.8	0.04	0.26	0.77	0.86	34,473
URY - Uruguay	1996	2.90	2.31	0.06	0.67	0.90	0.89	20,313
VEN - Venezuela	2001	3.93	3.32	0.03	0.33	0.82	0.83	137,955
CAM - Cameroon	2005	4.98	3.9	0.17	0.22	0.82	0.88	50,876
GHA - Ghana	2010	4.71	3.00	0.08	0.46	0.96	0.94	116,990
KEN - Kenya	1999	6.27	4.13	0.03	0.21	0.92	0.94	42,051
LBR - Liberia	2008	5.27	4.18	0.11	0.26	0.86	0.86	12,995
MAR - Morrocco	2004	4.86		0.06		0.91	0.95	97,332
MLI - Mali	2009	5.08	3.67	0.14	0.48	0.93	0.95	20,940
MWI - Malawi	2008	5.30	4.24	0.05	0.39	0.98	0.98	40,906
RWA - Rwanda	2002	5.63	3.45	0.02	0.31	0.94	0.96	23,877
SEN - Senegal	2002	5.34	3.68	0.04	0.38	0.92	0.94	19,475
SLE - Sierra-Leone	2004	4.62	4.14	0.09	0.47	0.89	0.86	13,647
TZA - Tanzania	2002	6.07	4.26	0.04	0.20	0.94	0.94	136,317
UGA - Uganda	2002	6.30	4.78	0.05	0.25	0.94	0.93	54,428
ZAF - South Africa	2001	3.61	2.81	0.05	0.17	0.75	0.83	189,722
ZMB - Zambia	2010	5.64	3.13	0.09	0.52	0.96	0.97	38,106
IDN - Indonesia	1995	4.09		0.04		0.98	0.99	40,068
KHM - Cambodia	2008	4.38	3.01	0.03	0.92	0.94	0.98	89,137
THA - Thailand	2000	2.64		0.06		0.92	0.95	46,798
VNM - Vietnam	2009	2.69	1.29	0.02	0.89	0.94	0.98	788,013
WBG - Palestine	1997	7.39		0.04		0.91	0.99	9,548
All		3.75	2.62	0.05	0.50	0.90	0.92	4,539,611

Table 1: Countries code and names, census year, average fertility of married and single mothers, childlessness rates among married and single women, marriage rates of females and males, NObs denotes the total number of women in each sample. Averages are weighted while total numbers of observations are not. Note: For Morocco, Indonesia, Thailand and Palestine the Census only provided information on completed fertility for married women.

union as if they were married.

Stylized facts

From the selected sample we compute the fertility rates of mothers, childlessness rates of women, and marriage rates of men and women. Both childlessness and the completed fertility of mothers are constructed from the children surviving variable to account for child mortality. Table 1 highlights strong inter-country differences in fertility and childlessness. For instance, very high fertility rates can be found in countries like Kenya, Cameroon, Tanzania and Palestine while much lower levels arise in Vietnam, Chile, Argentina and Brazil whatever the marital status of mothers. The same kind of variability applies to childlessness rates. Regarding childlessness of married women, some countries like Liberia, Cameroon and Mali are much more affected than the others while in those countries, fertility of married mothers is very high. This is indicative that countries where fertility is high are not necessarily those where childlessness is low, childlessness is not always an extreme case of low fertility. Figure 2 confirms this statement, the correlation between childlessness and fertility is negative among single women while it is slightly positive married women. This shows once again how important it is to study determinants of childlessness within these two populations.

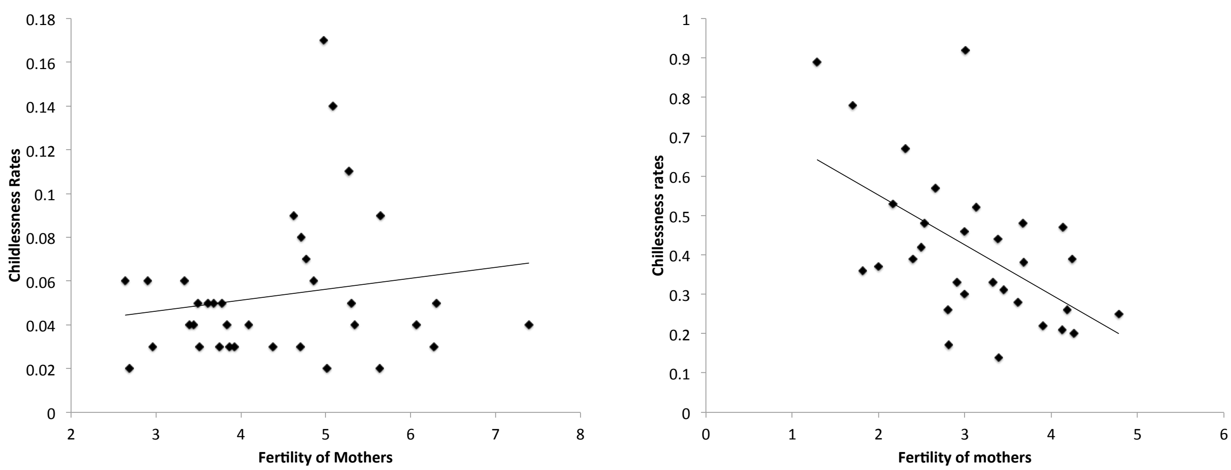


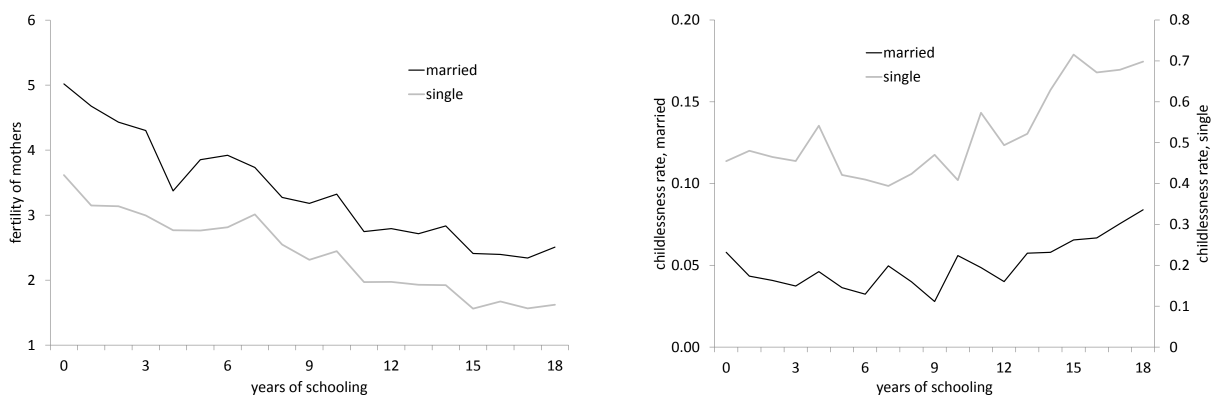
Figure 2: Fertility of mothers and childlessness among married and single women. Observations are weighted.

In each country, we divide the population into 19 education categories at most, each category corresponding to the number of years of schooling. The years of schooling goes from none

were formally married were coded as married). Roberts (1957) reports that 11% of women and 22% of men aged 45-54 are in common law marriages in Jamaica.

or pre-school to 18 years or more. For some countries, the number of years of schooling has a maximum value of 12 or 13 years, which leads to under-estimating the actual years of schooling for those who have a post secondary education. This is true for Cambodia, Kenya, Peru, Sierra Leone, South Africa, Tanzania and Uganda. For these countries, we adjusted the years of schooling using the information provided by the international recode variable of educational attainment.[13] We then compute the fertility rates of mothers, childlessness rates of women, and marriage rates of men and women, with respect to their years of schooling.[14]

In general, we can observe three facts: (i) there is either a U-shape or a J-shape relationship linking years of schooling and childlessness rates, (ii) fertility declines with education, and (iii) highly educated women experience marriage rates that are smaller than for the rest of the population, while for men, it is those with the lowest education who marry less. These are the moments used to calibrate the model of Section 3. Figure 3 and 4 shows these three regularities for the 36 countries of our sample. One could be curious to know if these regularities are the result of the inter-country aggregation. To that question, the answer is clearly negative. In Figures 4 and 5, we show the three stylized facts for Mexico. The same exercize could be done for many other countries.



Note: Single and married women aged 40-54 from 36 developing countries. Censuses from various years (1991-2010).

Figure 3: Extensive and intensive margins of fertility, by years of education at the aggregate level

As explained by Baudin, de la Croix, and Gobbi (2015), the U-shape relationship between childlessness rates and education is indicative of the co-existence of many types of child-

[13]Appendix A.1 carefully explains how we made these changes. Tables 20 and 21 show the education shares for each country.

[14]Tables 15 and 16 of Appendix A.4 show childlessness rates by country and years of education, respectively for single and married women. Tables 13 and 14 show the completed fertility of married and single mothers respectively, by country and years of schooling. Marriage rates for men and women, by education and country are provided in Tables 17 and 18 respectively.

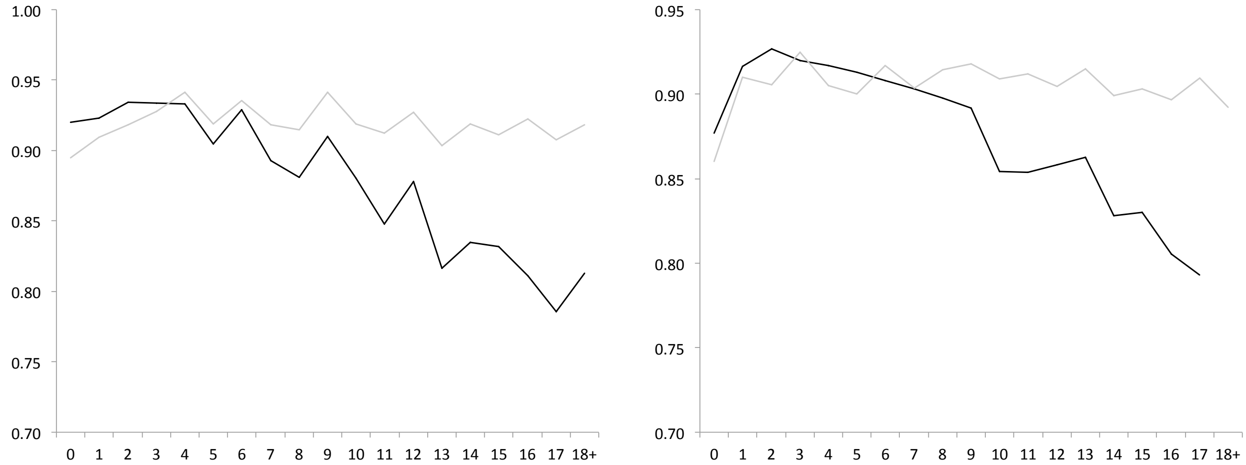


Figure 4: Marriage rates of males and females, by years of education at the aggregate level (left) and in Mexico (right).

lessness. In the context of developing countries, this phenomenon has been documented by Poston and Trent (1982) in a slightly different way. Indeed, they document a U-shaped relationship between childlessness and the development level of countries: childlessness in developing countries is high because a high proportion of women are affected by factors leading to subfecundity and consequently remain involuntarily childless, while in developed countries women do not want to become mothers so voluntary childlessness is high. As a country develops, childlessness decreases down to a minimum level and then increases because of voluntary reasons. If the average level of education could be considered as a good proxy for the level of development, our facts confirms those of Poston and Trent (1982).

The literature in demography, economics and sociology points to some specificities regarding fertility behaviors in developing countries. Exploring data and literatures, it appears that at least three of them deserve a special attention: educational homogamy, child mortality and unwanted births.

Educational homogamy, child mortality and unwanted births

Educational homogamy is not specific to developing countries, among others, Greenwood et al. (2014) show how it has increased in the US during the twentieth century. Smits, Ultee, and Lammers (1998) underlines the importance of educational homogamy in developing countries and documents a U-shape relationship between the degree of educational homogamy in a country and its level of development. We quantify the degree of educational homogamy in our sample simply by computing the correlation that exists between the educa-

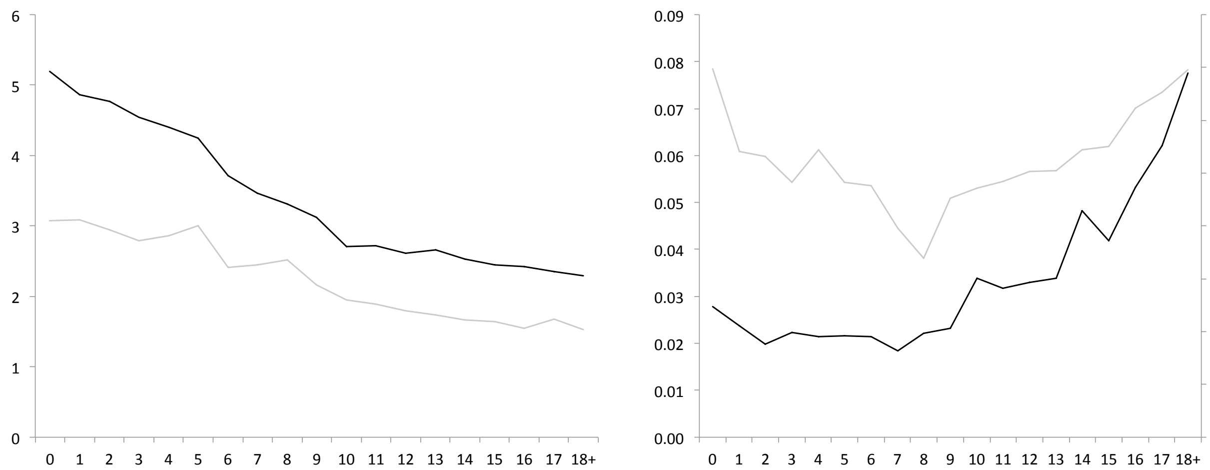


Figure 5: Left panel: completed fertility of mothers (married in black, single in grey) and childlessness rates (married in black, single in grey) by years of education in Mexico.

tion of spouses. Table 2 displays this correlation for each country and for the entire sample. To understand better this result, one should remember that in a situation of pure random matching where people always accept marrying the person they are matched, this correlation would be zero. Conversely, in a case where matching is strictly assortative such that people are matched only with persons from the same education category, correlation would be one.

The results are indicative of a positive degree of educational assortative mating in each country. This degree of assertiveness is highly variable from one country to another. For instance, the correlation between spouses' education is only 0.37 in Liberia while it is almost double in Bolivia with a correlation equal to 0.72. For any country in our sample, the theoretical degree of educational homogamy that would result from a process of random matching where everybody agree to marry would result in much smaller correlations between spouses' education levels.

To assess the importance of child mortality, we use IPUMS data to compute survival rates per education category in each country. For each woman in the data, we know how many children she gave birth to and how many of them survived. The ratio between the total number of surviving children and the total number of births gives a measure for the synthetic survival rate, which includes both child and young adult mortality. Table 19 in Appendix A.4 reports the data on survival rates, by women's education for each country, these data are illustrated in Figure 6. The relationship between mothers' education and survival rates is increasing and concave.[15] Clear cross-country inequalities appear. For instance, the average survival

[15]The survival rates of children might also depend on fathers' education. We can study this relation for married women only. A linear probability model shows that the mother's education e_f is twice as important

Country	Correlation	Country	Correlation	Country	Correlation
ARG	0.66	PAN	0.67	RWA	0.43
BOL	0.72	PER	0.66	SEN	0.62
BRA	0.70	SAL	0.67	SLE	0.52
CHL	0.62	URY	0.57	TZA	0.53
COL	0.71	VEN	0.64	UGA	0.50
CRI	0.65	CAM	0.70	ZAF	0.76
DOM	0.59	GHA	0.56	ZMB	0.55
ECU	0.69	KEN	0.63	DN	0.73
HTI	0.63	LBR	0.37	KHM	0.47
JAM	0.58	MAR	0.65	THA	0.63
MEX	0.70	MLI	0.57	VNM	0.59
NIC	0.71	MWI	0.47	WBG	0.56
All	**0.70**				

Table 2: Correlation between spouses' education per country.

rate equals 72% in Sierra Leone and 98% in Vietnam. Differences in survival rates across countries are especially large for low levels of education.

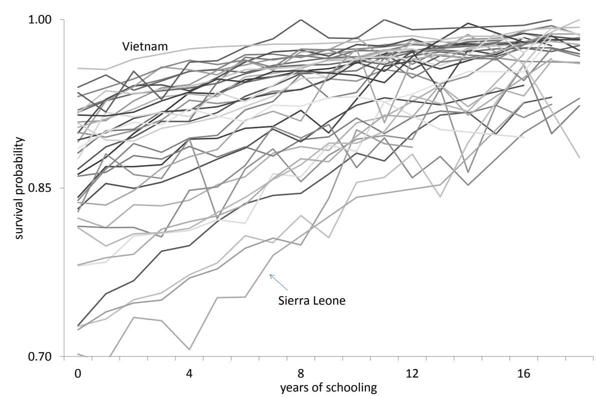


Figure 6: Children survival rates by country and by education category.

For more than two decades, demographers have discussed the way to measure the difference between desired and completed fertility. The debate between Pritchett (1994a, 1994b) and Bongaarts (1994) about undesired births has been magnified by their opposition on the need for family planning programs in developing countries. These authors have focused on the proportion of births which are not desired, paying however little, or even no attention to the

as the father's education e_m in determining survival. It also shows some substitutability between parents' education levels, as the effect of the interaction term $e_f \times e_m$ is negative for most countries.

proportion of women experiencing unwanted births which is what we focus on in this paper. We use data from Demographic and Health Surveys (DHS) to estimate these proportions in each country. We construct a variable that denotes a women as not able to control her fertility if she declares that her ideal fertility is at least two fewer than her completed fertility and if she believes that her partner did not want more children than herself. This last requirement gives confidence that the difference between the number of children ever born and the ideal number of children is not the outcome of a rational household decision where, for instance, the husband has a higher ideal number of children together with a higher bargaining position. We use this variable to predict the probability for a woman i with e years of schooling of not controlling fertility in country j. We provide, for each country, in Table 3, the proportion of women able to control their fertility as defined above and the parameters of the following simple bivariate regression model where $\kappa(e_j^f)$ denotes the proportion of women endowed with e_j^f years of education in country j who control their fertility:

$$\kappa(e_j^f) = a_j + b_i e_j^f$$

Country	Year	Probability	$a_j * 10$	b_j	Country	Year	Probability	$a_j * 10$	b_j
BOL	2008	0.374	-0.018	0.419	MLI	20012-13	0.075	-0.007	0.116
BRA	2010	0.281	-0.025	0.436	MWI	2010	0.315	-0.025	0.372
COL	2010	0.236	-0.028	0.462	RWA	2010	0.516	-0.015	0.576
DOM	2007	0.165	-0.017	0.274	SEN	2012-13	0.045	-0.003	0.057
HTI	2012	0.335	-0.022	0.420	UGA	2011	0.223	-0.007	0.252
MAR	2003-4	0.373	-0.025	0.443	ZAF	1998	0.201	-0.011	0.265
NIC	2001	0.347	-0.019	0.419	ZAM	2007	0.200	-0.003	0.189
PER	2012	0.392	-0.031	0.602	IDN	2012	0.185	-0.007	0.211
GHA	2008	0.239	-0.014	0.305	KHM	2010	0.260	-0.019	0.339
KEN	2008-9	0.294	-0.004	0.305	VNM	2002	0.419	-0.024	0.537
LIB	2013	0.145	-0.007	0.183					

Table 3: Prevalence of fertility control and parameters estimates - data from DHS. Year indicates the year of the survey.

Once again, large inter-country differences emerge. In a country like Senegal, the proportion of women experiencing multiple unwanted births is only 4.5% while it is almost 40% in Peru. The remarkably low prevalence of unwanted births in Senegal and also in Mali compared to the other countries is explained by the requirement that the distance between ideal and actual fertility should not be the result of the intra-household negotiation process. Table 10 in Appendix A.2 indicates that once the condition on the husband's ideal number of births is relaxed, 41.6% of Senagalese women experience two undesired births while this percentage equals 34.9% in Mali. This result is indicative of strong gender differences in ideal number of births between men and women in these countries.

The literature about desired fertility and family planning (see for instance Pritchett (1994a)) reports the existence of an ex-post rationalization bias making women declare their ideal number of children in conformity with their actual number of children. Such a bias may undoubtedly exist in our measure and could lead to underestimating the probability to experience an undesired birth. We discuss this issue more deeply in Appendix A.2 which also provides both alternative measures of unwanted births and details on the sample construction.[16] As shown in Table 3, only 25 out of 36 countries of our sample have DHS data about unwanted births. To overcome this difficulty, we use the estimates of the "closest country" with respect to the pattern of the completed fertility of married mothers, by years of schooling. This technic is fully explained in Appendix A.2.

All the facts exposed in this section underline how important it is to disentangle the determinants of the intensive and the extensive margins of fertility to understand how economic shocks or economic policies may change average fertility rates in developing countries. This is the main objective of our theory.

3 Theory

To keep notation clear, we abstract from country specific indexes. All variables and parameters are country specific, but we consider one country at a time.

We consider an economy populated by heterogeneous adults, each being characterized by a triplet: sex $i = \{m, f\}$, education e, and non-labor income a. Marriage is a two-stage game. During the first stage, agents are matched randomly with an agent of the opposite sex from his or her own country. They decide to marry or to remain single. A match will end up in a marriage only if the two agents choose to marry. During the second stage of the game, they discover, at no cost, their reproductive abilities: are they sterile (with probability χ_i) or fecund (with probability $1 - \chi_i$)? For couples, are they able to control their fertility (with probability κ) or not (with probability $1 - \kappa$)? We consider that single women have full

[16] One could also be curious to know how our measure would be changed in instead of putting a difference of two children between ideal and actual number of children, we put one. This obviously strongly increase the proportion of unwanted births but does not change its educational gradient. The same measure is also provide for a differential equal to four, the prevalence of unwanted births is unsurprisingly reduced but far from zero. See Appendix A.2.

control over their fertility.[17] Next, agents decide how much to consume and, eventually, how many children to give birth to, if any.

Preferences are identical across genders and education levels. The utility of an individual of sex i is

$$u\left(c_i, n\right) = \ln\left(c_i\right) + \ln\left(n + \nu\right), \tag{1}$$

where c_i is the individual's consumption, n the number of children who survive to adulthood and $\nu > 0$ a preference parameter.

We assume that each newborn has a country specific probability $q(e_f)$ of surviving to adulthood, which depends on the education of his/her mother. This probability is independent from the number of children born. The more educated a mother is, the smaller the probability for a newborn of dying: $q'(e_f) > 0$. As in Sah (1991), the number of surviving children n follows a binomial distribution such that the probability that n children survive out of N births is written:

$$P(n|N) = \binom{N}{n} [q(e_f)]^n [1 - q(e_f)]^{N-n}. \tag{2}$$

Both N and n are integer numbers. This way of modeling mortality allows us to introduce uncertainty on the number of children that households have. An alternative to this method is the one used in Leukhina and Bar (2010) in which households choose the number of surviving children. Their framework is however unable to explain the share of women that remain childless due to mortality. One feature of binomial distributions is that events are independent, meaning that the survival of a child is independent from the survival of his/her siblings. Facing this type of uncertainty, parents will either have a precautionary demand for children (overshooting of fertility) or restrain their fertility to limit the potential number of child deaths (undershooting).[18]

To model couples' decision making, we assume a collective decision model following Chiappori (1988). Spouses negotiate on c_m, c_f and n. Their objective function is

$$W(c_f, c_m, n) = \theta\ u(c_f, n) + (1 - \theta)\ u(c_m, n)$$

where θ is the wife's bargaining power. Following de la Croix and Vander Donckt (2010), θ

[17] Cleland, Ali, and Shah (2006) show that among 18 Sub-Saharan countries, the median percent of single women reporting no sexual intercourse was about 60% and that single women were more likely to use any method of contraception than married women.

[18] Following Baudin (2012), we can directly deduce from the individual utility function that parents will have a precautionary demand only if parameter ν is not too high. The exact condition to observe a precautionary demand of children is $\nu < q(e_f)N$.

depends on relative earning power and is given by

$$\theta \equiv \frac{1}{2}\,\underline{\theta} + (1-\underline{\theta})\frac{w_f}{w_f+w_m}. \quad (3)$$

We specifically assume that the negotiation power of spouses is bounded, with a lower bound equal to $\underline{\theta}/2$, and positively related to their relative wage. The boundedness of the bargaining power function comes from the legal aspect of marriage: spouses have to respect a minimal level of solidarity inside marriage. w_i denotes the wage of a person i which increases with education. Wages are exogenous and computed as follows:

$$w_f = \gamma \exp\{\rho e_f\}, \quad w_m = \exp\{\rho e_m\} \quad (4)$$

where ρ is the Mincerian return of one additional year of education and γ denotes the gender wage gap. Wages measure earning power, either from home production, agriculture, or as employee.[19]

During the last stage of the game, each person or couple maximizes their expected utility. In addition to the constraints imposed by their reproductive abilities, they will have to respect two additional constraints. First, beyond natural sterility, a woman has to consume at least $\hat{c}$ in order to be able to give birth:

$$c_f < \hat{c} \Rightarrow N = 0. \quad (5)$$

This assumption is discussed in Baudin, de la Croix, and Gobbi (2015) and accounts for the fact that lower-income groups are more often exposed to causes of subfecundity than the rest of the population, because of malnutrition, exposition to unhealthy environments, and risky behavior.

The second type of constraint is a budget constraint. We assume that each adult is endowed with a non labor income $a_i > 0$ drawn from an exponential distribution $\mathcal{F}_i(\beta)$ where β is the mean of the distribution (the inverse of the rate parameter). Non-labor income corresponds to the income that is uncorrelated with education. The total non-labor income for a couple equals $a_f + a_m$. Each household has to pay a goods cost, μ, which is a public good within the household. This type of cost is commonly assumed in the literature and gives some incentive to form couples (eg. Greenwood et al. (2012)).

[19] Looking at the variable "Occupation, ISCO general" that records the person's primary occupation according to the major categories in the International Standard Classification of Occupations scheme for 1988, we find that a majority of Latin American women of our sample works as "service workers and shop and market sales". In Africa and Asia, a majority of women works as "agricultural and fishery workers".

We assume that single women can have children while single men cannot. The time endowment is 1 for married persons and $1-\delta_i$ for singles. δ_i is the time cost that individuals lose due to their singleness. Single men's consumption c_m equals income minus the household goods cost:

$$c_m = (1-\delta_m)w_m + a_m - \mu.$$

Single women can have children, their budget constraint is:

$$c_f + \phi n w_f = (1-\delta_f)w_f + a_f - \mu. \tag{6}$$

Each fecund individual has to share time between child rearing and working. Having children entails a time cost ϕn.[20] If single, the mother has to bear the full time-cost alone. Given the time constraint $\phi n \leq 1-\delta^f$ the maximum number of children a single woman can have is $\underline{N}_{\text{M}} = \left\lfloor \frac{1-\delta^f}{\phi} \right\rfloor \in \mathbb{N}$.

When married, the husband bears a share $1-\alpha$ of the childrearing time. The total non-labor income of a couple net of cost is $a = a_m + a_f - \mu$. Their budget constraint is

$$c_f + c_m + \phi n \left(\alpha w_f + (1-\alpha)w_m\right) = w_m + w_f + a. \tag{7}$$

The maximum fertility rate of a married woman equals $\overline{N}_{\text{M}} = \left\lfloor \frac{1}{\alpha\phi} \right\rfloor \in \mathbb{N}$.

Definition 1 $\mathcal{B}(n)$ *denotes the remaining income of a couple having n surviving children:*

$$\mathcal{B}(n) = (1-\alpha\phi n)w_f + (1-(1-\alpha)\phi n)w_m + a.$$

We now solve the game backward, starting from the last step; the choice of fertility and consumption given the marital status.

3.1 Behaviors during the last stage of the game

While the fertility behaviors of single men, naturally sterile women, and couples who are unable to control their fertility are simple to analyze, the behaviors of fertile women or households are more complex. As a woman cannot have children if she consumes less than $\hat{c}$, N is potentially limited by income. A fecund single woman or a fecund couple can then be in one of three different cases: unconstrained fertility, social sterility, and limited fertility.

[20] We assume a child who does not survive does not cost parents anything. Relaxing this assumption neither changes our results, nor affects the estimates of childlessness rates in Section 4.

3.1.1 Single men, sterile women and sterile couples

As men cannot have children if single, they consume all their income minus the household goods cost. Their indirect utility then equals

$$V_m \equiv u((1-\delta_m)w_m + a_m - \mu, 0).$$

A single woman who is infertile has the same behavior as a single man and her indirect utility equals

$$\tilde{V}_f \equiv u((1-\delta_f)w_f + a_f - \mu, 0).$$

Finally a couple who cannot have children will share the household income such that $c_f = \theta\mathcal{B}(0)$ and $c_m = (1-\theta)\mathcal{B}(0)$. The indirect utilities of a man and a woman engaged in a sterile marriage are respectively equal to

$$\tilde{U}_f \equiv u(\theta\mathcal{B}(0), 0) \quad \text{and} \quad \tilde{U}_m \equiv u((1-\theta)\mathcal{B}(0), 0).$$

3.1.2 Fecund single women

The expected utility of a single woman who is not sterile and gives birth to N children is written:

$$\mathbb{E}_n\left[u(c_f, n)|N\right] = \sum_{n=0}^{N} P(n|N)u(c_f, n).$$

Unconstrained fertility: This case arises when $a_f - \mu + (1-\delta_f - \phi\underline{N}_{\mathrm{M}})w_f \geq \hat{c}$ which means that even if she has the maximal number of surviving births, she can consume at least $\hat{c}$.[21] In this case, she can give birth to $N \in [0, \underline{N}_{\mathrm{M}}]$ and her optimal fertility rate N^* is such that:

$$N^* = \underset{N\in[0,\underline{N}_{\mathrm{M}}]}{\text{argmax}}\ \mathbb{E}_n\left[u(c_f, n)|N\right] = \underset{N\in[0,\underline{N}_{\mathrm{M}}]}{\text{argmax}} \sum_{n=0}^{N} P(n|N)u(w_f(1-\delta_f-\phi n) + a_f - \mu, n).$$

When $a_f - \mu + (1-\delta_f - \phi\underline{N}_{\mathrm{M}})w_f < \hat{c}$ the fertility rate of a single fecund woman is limited by her income. She may then either be in the social sterility or in the limited fertility case.

Social sterility: Sterility can arise when the woman is naturally sterile but also when $a_f - \mu + (1-\delta_f-\phi)w_f < \hat{c}$ meaning that she is too poor to have at least one surviving child while consuming at least $\hat{c}$. In such a situation: $N^* = 0$ and $c_f = a_f - \mu + (1-\delta_f)w_f$.

[21] Notice from (6) that when $a_f - \mu \geq \hat{c}$, working is not necessary to have the maximal number of children.

Limited fertility: When $a_f - \mu + (1 - \delta_f - \phi) w_f \geq \hat{c}$, a single woman can have children but the number of children is limited by her income. Let us define $\overline{N}_s$ as the maximal number of surviving children a single woman can give birth to in the present case:

$$\overline{N}_s \in \mathbb{N} \equiv \left\lfloor \frac{(1 - \delta^f) w_f + a_f - \mu - \hat{c}}{\phi w_f} \right\rfloor .$$

We can then determine her optimal fertility as:

$$N^* = \underset{N \in [0, \overline{N}_s]}{\text{argmax}} \; \mathbb{E}_n \left[u(c_f, n) | N \right] = \underset{N \in [0, \overline{N}_s]}{\text{argmax}} \sum_{n=0}^{N} P(n|N) u(w_f(1 - \delta^f - \phi n) + a_f - \mu, n).$$

Notice that the three situations described above cannot exist simultaneously. We can then denote the expected well-being of a fertile single woman as

$$V_f = \mathbb{E}_n \left[u(w_f(1 - \delta^f - \phi n) + a_f - \mu, n) | N^* \right] .$$

3.1.3 Fecund couples controlling their fertility

The expected weighted sum of utilities of a non-sterile couple equals:

$$\mathbb{E}_n \left[W(c_f, c_m, n) | N \right] = \sum_{n=0}^{N} P(n|N) W(c_f, c_m, n).$$

As for single women, the fertility of couples is potentially limited by the income of spouses.

Unconstrained fertility: This case arises when the remaining income of the couple after having the maximal feasible number of children $\overline{N}_{\text{M}}$ remains greater than $\hat{c}$. This condition is written: $\theta \mathcal{B}(\overline{N}_{\text{M}}) \geq \hat{c}$. In this case, the couple can choose their optimal number of births between zero and $\overline{N}_{\text{M}}$ such that:

$$\begin{aligned} N^{**} &= \underset{N \in [0, \overline{N}_{\text{M}}]}{\text{argmax}} \; \mathbb{E}_n \left[W(c_f, c_m, n) | N \right] \\ &= \underset{N \in [0, \overline{N}_{\text{M}}]}{\text{argmax}} \sum_{n=0}^{N} P(n|N) \mathbf{W} \left[\theta \mathcal{B}(n), (1 - \theta) \mathcal{B}(n), n \right] \end{aligned}$$

Let us now focus on poorer couples for whom $\theta \mathcal{B}(\overline{N}_{\text{M}}) < \hat{c}$ so that reaching $\overline{N}_{\text{M}}$ is not feasible. In this situation, the income of the household will determine wether the couple is subject to social sterility or to a limitation in terms of the total number of births.

Social sterility: When $\mathcal{B}(1) = (1-\alpha\phi)w_f + (1-(1-\alpha)\phi)w_m + a \leq \hat{c}$ then $N^{**} = 0$ and spouses share their total income as a function of negotiation powers such that $\{c_f, c_m, n\} = \{\theta\mathcal{B}(0), (1-\theta)\mathcal{B}(0), 0\}$. This kind of sterility arises when the couple is so poor that if they had one surviving child their income would then be smaller than $\hat{c}$.[22]

Limited fertility: When $\mathcal{B}(1) = (1-\alpha\phi)w_f + (1-(1-\alpha)\phi)w_m + a_f + a_m - \mu > \hat{c}$, a couple can have children but their maximal number of children is smaller than $\overline{N}_{\mathrm{M}}$ as it is limited by their income. We denote the maximal feasible number of births as $\overline{N}$; when $N = \overline{N}$, the wife's consumption is close to $\hat{c}$ and the husband's to zero:

$$\overline{N} = \left\lfloor \frac{w_f + w_m + a - \hat{c}}{\phi(\alpha w_f + (1-\alpha)w_m)} \right\rfloor .$$

The optimal behavior of a couple with limited fertility is then written as:

$$N^{**} = \underset{N\in[0,\overline{N}]}{\operatorname{argmax}} \sum_{n=0}^{N} P(n|N)\mathbf{W}(c_f, c_m, n).$$

The $[0, \overline{N}]$ set can be rewritten as $[0, \tilde{N}[\bigcup[\tilde{N}, \overline{N}]$ where $\tilde{N} \equiv \left\lfloor \frac{w_f + w_m + a - \frac{\hat{c}}{\theta}}{\phi(\alpha w_f + (1-\alpha)w_m)} \right\rfloor$. As long as $n \leq \tilde{N}$, $c_f \geq \hat{c}$ which means that the potential income of the household is high enough to raise the n children without depriving spouses of consumption. Once n becomes higher than $\tilde{N}$, the husband has to give his wife part of his consumption in order to enable her to consume $\hat{c}$. If such a behavior can be optimal up to a point, once the husband's consumption is too close to zero, the couple necessarily decides not to have children to prevent a situation of pauperized parenthood. This situation of childlessness is driven by poverty.

As in the case of single women, the situation that prevails for a fertile couple depends on spouses' income and only one of the previous cases prevails for a given set $\{w_m, w_f, a\}$. We then denote $U^m \equiv \mathbb{E}_n[u(c_f(n), n)|N^{**}]$ the expected well-being of a woman engaged in a fecund marriage while $U^f \equiv \mathbb{E}_n[u(c_m(n), n)|N^{**}]$ is the expected well-being of the husband.

3.1.4 Fecund couples who do not control their fertility

With probability $1 - \kappa$, a couple is unable to control their fertility. In this case, we assume that spouses have as many children as they can. Such a situation is relevant only if the total income of the family is sufficient to allow the woman to consume $\hat{c}$; couples having incomes such that $\mathcal{B}(1) \leq \hat{c}$ are not concerned by uncontrolled fertility (they are concerned by social

[22] When $\mathcal{B}(1) = \hat{c}$, the woman can have one child but then her husband has zero consumption.

sterility). For the others, their number of children, denoted $\widehat{N}$, equals:

$$\widehat{N} = \begin{cases} \overline{N} & \text{if } \mathcal{B}(\overline{N}_{\mathrm{M}}) < \frac{\hat{c}}{\theta} \\ \overline{N}_{\mathrm{M}} & \text{otherwise.} \end{cases}$$

Once maximal fertility has been reached, each spouse's consumption is:

$$\{c_f, c_m\} = \begin{cases} \{\hat{c}, w_f + w_m - \phi(\alpha w_f + (1-\alpha) w_m)\widehat{N} - \hat{c}\} & \text{if } \mathcal{B}(\overline{N}_{\mathrm{M}}) \leq \frac{\hat{c}}{\theta} \\ \{\theta \mathcal{B}(\overline{N}_{\mathrm{M}}), (1-\theta)\mathcal{B}(\overline{N}_{\mathrm{M}})\} & \text{otherwise} \end{cases}$$

In the first case, the husband has to give his wife some of his consumption in order to allow her to have the maximal number of children. Such a situation is not optimal as the couple did not choose it. This will be important when men evaluate the opportunity to marry the woman they have been matched with on the marriage market: if their potential bride has a high probability of not controlling her fertility, they have a high probability of becoming poor fathers. It reduces their incentive to marry; this effect will be strong among poor men.

The wife's expected well-being is denoted $\widehat{U}^f \equiv \mathbb{E}_n[u(c_f(n), n)|\widehat{N}]$ and the husband's $\widehat{U}^m \equiv \mathbb{E}_n[u(c_f(n), n)|\widehat{N}]$.

3.2 First stage: marriage decisions

During the last stage of the game, agents know if they are sterile or not and if they are able to freely determine their number of children. Nevertheless, they have to decide to marry or to remain single before obtaining this information and hence calculate the expected value of a marriage offer. We denote $\mathcal{M}_f(e_f, a_f, e_m, a_m)$ the value of accepting a marriage offer from a man endowed with e_m and a_m for a woman enjoying an education e_f and a non labor income a_f:

$$\begin{aligned} \mathcal{M}_f(e_f, a_f, e_m, a_m) = {} & (\chi_f + (1-\chi_f)\chi_m)\, \tilde{U}^f \\ & + (1 - \chi_f - (1-\chi_f)\chi_m) \left(\kappa(e_f) U^f + (1-\kappa(e_f))\widehat{U}^f \right) \end{aligned}$$

where χ_f and χ_m respectively describe the percentage of females and males who are naturally sterile. For a man with an education e_m and a non labor income a_m, the value of a marriage offer coming from a woman endowed with $\{e_f, a_f\}$ is:

$$\mathcal{M}_m(e_m, a_m, e_f, a_f) = (\chi_m + (1-\chi_m)\chi_f)\,\tilde{U}^m \\ + (1-\chi_m-(1-\chi_m)\chi_f)\left(\kappa(e_f)U^m + (1-\kappa(e_f))\widehat{U}^m\right).$$

$\mathcal{S}(e_i, a_i)$ denotes the expected value of being single with education e_i and non labor income a_i. It is written respectively for a woman and a man:

$$\begin{aligned} \mathcal{S}(e_f, a_f) &= \chi_f \tilde{V}^f + (1-\chi_f)V^f \\ \mathcal{S}(e_m, a_m) &= V^m. \end{aligned}$$

A match on the marriage market will end up married only if both partners are willing, that is to say if and only if

$$\mathcal{M}_f(e_f, a_f, e_m, a_m) \geq \mathcal{S}(e_f, a_f) \quad \text{and} \quad \mathcal{M}_m(e_m, a_m, e_f, a_f) \geq \mathcal{S}(e_m, a_m). \tag{8}$$

In Appendix E, we study the case where only the consent of the groom is needed for a marriage to occur.

Some properties of the model will be crucial to fit the stylized facts we have exposed in the previous section. The U-shaped pattern of childlessness in the data is related to the coexistence of the various types of childlessness and the way their intensity varies with education. Natural sterility is not at stake here as we have assumed it is uniformly distributed across the population.[23] On the contrary, social sterility is closely related to poverty, as it arises when income is not sufficient to allow the woman to consume at least $\hat{c}$. It therefore decreases with income and explains why total childlessness decreases with education at low levels of education. Finally, voluntary childlessness arises when, despite being fertile and not facing a binding economic constraint on their decisions, single women or couples decide not to have children. Those who are concerned by this situation are women earning high salary incomes, and, hence, having a greater opportunity cost to raise children.[24] Voluntary childlessness is responsible for the increasing pattern of childlessness rates, at high levels of education. Notice that better educated mothers also reduce their number of births (ie. the

[23]If the law of large numbers applies, a share χ_f of single women will be sterile while the share of sterile couples will be higher and equal to $\chi_f + (1-\chi_f)\chi_m$. The prevalence of natural sterility depends on education only indirectly, through the marriage rate.

[24]Notice that, as shown by Baudin, de la Croix, and Gobbi (2015), this is true only when, after an increase in w_f, the substitution effect dominates the income effect, which is more likely to arise in families with sufficiently high male wages and non labor incomes.

intensive margin of fertility).

Concerning the pattern of marriages rates we observe in the data, the following elements are important. First, the risks of sterility as well as of unwanted pregnancies can be powerful incentives to stay single. Sterility can be natural but also due to poverty. It implies that a poor man has a low incentive to marry a poor woman as the risk of being sterile because of poverty is great. Furthermore, marrying a woman with low education increases the risk of losing control over fertility during marriage. For a rich man, this only means having many children while for a poor man, it means suffering consumption deprivation. This mechanism has a negative impact on the degree of endogamy. On the other hand, the sharing rule within marriage affects the degree of endogamy positively.

Child mortality is also crucial to marriage decisions. The risk of ending up with zero children due to mortality lowers men's willingness to marry as having children is the main advantage of marriage for a man. In this case, the single woman or the couple is neither naturally nor socially sterile. For any woman endowed with e_f and giving birth to N children, the probability of being childless because of mortality is $P(0|N) = (1-q(e_f))^N$. If the law of large numbers applies, the proportion of women who are childless because of child mortality in each category of education equals $\sum_{N=0}^{\overline{N}_{\mathrm{M}}} \eta_{\{N,e_f\}}(1-q(e_f))^N$, with $\eta_{\{N,e_f\}}$ describing the proportion of women with an education level equal to e_f who had N births. As the probability that a newborn survives is positively correlated to his/her mother's education, mortality driven childlessness is not uniformly distributed across the population. It is not necessarily greater among low-educated women than among highly educated women. Indeed, low-educated women face a higher risk that each of their children will die but have a higher fertility rate when they are not sterile; while highly educated women face a lower risk but have fewer children.

4 Identification of the Parameters

The objective is to use the theory developed in Section 3 to decompose the observed childlessness into its four components and, by conducting policy experiments, analyze whether taking the extensive margin of fertility into account matters. For this purpose we first estimate the parameters from the data.

4.1 A Priori Information

Some parameters are fixed a priori. The two sterility parameters are fixed at 1%. The percentage of naturally sterile couples, $\chi_f + (1-\chi_f)\chi_m$, is then equal to 1.9%. This allows us to match the lowest childlessness rates in our sample (Nicaragua, Rwanda, and Vietnam).[25]

To compute wages, we need to know the parameters ρ, which is the Mincerian return of one additional year of education, and γ, which denotes the gender wage gap. 10% is a usual yardstick for the Mincerian return to years of schooling. Evidence for developing countries is however mixed. Old evidence shows that rates of return to investment in education in developing countries are above this benchmark. Recent country specific studies, however, find lower returns, closer to 5% (see the survey of Oyelere (2008) for Africa). As we impute this return starting from the first year of education, we have decided to be relatively conservative and set $\rho = 0.05$. A robustness analysis to this assumption is provided in Appendix E where we use the values provided in Montenegro and Patrinos (2014) instead. Country specific gender wage gaps γ are computed from the Global Gender Gap Report (Hausmann et al. 2013) normalizing the measure to 1 for Iceland, the country with the smallest gap in the world. For a few countries (Haiti, Rwanda, Sierra Leone, and Palestine), data are not available, and the sample average (0.794) was imputed to them. All the resulting γs are shown in Table 12. All wages are finally normalized so that the maximum wage (that of a man with 18 years of schooling) is equal to one for each country.

4.2 Minimum Distance Estimates

We next identify the remaining 9 parameters of the model using the Simulated Method of Moments (SMM). The moments are the marriage rates of men and women, the completed fertility of mothers and the childlessness rates among both singles and married women, for the 19 education categories. Aas there is an equal number of men and women in the model, we adjust the marriage rate of men to equal the marriage rate of women in each economy. This sums to 114 moments. The objective function to minimize is given by:

$$f(p) = [d - s(p)]\,[W]\,[d - s(p)]'$$

[25] The ideal population to measure sterility among couples is one in which marriage is associated with the desire to have children, women marry young, do not divorce (e.g. because of sterility), are faithful to their husbands and live in a healthy environment. The closest to this ideal are Hutterites. According to (Tietze 1957), who studies sterility rates among this population, we should set the percentage of naturally sterile couples, $\chi_f + (1-\chi_f)\chi_m$, at 2.4%. In our sample here, couples from Nicaragua, Rwanda and Vietnam are even less childless than Hutterites.

where p is the vector of the parameters of the model, d denotes the vector of empirical moments and s the vector of simulated moments, depending on the parameters. W is a diagonal weighting matrix with $1/d^2$ as elements, implying that we minimize the sum of squared deviation in percentage terms. The minimization is performed under the constraint of reproducing the aggregate marriage rate perfectly. We impose this constraint in order to compute the aggregate childlessness rates with the right weights of singles and married people.

To compute simulated moments, we consider a large number of women $(100,000)$ for each category of education. For each woman, we draw her non-labor income from an exponential distribution written as $-\beta \ln x$ where x is drawn from a uniform distribution $[0, 1]$ and β is the mean of the exponential distribution.[26]

For each woman in each category of education, we also draw a potential husband from the empirical distribution of education levels among men.[27] For each level of men's education, the non-labor income is drawn from the same distribution as for women. Each woman, given her education and country, also faces survival probabilities for her children, taken from Table 19, and a probability of not controlling her fertility, taken from Table 22. Given these probabilities, we compute the expected utility if married and single, and the expected utility of the possible husband we have drawn for her. We thus obtain a decision about marriage for each person. Then, drawing realizations for mortality and fertility control shocks, we compute her actual fertility. For each category of education for women, we therefore obtain a large number of decisions about marriage and fertility that we can average, and calculate the simulated moments.

We estimate the parameters assuming, first, that they are common to all countries, hence matching global moments only, and, second, that parameters are country specific. The third column of Table 4 shows the values of parameters estimated using the global moments. The last three columns show the range of the values of the parameters when they are allowed to be country specific. Appendix C shows the values and distribution of the parameters for all countries.

The parameters β, $\hat{c}$ and μ should be interpreted in light of the normalization for wages. Their value implies that a single woman with average non-labor income (0.28) and no education ($w_f = 0.32$) cannot pay the cost μ and consume $\hat{c}$. The parameters ϕ, α and δ^f imply

[26] Using instead a two-parameter distribution does not improve the fit of the model (we tried lognormal and Gamma).

[27] Appendix E studies the robustness of the results when accounting for an exogenous degree of assortative matching.

Description	p	Global Value	Country specific Min	Mean	Max
Mean of the exponential distribution	β	0.278	0.152	0.372	0.807
Preference parameter	ν	6.773	5.119	7.029	9.249
Minimum consumption level to be able to procreate	$\hat{c}$	0.345	0.081	0.306	0.538
Goods cost to be supported by a household	μ	0.230	0.045	0.293	0.565
Fraction of childrearing supported by women	α	0.797	0.663	0.871	0.999
Time cost for one child	ϕ	0.207	0.131	0.184	0.230
Time cost of being single (men)	δ^m	0.262	-0.028	0.194	0.439
Time cost of being single (women)	δ^f	0.080	-0.131	0.124	0.429
Bargaining parameter	$\underline{\theta}$	0.722	0.010	0.632	0.948

Table 4: Identified parameters for all countries

an upper bound on fertility of 6 children for married women and 4 for single women. The difference between δ^m and δ^f is noteworthy (and it is present in a large majority of countries): it implies that the gain from marriage in terms of time accrues mostly to men, who seem less efficient than women to manage their life when single.

Using the estimated value of the parameters, Figures 7, 8 and 9 show the empirical and simulated moments. The dashed lines represent the simulated moments when the parameters are obtained by fitting the global moments. We see that the model allows replicating all the empirical patterns qualitatively. The solid gray line represents the moments obtained by aggregating country specific simulated moments. The fit is even better, not surprisingly.[28]

The fit of the model in terms of childlessness rates is given in Figure 10. We correlate the observed level of childlessness with the simulated one. The model explains 97% of the variation in childlessness across countries, when allowing the structural parameters to differ across them.

Appendix B sheds light on how each of the parameters of the structural model is identified from the data. For example, Figure 11 shows how the slope of the relationship between childlessness and education changes after a 20% increase in the estimated value of $\hat{c}$ and α respectively, all else kept constant. A higher $\hat{c}$ increases poverty driven childlessness but leaves voluntary childlessness unchanged. A higher α, on the contrary, mostly affects voluntary childlessness.[29] We can then infer that $\hat{c}$ is identified from the decreasing part of

[28] The theory predicts a (small) positive relationship between the marriage rates of men and their education, which is not present in the data. This might be due to the assumption that children are a superior good and hence highly educated men have a very high incentive to marry, as otherwise they cannot become fathers.

[29] To be precise, Appendix B shows that changing α and $\hat{c}$ also affects marriage decisions. A higher α gives

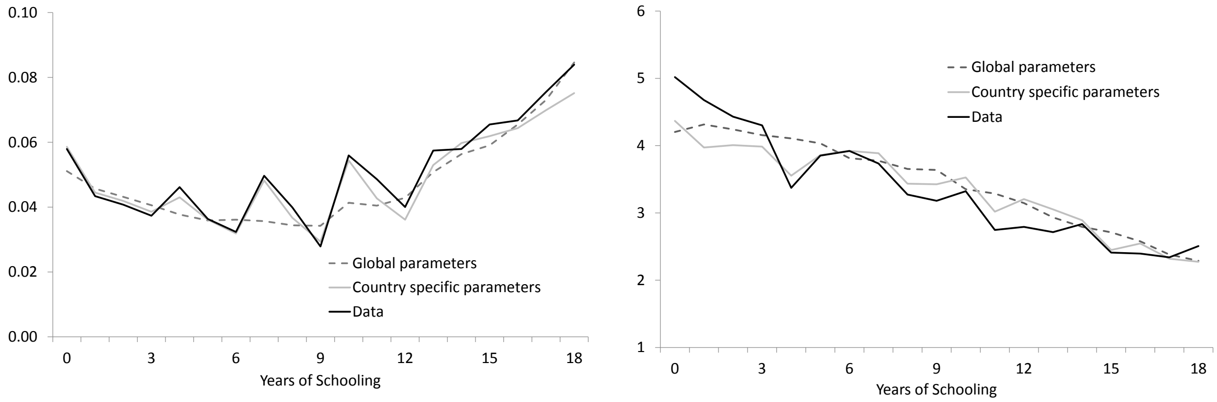


Figure 7: Childlessness rate and completed fertility of mothers, married women.

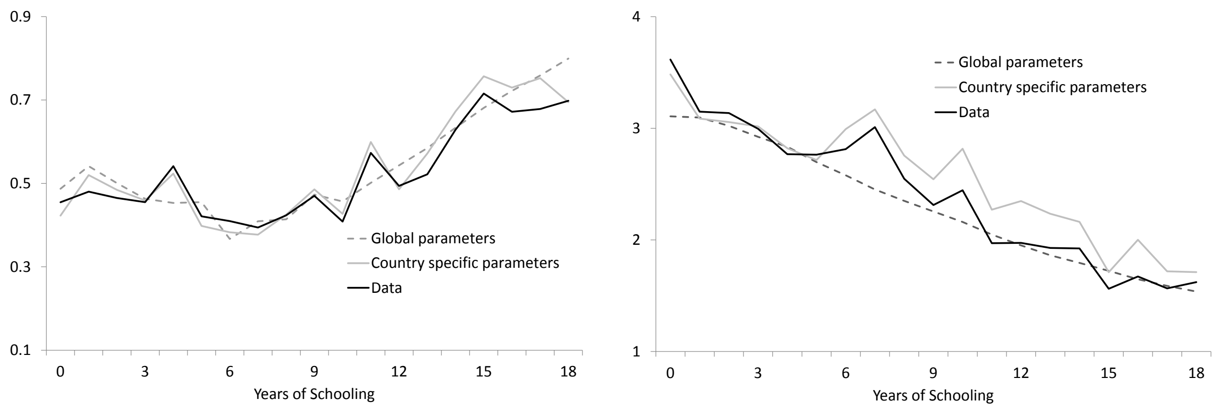


Figure 8: Childlessness rate and completed fertility of mothers, single women.

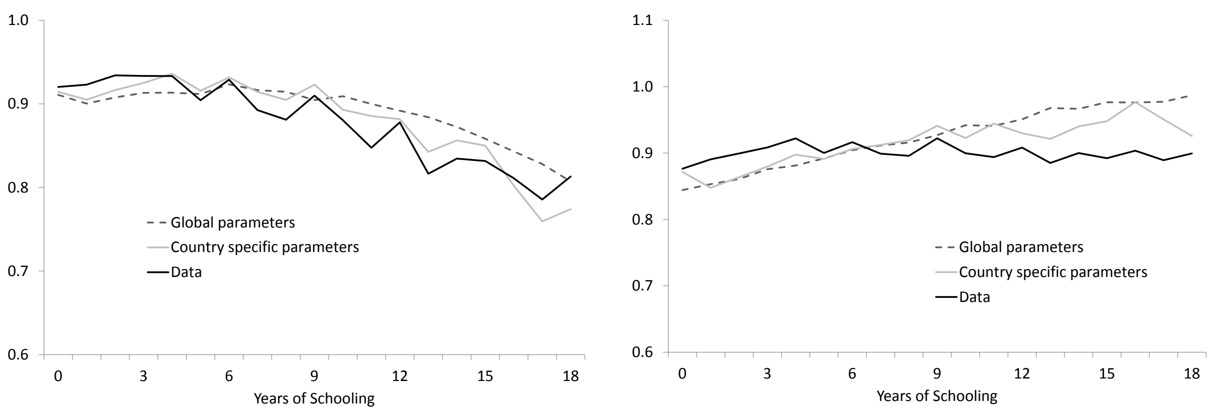
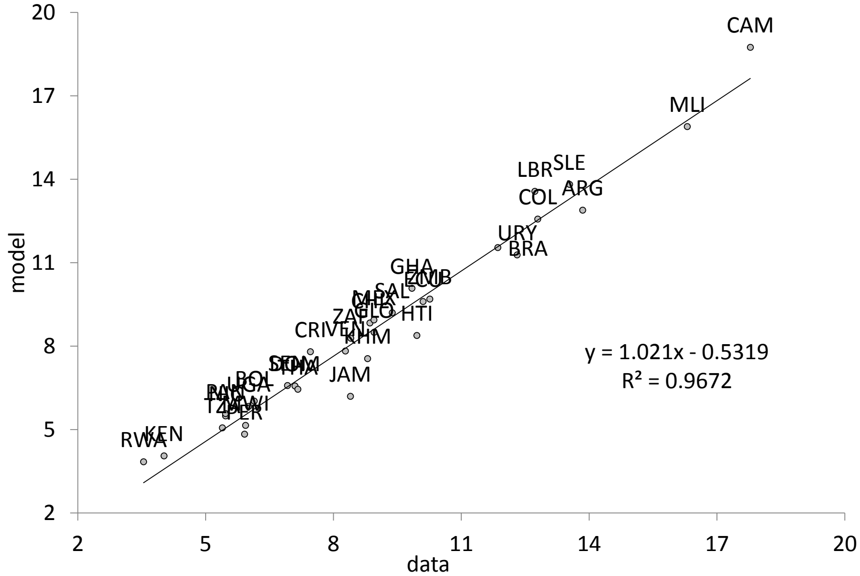


Figure 9: Marriage rates of women (left) and men (right).



Note: Morocco, Indonesia, Thailand and Palestine are excluded as we do not have the information on the childlessness of singles for them.

Figure 10: Theoretical vs. empirical childlessness rates

the U-shaped relationship between childlessness and the education of married women while α is identified from the increasing part of the U-shaped relationship.

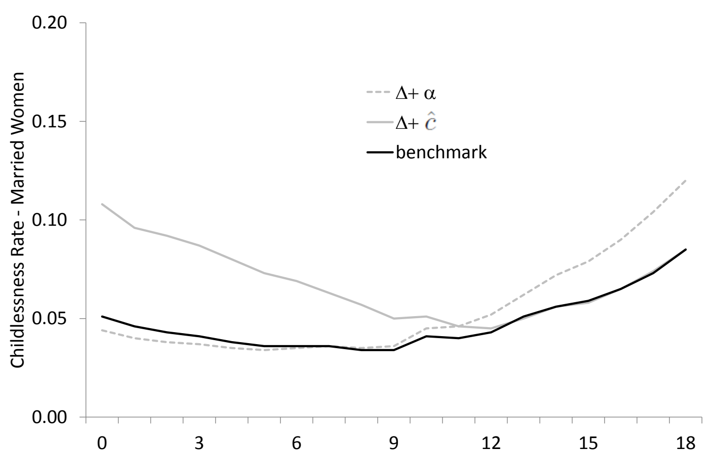


Figure 11: Identification of $\hat{c}$ (solid gray) and α (dashed gray).

to men an extra incentive to accept a marriage with a low-educated woman as his opportunity cost in terms of foregone income due to childrearing diminishes. A higher $\hat{c}$ has the opposite effect: men are less willing to marry lowly educated women as they would have to provide to much in terms of consumption to their wife.

4.3 Decomposition of Childlessness

Using the theory and the estimated parameters, we show the decomposition of the sources of childlessness for the 36 developing countries considered in Table 5. Globally, we estimate that only 2.1% of women are childless because the opportunity cost of childrearing is too great. The remaining women's childlessness is due to involuntary reasons. 3.8% of women are childless due to poverty and 0.6% because all their children died. The highest levels of voluntary childlessness are found in Argentina and Colombia (respectively 9.0 and 6.4%). Childlessness caused by poverty is maximal in Cameroon (16.2%), while Liberia, Mali and Sierra Leone have a rate of poverty driven childlessness above 10%. Mortality driven childlessness is at its maximum in Malawi (1.4%), and at its minimum in Kenya, Jamaica and Panama (0.1%)[30].

Figure 12 correlates the two main types of childlessness, poverty-driven childlessness and opportunity-cost-driven childlessness with the mean education level of each country. The figure also displays these two sources of childlessness as a function of education in the artificial economy with global parameters (dotted line with squares). A one-year rise in school life expectancy reduces social sterility by 0.75 percentage points on average (from the regression line of figure 7's top panel). There are some outliers, notably Cameroon, with unusually high levels of poverty driven childlessness given their level of development.[31] The part of childlessness that is driven by a high opportunity cost emerges along with economic development. From the artificial global economy, voluntary childlessness rises above 4% for education categories with more than 10 years of schooling. Across countries, one-year rise in school-life expectancy increases voluntary childlessness by 0.57 percentage points.[32] Figure 12 confirms the intuitions of Poston and Trent (1982) according to whom, as a country develops, childlessness decreases to a minimum level because of the reduction of subfecundity and then increases because of voluntary reasons. The minimum level of childlessness is attained when voluntary childlessness is still negligible, that is when the population has an

[30] One may be surprised to find the lowest rate of mortality driven childlessness in countries with high mortality like Kenya (or even Rwanda). The reason behind this result is that such countries are characterized by a high completed fertility of married and single mothers (see Tables 13 and 14) and a low dispersion of this fertility across education categories. As very large families are the norm, the share of these families which has been totally destroyed by mortality is relatively low.

[31] Cameroon belongs to a region labeled as the *African Infertility Belt* due to the high prevalence of childlessness.

[32] Each point of the dotted line represents childlessness in a hypothetical country where all citizens have the same education level. The cloud of countries lies above this line because there is inequality in actual countries: as the relationship between childlessness and education is convex, averaging childlessness in one country with dispersed levels of education leads to a higher level of childlessness than in the hypothetical economy with no inequality.

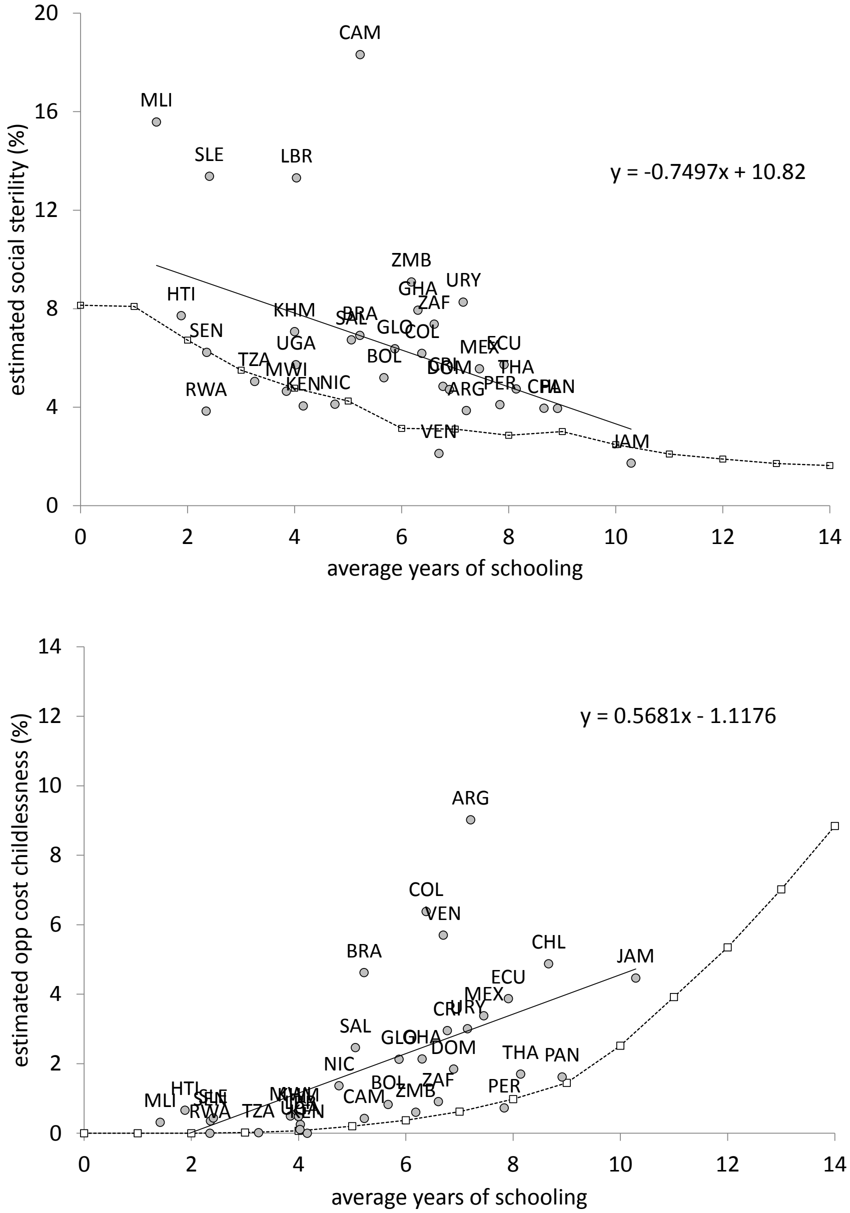


Figure 12: Estimates for poverty driven childlessness (top) and childlessness due to a too high opportunity cost of childrearing (bottom).

	simulation					data		simulation					data
	(1)	(2)	(3)	(4)	(5)			(1)	(2)	(3)	(4)	(5)	
ARG	12.9	9.0	1.3	0.7	1.9	13.9	KEN	4.1	0.0	2.0	0.1	1.9	4.0
BOL	6.0	0.8	2.8	0.6	1.9	6.1	LBR	13.6	0.3	11.0	0.4	1.9	12.7
BRA	11.5	4.6	4.3	0.8	1.9	11.9	MAR	5.5	0.6	2.5	0.5	2.0	5.2⋆
CHL	8.8	4.9	1.7	0.4	1.8	8.9	MLI	15.9	0.3	13.0	0.7	1.9	16.3
COL	12.6	6.4	4.0	0.4	1.8	12.8	MWI	5.1	0.5	1.3	1.4	2.0	5.9
CRI	7.8	3.0	2.8	0.2	1.8	7.5	RWA	3.8	0.0	1.7	0.2	1.9	3.5
DOM	6.6	1.8	2.2	0.6	1.9	7.1	SEN	6.6	0.4	3.8	0.5	1.9	6.9
ECU	9.6	3.9	3.6	0.3	1.9	10.1	SLE	13.8	0.4	10.4	1.1	1.9	13.5
HTI	8.4	0.7	5.1	0.7	1.9	10.0	TZA	5.1	0.0	2.6	0.5	1.9	5.4
JAM	6.2	4.5	0.0	0.1	1.6	8.4	UGA	5.8	0.1	3.4	0.4	1.9	6.0
MEX	8.9	3.4	3.4	0.3	1.9	8.9	ZAF	8.3	0.9	5.4	0.2	1.8	8.4
NIC	5.5	1.4	2.1	0.2	1.9	5.5	ZMB	9.7	0.6	5.8	1.3	2.0	10.3
PAN	5.6	1.6	2.0	0.1	1.9	5.5	IDN	4.1	0.0	1.4	0.7	2.0	4.2⋆
PER	4.8	0.7	2.0	0.2	1.9	5.9	KHM	7.5	0.5	4.9	0.3	1.9	8.8
SAL	9.2	2.5	4.6	0.3	1.8	9.4	THA	5.3	0.5	2.4	0.4	2.0	5.7⋆
URY	11.3	3.0	6.0	0.4	1.9	12.3	VNM	6.4	1.7	2.6	0.2	1.9	7.2
VEN	7.8	5.7	0.1	0.2	1.8	8.3	WBG	4.5	2.2	0.0	0.3	2.0	4.0⋆
CAM	18.7	0.4	16.2	0.4	1.8	17.8							
GHA	10.1	2.1	5.1	0.9	1.9	9.8	All	8.5	2.1	3.8	0.6	1.9	9.0

Note: (2): opportunity cost driven childlessness (voluntary), (3): poverty driven childlessness, (4): mortality driven childlessness, (5): natural sterility, (1): (2)+(3)+(4)+(5). ⋆ indicates childlessness rates for married only.

Table 5: Decomposition of childlessness into its four components (%), by country

average level of education of about 6 to 7 years of schooling.

5 Policy Experiments

In addition to decomposing fertility into its margins, we quantify the impact of four development policies on them. The policies we study are those recommended by most national and international organizations, and non governmental organizations: achieving universal primary education,[33] putting an end to unwanted births,[34] eradicating child mortality[35] and closing the gender wage gap.[36] Notice that we do not model the relative cost of these policies, which prevents us from providing a full-fledged cost-benefit analysis.

The completed fertility in the population F can be decomposed as:

$$\mathsf{F} = \mathsf{m}\,(1 - \mathsf{C}_{\text{married}})\, n_{\text{married}} + (1 - \mathsf{m})\,(1 - \mathsf{C}_{\text{single}})\, n_{\text{single}}$$

where m is the marriage rate, C is the childlessness rate, and n is the fertility of mothers. The long-term impact of a policy on completed fertility does not only depend on the effect on the fertility of mothers, but also on how marriage rates and childlessness rates are affected. Figures (13) to (15) summarize the outcome of simulating the global model under the four policies on m, C and n.[37]

In order to see the importance of endogenous marriage rates and childlessness rates when computing the effect of development policies on completed fertility, F, we compute the partial change in fertility as:[38]

$$\Delta\mathsf{F}_{\text{p}} = \mathsf{m}\,(1 - \mathsf{C}_{\text{married}})\, \Delta n_{\text{married}} + (1 - \mathsf{m})\,(1 - \mathsf{C}_{\text{single}})\, \Delta n_{\text{single}}$$

and compare it to the total change, which also accounts for changes in marriage and childlessness:

$$\begin{aligned}\Delta\mathsf{F} = \Delta\mathsf{F}_{\text{p}} + \; &\left((1 - \mathsf{C}_{\text{married}})\, n_{\text{married}} - (1 - \mathsf{C}_{\text{single}})\, n_{\text{single}}\right)\; \Delta\mathsf{m} \\ &- \mathsf{m}\, n_{\text{married}}\, \Delta\mathsf{C}_{\text{married}} - (1 - \mathsf{m})\, n_{\text{single}}\, \Delta\mathsf{C}_{\text{single}}.\end{aligned}$$

Table 6 compares the variation of completed fertility predicted by our model $\Delta\mathsf{F}$ to $\Delta\mathsf{F}_{\text{p}}$.[39]

[33]The second goal of the Millennium Development Goals is to "ensure that by 2015, children everywhere, boys and girls alike will be able to complete a full course of primary schooling".

[34]Fact sheet# 351 of the World Health Organization states that family planning is key to slowing unsustainable population growth and the resulting negative impacts on the economy, environment, and national and regional development efforts.

[35]Target 4.A of the Millennium Development Goals is to reduce the under-five mortality rate by two-thirds, between 1990 and 2015.

[36]"Achieving our objectives for global development will demand accelerated efforts to achieve gender equality and women's empowerment. Otherwise, peace and prosperity will have their own glass ceiling." Hillary Clinton, Jan 2012.

[37]Using the model with country specific parameters instead does not yield different qualitative results at the aggregate level, while results are easier to read with the global model as curves are smoother.

[38]This question is crucial as one goal of international organizations is to limit population growth rates in the near future.

[39]For illustration purposes, we show only 16 among the 36 countries. The complete list can be found in Appendix D. The countries considered here are those for which we have data on unwanted births (Ap-

Cntry	Benchm. fertility	Universal primary education		Perfect family planning		No child mortality		Gender wage equality	
		$\Delta F/F$	$\Delta F_p/F$	$\Delta F/F$	$\Delta F_p/F$	$\Delta F/F$	$\Delta F_p/F$	$\Delta F/F$	$\Delta F_p/F$
BOL	3.41	7.97	5.00	-3.17	-3.99	20.51	21.14	-4.96	-3.91
BRA	2.75	2.37	-4.53	-18.28	-20.32	2.86	4.87	-13.93	-7.17
COL	3.07	2.28	-1.84	-9.59	-9.36	3.34	3.49	-12.57	-7.20
DOM	3.12	1.61	-1.18	-5.23	-5.30	4.67	4.07	-13.78	-10.80
HTI	3.97	0.96	-3.79	-12.97	-11.81	12.10	13.32	-7.59	-6.66
PER	3.41	1.21	-0.96	-11.39	-13.17	3.32	4.31	-8.86	-8.13
URY	3.07	0.79	-0.95	-14.57	-15.27	1.95	2.10	-14.07	-8.80
GHA	3.95	-1.85	-6.14	-13.34	-12.31	7.66	7.92	-9.26	-8.03
KEN	5.32	3.88	2.49	-2.59	-3.92	12.21	13.57	-1.91	-3.21
MLW	5.17	-1.50	-3.61	-17.40	-16.67	13.58	18.11	-2.58	-3.43
RWA	4.87	8.51	6.95	-3.33	-4.71	25.99	31.69	0.34	-1.29
UGA	5.34	4.87	1.51	-5.06	-4.68	18.44	18.80	-4.90	-5.69
ZAF	3.74	2.47	-0.21	-2.92	-2.35	6.64	5.92	-4.84	-3.43
ZMB	4.15	-0.19	-2.33	-11.80	-11.02	9.15	9.49	-7.76	-8.52
KHM	3.68	-2.21	-2.49	-6.48	-6.38	6.62	5.68	-12.49	-10.51
VNM	2.97	1.48	-1.07	-26.55	-28.78	0.83	1.35	-10.14	-8.41
All	3.47	0.05	-3.60	-13.63	-15.00	4.10	5.69	-11.84	-8.42

Table 6: Impact in percentages of policies in the case where childlessness and marriage are endogenous ($\Delta F/F$) and in the case where childlessness and marriage are fixed to their benchmark values ($\Delta F_p/F$).

The latter depicts a situation where childlessness and marriage rates are fixed to their benchmark values.[40]

We discuss the impact of each policy on completed fertility, F, and each of its components, m, C and n, one by one.

Universal primary education

This policy consists in providing at least completed primary education to all the individuals in our sample. All the persons who had less than 7 years of schooling in our original simulation have now 7 years. A first impact of this policy is to reduce poverty driven childlessness

pendix A.2), on the fertility of single women, and for which there are more than 30,000 married women.

[40]As the equilibrium on the marriage market has no impact on individual decisions, this way of calculating the marginal contribution of our mechanisms is valid.

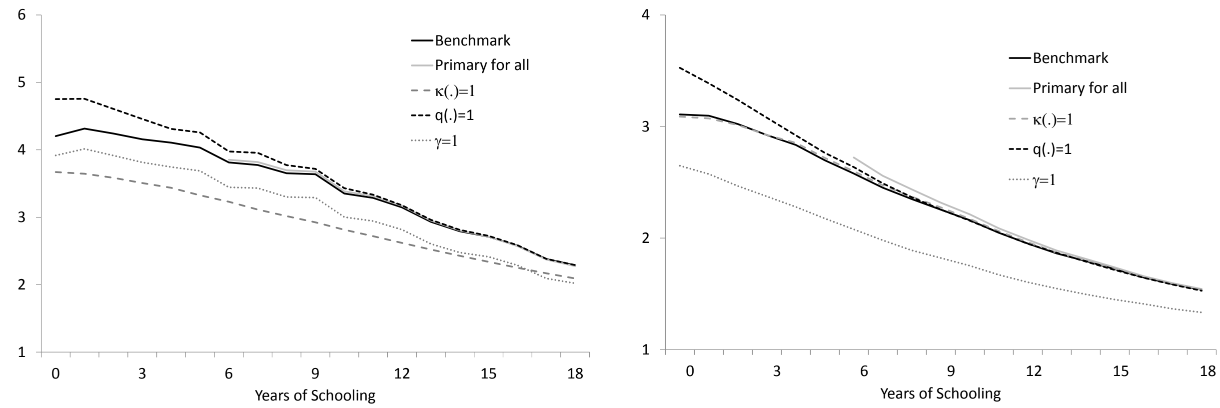


Figure 13: Fertility of married (left) and single (right) mothers. Benchmark (black), universal primary education (grey), perfect family planning (dashed grey), no mortality (dashed black), gender equality (dotted grey).

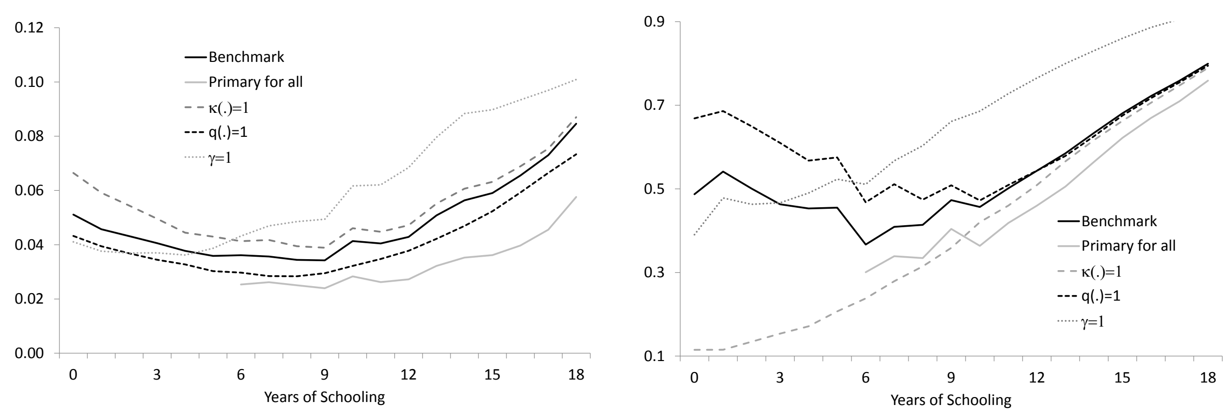


Figure 14: Childlessness rates of married (left) and single (right) women. Benchmark (black), universal primary education (grey), perfect family planning (dashed grey), no mortality (dashed black), gender equality (dotted grey).

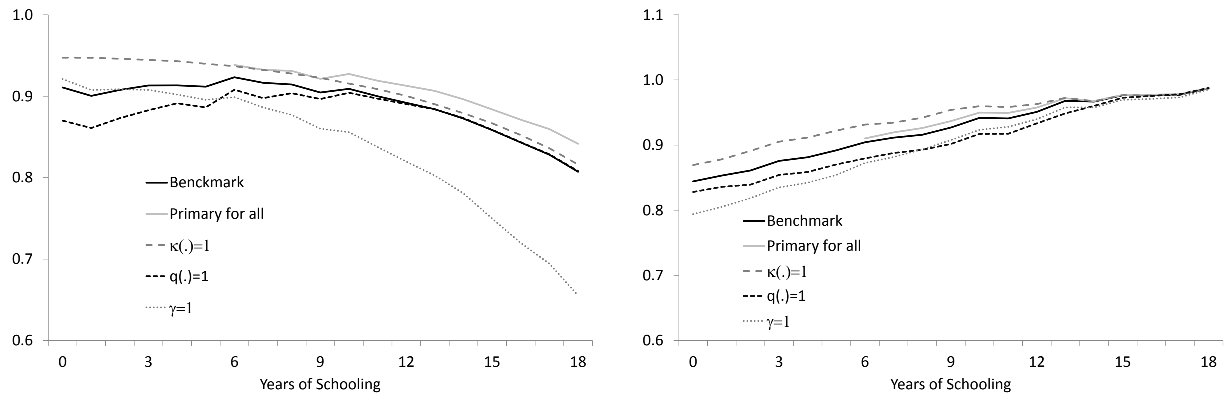


Figure 15: Marriage rates of women (left) and men (right). Benchmark (black), universal primary education (grey), perfect family planning (dashed grey), no mortality (dashed black), gender equality (dotted grey).

drastically. At the aggregate level, social sterility has been divided by more than 2 receding from 3.8% in the benchmark to 1.6% when the policy is implemented. This effect is quantitatively impressive in countries where social sterility is high. This is the case for Sierra Leone (3.7% with the policy against 10.4 without), Mali (4 against 13) and Liberia (5.7 against 11). Primary education for all is not enough to reduce social sterility in Cameroon, for whom social sterility only decreases from 16 to 13%. This is due to the very high value of $\hat{c}$ in this country meaning that all the education categories are concerned by social sterility. At the aggregate level, this policy has no impact on the voluntary component of childlessness and the implied effect on total childlessness is therefore negative: childlessness decreases from 8.5% to 5.2%.

The effect of universal primary education on the intensive margin of fertility is also negative due to the increased opportunity cost of childrearing. At the aggregate level, the fertility of mothers drops from 3.8 children to 3.6 for married women and from 2.6 to 2.5 for singles. In very poor countries which are strongly concerned by Malthusian checks, universal primary education can however significantly increase the fertility of mothers as higher wages offer them the possibility to increase their fertility. This is the case for instance in Rwanda where, due to the education policy, the fertility of married mothers increases from 5 to 5.4 while the fertility of single mothers increases from 3 to 3.2 children.

The comparison between $\Delta \mathsf{F}/\mathsf{F}$ and $\Delta \mathsf{F}_p/\mathsf{F}$ brings an important result. At the aggregate level, completed fertility would be reduced by 3.6% if marriage and childlessness were ignored (Table 6). Including these two margins implies that completed fertility remains almost stable (increasing by 0.05%). Nevertheless, this apparent neutrality hides a strong heterogeneity across countries. We can identify three main cases. For the first group of countries, the endogeneity of childlessness and marriage only weakens the negative impact of the policy on mother's fertility. This happens in Cambodia, Ghana and Malawi where universal primary education still reduces average completed fertility, in line with the predictions of the standard Beckerian fertility models. For instance in Cambodia the drop in fertility is 2.21% while it would be 2.49% without including all the margins. For the second group of countries, the impact of generalizing education on the intensive margin of fertility is still negative but this effect is more than compensated by the decrease in poverty driven childlessness. This is the case for instance in Brazil where instead of decreasing by 4.53%, completed fertility finally increases by 2.37%. The same kind of results are found in many Latin American countries, South Africa and Vietnam. The last group is composed by countries strongly affected by Malthusian behaviors. These are countries like Bolivia, Rwanda and Uganda, where the generalization of education increases the fertility of mothers and this rise is magnified by the reduction of poverty driven childlessness. For instance, in Bolivia completed fertility increases by 8%.

We conclude that generalizing primary education is a powerful tool to fight against poverty driven childlessness but that it is not necessary a good one to reduce completed fertility. To the best of our knowledge, such a result has not yet been underlined by the economic literature as this latter did not consider endogenous childlessness and marriage to discuss the impact of education on fertility in developing countries.

Perfect family planning

The second policy is an ideal family planning program which sets the percentage of couples able to control their fertility κ equal to 1, making unwanted births disappear. The fertility of low-educated married mothers accordingly decreases (left panel of Figure 13). When married women have full control over their fertility, there is less uncertainty concerning the outcome of marriage (mortality remains) and everybody is also more willing and likely to marry: the dashed-gray line of Figure 15 is systematically above the black line (benchmark). The effect is stronger for low-educated people who are more subject to unwanted pregnancies. The rise in marriage rates decreases childlessness rates among low-educated single women (right panel of Figure 14). This happens because marrying a low-educated woman becomes less risky. A selection into marriage occurs among low-educated women; those with the lowest non-labor income are more prone to accept marriage than those with high non labor income (who rely less on marriage to be protected against poverty and social sterility). This selection leaves low-educated women who are less concerned with social sterility single. This reduces the prevalence of involuntary childlessness among single women. As married women can now control their fertility, they will also be more likely childless, if optimal (left panel of Figure 14). As more poor women marry, this also increases marital childlessness rates among the low-educated. On the whole, social sterility changes from 3.8% to 2.1% for the average country.

Taking all these effects into account, eliminating unwanted births lowers the completed fertility from 3.47 to 3.00 children on average per woman for the entire population. This drop of 0.47 children lies just below the lower bound of May (2012)'s prediction concerning the efficiency of family planning on reducing fertility. In a framework that abstract from the endogeneity of marriage and childlessness, we would expect this policy to decrease fertility by 0.52 children in average. At the country level, we find that the effect of this policy is heterogeneous. In countries where the percentage of unwanted births is high, the effect of family planning policies is always lower than in the case where the marriage and childlessness channels are ignored. This is true for Peru, Rwanda and Vietnam. In particular for Vietnam, family planning remains a strong engine of fertility decline as it reduces total fertility by 0.79 children. The reverse is true in Haiti, Ghana, Malawi, South Africa and Zambia where the endogenous adjustments of childlessness and marriage magnify the impact of family planning policies. In all these countries, the prevalence of unwanted births is relatively high among highly educated women (see Table 22). Then, once they no longer face the risk of experiencing unwanted births, a significant share of these women decide to remain childless, which diminishes completed fertility.[41]

Health policy

Let us now consider a policy which eradicates child mortality ($q(\cdot) = 1$). Figure 13 shows that the reduction of mortality increases the fertility of mothers, in particular for the poorly educated. The effect is of the order of half a child for a mother with no education.[42] In addition to this well-known effect, marriage and childlessness rates vary. The childlessness rate of married women recedes from 4.3 to 3.6% while it increases from 50 to 59% among single women (Figure 14). The explanation we can derive from the theory is the following.

[41] This result is in line with Baudin and Gobbi (2014) who propose a synthetic index of the needs for population policies in developing countries. They argue that nowadays, most African countries need population policies which affect the deep determinants of fertility rather than the proximate ones while this is not the case in Asian countries like Vietnam. The main reason behind this result is that African countries have been the main recipients of family planning programs during the last decades. DHS data shows indeed that unwanted births are much more prevalent in Vietnam than in Mali.

[42] With uncertainty about child survival, parents tend to have fewer children than needed to compensate for those who will die. This has been described as "under shooting" in previous studies (see Baudin (2012)).

Child mortality rates are higher among poorly educated women who are also more likely to experience unwanted pregnancies. Child mortality then "helps" families who have more children than optimal to regulate their size. A reduction in mortality rates then increases the risk in terms of potential consumption loss for males from marrying low-educated women, this is especially important for poor males. This makes a man less likely to accept a marriage offer from a low-educated woman but also a low-educated woman less likely to accept any offer (Figure 15). Indeed, when single, a woman is not concerned by uncontrolled fertility. This implies that low-educated women are more likely to be single and hence childless. The theory predicts that social sterility increases from 3.8% to 5.9% after this shock. This highlights an interesting mechanism on how mortality allows to regulate fertility. This mechanism is in line with Malthusian theory according to which child mortality has some "virtues". A policy implication of this result is that promoting health without family planning can be costly for poor women.

Similarly to eliminating unwanted births, eradicating child mortality has a limited impact on average fertility at the global level but a dramatic one in countries which are strongly concerned by child mortality. At the global level, we find that completed fertility remains almost unchanged: from 3.47 to 3.61 (fertility increases on the intensive margin but decreases on the extensive margin). The impact is also lower than in a framework that neglects marriage and childlessness reactions to the policy. For example in Brazil, the disappearance of child mortality increases completed fertility by 2.86% when accounting for the marriage and childlessness channels while with exogenous childlessness and marriage, completed fertility increases by 4.87%. The difference is even bigger in Rwanda, which is the country with the highest child mortality in Table 6. In Rwanda, eradicating child mortality increases completed fertility by 1.26 children. Childlessness in Rwanda increases with the drop in mortality (social sterility increases from 1.7% to 6.3%), counteracting the rise in completed fertility. Hence, our theory predicts that, in some countries, the eradication of mortality goes hand in hand with an increase in social sterility, which reflects a pauperization among uneducated women.[43]

Both the family planning policy and the health policy experiments stress the importance of uncertainty for family decisions such as marriage and fertility.

[43] For Sierra Leone, where we find the highest mortality rates (Table 19), the policy increases average fertility by 1.31 children (Table 24). In this case, both margins of fertility increase, so accounting for the extensive margin of fertility magnifies the already known effect of child mortality.

Female empowerment

The last policy consists in removing the gender wage gap on the labor market. To fix ideas, this implies that γ goes from 0.79 to 1.00 in the average country (but from 0.67 to 1.00 in Morocco, which is the country with the strongest gender gap). Or, in other words, gender equality becomes similar to the one in Iceland all over the world.[44] Beyond making women richer, such a policy also increases women's bargaining power θ. In this last sense, it empowers women within their couple.[45]

The first direct effect of this policy is to make women relatively richer than in the benchmark. This implies that the gains from marriage will be lower and hence highly educated women will marry less (Figure 15, left panel). The effect on fertility rates is negative due to a higher opportunity cost to raising children for both single and married women (Figure 13). In addition, Figure 14 shows that the effect on childlessness is negative for poorly educated women (who are now richer and suffer less from social sterility) while it is positive for highly educated women (for whom the opportunity cost is greater).

Closing the gender wage gap increases total childlessness from 8.5% to 11.9%. Voluntary childlessness rises from 2.1% to 6.6% and social sterility declines from 3.8% to 2.5%. In Mali, for example, closing the gender wage gap decreases social sterility from 13.0% to 10.1% and increases voluntary childlessness from 0.3% to 1.8%. In addition to its effect on childlessness, closing the gender gap also seems a very effective policy to reduce fertility rates (Figure 13). We already knew from the literature that it may lower total fertility rates (Diebolt and Perrin 2013). Here we highlight another channel, childlessness, which can either amplify or hamper the effect of the intensive margin on average fertility. This depends on whether the positive effect of social sterility on completed fertility dominates the negative one of voluntary childlessness.

At the global level, the endogeneity of childlessness and marriage magnifies the impact of closing the gender wage gap. The effect is also increased in Colombia, that has a high voluntary childlessness component relative to other countries. In the case of Rwanda, considering

[44] Notice that the gender equality we are dealing with is of the type "economic participation and support", and is not related to "educational attainment", or to "health and survival", which are other important dimensions of gender discrimination.

[45] Another way to empower women consists in sharing childrearing time equally between women and men. To analyze this policy in a meaningful way, one should model the time use choice of the households (see Gobbi (2014) on this issue), and the incentives that a government can manipulate to decentralize such a policy. In the absence of such a framework, one can still get a preview of this policy by setting $\alpha = \frac{1}{2}$. Such a parameter change leads to various effects. Marriage rates are reduced (rich men do not want to marry any more), which reduces fertility, but couples who do not control their fertility achieve a higher number of children because their time constraint is less binding thanks to husbands' participation to domestic tasks. On average, fertility increases.

childlessness and marriage as fixed leads us to estimate that gender equity reduces completed fertility by 1.28% which would be in line with the intuition that women with higher wages reduce their number of children. This intuition is valid but this mechanism is dominated by a strong reduction of childlessness due to poverty that makes completed fertility increase by 0.34%. These examples show that eluding adjustments of childlessness and marriage could lead to incorrect conclusions in terms of economic policies. It also shows that in a country like Rwanda, playing with the deep determinants of fertility can lead to unexpected increases of completed fertility due to the reduction of social sterility.

6 Conclusion

In this paper, we look at the extensive margin of fertility, how it changes with economic development, and how it may affect development policy recommendations.

The extensive margin of fertility is endogenous to development. In the poorest countries, it is mostly composed of social sterility, which reflects situations in which women are so poor that their fecundity is affected, and they end up being childless because of poverty. This situation echoes Malthus's preventive check.

We propose a methodology to identify the part of childlessness that is related to poverty. It is based on estimating the structural parameters of an economic model in which both men and women decide whether to marry and how many children to have. This estimation is carried out by a simulated method of moment, in which the empirical moments used in the estimation include fertility, childlessness and marriage rates for 36 developing countries.

Comparing the breakdown of childlessness into its causes across countries, we show that when a country develops, poverty-driven childlessness diminishes. However, another type of childlessness appears: voluntary childlessness, which is driven by the high opportunity cost of having children for more educated individuals.

The endogeneity of childlessness matters for development policy. Imposing universal primary education is commonly expected to reduce fertility in developing countries. We find that it indeed has a negative impact on the intensive margin of fertility but it makes poverty-driven childlessness less likely. On average, fertility rates may not decrease after this policy and will probably increase in countries where Malthusian checks are still at play nowadays.

When implementing family planning, the fertility of married mothers decreases (by about one child on average for the poor). This is the usual effect advocated by development agencies.

However, marriage rates increase and the social sterility of poor single women decreases as these poor women can now more easily find a husband. On the whole, taking the endogeneity of marriage and childlessness into account makes family planning less effective.

The third policy we consider is promoting gender equality on the labor market. Here, better paid women lead to less social sterility in the economy, but more voluntary childlessness. In sufficiently advanced economies, this reinforces the effect on fertility, making the gender parity policy the most effective one to reduce total fertility. In the least developed countries, this is not the case though, as the drop in social sterility may counteract the effect on the intensive margin of fertility.

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A Details on the Data

A.1 IPUMS-International

Country selection

Some countries were previously selected and dropped afterwards. This is the case of Guinea and Nepal. We dropped the 1996 Guinea Census data because it did not allow women to give a polygynous response to the question on marriage. Consequently, 0% of women aged 40-54 were reported as being in a polygynous marriage while 45.6% of men were (see Table 7 of Appendix A.1). This prevents us from distinguishing between monogamous unions (on which we focus the analysis) and polygynous unions. The 2001 Nepal Census data used to be in IPUMS international but was taken out because of sampling weight errors.

Marital types and multifamily households

Polygyny is present in Cameroon, Kenya, Liberia, Mali, Rwanda, Senegal, Sierra Leone and Uganda. The highest percentages of polygynous unions among women are 50.6% in Senegal and 46.5% in Mali. The fertility of mothers involved in monogamous unions is slightly higher than that of women involved in polygynous unions. Childlessness is in general higher for polygynous women.

The 2002 Rwanda Census data shows that 30.3% of 40-54 year old women were widowed (compared to 3.9% for men). This is much higher than in any other country. Our results for Rwanda may therefore suffer from some biases, as dropping 30% of the sample may induce a large selection bias. Another extreme case is the Dominican Republic, where 25.8% of women are in the separated/divorced/spouse absent category. Among these, 70.7% are separated from a consensual union.

Multifamily households, even though they exist, are not the norm for any level of education. 95.2% of women in our sample are in a household composed of only one family. The percentage is however lower in some specific countries. In Rwanda, Senegal and Tanzania, the percentage of women who are in households composed by more than one family is respectively 19.9%, 20.9% and 22.5%. In these three countries, half of those women living in households composed by more than one family did not go to school (so it's around 10% among the "no school" of these countries). Among singles, 90.1% of women live in a one family type household.

Education levels

For some of the countries in Table 9, the variable on years of schooling had a top code of 12 or 13. For these countries, we added 2 years of schooling to the required number of years to achieve high school for individuals who had completed secondary education and had a post-secondary technical education or completed some college. For those who had completed university, we added 4 years of schooling.

More precisely, Cambodia, Kenya, Nigeria, Sierra Leone, South Africa and Zambia have a top code of 13 years of schooling. For all these countries, we give 16 years of schooling to all the observations who completed university. In Cambodia, Nigeria and Zambia, we give a value of 14 years of schooling to those who had a post-secondary technical education. Peru's top code is 12. We give 13 years of schooling to those who had a post-secondary technical education and 15 years to those who had completed university. Bolivia, Brazil, Indonesia, Liberia and Palestine have a top code of 17 years. We do not change the classification for these countries. For Haiti, there were observations coded as having completed secondary education but with less than 11 years of schooling. We dropped these observations. For Jamaica, we dropped: the observations with more than 5 years of schooling and coded as having completed less than primary education, the observations with less than 6 years of schooling and coded as having completed primary, the observations with less than 11 years of schooling and coded as having completed secondary, and the observations with less than 14 years of schooling and coded as having completed university.

Mistakes

We drop women who had declared to have less children born than children that survived from the sample. This concerns one observation in Jamaica and Uruguay, 715 observations in Senegal and 14 observations in Vietnam.

	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
ARG	0.091	0.840	0.000	0.049	0.020	0.081	0.778	0.000	0.081	0.060
BOL	0.105	0.818	0.000	0.039	0.037	0.102	0.755	0.000	0.071	0.071
BRA	0.067	0.840	0.000	0.080	0.013	0.072	0.716	0.000	0.152	0.060
CHL	0.135	0.781	0.000	0.068	0.016	0.155	0.704	0.000	0.102	0.039
COL	0.168	0.752	0.000	0.062	0.019	0.163	0.674	0.000	0.105	0.058
CRI	0.115	0.813	0.000	0.063	0.010	0.131	0.706	0.000	0.129	0.034
DOM	0.090	0.718	0.000	0.177	0.015	0.036	0.658	0.000	0.258	0.048
ECU	0.111	0.791	0.000	0.083	0.015	0.123	0.703	0.000	0.133	0.041
HTI	0.091	0.836	0.000	0.045	0.028	0.068	0.788	0.000	0.077	0.066
JAM	0.333	0.621	0.000	0.034	0.012	0.368	0.582	0.000	0.033	0.017
MEX	0.078	0.859	0.000	0.044	0.019	0.088	0.760	0.000	0.094	0.058
NIC	0.110	0.813	0.000	0.059	0.018	0.103	0.663	0.000	0.170	0.065
PAN	0.163	0.735	0.000	0.091	0.011	0.102	0.692	0.000	0.179	0.027
PER	0.114	0.821	0.000	0.046	0.019	0.087	0.778	0.000	0.090	0.045
SAL	0.135	0.810	0.000	0.040	0.015	0.196	0.655	0.000	0.090	0.058
URY	0.104	0.808	0.000	0.073	0.015	0.082	0.744	0.000	0.129	0.045
VEN	0.154	0.767	0.000	0.067	0.013	0.140	0.658	0.000	0.156	0.047
CAM	0.095	0.681	0.160	0.029	0.036	0.112	0.492	0.197	0.049	0.150
GHA	0.051	0.840	0.000	0.082	0.027	0.033	0.724	0.000	0.142	0.100
GIN	0.031	0.471	0.456	0.020	0.022	0.007	0.859	0.000	0.027	0.107
KEN	0.044	0.750	0.158	0.030	0.019	0.050	0.607	0.192	0.044	0.107
LBR	0.123	0.766	0.048	0.045	0.017	0.108	0.682	0.043	0.064	0.104
MAR	0.051	0.928	0.000	0.012	0.009	0.077	0.772	0.000	0.053	0.098
MLI	0.033	0.574	0.371	0.006	0.016	0.031	0.422	0.465	0.014	0.068
MWI	0.019	0.922	0.000	0.037	0.022	0.014	0.751	0.000	0.106	0.129
RWA	0.038	0.835	0.062	0.015	0.050	0.033	0.540	0.086	0.034	0.307
SEN	0.044	0.677	0.262	0.009	0.008	0.032	0.380	0.506	0.024	0.057
SLE	0.092	0.588	0.258	0.039	0.023	0.061	0.478	0.297	0.042	0.122
TZA	0.054	0.849	0.000	0.063	0.033	0.051	0.703	0.000	0.123	0.123
UGA	0.050	0.656	0.186	0.072	0.037	0.032	0.519	0.166	0.113	0.171
ZAF	0.160	0.767	0.003	0.046	0.024	0.214	0.626	0.000	0.078	0.082
ZMB	0.030	0.893	0.000	0.041	0.036	0.027	0.682	0.000	0.111	0.180
IDN	0.012	0.945	0.000	0.010	0.033	0.022	0.829	0.000	0.036	0.113
KHM	0.018	0.957	0.000	0.010	0.014	0.053	0.804	0.000	0.050	0.093
THA	0.048	0.908	0.000	0.017	0.027	0.076	0.812	0.000	0.034	0.078
VNM	0.017	0.960	0.000	0.013	0.010	0.047	0.857	0.000	0.031	0.065
WBG	0.013	0.972	0.000	0.005	0.010	0.079	0.821	0.000	0.020	0.080

Table 7: Percentage of men and women by marital status and country. (1): single/never married, (2): monogamous marriage/in union (monogamous), (3): polygamous marriage, (4): separated/divorced/spouse absent, and (5): widowed.

	5%	95%		5%	95%		5%	95%
ARG	38	62	PER	37	63	SEN	42	75
BOL	37	62	SAL	36	66	SLE	35	80
BRA	37	63	URY	38	63	TZA	41	72
CHL	38	62	VEN	36	64	UGA	39	71
COL	37	65	CAM	41	70	ZAF	39	62
CRI	37	63	GHA	40	70	ZMB	42	68
DOM	35	66	GIN	43	77	IDN	42	63
ECU	37	63	KEN	42	69	KHM	38	61
HTI	38	67	LBR	39	66	THA	39	61
JAM	35	62	MAR	42	66	VNM	40	54
MEX	39	63	MLI	44	70	WBG	42	67
NIC	36	65	MWI	41	68			
PAN	36	64	RWA	40	67			

Table 8: 5th and 95 percentiles for the age of the spouse of married monogamous women.

Country Code	Country Name	Year	Number of Observations			
			Men		Women	
			Single	Married	Single	Married
ARG	Argentina	1991	46,379	426,773	26,991	258,630
BOL	Bolivia	2001	8,290	64,465	5,093	37,566
BRA	Brazil	2000	80,626	1,010,146	56,802	564,511
CHL	Chile	2002	27,772	160,298	21,439	97,221
COL	Colombia	2005	85,217	381,504	48,497	200,283
CRI	Costa Rica	2000	5,141	36,467	3,704	19,904
DOM	Dominican Republic	2010	12,419	98,769	2,596	47,895
ECU	Ecuador	2010	18,517	132,191	12,961	74,013
HTI	Haiti	2003	6,781	62,523	3,310	38,288
JAM*	Jamaica	2001	7,449	13,907	3,347	5,292
MEX	Mexico	2010	94,945	1,042,567	79,231	685,238
NIC	Nicaragua	2005	5,520	40,876	3,207	20,679
PAN	Panama	2010	8,059	36,328	2,870	19,506
PER	Peru	2007	37,697	272,159	17,747	158,823
SAL	El Salvador	2007	8,460	50,713	7,955	26,518
URY	Uruguay	1996	3,895	30,167	2,007	18,306
VEN	Venezuela	2001	43,288	215,939	24,189	113,766
CAM	Cameroun	2005	10,861	77,613	9,406	41,470
GHA	Ghana	2010	10,734	177,005	5,158	111,832
KEN	Kenya	1999	3,408	58,019	3,194	38,857
LBR	Liberia	2008	3,292	20,460	1,773	11,222
MAR	Morocco	2004	6,926	126,201	8,832	88,500
MLI*	Mali	2009	2,580	45,461	1,435	19,505
MWI	Malawi	2008	1,408	66,764	727	40,179
RWA	Rwanda	2002	1,699	37,269	1,380	22,497
SEN	Senegal	2002	3,088	47,298	1,504	17,971
SLE	Sierra Leone	2004	4,976	31,750	1,552	12,095
TZA	Tanzania	2002	13,385	208,581	9,255	127,062
UGA	Uganda	2002	8,258	109,317	3,168	51,260
ZAF**	South Africa	2001	53,426	256,875	48,298	141,424
ZMB	Zambia	2010	1,897	56,025	1,460	36,646
IDN	Indonesia	1995	679	55,683	1,019	39,049
KHM	Cambodia	2008	2,219	116,660	5,513	83,624
THA	Thailand	2000	3,355	63,908	3,983	42,815
VNM*	Vietnam	2009	20,335	1134199	41,053	746,960
WBG	Palestine	1997	202	15,217	837	8,711
	Total		653,183	6,780,097	471,493	4,068,118

* indicates countries where women are aged 40-49.
** indicates countries where women are aged 40-50.
Note: The age range of men differs by country according to Table 8.

Table 9: Census data and number of (unweighted) observations.

A.2 DHS Data

Here we provide four other alternative measures of "uncontrolled fertility" than the one provided in Section 2. For all the measures, we have only considered monogamous married women.

A.2.1 Different Measures

The first measure we propose considers that a woman, over 40, is unable to control her fertility if the number of children ever born to her is at least two more children than her declared ideal number.[46] Under this measure (measure 1), half of the women are unable to control their fertility. One major weakness of this measure is that the difference between the number of children ever born and the ideal number of children can be the outcome of a rational choice. It could, for instance, reflect that the husband has a higher ideal number of children together with a higher bargaining position.[47] Measure 2 accounts for this weakness and is the one we choose as benchmark in the main text. To account for the perceived desired fertility of husbands, we use the answer to "whether the respondent believes her partner wants the same number of children, more children or fewer children than she wants herself".[48] Measure 3 uses the same definition as measure 2 except that the differential between completed fertility and the ideal number of children must be at least three instead of two.

Measure 4 relies on the idea that a woman who does not control her fertility has a very large number of children ever born. This measure is simply the percentage of women over 40 who had at least nine children while their ideal number of children is below or equal to four. The percentages are small compared to alternative measures. The correlation between Measures 1 and 4 equals 0.84.

The literature about desired fertility and family planning (see for instance Pritchett (1994a)) reports the existence of an ex-post rationalization bias making women declare their ideal number of children in conformity with their actual number of children. To control for this

[46] The ideal number of children is given as the answer to "*[What is] The ideal number of children that the respondent would have liked to have in her whole life, irrespective of the number she already has.*" We then use the number of births rather than with the number of surviving children because it includes the children who did not survive.

[47] Ashraf, Field, and Lee (2013) find that facilitating family planning services reduces births, in particular among women having a husband who desires more children than themselves.

[48] Responses for beliefs regarding husbands fertility intentions is not available for Ecuador, Mexico and Thailand. Across the remaining 22 countries where data about male's perceived desires are available, we find that the coefficient of linear correlation between measures 1 and 2 is 0.77.

bias, Measure 5 focuses on women aged between 35 and 40 who had a birth within the last three/five years before the DHS study.[49] We consider that these women did not control their fertility if their answered "not at all" to the question of whether the child born in the last three/five years was wanted at the time, later or not at all (question v367). The correlation between Measures 1 and 5 equals 0.67.

A.2.2 Missing countries

Unwanted births are measured using DHS data as explained in the main text. For some countries listed in Table 9, the data needed to calculate Measure 2 are not available. For these countries, we use the estimates of the "closest country" with respect to the pattern of the completed fertility of married mothers, by years of schooling. In practice, we regressed the means of the completed fertility of married mothers for each year of schooling of the country lacking DHS data on unwanted births on the completed fertility of married mothers for each year of schooling of another country with DHS data on unwanted births, on the same continent. These means were taken from our samples from IPUMS international. In the regression, we used the number of observations by years of schooling of the country lacking DHS data as weights. The "closest country" was the one for which the R^2 was the highest. Table 11 shows the countries for which there was no data on unwanted births in DHS in the "missing countries" column and the countries for which we used the estimates in the "used countries" column.[50]

A.2.3 Predicted Values for All Education Levels

DHS provides two measures of educational attainment, respectively close to years of schooling and educational attainment in IPUMS International. Our exploration of these data gave us more confidence in the variable similar to educational attainment, which divides the population into four education categories: "no school", "primary education", "secondary education" and "higher education". To obtain values for all years of educations, the following linear regression model appears to be the best bivariate regression model of the percentage of women who do not control their fertility $1 - \kappa_j(e_i)$:

$$1 - \kappa_j(e_i) = a_j e_i + b_j + \varepsilon_{ij} \tag{9}$$

[49]We do not include very young women because the probability for a woman who is not able to control her fertility of facing an unwanted birth increases with age.

[50]For Cameroon the estimate of the coefficient relating education to the probability of not controlling fertility was positive. This is not plausible so we decided to use the estimate for Kenya.

Country	Year	Measure 1	Measure 2	Measure 3	Measure 4	Measure 5	$a_j * 10$	b_j
BOL	2008	0.713	0.374	0.313	0.207	0.696	-0.018	0.419
BRA	2010	0.491	0.281	0.238	0.141	0.548	-0.025	0.436
COL	2010	0.385	0.236	0.159	0.033	0.464	-0.028	0.462
DOM	2007	0.334	0.165	0.129	0.036	0.358	-0.017	0.274
ECU	1987	0.609			0.246	0.299		
HTI	2012	0.693	0.335	0.278	0.193	0.497	-0.022	0.420
MEX	1987	0.665			0.319	0.720		
NIC	2001	0.639	0.347	0.303	0.217	0.572	-0.019	0.419
PER	2012	0.540	0.392	0.307	0.085	0.479	-0.031	0.602
GHA	2008	0.388	0.239	0.159	0.032	0.256	-0.014	0.305
KEN	2008-9	0.539	0.294	0.237	0.108	0.394	-0.004	0.305
LIB	2013	0.427	0.145	0.105	0.069	0.144	-0.007	0.183
MAR	2003-4	0.588	0.373	0.264	0.133	0.379	-0.025	0.443
MLI	20012-13	0.349	0.075	0.048	0.030	0.078	-0.007	0.116
MWI	2010	0.572	0.315	0.260	0.124	0.416	-0.025	0.372
RWA	2010	0.686	0.516	0.432	0.157	0.309	-0.015	0.576
SEN	2012-13	0.416	0.045	0.027	0.041	0.122	-0.003	0.057
SLE	2013	0.347	0.082	0.045	0.050	0.059	-0.005	0.118
UGA	2011	0.568	0.223	0.191	0.122	0.373	-0.007	0.252
ZAF	1998	0.366	0.201	0.116	0.033	0.372	-0.011	0.265
ZAM	2007	0.443	0.200	0.157	0.090	0.298	-0.003	0.189
IDN	2012	0.316	0.185	0.108	0.026	0.224	-0.007	0.211
KHM	2010	0.420	0.260	0.174	0.050	0.235	-0.019	0.339
THA	1987	0.602			0.088	0.402		
VNM	2002	0.490	0.419	0.211	0.026	0.354	-0.024	0.537

Table 10: Alternative measures of uncontrolled fertility - data from DHS

Missing countries	Used countries	Missing countries	Used countries
ARG	BRA	SAL	NIC
CHL	DOM	URY	NIC
CRI	NIC	VEN	DOM
ECU	DOM	CAM	KEN
JAM	BOL	TZA	KEN
MEX	NIC	THA	KHM
PAN	NIC	WBG	KHM

Table 11: Countries coupled when there was no data on unwanted births in DHS.

where $\varepsilon_{ij} \sim \mathcal{N}(0, \sigma_j^2)$. Table 10 shows the estimated values of a_j and b_j for all the countries for which we have the data. For countries for which that data is missing, we use the estimates of the "closest country" as explained in Appendix A.2.2. The gradient of the relationship between the probability of not controlling her fertility and the woman's education is always significantly negative.[51] Final probabilities of being a woman who cannot control her fertility, by country and education are provided in Table 22.

[51] The correlation between our measure of uncontrolled fertility and the % of desired fertility proposed in Pritchett (1994a) (pages 44-45) for the countries included in both studies equals 0.66.

A.3 Data on Education and Gender Wage Gap

	e_f	e_m	γ		e_f	e_m	γ
ARG	7.83	7.79	0.82	KEN	3.83	5.44	0.78
BOL	5.46	7.53	0.84	LBR	2.42	6.08	0.79 ⋆
BRA	5.97	5.77	0.80	MAR	2.15	3.60	0.67
CHL	9.40	9.49	0.76	MLI	1.08	1.78	0.67
COL	7.30	6.87	0.82	MWI	3.15	5.24	0.79 ⋆
CRI	7.54	7.50	0.83	RWA	1.99	3.22	0.78
DOM	8.05	7.37	0.79	SEN	2.18	3.07	0.79 ⋆
ECU	8.90	8.80	0.79 ⋆	SLE	1.79	3.44	0.78
HTI	1.59	2.60	0.78	TZA	2.82	4.29	0.79
JAM	11.34	10.47	0.81	UGA	2.96	5.33	0.81
MEX	8.16	8.48	0.79	ZAF	6.65	6.86	0.86
NIC	5.31	5.40	0.88	ZMB	5.53	7.79	0.72
PAN	10.03	9.39	0.82	IDN	4.82	5.91	0.76
PER	7.96	9.20	0.78	KHM	3.27	5.24	0.75
SAL	5.59	6.25	0.76	THA	4.83	5.55	0.79
URY	8.16	7.43	0.78	VNM	8.00	8.50	0.79
VEN	7.39	7.28	0.81	WBG	6.12	8.03	0.79 ⋆
CAM	5.14	6.22	0.75	**All**	**6.14**	**6.68**	**0.79**
GHA	5.44	7.79	0.79				

⋆ indicates that we used the average of the sample value for the respective countries, due to a lack of information.

Table 12: Average education, female and male, and gender wage gaps by country

A.4 Tables

Yrschl.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18+	**Mean**
ARG	5.37	4.95	4.64	4.14	3.87	3.69	2.94	2.93	2.78	2.73	2.68	2.70	2.56	2.63	2.64	2.64	2.63	2.67	2.57	**3.18**
BOL	5.46	5.25	5.27	5.15	5.19	4.87	4.67	4.56	4.33	4.15	4.16	4.02	3.36	3.27	3.11	2.93	3.02	2.68		**4.70**
BRA	5.23	4.75	4.41	3.97	3.37	3.34	3.07	2.95	2.80	2.72	2.62	2.47	2.37	2.32	2.29	2.24	2.22	2.24		**3.49**
CHL	3.77	3.52	3.89	3.72	3.55	3.47	3.32	3.17	3.04	2.87	2.89	2.84	2.64	2.54	2.52	2.55	2.53	2.53	2.57	**2.96**
COL	5.14	4.57	4.38	4.15	3.94	3.47	3.16	3.03	2.92	2.81	2.76	2.53	2.34	2.36	2.26	2.23	2.19	2.21		**3.34**
CRI	5.58	5.06	5.00	4.69	4.61	4.45	3.81	3.59	3.41	3.27	3.15	2.96	2.80	2.81	2.81	2.79	2.70	2.71	2.54	**3.75**
DOM	4.26	4.12	4.06	3.96	3.86	3.71	3.58	3.53	3.34	3.21	3.07	3.00	2.85	2.73	2.72	2.68	2.58	2.56	2.56	**3.39**
ECU	5.50	4.90	4.71	4.78	4.74	4.53	4.15	3.91	3.64	3.31	3.27	3.20	2.92	2.71	2.63	2.61	2.52	2.47	2.43	**3.68**
HTI	4.97	4.79	4.62	4.67	4.55	4.40	4.26	3.90	3.84	3.73	3.83	3.04	2.95	2.73				2.58	2.45	**4.77**
JAM						4.72	4.66	4.53	4.47	4.34	4.02	3.97	3.83	3.57	3.27	2.92	2.51	2.58	2.31	**3.78**
MEX	5.19	4.86	4.77	4.54	4.40	4.24	3.71	3.47	3.31	3.13	2.71	2.72	2.61	2.66	2.53	2.45	2.42	2.35	2.29	**3.51**
NIC	6.61	6.14	5.99	5.63	5.23	4.91	4.48	4.02	3.93	3.60	3.55	3.12	2.97	2.79	2.85	2.64	2.57	2.39		**5.02**
PAN	5.88	5.07	5.59	5.35	5.26	5.28	4.07	3.79	3.57	3.25	3.25	3.27	2.71	2.61	2.48	2.36	2.32	2.21	2.22	**3.44**
PER	5.43	5.24	5.15	4.98	4.80	4.36	4.35	4.04	3.91	3.81	3.68	3.15	2.76			2.46				**3.87**
SAL	4.84	4.67	4.59	4.30	4.10	3.80	3.55	3.40	3.30	2.94	2.73	2.76	2.63	2.78	2.58	2.49	2.53	2.43	2.39	**3.84**
URY	3.59	3.99	3.92	3.80	3.64	3.33	3.05	2.91	2.87	2.55	2.51	2.33	2.53	2.45	2.48	2.50	2.40	2.34		**2.90**
VEN	6.03	5.21	5.28	5.12	5.16	4.89	4.26	3.99	3.70	3.43	3.37	2.92	2.55	2.60	2.48	2.52	2.51	2.44		**3.93**
CAM	5.04	4.89	5.09	5.07	5.14	5.22	5.22	5.07	5.00	4.78	4.76	4.53	4.47	4.37	4.20	3.87	4.07	3.71	3.83	**4.98**
GHA	5.26	5.05	5.19	5.07	4.84	5.04	4.73	4.90	4.66	4.44	4.21	3.84	3.51	3.44	3.62	3.34	3.42	3.31	3.24	**4.71**
KEN	6.43	6.71	6.71	6.72	6.68	6.70	6.48	6.30	6.02	5.70	5.35	4.85		4.31			3.57			**6.27**
LBR	5.34	5.22	5.87	5.28	5.83	5.48	5.37	5.45	5.33	5.15	5.16	5.52	4.62	4.55	4.32		3.92	3.82		**5.27**
MAR	5.30	4.26	4.06	4.21	4.13	3.94	3.80	3.65	3.61	3.31	3.18	3.14	2.83	2.69	2.60	2.70	2.52	2.49	2.54	**4.86**
MLI	5.11	5.27	5.16	5.32	5.43	5.12	5.14	5.15	4.69	4.56	4.02	3.87	3.31	3.53	4.25		3.76		3.50	**5.08**
MWI	5.25	5.40	5.49	5.38	5.46	5.45	5.49	5.48	5.42	5.17	4.99	4.94	4.47	4.11	4.37	3.74	3.60			**5.30**
RWA	5.63	5.67	5.77	5.65	5.69	5.68	5.65	5.54	5.38	5.23	5.58	4.97	4.63							**5.63**
SEN	5.47	5.74	5.87	5.26	5.60	5.34	5.46	5.14	5.24	5.01	4.74	4.51	4.17	4.12	4.25	3.69	3.46	3.54	3.08	**5.34**
SLE	4.68	5.14	4.95	5.21	4.66	4.86	4.91	4.58			3.98			3.69			2.96			**4.62**
TZA	6.14	6.33	6.32	6.41	6.45	6.31	6.34	5.81	5.60	5.69	6.06	4.69		4.04			4.87			**6.07**
UGA	6.13	6.39	6.54	6.57	6.67	6.59	6.75	6.69	6.66	6.36	6.27	5.77	6.41	5.38	5.50			4.18		**6.30**
ZAF	4.40	4.22	4.15	4.24	4.17	4.05	3.95	3.83	3.60	3.51	3.07	3.09	2.70				2.62			**3.61**
ZMB	5.63	5.78	5.87	5.96	5.91	5.85	5.98	5.84	5.74	5.49	5.51	5.46	4.93		4.49		3.38			**5.64**
IDN	4.00	4.21	4.08	4.33	4.30	4.31	4.18	4.43	4.25	4.12	3.73	4.14	3.52	3.14	3.38	2.96	2.80			**4.09**
KHM	4.65	4.72	4.54	4.47	4.30	4.22	4.10	3.90	3.87	3.83	4.12	4.14	3.57		3.13		2.42			**4.38**
THA	3.19	2.87	2.88	2.82	2.66	2.51	2.47	2.36	2.67	2.29	2.20	2.13	2.09				1.98	2.01		**2.64**
VNM	3.16	3.33	3.26	3.14	3.04	2.88	2.86	2.79	2.72	2.69	2.42	2.18	2.29	2.03	2.07	2.07	1.93	1.91	1.86	**2.69**
WBG	8.02	8.15	8.28	7.94	7.77	7.94	7.49	7.76	7.30	7.44	7.65	7.15	6.50		5.61		4.36	3.83		**7.39**
All	**5.02**	**4.68**	**4.43**	**4.30**	**3.37**	**3.85**	**3.92**	**3.73**	**3.27**	**3.18**	**3.32**	**2.75**	**2.79**	**2.71**	**2.83**	**2.41**	**2.40**	**2.34**	**2.51**	3.75

Table 13: Completed fertility of mothers – married

Yrschl.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18+	**Mean**
ARG	3.49	3.19	3.13	2.77	2.74	2.53	2.14	2.02	1.76	2.11	1.59	1.59	1.45	1.80	1.47	1.54	1.38	1.31	1.46	**2.32**
BOL	3.43	3.38	3.44	3.55	3.45	3.37	3.28	3.37	3.50	2.73	2.96	2.80	2.17	1.85	1.94	1.92	1.66	1.49		**3.01**
BRA	2.55	2.24	2.17	1.86	1.76	1.86	1.71	1.60	1.59	1.45	1.43	1.30	1.21	1.27	1.22	1.16	1.23	1.14		**1.71**
CHL	2.65	2.49	2.76	2.55	2.48	2.53	2.37	2.28	2.19	2.03	2.00	2.13	1.78	1.66	1.65	1.52	1.55	1.55	1.65	**2.07**
COL	3.66	3.33	3.16	2.97	2.72	2.58	2.28	2.29	2.18	2.10	1.97	1.76	1.74	1.58	1.52	1.42	1.39	1.41		**2.40**
CRI	4.02	4.26	3.91	3.90	3.94	3.42	2.85	3.11	2.71	2.51	2.14	2.18		2.18	1.70	1.93	1.71	1.51		**2.91**
DOM	3.33		3.00	2.74	3.47	2.82	3.61	3.18	2.67	2.64	2.57	2.33	2.26				1.58	1.86	2.10	**2.66**
ECU	3.26	3.66	3.38	3.11	3.19	3.32	2.88	3.16	2.70	2.50	2.39	2.30	2.06	1.87	1.85	1.71	1.61	1.58	1.58	**2.49**
HTI	3.64		3.05	3.27	3.72	3.28	3.14	2.74	3.61	3.33	2.38	2.30	2.36							**3.38**
JAM							4.30	3.74	3.98	3.77	3.83	3.43	3.49	2.95	2.97	2.57	1.88	1.99	1.56	**3.39**
MEX	3.08	3.09	2.95	2.79	2.86	3.00	2.41	2.44	2.52	2.17	1.95	1.89	1.79	1.73	1.67	1.64	1.55	1.68	1.53	**2.17**
NIC	4.81	5.45	4.55	4.16	4.04	4.10	3.73	3.46	3.29	3.43	2.84	2.63	2.51		2.13		2.01			**3.61**
PAN	3.54					2.94	3.17	3.10	3.18	2.80		2.97	2.19		1.91	1.97	1.71	1.58	1.77	**2.53**
PER	1.98	2.10	2.05	2.11	2.10	2.07	2.05	2.24	2.06	2.13	1.97	1.83	1.69			1.51				**1.82**
SAL	3.44	3.27	3.26	3.17	2.94	3.09	2.90	2.68	2.79	2.51	2.64	2.25	2.05		1.98	1.83		1.75	1.67	**2.89**
URY			3.23	2.53	2.96	2.81	2.35		2.78	1.77										**2.31**
VEN	4.86	4.29	4.45	4.30	4.24	4.07	3.63	3.45	3.11	2.90	2.61	2.21	1.81		2.27	2.28		1.68		**3.32**
CAM	4.30	3.93	3.79	4.35	4.20	4.18	4.24	4.00	3.87	3.76	3.43	3.50	3.24	3.10	2.83	2.58	2.72		2.82	**3.96**
GHA	3.66	4.19	3.09	3.44	3.38	3.21	3.51	3.65	3.15	3.03	2.66		2.31	2.13	2.25	1.91			1.82	**3.00**
KEN	4.90	5.18	4.89	5.03	4.31	4.87	4.20	3.93	3.64	3.34		2.75					2.14			**4.13**
LBR	4.39						4.91		4.23	4.05	4.51		3.78							**4.18**
MLI	3.94								2.65											**3.67**
MWI	4.46								4.52											**4.24**
RWA	3.52	3.58	3.09	3.38	3.64	3.97	3.07													**3.45**
SEN	4.09						3.15				2.35									**3.68**
SLE	4.62						4.47	3.34			3.16						2.85			**4.14**
TZA	4.67	6.24	4.57	4.24	4.69	4.40	4.83	3.93		2.99		3.01		3.64			4.11			**4.26**
UGA	5.04	5.12	5.31	4.54	4.82	4.98	5.23	4.94		4.77	3.66	3.98			3.75			2.92		**4.78**
ZAF	3.14	3.06	2.99	2.97	2.96	3.04	2.88	2.85	2.74	2.69	2.55	2.48	2.28				2.09			**2.81**
ZMB	3.58						3.80	3.75		3.17			2.31		2.06					**3.13**
KHM	3.21			2.73	2.66															**3.01**
VNM		1.37	1.33	1.39	1.42	1.34	1.37	1.28	1.30	1.21	1.45	1.18	1.30			1.30	1.24			**1.29**
All	**3.62**	**3.15**	**3.14**	**3.00**	**2.77**	**2.76**	**2.81**	**3.01**	**2.55**	**2.31**	**2.45**	**1.97**	**1.97**	**1.93**	**1.92**	**1.56**	**1.67**	**1.57**	**1.62**	2.62

Note: For Morocco, Indonesia, Thailand and Palestine the Census only provided information on completed fertility for married women.

Table 14: Completed fertility of mothers – singles

Yrschl.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18+	**Mean**
ARG	0.06	0.09	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.09	0.07	0.10	0.09	0.07	0.09	0.08	0.10	**0.07**
BOL	0.04	0.03	0.03	0.03	0.03	0.03	0.03						0.02				0.03	0.05		**0.03**
BRA	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.05	0.06	0.07	0.08	0.07	0.09	0.10	0.11		**0.05**
CHL	0.03	0.02	0.03	0.02	0.03	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.04	0.04	0.04	0.05	0.04	0.05	**0.03**
COL	0.09	0.05	0.04	0.05	0.05	0.04	0.05	0.04	0.05	0.05	0.05	0.06	0.07	0.06	0.07	0.06	0.08	0.09		**0.06**
CRI				0.02			0.02					0.03			0.05		0.05			**0.03**
DOM	0.05	0.04	0.03	0.04	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.05		0.05	0.05	0.07	0.06	0.07	**0.04**
ECU	0.06	0.03	0.04	0.03	0.04	0.05	0.04	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.05	0.06	0.05	0.07	0.07	**0.05**
HTI	0.07		0.05	0.05	0.05	0.07	0.06			0.07	0.09	0.08	0.08	0.10						**0.07**
JAM									0.04											**0.05**
MEX	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.05	0.04	0.05	0.06	0.08	**0.03**
NIC	0.02			0.02			0.02					0.03					0.04			**0.02**
PAN	0.03						0.02			0.02			0.05		0.08	0.05	0.07	0.07	0.08	**0.04**
PER	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.03	0.03			0.04				**0.03**
SAL	0.05		0.03	0.04	0.04	0.05	0.04	0.05		0.04			0.04			0.05		0.07		**0.04**
URY				0.04	0.06	0.06	0.06		0.07	0.06	0.06	0.08				0.11	0.08	0.11		**0.06**
VEN	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.03	0.04	0.06							**0.03**
CAM	0.14	0.20	0.20	0.15	0.17	0.16	0.18	0.18	0.17	0.19	0.22	0.21	0.19	0.19		0.22	0.20		0.20	**0.17**
GHA	0.07	0.09	0.07	0.09	0.10	0.07	0.09	0.07	0.06	0.09	0.08	0.11	0.14	0.11	0.11	0.10		0.14	0.12	**0.08**
KEN	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.03			0.02								**0.03**
LBR	0.10								0.15				0.12							**0.11**
MAR	0.05		0.07	0.05	0.05	0.06	0.06	0.07	0.06	0.06	0.06	0.07	0.08	0.11	0.07		0.09			**0.06**
MLI	0.14			0.16	0.11	0.11	0.14		0.10	0.16										**0.14**
MWI	0.06	0.04	0.05	0.05	0.04	0.05	0.04	0.04	0.04		0.05		0.07							**0.05**
RWA	0.02			0.02			0.01													**0.02**
SEN	0.04						0.03				0.05									**0.04**
SLE	0.09		0.24					0.08			0.10									**0.09**
TZA	0.05		0.04	0.04	0.04	0.03	0.03	0.03				0.04								**0.04**
UGA	0.06	0.05	0.04	0.04	0.04	0.03	0.04	0.04				0.03			0.03					**0.05**
ZAF	0.06	0.07	0.06	0.05	0.06	0.05	0.06	0.06	0.05	0.05	0.05	0.05	0.05				0.07			**0.05**
ZMB	0.11	0.08	0.10	0.07	0.08	0.09	0.07	0.07	0.07	0.07	0.07		0.11		0.08					**0.09**
IDN	0.07	0.06	0.06	0.04	0.04	0.03	0.03			0.03			0.02							**0.04**
KHM	0.04	0.04	0.03	0.03	0.02	0.03	0.03	0.04	0.03	0.04	0.04	0.04	0.05				0.16			**0.03**
THA	0.06		0.06	0.09	0.06		0.10	0.07		0.08			0.08				0.09	0.20		**0.06**
VNM		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.01	0.03	0.02	0.02			0.02	0.03	0.02	0.03	**0.02**
WBG	0.05						0.05						0.04		0.07					**0.04**
All	**0.06**	**0.04**	**0.04**	**0.04**	**0.05**	**0.04**	**0.03**	**0.05**	**0.04**	**0.03**	**0.06**	**0.05**	**0.04**	**0.06**	**0.06**	**0.07**	**0.07**	**0.08**	**0.08**	**0.05**

Table 15: Childlessness rate – married

Yrschl.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18+	**Mean**
ARG	0.63	0.57	0.49	0.53	0.55	0.56	0.72	0.68	0.74	0.72	0.77	0.78	0.88	0.87	0.88	0.90	0.91	0.93	0.92	**0.74**
BOL	0.31	0.28	0.26	0.27	0.20	0.26	0.24		0.20		0.25	0.23	0.32			0.38	0.41	0.52		**0.30**
BRA	0.80	0.73	0.73	0.72	0.72	0.65	0.68	0.68	0.73	0.69	0.74	0.81	0.84	0.85	0.89	0.89	0.89	0.90		**0.78**
CHL	0.42	0.32	0.31	0.25	0.25	0.24	0.30	0.28	0.27	0.29	0.28	0.27	0.39	0.49	0.45	0.50	0.56	0.61	0.70	**0.37**
COL	0.44	0.23	0.24	0.27	0.26	0.28	0.28	0.29	0.26	0.36	0.36	0.45	0.46	0.49	0.60	0.63	0.64	0.65		**0.39**
CRI	0.43			0.21	0.26	0.21	0.28		0.29	0.28		0.42		0.43	0.48	0.54	0.50	0.62		**0.33**
DOM	0.62			0.47				0.46	0.32	0.41	0.59	0.45	0.59		0.59	0.68	0.77	0.72	0.72	**0.57**
ECU	0.48	0.40	0.31	0.27	0.30	0.36	0.34	0.30	0.29	0.32	0.28	0.37	0.41	0.45	0.44	0.52	0.56	0.59	0.59	**0.42**
HTI	0.41			0.37	0.42	0.46	0.35	0.42		0.48	0.45	0.54	0.56	0.67						**0.44**
JAM									0.08			0.08	0.10	0.14	0.17	0.20			0.51	**0.14**
MEX	0.70	0.54	0.53	0.48	0.54	0.48	0.48	0.40	0.34	0.45	0.47	0.48	0.50	0.50	0.54	0.55	0.62	0.65	0.70	**0.53**
NIC	0.35			0.17	0.21		0.23			0.24		0.30	0.32				0.40			**0.28**
PAN	0.72						0.37			0.35			0.41		0.46	0.46	0.53	0.68	0.69	**0.48**
PER	0.46	0.33	0.34	0.28	0.30	0.30	0.29	0.25	0.29	0.22	0.20	0.31	0.37			0.46				**0.36**
SAL	0.26	0.16	0.18	0.21	0.20	0.20	0.23	0.18		0.25			0.32		0.36	0.47		0.50	0.55	**0.26**
URY				0.45	0.40	0.51	0.56	0.63	0.49	0.75	0.76	0.81	0.84		0.84	0.89	0.91	0.91		**0.67**
VEN	0.32	0.19	0.17	0.17	0.17	0.17	0.23	0.24	0.28	0.26	0.33	0.40	0.56		0.54	0.57	0.61	0.60		**0.33**
CAM	0.20				0.20	0.22	0.22	0.22	0.20	0.23	0.25	0.27	0.23	0.23		0.39	0.35			**0.22**
GHA	0.42		0.48	0.48	0.47	0.37	0.38			0.37	0.42	0.65	0.60	0.58	0.53	0.58			0.66	**0.46**
KEN	0.23			0.28	0.20	0.24	0.24	0.11	0.16			0.19								**0.21**
LBR	0.28												0.22							**0.26**
MLI	0.50																			**0.48**
MWI	0.38												0.63							**0.39**
RWA	0.29				0.31		0.36													**0.31**
SEN	0.34						0.35				0.48									**0.38**
SLE	0.46							0.43			0.39									**0.47**
TZA	0.22				0.18			0.17				0.21					0.35			**0.20**
UGA	0.27					0.22	0.26	0.23							0.31			0.46		**0.25**
ZAF	0.17	0.14	0.16	0.16	0.15	0.15	0.14	0.14	0.14	0.15	0.16	0.16	0.25				0.38			**0.17**
ZMB	0.58							0.44		0.47			0.63		0.48					**0.52**
KHM	0.92	0.90	0.94	0.93	0.92	0.92	0.91	0.93	0.93	0.92	0.91	1.00	0.94				0.98			**0.92**
VNM		0.90	0.90	0.89	0.88	0.89	0.90	0.89	0.90	0.83	0.95	0.92	0.93	0.95	0.98	0.94	0.97	0.98	0.98	**0.89**
All	**0.45**	**0.48**	**0.47**	**0.46**	**0.54**	**0.42**	**0.41**	**0.39**	**0.42**	**0.47**	**0.41**	**0.57**	**0.49**	**0.52**	**0.63**	**0.72**	**0.67**	**0.68**	**0.70**	**0.50**

Table 16: Childlessness rate – singles

Yrschl.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18+	**Mean**
ARG	0.83	0.87	0.91	0.92	0.92	0.92	0.92	0.92	0.89	0.90	0.90	0.88	0.89	0.84	0.87	0.85	0.85	0.82	0.82	**0.90**
BOL	0.90	0.90	0.90	0.90	0.89	0.88	0.87	0.89	0.86	0.86	0.87	0.87	0.85	0.84	0.87	0.84	0.84	0.80		**0.88**
BRA	0.91	0.94	0.95	0.94	0.94	0.93	0.92	0.92	0.91	0.89	0.89	0.86	0.85	0.84	0.82	0.80	0.80	0.81		**0.91**
CHL	0.77	0.79	0.81	0.84	0.83	0.84	0.84	0.83	0.83	0.84	0.84	0.84	0.81	0.79	0.79	0.80	0.79	0.81	0.81	**0.82**
COL	0.77	0.81	0.84	0.83	0.81	0.80	0.79	0.80	0.80	0.79	0.79	0.76	0.76	0.73	0.72	0.70	0.75	0.72		**0.78**
CRI	0.78	0.83	0.86	0.85	0.85	0.84	0.86	0.85	0.84	0.85	0.84	0.85	0.83	0.87	0.81	0.83	0.81	0.83	0.80	**0.84**
DOM	0.94	0.96	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.96	0.96	0.95	0.94	0.95	0.93	0.93	0.91	0.92	0.92	**0.95**
ECU	0.84	0.87	0.87	0.87	0.88	0.87	0.88	0.87	0.86	0.88	0.88	0.86	0.85	0.83	0.83	0.83	0.81	0.78	0.78	**0.85**
HTI	0.94	0.91	0.91	0.91	0.90	0.89	0.87	0.85	0.85	0.83	0.83	0.80	0.77	0.80				0.79	0.78	**0.92**
JAM						0.61	0.63	0.62	0.62	0.63	0.61	0.57	0.61	0.59	0.59	0.65	0.67	0.66	0.64	**0.61**
MEX	0.88	0.92	0.93	0.92	0.92	0.91	0.91	0.90	0.90	0.89	0.85	0.85	0.86	0.86	0.83	0.83	0.81	0.79	0.77	**0.88**
NIC	0.90	0.90	0.91	0.91	0.88	0.90	0.85	0.84	0.83	0.82	0.85	0.81	0.81	0.79	0.82	0.81	0.78	0.70		**0.87**
PAN	0.86	0.92	0.94	0.91	0.92	0.90	0.91	0.88	0.90	0.88	0.90	0.88	0.86	0.84	0.86	0.84	0.83	0.83	0.81	**0.87**
PER	0.94	0.95	0.95	0.95	0.94	0.94	0.93	0.92	0.91	0.92	0.91	0.89	0.85			0.83				**0.90**
SAL	0.77	0.81	0.80	0.79	0.77	0.78	0.75	0.75	0.76	0.75	0.70	0.78	0.76	0.81	0.76	0.77	0.81	0.75	0.72	**0.77**
URY	0.75	0.85	0.87	0.92	0.92	0.91	0.92	0.89	0.91	0.91	0.88	0.87	0.85	0.90	0.88	0.84	0.90	0.82		**0.90**
VEN	0.79	0.82	0.84	0.84	0.85	0.84	0.83	0.84	0.84	0.84	0.84	0.83	0.80	0.84	0.79	0.81	0.81	0.71		**0.82**
CAM	0.84	0.83	0.85	0.82	0.84	0.85	0.82	0.81	0.79	0.77	0.78	0.76	0.74	0.76	0.74	0.73	0.76	0.77	0.81	**0.82**
GHA	0.97	0.95	0.96	0.95	0.95	0.96	0.95	0.96	0.96	0.95	0.95	0.87	0.87	0.92	0.91	0.92	0.91	0.91	0.91	**0.96**
KEN	0.94	0.93	0.94	0.93	0.93	0.92	0.91	0.91	0.91	0.90	0.89	0.86		0.88			0.85			**0.92**
LBR	0.88	0.84	0.82	0.85	0.85	0.85	0.87	0.83	0.86	0.84	0.77	0.80	0.78	0.81	0.71		0.77	0.81		**0.86**
MAR	0.94	0.82	0.86	0.86	0.83	0.83	0.88	0.88	0.84	0.84	0.86	0.84	0.84	0.79	0.80	0.79	0.81	0.88	0.86	**0.91**
MLI	0.94	0.91	0.91	0.91	0.90	0.91	0.89	0.87	0.86	0.84	0.86	0.81	0.81	0.74	0.85		0.83		0.71	**0.93**
MWI	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.98	0.96	0.97	0.96	0.95	0.90	0.98	0.93	0.91			**0.98**
RWA	0.95	0.93	0.95	0.95	0.94	0.93	0.94	0.93	0.90	0.90	0.92	0.97	0.92							**0.94**
SEN	0.94	0.94	0.94	0.88	0.87	0.88	0.88	0.93	0.89	0.86	0.88	0.87	0.85	0.89	0.93	0.90	0.93	0.86	0.90	**0.92**
SLE	0.91	0.79	0.81	0.84	0.84	0.87	0.83	0.81			0.79			0.80			0.68			**0.89**
TZA	0.96	0.95	0.96	0.96	0.95	0.95	0.95	0.91	0.95	0.84	0.95	0.85		0.80			0.72			**0.94**
UGA	0.95	0.94	0.96	0.96	0.95	0.94	0.94	0.93	0.95	0.90	0.88	0.87	0.85	0.83	0.84			0.82		**0.94**
ZAF	0.73	0.70	0.73	0.71	0.71	0.71	0.71	0.71	0.72	0.72	0.77	0.73	0.83				0.85			**0.75**
ZMB	0.96	0.99	0.98	0.98	0.98	0.98	0.98	0.98	0.96	0.95	0.96	0.94	0.90		0.89		0.87			**0.96**
IDN	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.95	0.99	0.98	1.00	0.96	0.97	0.98	0.97	0.95	0.90			**0.98**
KHM	0.93	0.95	0.94	0.95	0.95	0.95	0.94	0.95	0.94	0.93	0.94	0.95	0.91		0.89		0.84			**0.94**
THA	0.93	0.96	0.94	0.93	0.94	0.84	0.89	0.88	0.89	0.86	0.98	0.85	0.83				0.70	0.68		**0.92**
VNM	0.82	0.93	0.94	0.94	0.93	0.93	0.93	0.94	0.93	0.95	0.93	0.94	0.94	0.92	0.93	0.95	0.92	0.94	0.94	**0.94**
WBG	0.91	0.93	0.93	0.92	0.95	0.92	0.93	0.91	0.93	0.94	0.96	0.90	0.90		0.86		0.79	0.69		**0.91**
All	**0.92**	**0.92**	**0.93**	**0.93**	**0.93**	**0.90**	**0.93**	**0.89**	**0.88**	**0.91**	**0.88**	**0.85**	**0.88**	**0.82**	**0.83**	**0.83**	**0.81**	**0.79**	**0.81**	0.90

Table 17: Marriage rates – female

Yrschl.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18+	**Mean**
ARG	0.69	0.78	0.83	0.86	0.86	0.87	0.91	0.91	0.92	0.93	0.94	0.93	0.93	0.94	0.93	0.93	0.93	0.92	0.94	**0.90**
BOL	0.82	0.90	0.90	0.90	0.90	0.90	0.91	0.89	0.89	0.90	0.89	0.88	0.87	0.88	0.87	0.90	0.89	0.88		**0.89**
BRA	0.89	0.92	0.92	0.93	0.94	0.93	0.93	0.93	0.94	0.94	0.94	0.93	0.93	0.93	0.92	0.92	0.93	0.93		**0.92**
CHL	0.66	0.74	0.74	0.80	0.79	0.79	0.83	0.83	0.85	0.86	0.87	0.87	0.89	0.90	0.90	0.90	0.90	0.91	0.91	**0.85**
COL	0.74	0.82	0.83	0.83	0.81	0.85	0.83	0.85	0.86	0.86	0.85	0.86	0.87	0.87	0.85	0.83	0.86	0.87		**0.84**
CRI	0.74	0.82	0.85	0.87	0.84	0.84	0.89	0.88	0.89	0.91	0.91	0.89	0.90	0.91	0.92	0.89	0.91	0.91	0.88	**0.88**
DOM	0.80	0.87	0.89	0.90	0.90	0.89	0.90	0.91	0.91	0.91	0.91	0.91	0.91	0.90	0.91	0.91	0.92	0.93	0.92	**0.89**
ECU	0.78	0.84	0.87	0.88	0.86	0.85	0.89	0.84	0.87	0.89	0.88	0.88	0.89	0.88	0.89	0.90	0.90	0.89	0.90	**0.88**
HTI	0.91	0.88	0.91	0.91	0.91	0.92	0.91	0.89	0.89	0.87	0.87	0.86	0.84	0.82	0.82	0.86	0.77	0.89	0.85	**0.90**
JAM	0.36		0.47	0.47	0.59	0.56	0.62	0.61	0.63	0.63	0.64	0.65	0.64	0.69	0.68	0.72	0.77	0.82	0.84	**0.65**
MEX	0.86	0.91	0.91	0.92	0.91	0.90	0.92	0.90	0.91	0.92	0.91	0.91	0.90	0.92	0.90	0.90	0.90	0.91	0.89	**0.91**
NIC	0.84	0.91	0.91	0.90	0.89	0.89	0.89	0.90	0.89	0.90	0.87	0.88	0.91	0.88	0.89	0.91	0.91	0.87	0.92	**0.88**
PAN	0.73	0.74	0.74	0.77	0.75	0.75	0.81	0.81	0.82	0.82	0.84	0.85	0.85	0.86	0.86	0.85	0.83	0.83	0.84	**0.82**
PER	0.83	0.92	0.92	0.92	0.91	0.91	0.91	0.87	0.88	0.89	0.88	0.86	0.86			0.86				**0.88**
SAL	0.81	0.88	0.88	0.86	0.84	0.82	0.86	0.85	0.87	0.88	0.87	0.86	0.87	0.90	0.90	0.89	0.89	0.91	0.89	**0.86**
URY	0.75	0.76	0.79	0.82	0.83	0.85	0.88	0.91	0.92	0.93	0.92	0.93	0.90	0.90	0.90	0.93	0.93	0.94		**0.89**
VEN	0.68	0.77	0.78	0.80	0.78	0.78	0.82	0.83	0.84	0.88	0.87	0.88	0.90	0.88	0.92	0.89	0.86	0.86	0.88	**0.83**
CAM	0.86	0.87	0.84	0.87	0.87	0.87	0.87	0.87	0.88	0.88	0.89	0.90	0.90	0.91	0.90	0.91	0.92	0.91	0.92	**0.88**
GHA	0.94	0.88	0.90	0.91	0.91	0.93	0.93	0.94	0.93	0.94	0.95	0.87	0.89	0.93	0.94	0.94	0.93	0.94	0.96	**0.94**
KEN	0.91	0.92	0.93	0.94	0.95	0.94	0.96	0.96	0.96	0.97	0.96	0.97		0.96			0.94			**0.94**
LBR	0.86	0.84	0.85	0.85	0.88	0.88	0.91	0.88	0.87	0.87	0.86	0.85	0.86	0.84	0.86	0.86	0.85	0.85		**0.86**
MAR	0.97	0.93	0.94	0.93	0.92	0.93	0.92	0.90	0.93	0.93	0.92	0.93	0.93	0.89	0.91	0.92	0.93	0.94	0.95	**0.95**
MLI	0.95	0.94	0.95	0.94	0.93	0.93	0.93	0.92	0.92	0.89	0.91	0.93	0.92	0.96	0.95	0.94	0.96	0.93	0.94	**0.95**
MWI	0.97	0.98	0.98	0.98	0.98	0.98	0.99	0.98	0.99	0.97	0.98	0.98	0.98	0.99	0.98	0.98	0.98	0.95	0.95	**0.98**
RWA	0.95	0.95	0.96	0.97	0.97	0.97	0.96	0.93	0.94	0.95	0.92	0.94	0.93		0.89	0.86	0.83	0.91	0.88	**0.96**
SEN	0.95	0.90	0.95	0.93	0.92	0.90	0.91	0.89	0.89	0.90	0.91	0.91	0.91	0.93	0.93	0.94	0.93	0.93	0.96	**0.94**
SLE	0.88	0.81	0.82	0.82	0.84	0.82	0.86	0.82			0.83			0.89			0.84			**0.86**
TZA	0.93	0.94	0.96	0.95	0.96	0.95	0.95	0.94	0.96	0.97	0.97	0.96	0.92	0.95			0.91			**0.94**
UGA	0.88	0.90	0.93	0.93	0.93	0.94	0.95	0.95	0.95	0.95	0.94	0.95	0.91	0.93	0.97			0.92		**0.93**
ZAF	0.78	0.76	0.78	0.78	0.78	0.78	0.79	0.80	0.83	0.81	0.86	0.85	0.91				0.94			**0.83**
ZMB	0.94	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.96	0.96	0.96	0.98		0.97			**0.97**
IDN	0.98	0.99	1.00	1.00	0.99	1.00	0.99	0.98	0.99	0.99	1.00	0.99	0.99	0.94	0.98	0.99	0.99			**0.99**
KHM	0.97	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.98	0.98	0.97	0.96		0.97		0.93			**0.98**
THA	0.91	0.94	0.95	0.94	0.96	0.89	0.92	0.94	0.91	0.94	0.87	0.94	0.93				0.90	0.92		**0.95**
VNM	0.95	0.96	0.97	0.97	0.98	0.98	0.97	0.98	0.97	0.99	0.97	0.98	0.97	0.97	0.97	0.98	0.97	0.98	0.98	**0.98**
WBG	0.98	0.99	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.97	0.99	0.95	0.98	0.98		**0.99**
All	**0.89**	**0.91**	**0.92**	**0.93**	**0.94**	**0.92**	**0.94**	**0.92**	**0.91**	**0.94**	**0.92**	**0.91**	**0.93**	**0.90**	**0.92**	**0.91**	**0.92**	**0.91**	**0.92**	0.92

Table 18: Marriage rates – male

Yrschl.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18+	**Mean**
ARG	0.92	0.93	0.94	0.95	0.95	0.96	0.97	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	**0.96**
BOL	0.73	0.76	0.77	0.79	0.80	0.82	0.84	0.84	0.85	0.86	0.88	0.87	0.90	0.91	0.92	0.90	0.93	0.93		**0.79**
BRA	0.86	0.88	0.90	0.92	0.93	0.93	0.95	0.95	0.95	0.96	0.96	0.97	0.97	0.98	0.98	0.98	0.98	0.98		**0.92**
CHL	0.94	0.95	0.94	0.95	0.95	0.96	0.95	0.96	0.96	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.98	**0.96**
COL	0.91	0.91	0.93	0.94	0.94	0.95	0.96	0.96	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.99	0.98		**0.95**
CRI	0.90	0.93	0.94	0.94	0.94	0.95	0.96	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.99	0.99	0.98	**0.96**
DOM	0.90	0.90	0.90	0.91	0.93	0.93	0.93	0.94	0.94	0.95	0.95	0.96	0.95	0.94	0.95	0.97	0.96	0.96	0.96	**0.93**
ECU	0.92	0.93	0.93	0.94	0.94	0.94	0.95	0.96	0.96	0.96	0.96	0.96	0.97	0.97	0.97	0.97	0.97	0.97	0.97	**0.95**
HTI	0.84	0.87	0.87	0.87	0.89	0.89	0.90	0.90	0.92	0.90	0.93	0.96	0.96	0.96				0.99	0.97	**0.85**
JAM					0.91	0.94	0.97	0.96	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.99	0.99	0.99	**0.97**
MEX	0.90	0.91	0.92	0.93	0.93	0.93	0.95	0.95	0.96	0.96	0.97	0.97	0.97	0.96	0.97	0.98	0.98	0.98	0.98	**0.95**
NIC	0.87	0.89	0.90	0.91	0.91	0.92	0.93	0.94	0.95	0.95	0.96	0.97	0.96	0.97	0.97	0.97	0.98	0.98		**0.90**
PAN	0.89	0.93	0.94	0.96	0.96	0.95	0.96	0.95	0.97	0.97	0.98	0.97	0.98	0.97	0.99	0.97	0.98	0.99	0.99	**0.96**
PER	0.88	0.90	0.90	0.92	0.92	0.93	0.94	0.95	0.95	0.95	0.95	0.97	0.97			0.98				**0.93**
SAL	0.89	0.90	0.91	0.92	0.92	0.92	0.93	0.93	0.94	0.95	0.96	0.95	0.97	0.94	0.97	0.97	0.98	0.98	0.98	**0.92**
URY	0.93	0.94	0.95	0.96	0.96	0.96	0.96	0.96	0.97	0.97	0.96	0.97	0.96	0.97	0.97	0.96	0.98	0.99		**0.97**
VEN	0.92	0.94	0.93	0.94	0.94	0.95	0.96	0.96	0.96	0.96	0.96	0.97	0.97	0.97	0.97	0.98	0.96	0.99	1.00	**0.95**
CAM	0.82	0.81	0.84	0.83	0.84	0.85	0.86	0.88	0.89	0.88	0.91	0.91	0.93	0.94	0.92	0.94	0.93	0.96	0.96	**0.86**
GHA	0.86	0.86	0.88	0.88	0.89	0.88	0.89	0.88	0.89	0.90	0.91	0.90	0.91	0.92	0.92	0.92	0.96	0.90	0.92	**0.88**
KEN	0.83	0.85	0.85	0.86	0.86	0.88	0.89	0.90	0.89	0.91	0.92	0.93		0.92			0.94			**0.86**
LBR	0.83	0.88	0.86	0.86	0.89	0.82	0.87	0.88	0.86	0.88	0.89	0.90	0.89	0.94	0.86	0.92	0.91	0.92		**0.84**
MAR	0.88	0.92	0.91	0.92	0.91	0.94	0.93	0.94	0.96	0.95	0.97	0.97	0.96	0.96	0.97	0.99	0.97	0.99	0.99	**0.89**
MLI	0.82	0.81	0.81	0.81	0.85	0.85	0.87	0.90	0.89	0.91	0.87	0.89	0.86	0.88	0.85		0.90		0.93	**0.82**
MWI	0.73	0.73	0.75	0.76	0.77	0.78	0.81	0.80	0.83	0.81	0.85	0.86	0.88	0.84	0.89	0.93	0.96		0.88	**0.76**
RWA	0.72	0.74	0.75	0.75	0.77	0.78	0.80	0.81	0.80	0.84	0.90	0.89	0.89							**0.75**
SEN	0.84	0.87	0.89	0.88	0.89	0.90	0.92	0.93	0.95	0.93	0.94	0.97	0.95	0.96	0.97	0.97	0.95	0.97	0.97	**0.86**
SLE	0.70	0.69	0.73	0.73	0.71	0.75	0.75	0.79			0.84			0.85			0.93			**0.72**
TZA	0.78	0.78	0.81	0.81	0.81	0.82	0.82	0.86	0.86	0.89	0.88	0.93		0.90			0.90			**0.81**
UGA	0.78	0.79	0.79	0.81	0.82	0.83	0.84	0.86	0.88	0.87	0.90	0.91	0.91	0.94	0.91			0.97		**0.81**
ZAF	0.91	0.89	0.89	0.90	0.91	0.91	0.92	0.93	0.95	0.95	0.97	0.96	0.98				0.98			**0.93**
ZMB	0.81	0.80	0.81	0.81	0.81	0.83	0.84	0.86	0.87	0.89	0.89	0.90	0.93		0.92		0.97			**0.84**
IDN	0.84	0.83	0.85	0.87	0.88	0.88	0.91	0.92	0.91	0.95	0.97	0.91	0.96	0.97	0.97	0.97	0.98			**0.89**
KHM	0.92	0.91	0.92	0.93	0.94	0.95	0.94	0.95	0.95	0.95	0.95	0.94	0.97		1.00		0.98			**0.93**
THA	0.93	0.92	0.95	0.93	0.96	0.96	0.98	0.98	1.00	0.98	0.98	1.00	0.99				0.99	1.00		**0.96**
VNM	0.96	0.96	0.96	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.99	0.98	0.99	0.99	0.99	0.99	0.99	**0.98**
WBG	0.89	0.90	0.91	0.91	0.92	0.91	0.91	0.92	0.92	0.93	0.93	0.93	0.93		0.95		0.95	0.98		**0.91**
All	**0.85**	**0.88**	**0.89**	**0.90**	**0.93**	**0.92**	**0.93**	**0.92**	**0.94**	**0.96**	**0.94**	**0.97**	**0.97**	**0.96**	**0.96**	**0.98**	**0.98**	**0.98**	**0.97**	0.91

Note: Each entry shows the ratio between the average number of children who survived in one country for a number of years of schooling and the average number of children who were ever born in this country for this number of years of schooling.

Table 19: Survival rates

Yrschl.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18+
ARG	0.04	0.01	0.04	0.06	0.06	0.05	0.13	0.24	0.02	0.03	0.05	0.02	0.12	0.01	0.01	0.02	0.03	0.02	0.03
BOL	0.24	0.06	0.10	0.10	0.06	0.08	0.04	0.02	0.03	0.02	0.03	0.02	0.08	0.01	0.01	0.01	0.06	0.04	0.00
BRA	0.13	0.05	0.06	0.08	0.21	0.05	0.02	0.03	0.09	0.01	0.02	0.14	0.01	0.01	0.01	0.05	0.02	0.01	0.00
CHL	0.04	0.02	0.01	0.03	0.04	0.04	0.08	0.04	0.11	0.07	0.07	0.04	0.19	0.08	0.03	0.02	0.03	0.04	0.01
COL	0.08	0.03	0.07	0.08	0.05	0.19	0.04	0.04	0.05	0.05	0.02	0.15	0.01	0.03	0.02	0.01	0.03	0.08	0.00
CRI	0.05	0.02	0.04	0.07	0.04	0.04	0.31	0.02	0.04	0.06	0.02	0.11	0.01	0.02	0.04	0.02	0.04	0.02	0.01
DOM	0.15	0.02	0.04	0.05	0.05	0.05	0.05	0.07	0.07	0.05	0.04	0.04	0.13	0.01	0.02	0.02	0.06	0.04	0.04
ECU	0.08	0.01	0.03	0.04	0.03	0.03	0.25	0.01	0.03	0.06	0.03	0.03	0.16	0.01	0.03	0.04	0.04	0.04	0.07
HTI	0.75	0.01	0.02	0.03	0.03	0.03	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
JAM	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.03	0.19	0.06	0.06	0.12	0.11	0.13	0.09	0.07	0.02	0.02	0.06
MEX	0.08	0.02	0.04	0.06	0.03	0.02	0.21	0.01	0.02	0.19	0.01	0.02	0.11	0.01	0.01	0.03	0.06	0.04	0.02
NIC	0.28	0.02	0.06	0.09	0.06	0.03	0.13	0.03	0.03	0.05	0.02	0.07	0.03	0.01	0.02	0.00	0.06	0.00	0.00
PAN	0.06	0.01	0.01	0.02	0.02	0.02	0.21	0.02	0.04	0.09	0.02	0.03	0.20	0.01	0.03	0.03	0.03	0.06	0.11
PER	0.12	0.02	0.04	0.06	0.03	0.09	0.05	0.02	0.03	0.04	0.02	0.17	0.18	0.00	0.00	0.12	0.00	0.00	0.00
SAL	0.27	0.03	0.07	0.08	0.06	0.04	0.11	0.02	0.02	0.08	0.01	0.01	0.10	0.00	0.01	0.03	0.00	0.04	0.01
URY	0.00	0.01	0.02	0.04	0.05	0.06	0.33	0.03	0.04	0.16	0.04	0.05	0.01	0.01	0.02	0.02	0.07	0.04	0.00
VEN	0.09	0.01	0.02	0.05	0.04	0.02	0.23	0.04	0.04	0.08	0.03	0.14	0.17	0.00	0.00	0.00	0.00	0.00	0.00
CAM	0.34	0.01	0.01	0.01	0.03	0.04	0.06	0.28	0.03	0.03	0.06	0.01	0.03	0.02	0.00	0.01	0.01	0.00	0.01
GHA	0.44	0.01	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.27	0.00	0.01	0.03	0.01	0.02	0.00	0.00	0.05
KEN	0.40	0.03	0.04	0.06	0.06	0.05	0.06	0.12	0.05	0.03	0.01	0.08	0.00	0.01	0.00	0.00	0.01	0.00	0.00
LBR	0.74	0.00	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.07	0.01	0.01	0.00	0.01	0.01	0.00
MAR	0.74	0.00	0.01	0.01	0.02	0.07	0.01	0.01	0.01	0.03	0.01	0.01	0.04	0.00	0.01	0.00	0.01	0.00	0.00
MLI	0.84	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MWI	0.48	0.02	0.04	0.06	0.06	0.07	0.06	0.05	0.09	0.00	0.02	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
RWA	0.58	0.03	0.05	0.07	0.07	0.06	0.10	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SEN	0.74	0.00	0.01	0.01	0.01	0.01	0.09	0.01	0.01	0.01	0.04	0.01	0.01	0.02	0.00	0.01	0.00	0.00	0.01
SLE	0.77	0.01	0.01	0.01	0.01	0.02	0.03	0.05	0.00	0.00	0.07	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
TZA	0.54	0.00	0.02	0.02	0.11	0.01	0.02	0.23	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.01	0.00	0.00
UGA	0.50	0.02	0.05	0.06	0.06	0.05	0.06	0.08	0.01	0.02	0.01	0.02	0.00	0.00	0.03	0.00	0.00	0.01	0.00
ZAF	0.22	0.01	0.02	0.03	0.05	0.05	0.06	0.08	0.10	0.05	0.09	0.04	0.17	0.00	0.00	0.00	0.03	0.00	0.00
ZMB	0.24	0.02	0.03	0.04	0.07	0.06	0.08	0.20	0.04	0.08	0.03	0.01	0.03	0.00	0.07	0.00	0.01	0.00	0.00
IDN	0.22	0.02	0.06	0.10	0.07	0.06	0.28	0.00	0.01	0.08	0.00	0.00	0.08	0.00	0.01	0.01	0.01	0.00	0.00
KHM	0.36	0.02	0.08	0.13	0.11	0.07	0.05	0.05	0.03	0.04	0.02	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00
THA	0.07	0.00	0.01	0.01	0.71	0.00	0.02	0.05	0.00	0.04	0.00	0.00	0.03	0.00	0.00	0.00	0.03	0.01	0.00
VNM	0.00	0.01	0.04	0.05	0.07	0.11	0.07	0.08	0.05	0.28	0.03	0.05	0.11	0.00	0.00	0.02	0.02	0.01	0.00
WBG	0.28	0.01	0.02	0.04	0.05	0.05	0.11	0.04	0.05	0.08	0.03	0.04	0.11	0.00	0.05	0.00	0.03	0.01	0.00
All	**0.18**	**0.02**	**0.04**	**0.06**	**0.13**	**0.05**	**0.11**	**0.05**	**0.04**	**0.08**	**0.02**	**0.05**	**0.07**	**0.01**	**0.01**	**0.02**	**0.02**	**0.01**	**0.01**

Table 20: Education shares – female

Yrschl.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18+
ARG	0.04	0.01	0.04	0.07	0.07	0.05	0.12	0.24	0.02	0.04	0.06	0.03	0.07	0.02	0.02	0.02	0.02	0.01	0.05
BOL	0.08	0.03	0.07	0.10	0.08	0.10	0.06	0.03	0.05	0.03	0.05	0.04	0.12	0.01	0.01	0.02	0.05	0.08	0.00
BRA	0.14	0.05	0.06	0.08	0.22	0.05	0.03	0.03	0.09	0.01	0.02	0.12	0.01	0.01	0.01	0.04	0.03	0.01	0.00
CHL	0.04	0.02	0.02	0.03	0.04	0.03	0.08	0.04	0.11	0.07	0.06	0.03	0.20	0.07	0.02	0.02	0.04	0.04	0.03
COL	0.10	0.03	0.08	0.08	0.05	0.19	0.04	0.04	0.04	0.04	0.01	0.14	0.01	0.03	0.02	0.00	0.02	0.08	0.00
CRI	0.06	0.02	0.04	0.07	0.04	0.03	0.31	0.02	0.04	0.06	0.02	0.10	0.01	0.02	0.03	0.02	0.04	0.03	0.02
DOM	0.16	0.02	0.04	0.06	0.05	0.05	0.05	0.08	0.08	0.05	0.05	0.04	0.11	0.01	0.01	0.02	0.04	0.03	0.04
ECU	0.07	0.01	0.03	0.04	0.03	0.03	0.28	0.01	0.03	0.05	0.03	0.03	0.15	0.01	0.02	0.03	0.03	0.03	0.09
HTI	0.62	0.01	0.03	0.04	0.05	0.04	0.07	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.01	0.00
JAM	0.01	0.00	0.01	0.00	0.01	0.01	0.06	0.04	0.24	0.07	0.06	0.10	0.10	0.11	0.08	0.05	0.01	0.01	0.04
MEX	0.07	0.02	0.04	0.06	0.03	0.02	0.19	0.01	0.02	0.19	0.01	0.02	0.11	0.01	0.01	0.02	0.07	0.06	0.03
NIC	0.26	0.03	0.06	0.09	0.07	0.03	0.13	0.03	0.03	0.05	0.02	0.07	0.02	0.01	0.02	0.01	0.07	0.00	0.00
PAN	0.05	0.01	0.02	0.03	0.02	0.02	0.24	0.02	0.04	0.10	0.02	0.03	0.20	0.01	0.02	0.03	0.02	0.04	0.08
PER	0.04	0.02	0.03	0.05	0.03	0.09	0.05	0.02	0.03	0.05	0.02	0.22	0.20	0.00	0.00	0.15	0.00	0.00	0.00
SAL	0.21	0.03	0.07	0.08	0.05	0.03	0.13	0.02	0.02	0.11	0.01	0.02	0.10	0.01	0.01	0.03	0.01	0.05	0.02
URY	0.01	0.01	0.03	0.07	0.07	0.06	0.34	0.03	0.05	0.15	0.04	0.04	0.01	0.01	0.01	0.02	0.02	0.05	0.00
VEN	0.10	0.01	0.03	0.05	0.04	0.02	0.23	0.04	0.04	0.08	0.03	0.14	0.17	0.00	0.00	0.00	0.00	0.00	0.00
CAM	0.28	0.01	0.01	0.02	0.03	0.03	0.05	0.28	0.02	0.03	0.07	0.02	0.04	0.04	0.01	0.01	0.02	0.01	0.02
GHA	0.30	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.02	0.35	0.00	0.01	0.03	0.02	0.03	0.00	0.01	0.11
KEN	0.23	0.03	0.04	0.07	0.07	0.05	0.06	0.13	0.10	0.04	0.01	0.13	0.00	0.02	0.00	0.00	0.02	0.00	0.00
LBR	0.41	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.04	0.05	0.04	0.03	0.20	0.02	0.01	0.01	0.04	0.02	0.00
MAR	0.56	0.01	0.01	0.02	0.03	0.13	0.01	0.01	0.02	0.04	0.02	0.02	0.06	0.01	0.01	0.00	0.02	0.00	0.01
MLI	0.80	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.02	0.02	0.00	0.01	0.00	0.01	0.01	0.00	0.02	0.00	0.01
MWI	0.25	0.02	0.04	0.06	0.07	0.08	0.07	0.07	0.18	0.01	0.05	0.01	0.07	0.00	0.01	0.00	0.01	0.00	0.00
RWA	0.37	0.03	0.06	0.09	0.10	0.09	0.19	0.01	0.01	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
SEN	0.68	0.00	0.00	0.01	0.01	0.01	0.09	0.01	0.01	0.01	0.05	0.01	0.01	0.03	0.01	0.01	0.01	0.01	0.02
SLE	0.60	0.01	0.01	0.01	0.02	0.02	0.03	0.09	0.00	0.00	0.14	0.00	0.00	0.03	0.00	0.00	0.03	0.00	0.00
TZA	0.31	0.01	0.03	0.03	0.18	0.02	0.02	0.31	0.00	0.01	0.00	0.05	0.00	0.01	0.00	0.00	0.01	0.00	0.00
UGA	0.25	0.02	0.04	0.07	0.08	0.07	0.10	0.13	0.03	0.04	0.02	0.05	0.00	0.01	0.06	0.00	0.00	0.02	0.00
ZAF	0.21	0.01	0.02	0.04	0.05	0.05	0.06	0.07	0.10	0.05	0.09	0.04	0.18	0.00	0.00	0.00	0.04	0.00	0.00
ZMB	0.13	0.01	0.02	0.03	0.04	0.04	0.07	0.18	0.04	0.10	0.06	0.02	0.09	0.00	0.15	0.00	0.03	0.00	0.00
IDN	0.13	0.02	0.05	0.11	0.06	0.05	0.31	0.00	0.01	0.09	0.00	0.01	0.12	0.00	0.01	0.02	0.02	0.00	0.00
KHM	0.18	0.01	0.05	0.10	0.11	0.09	0.07	0.11	0.06	0.09	0.04	0.02	0.05	0.00	0.01	0.00	0.02	0.00	0.00
THA	0.05	0.00	0.01	0.01	0.65	0.00	0.02	0.06	0.00	0.08	0.00	0.00	0.06	0.00	0.00	0.00	0.04	0.01	0.00
VNM	0.00	0.01	0.03	0.04	0.05	0.12	0.06	0.08	0.05	0.27	0.03	0.07	0.13	0.00	0.00	0.01	0.03	0.02	0.01
WBG	0.13	0.01	0.02	0.04	0.06	0.06	0.12	0.05	0.05	0.08	0.02	0.05	0.11	0.00	0.06	0.01	0.07	0.04	0.00
All	**0.14**	**0.02**	**0.04**	**0.06**	**0.12**	**0.06**	**0.11**	**0.05**	**0.04**	**0.08**	**0.03**	**0.06**	**0.08**	**0.01**	**0.01**	**0.02**	**0.03**	**0.02**	**0.01**

Table 21: Education shares – male

Yrschl.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18+
ARG	0.44	0.41	0.39	0.36	0.34	0.31	0.29	0.26	0.24	0.22	0.19	0.17	0.14	0.12	0.09	0.07	0.04	0.02	0.00
BOL	0.42	0.40	0.38	0.36	0.35	0.33	0.31	0.29	0.27	0.26	0.24	0.22	0.20	0.18	0.16	0.15	0.13	0.11	0.09
BRA	0.44	0.41	0.39	0.36	0.34	0.31	0.29	0.26	0.24	0.22	0.19	0.17	0.14	0.12	0.09	0.07	0.04	0.02	0.00
CHL	0.27	0.26	0.24	0.22	0.21	0.19	0.17	0.16	0.14	0.12	0.11	0.09	0.07	0.06	0.04	0.02	0.01	0.00	0.00
COL	0.46	0.43	0.41	0.38	0.35	0.32	0.29	0.27	0.24	0.21	0.18	0.15	0.12	0.10	0.07	0.04	0.01	0.00	0.00
CRI	0.42	0.40	0.38	0.36	0.34	0.33	0.31	0.29	0.27	0.25	0.23	0.21	0.20	0.18	0.16	0.14	0.12	0.10	0.08
DOM	0.27	0.26	0.24	0.22	0.21	0.19	0.17	0.16	0.14	0.12	0.11	0.09	0.07	0.06	0.04	0.02	0.01	0.00	0.00
ECU	0.27	0.26	0.24	0.22	0.21	0.19	0.17	0.16	0.14	0.12	0.11	0.09	0.07	0.06	0.04	0.02	0.01	0.00	0.00
HTI	0.42	0.40	0.38	0.35	0.33	0.31	0.29	0.26	0.24	0.22	0.20	0.18	0.15	0.13	0.11	0.09	0.06	0.04	0.02
JAM	0.42	0.40	0.38	0.36	0.35	0.33	0.31	0.29	0.27	0.26	0.24	0.22	0.20	0.18	0.16	0.15	0.13	0.11	0.09
MEX	0.42	0.40	0.38	0.36	0.34	0.33	0.31	0.29	0.27	0.25	0.23	0.21	0.20	0.18	0.16	0.14	0.12	0.10	0.08
NIC	0.42	0.40	0.38	0.36	0.34	0.33	0.31	0.29	0.27	0.25	0.23	0.21	0.20	0.18	0.16	0.14	0.12	0.10	0.08
PAN	0.42	0.40	0.38	0.36	0.34	0.33	0.31	0.29	0.27	0.25	0.23	0.21	0.20	0.18	0.16	0.14	0.12	0.10	0.08
PER	0.60	0.57	0.54	0.51	0.48	0.45	0.42	0.38	0.35	0.32	0.29	0.26	0.23	0.20	0.17	0.14	0.10	0.07	0.04
SAL	0.42	0.40	0.38	0.36	0.34	0.33	0.31	0.29	0.27	0.25	0.23	0.21	0.20	0.18	0.16	0.14	0.12	0.10	0.08
URY	0.42	0.40	0.38	0.36	0.34	0.33	0.31	0.29	0.27	0.25	0.23	0.21	0.20	0.18	0.16	0.14	0.12	0.10	0.08
VEN	0.27	0.26	0.24	0.22	0.21	0.19	0.17	0.16	0.14	0.12	0.11	0.09	0.07	0.06	0.04	0.02	0.01	0.00	0.00
CAM	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.28	0.27	0.27	0.26	0.26	0.25	0.25	0.25	0.24	0.24	0.23	0.23
GHA	0.30	0.29	0.28	0.26	0.25	0.24	0.22	0.21	0.20	0.18	0.17	0.15	0.14	0.13	0.11	0.10	0.09	0.07	0.06
KEN	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.28	0.27	0.27	0.26	0.26	0.25	0.25	0.25	0.24	0.24	0.23	0.23
LIB	0.18	0.18	0.17	0.16	0.15	0.15	0.14	0.13	0.12	0.12	0.11	0.10	0.10	0.09	0.08	0.07	0.07	0.06	0.05
MAR	0.44	0.42	0.39	0.37	0.34	0.32	0.29	0.27	0.24	0.21	0.19	0.16	0.14	0.11	0.09	0.06	0.04	0.01	0.00
MLI	0.12	0.11	0.10	0.09	0.09	0.08	0.07	0.07	0.06	0.05	0.05	0.04	0.03	0.03	0.02	0.01	0.00	0.00	0.00
MWI	0.37	0.35	0.32	0.30	0.27	0.25	0.22	0.20	0.17	0.15	0.12	0.09	0.07	0.04	0.02	0.00	0.00	0.00	0.00
RWA	0.58	0.56	0.55	0.53	0.52	0.50	0.49	0.47	0.46	0.44	0.43	0.41	0.40	0.38	0.37	0.35	0.34	0.32	0.31
SEN	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.00	0.00
SLE	0.12	0.11	0.11	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.05	0.05	0.04	0.04	0.03	0.03
TZA	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.28	0.27	0.27	0.26	0.26	0.25	0.25	0.25	0.24	0.24	0.23	0.23
UGA	0.25	0.25	0.24	0.23	0.23	0.22	0.21	0.21	0.20	0.19	0.19	0.18	0.17	0.17	0.16	0.15	0.15	0.14	0.13
ZAF	0.27	0.25	0.24	0.23	0.22	0.21	0.20	0.19	0.18	0.17	0.16	0.15	0.13	0.12	0.11	0.10	0.09	0.08	0.07
ZMB	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14
IDN	0.21	0.20	0.20	0.19	0.18	0.18	0.17	0.17	0.16	0.15	0.15	0.14	0.13	0.13	0.12	0.11	0.11	0.10	0.09
KHM	0.34	0.32	0.30	0.28	0.26	0.24	0.22	0.20	0.19	0.17	0.15	0.13	0.11	0.09	0.07	0.05	0.03	0.01	0.00
THA	0.34	0.32	0.30	0.28	0.26	0.24	0.22	0.20	0.19	0.17	0.15	0.13	0.11	0.09	0.07	0.05	0.03	0.01	0.00
VNM	0.54	0.51	0.49	0.46	0.44	0.42	0.39	0.37	0.34	0.32	0.29	0.27	0.25	0.22	0.20	0.17	0.15	0.12	0.10
WBG	0.34	0.32	0.30	0.28	0.26	0.24	0.22	0.20	0.19	0.17	0.15	0.13	0.11	0.09	0.07	0.05	0.03	0.01	0.00
ALL	**0.37**	**0.35**	**0.34**	**0.32**	**0.30**	**0.28**	**0.26**	**0.25**	**0.23**	**0.21**	**0.19**	**0.17**	**0.16**	**0.14**	**0.12**	**0.10**	**0.08**	**0.07**	**0.05**

Note: To compute the aggregated relationship between the probability that a woman experiences undesired births and education (last row), we use country specific probabilities from table 22 and use the weighted number of mothers provided by IPUMS. We then fit the linear trend (9) to these numbers, and use the fitted values.

Table 22: Probability of being uncontrolled (measure 2)

B Identification

To illustrate how parameters are identified from the data, we show the effect of increasing each parameter by 20% on the simulated moments for total sample in Figures 16 to 19. For each figure, the top panel shows the marriage rates of females (left) and males (right), the middle panel shows the childlessness rates and completed fertility of mothers for married women and the bottom panel shows the childlessness rates and completed fertility of mothers for single women. For each parameter change, we kept all the other variables fixed to their estimated values (third column in Table 4).

Figure 16 shows how a 20% increase in ϕ and $\underline{\theta}$ changes the simulated moments. The changes on the curves allow us to infer that $\underline{\theta}$ is identified from the concavity of the female marriage curve (top left panel). A higher $\underline{\theta}$ means a higher bargaining weight for the less educated person in a couple, who in the marriage market will then be more often rejected if low-educated. Hence, with a higher $\underline{\theta}$, lowly educated women will be rejected more and highly educated women will reject more when matched with a man with low education. This increases the amount of poor women among single and hence childlessness. Parameter ϕ is identified from the mean level of fertility of both single and married women, and from the mean level of voluntary childlessness which determines the slope of the relationship between childlessness and education.

Figure 17 shows the same exercise with δ_f and δ_m. We can see that both parameters are identified from the relationship between marriage rates and education. δ_m is identified from the slope of the relationship between male marriage rates and education (top right panel). A higher δ_m incites men to marry more so that they will accept a match with a low-educated women more often, which allows the alleviation of social sterility. Similarly, δ_f is identified from the slope of the relationship between female marriage rates and education (top left panel).

Figure 18 does the exercise for β, μ and ν. ν is identified from the increasing part of the U-shaped relationship between the childlessness of married women and education (an increase in ν makes children less valuable). μ is identified from the mean values of marriage rates: a higher μ increases the gains from marriage and hence the average marriage rate increases (top panel). β is identified from the average fertility rate: a higher non-labor income allows having more children, all else equal.

From Figure 19, we can provide intuitions on the identification of $\hat{c}$ and α. $\hat{c}$ is identified from the decreasing part of the U-shaped relationship between childlessness and the education of married women and from the marriage rates of low-educated women. A larger $\hat{c}$ implies that more women will remain socially sterile and also that poor women are less attractive in the marriage market as the husband will have to use more of his income in order to allow her to have children. α is identified from the increasing part of the U-shaped relationship between childlessness and the education of married women and the slope of the relationship between the completed fertility of married mothers and education (middle panels). In married couples, a larger α makes the opportunity cost of raising children more dependent on the wife's education, which is reflected in how fast fertility declines as the wife's education increases.

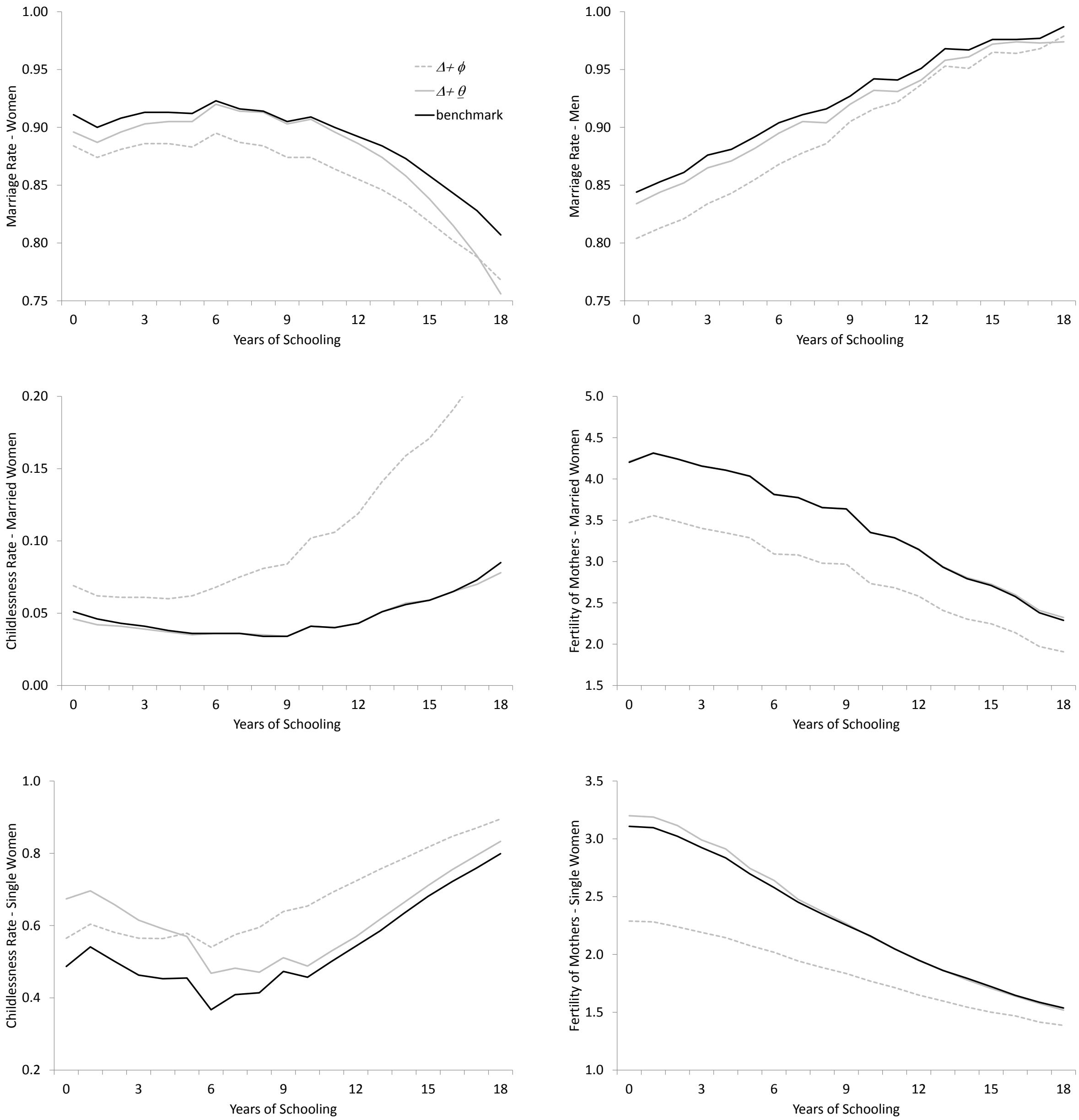

Figure 16: Effects of changes in ϕ (dashed gray) and $\underline{\theta}$ (solid gray).

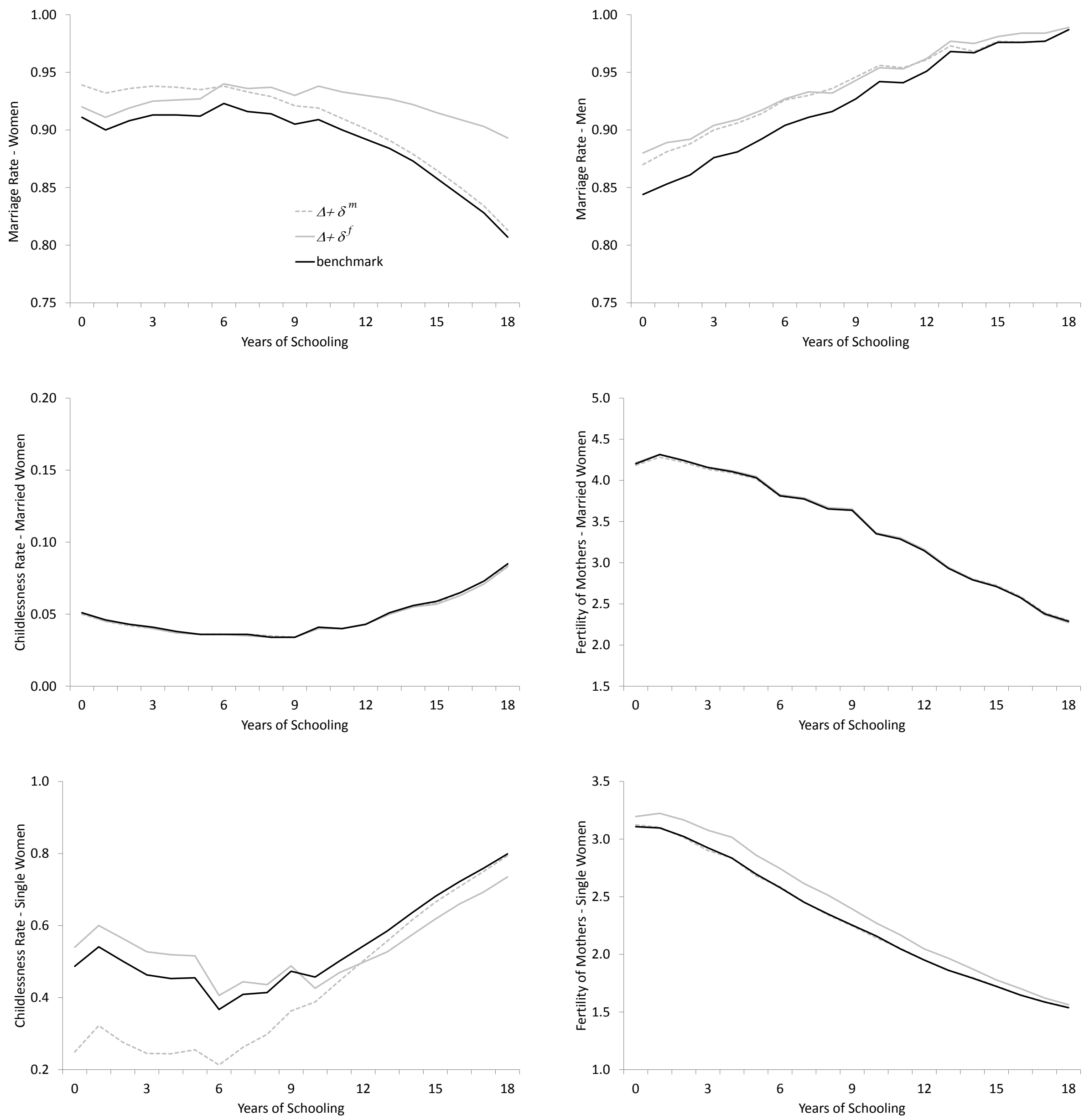

Figure 17: Effects of changes in δ^f (solid gray) and δ^m (dashed gray).

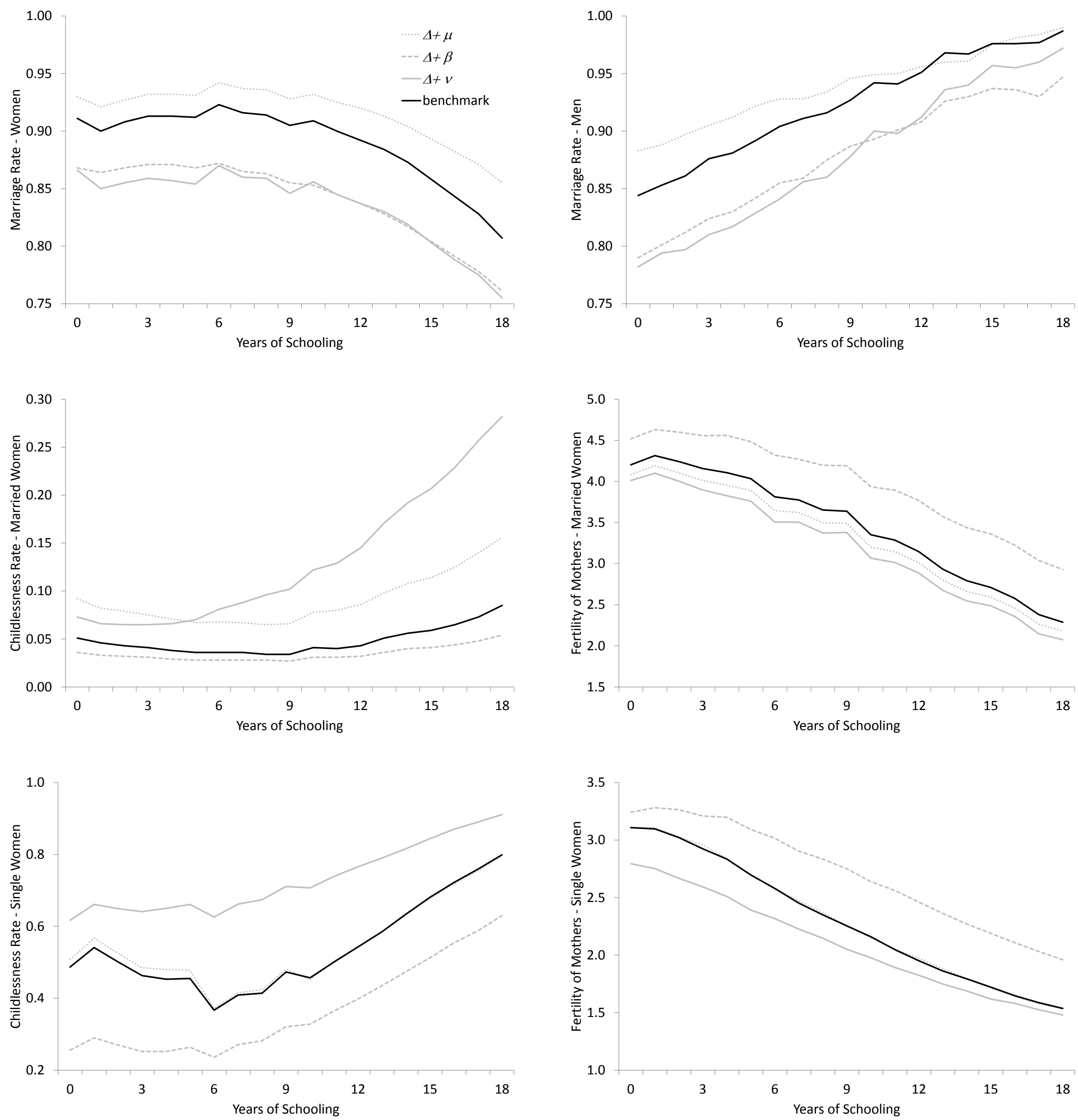

Figure 18: Effects of changes in μ (dotted gray), the mean of the exponential distribution of β (dashed gray) and ν (solid gray)

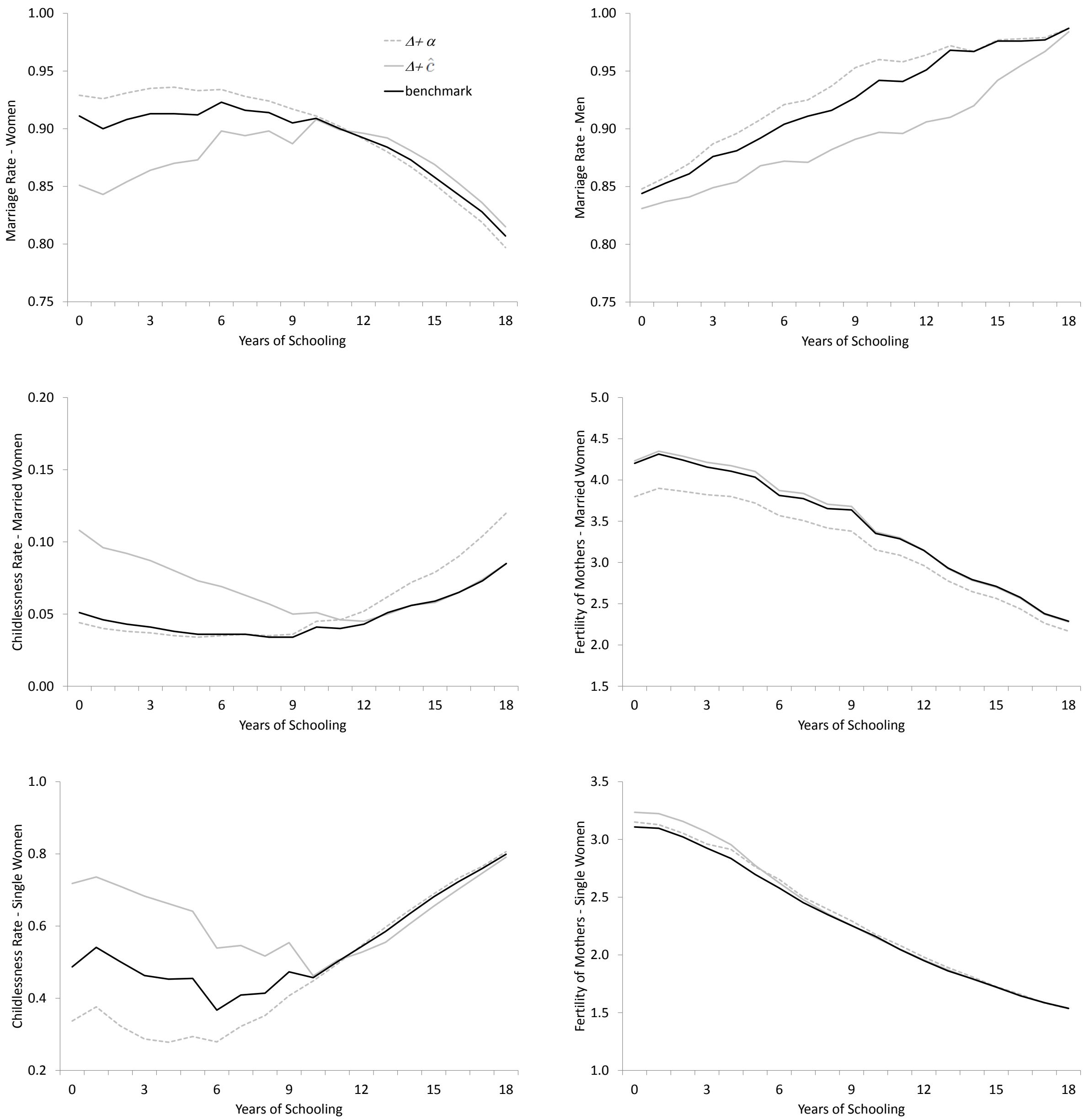

Figure 19: Effects of changes in $\hat{c}$ and α

C Estimated Parameters for Each Country

Country	β	ν	$\hat{c}$	μ	α	ϕ	δ^m	δ^f	$\underline{\theta}$
ARG	0.212	6.585	0.112	0.369	0.663	0.196	0.159	-0.053	0.481
BOL	0.375	5.814	0.382	0.224	0.999	0.200	0.168	0.085	0.668
BRA	0.152	6.868	0.314	0.214	0.836	0.200	0.195	0.003	0.639
CHL	0.288	6.950	0.310	0.203	0.701	0.203	0.208	-0.010	0.252
COL	0.314	7.597	0.446	0.152	0.890	0.200	0.378	0.011	0.334
CRI	0.364	7.091	0.383	0.209	0.931	0.196	0.236	0.055	0.540
DOM	0.254	6.731	0.326	0.245	0.859	0.196	0.210	0.169	0.917
ECU	0.398	7.375	0.395	0.234	0.875	0.199	0.261	0.080	0.781
HTI	0.318	7.666	0.276	0.300	0.850	0.179	0.215	0.178	0.721
JAM	0.578	5.910	0.081	0.045	0.959	0.196	0.131	-0.131	0.190
MEX	0.297	6.654	0.315	0.223	0.854	0.208	0.176	0.065	0.764
NIC	0.447	5.974	0.266	0.224	0.989	0.200	0.176	0.160	0.898
PAN	0.393	7.716	0.305	0.171	0.979	0.173	0.301	0.165	0.861
PER	0.223	5.584	0.311	0.106	0.789	0.230	0.195	0.113	0.221
SAL	0.399	7.177	0.406	0.173	0.878	0.204	0.310	0.047	0.214
URY	0.293	6.844	0.242	0.388	0.864	0.194	-0.015	0.164	0.010
VEN	0.379	7.972	0.157	0.137	0.968	0.189	0.366	0.050	0.855
CAM	0.724	8.449	0.538	0.565	0.906	0.182	0.439	-0.052	0.777
GHA	0.307	8.218	0.319	0.374	0.819	0.168	0.223	0.204	0.797
KEN	0.542	5.119	0.292	0.371	0.849	0.167	-0.007	0.178	0.815
LBR	0.638	7.613	0.458	0.472	0.845	0.169	0.310	0.032	0.918
MAR	0.291	5.671	0.189	0.393	0.878	0.201	0.087	-0.046	0.168
MLI	0.406	9.249	0.273	0.444	0.945	0.144	0.190	0.328	0.825
MWI	0.302	6.349	0.153	0.481	0.671	0.148	-0.028	0.311	0.373
RWA	0.381	5.363	0.275	0.303	0.899	0.151	0.018	0.308	0.709
SEN	0.452	7.548	0.242	0.360	0.898	0.157	0.095	0.293	0.760
SLE	0.395	9.131	0.330	0.363	0.974	0.143	0.162	0.157	0.787

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Country	β	ν	$\hat{c}$	μ	α	ϕ	δ^m	δ^f	$\underline{\theta}$
TZA	0.408	6.851	0.256	0.437	0.846	0.146	0.018	0.161	0.688
UGA	0.342	9.233	0.362	0.284	0.948	0.131	0.233	0.206	0.948
ZAF	0.807	6.593	0.507	0.328	0.925	0.203	0.356	0.000	0.719
ZMB	0.397	7.412	0.306	0.423	0.681	0.181	0.235	0.371	0.803
IDN	0.240	5.753	0.319	0.291	0.865	0.188	0.224	0.238	0.341
KHM	0.277	6.580	0.151	0.318	0.986	0.189	0.003	0.429	0.707
THA	0.166	7.594	0.367	0.207	0.860	0.195	0.293	-0.020	0.905
VNM	0.090	6.617	0.315	0.169	0.837	0.199	0.191	0.004	0.085
WBG	0.554	9.281	0.140	0.498	0.727	0.136	0.248	0.065	0.979

Table 23: Estimated values of the parameters, by country

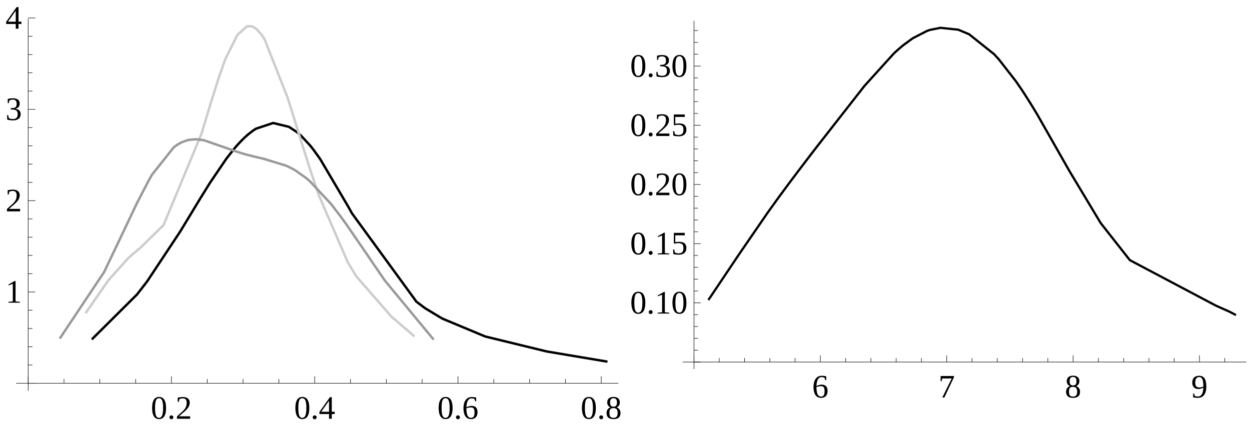

Figure 20: Distribution for β (left:black), $\hat{c}$ (left:light gray), μ (left:gray), and ν (right)

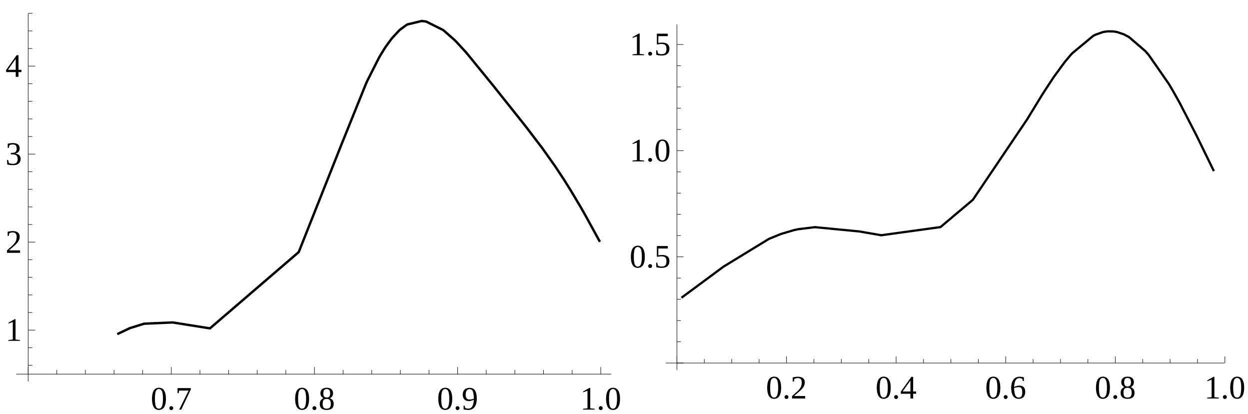

Figure 21: Distribution for α (left), and $\underline{\theta}$ (right)

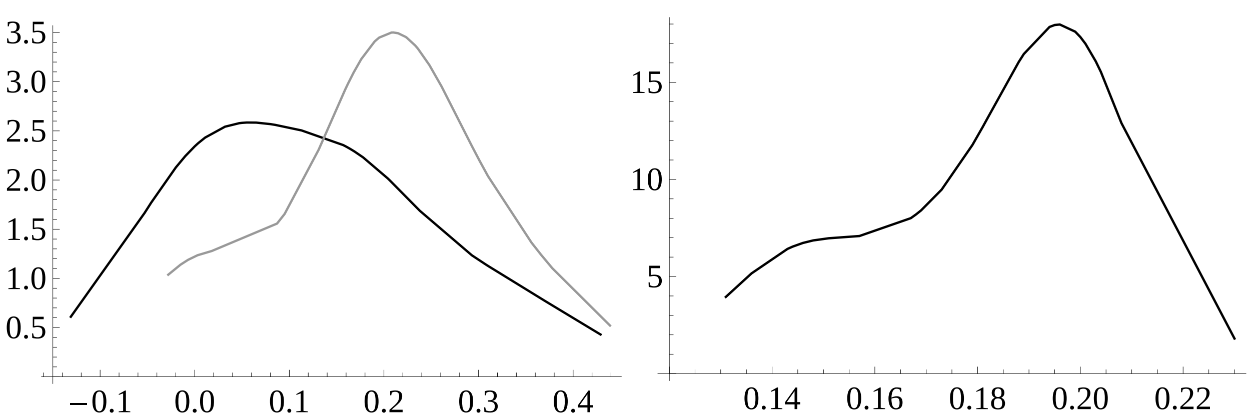

Figure 22: Distribution for δ^f (left:black), δ^m (left:gray), and ϕ (right)

D Policies – All Countries

Cntry	Benchm. fertility	Universal primary education		Perfect family planning		No child mortality		Gender wage equality	
		$\Delta F/F$	$\Delta F_p/F$	$\Delta F/F$	$\Delta F_p/F$	$\Delta F/F$	$\Delta F_p/F$	$\Delta F/F$	$\Delta F_p/F$
ARG	3.00	-1.49	-3.68	-31.13	-32.76	1.04	1.82	-10.99	-2.92
BOL	3.41	7.97	5.00	-3.17	-3.99	20.51	21.14	-4.96	-3.91
BRA	2.75	2.37	-4.53	-18.28	-20.32	2.86	4.87	-13.93	-7.17
CHL	3.16	-0.54	-1.69	-9.26	-10.52	1.25	1.41	-16.78	-11.11
COL	3.07	2.28	-1.84	-9.59	-9.36	3.34	3.49	-12.57	-7.20
CRI	3.56	1.97	-0.22	-6.90	-7.79	3.23	3.27	-11.33	-7.23
DOM	3.12	1.61	-1.18	-5.23	-5.30	4.67	4.07	-13.78	-10.80
ECU	3.27	1.01	-1.05	-3.37	-3.49	3.75	3.21	-15.08	-9.79
HAI	3.97	0.96	-3.79	-12.97	-11.81	12.10	13.32	-7.59	-6.66
JAM	4.02	0.27	0.04	-0.53	-0.97	2.35	2.07	-13.90	-6.51
MEX	3.28	1.17	-1.12	-9.46	-10.59	3.47	3.55	-14.22	-8.66
NIC	3.80	4.06	2.00	-4.55	-4.81	9.00	8.05	-4.75	-3.33
PAN	3.98	4.61	2.47	-3.70	-3.83	6.16	5.54	-7.83	-5.32
PER	3.41	1.21	-0.96	-11.39	-13.17	3.32	4.31	-8.86	-8.13
SAL	3.46	3.30	-1.21	-6.57	-7.02	6.42	6.73	-11.31	-7.53
URY	3.07	0.79	-0.95	-14.57	-15.27	1.95	2.10	-14.07	-8.80
VEN	3.62	1.55	-0.51	-2.63	-2.83	3.84	3.35	-17.57	-10.20
CAM	3.73	3.78	-0.15	-11.16	-5.25	15.04	13.97	-7.50	-6.53
GHA	3.95	-1.85	-6.14	-13.34	-12.31	7.66	7.92	-9.26	-8.03
KEN	5.32	3.88	2.49	-2.59	-3.92	12.21	13.57	-1.91	-3.21
LBR	4.40	5.36	-1.13	-4.62	-2.91	17.15	15.70	-2.96	-4.48
MAR	3.60	1.27	-3.05	-11.46	-9.88	9.00	9.47	-11.27	-9.09
MLI	4.17	10.28	-1.12	-3.69	-2.07	19.49	16.65	-11.47	-12.20
MWI	5.17	-1.50	-3.61	-17.40	-16.67	13.58	18.11	-2.58	-3.43
RWA	4.87	8.51	6.95	-3.33	-4.71	25.99	31.69	0.34	-1.29
SEN	4.64	6.29	2.67	-1.12	-0.95	13.96	11.75	-7.94	-7.35
SLE	3.79	10.64	1.73	-2.77	-1.78	34.52	30.15	-6.58	-6.87
TZA	5.27	2.83	-0.01	-7.64	-7.51	15.61	17.99	-3.82	-4.89
UGA	5.34	4.87	1.51	-5.06	-4.68	18.44	18.80	-4.90	-5.69

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Cntry	Benchm. fertility	Universal primary education		Perfect family planning		No child mortality		Gender wage equality	
		$\Delta F/F$	$\Delta F_p/F$	$\Delta F/F$	$\Delta F_p/F$	$\Delta F/F$	$\Delta F_p/F$	$\Delta F/F$	$\Delta F_p/F$
ZAF	3.74	2.47	-0.21	-2.92	-2.35	6.64	5.92	-4.84	-3.43
ZMB	4.15	-0.19	-2.33	-11.80	-11.02	9.15	9.49	-7.76	-8.52
IDN	3.87	3.79	1.72	-7.69	-7.31	7.40	7.48	-7.73	-8.88
KHM	3.68	-2.21	-2.49	-6.48	-6.38	6.62	5.68	-12.49	-10.51
THA	2.84	-0.79	-6.36	-17.64	-18.44	1.85	2.23	-17.04	-11.04
VNM	2.97	1.48	-1.07	-26.55	-28.78	0.83	1.35	-10.14	-8.41
WBG	6.29	-1.72	-2.94	-9.72	-9.21	7.00	6.39	-6.85	-5.43
All	**3.47**	**0.05**	**-3.60**	**-13.63**	**-15.00**	**4.10**	**5.69**	**-11.84**	**-8.42**

Table 24: Impact of policies in the case where childlessness and marriage are endogenous ($\Delta F/F$) and in the case where childlessness and marriage are fixed to their benchmark values ($\Delta F_p/F$) for all countries

E Robustness Analysis

In this section, we study the robustness of our analysis to some major changes in assumptions. In each case, we reestimate the parameters under the new assumption and redo the policy experiments. We first study robustness to the choice of the Mincerian return ρ. Instead of using a rate of return of education of 5% in all countries, we take the country specific returns rates collected in Montenegro and Patrinos (2014). Second, we look at the robustness to the assumption on marriage. In the main text, we assume that both spouses have to agree to marry for a marriage to take place (see Equation (8)). Here we assume a more machist society where only the consent of the groom is needed. Third, we allow for some degree of assortative matching.

E.1 Higher return to education

Table 25 displays the Mincerian return to schooling from Montenegro and Patrinos (2014) together with the year for which they are estimated. The results obtained under this alternative way of measuring ρ are compared to the benchmark result in Table 26. With the new ρ the people with low education are much poorer relatively to the highly educated ones: indeed the wage for people with no education is now 0.136 instead of 0.407 (remember that the wage of the highest degree of education is normalized to one). As a consequence, the parameters measuring good costs, μ and $\hat{c}$, are lower. The higher value of ρ also modifies the incentives to accept a marriage offer. In particular, it makes highly educated women less willing to match with lowly educated men. To counterbalance this effect, the estimated δ^f is higher, making singlessness more painful to educated women.

Concerning the fit of the model, we report the value of the minimized objective function $f(p)$ for the global data, and the R^2 of the fit of childlessness across countries (regression on Figure 10). We see that with the new value of ρ the global fit is worse, but still cross-country childlessness is matched as before.

The way development affects childlessness is not altered by the new estimation, as the slopes of the relationship between voluntary childessness and education (bottom panel of Figure 12) and between poverty driven childlessness and education (top panel of Figure 12) are almost unchanged. Moreover, the decomposition of childlessness is mildly modified, with more poverty driven childlessness with the higher ρ.

Finally, considering the policy experiments, our previous results still hold. The effect of education policy on fertility is still reversed by accounting for all margins. It remains true that neglecting the endogenous response of marriage and childlessness leads to overestimating the effectiveness of family planning policies, and to underestimating the effect of promoting gender equality on fertility. The impact of these two policies on total fertility is however smaller under the higher values of ρ.

E.2 Machist society

The second robustness exercise replaces the assumption that a match on the marriage market will end up married only if both partners are willing:

$$\mathcal{M}_f(e_f, a_f, e_m, a_m) \geq \mathcal{S}(e_f, a_f) \quad \text{and} \quad \mathcal{M}_m(e_m, a_m, e_f, a_f) \geq \mathcal{S}(e_m, a_m),$$

by the assumption that a match will end up married only if the man is willing:

$$\mathcal{M}_m(e_m, a_m, e_f, a_f) \geq \mathcal{S}(e_m, a_m).$$

This change of assumption has major consequences on the estimation. In the benchmark, the population of single women was composed of poor women who were denied marriage, and rich women who refused marriage. Now, only the first category subsists. As a consequence, single women are drawn from the poorest part of the society and tend to be much more childless, while the opposite holds for married women. Estimating the parameters under the new assumption leads to major change. In particular, the variance of the non labor income β^2 is multiplied by 15 !

Despite the fact that we reestimate the parameters under the new assumption, the fit of this version of the model is awful. The property that poverty driven childlessness decreases with development is kept, while the decomposition of childlessness leads to a higher estimate for the voluntary component (but which is no longer increasing with development). We conclude that assuming a machist society by just disregarding the interest of women in marriage is a bad assumption. In societies where the bride has no say, it might remain true that her interest is somewhat taken into account by her father, as in dote09 (2009).

E.3 Assortative matching

The benchmark model assumes random matching. Alternatively, we assume here that a share λ of women meets men of the same education level, while a share $1 - \lambda$ is still subject to random draws in the whole pool of men.

We will let the level of assortativeness λ to be country dependent. In order to measure λ in our sample, we propose the following non-linear equation:

$$m_{e_f} = \lambda + (1 - \lambda) m_{e_m} \tag{10}$$

where m_{e_f} is the proportion of women who are married with a partner of the same education than theirs and m_{e_m} is the proportion of married men in a given education category. When $\lambda = 0$, $m_{e_m} = m_{e_f}$, which describes the outcome of a purely random matching process, as assumed in the benchmark. λ denotes then the proportion of women who marry someone of their type, not due to the randomness part of marriage. The estimates of λ are shown in Table 25.

Results are presented in the last column of Table 26. Assuming some exogenous degree of assortative matching would *ceteris paribus* increase the percentage of households in poverty driven childlessness. Estimating the model under this assumption, however, shows that the other parameters adjust to match the observed level of childlessness, leaving most results unaffected by the assumption on assortative matching. Even the estimation of the share of poverty driven childlessness does not change much. On the whole, the results are very robust to the introduction of some exogenous degree of assortativeness on the marriage market.

	ρ	year	λ		ρ	year	λ
ARG	7.8	1992	0.16	KEN	16.9	2005	0.13
BOL	10.4	2001	0.11	LBR	12.4⋆		0.11
BRA	14.3	2001	0.16	MAR	10	1998	0.16
CHL	13.2	2003	0.16	MLI	13	1994	0.10
COL	11.3	2005	0.14	MWI	9.8	2010	0.14
CRI	9.3	2000	0.17	RWA	17.5	2005	0.15
DOM	9.5	2010	0.11	SEN	11.8	2011	0.08
ECU	7.8	2010	0.12	SLE	4.2	2003	0.10
HTI	8.3	2001	0.13	TZA	15.2	2000	0.10
JAM	11.1	2001	0.18	UGA	16.9	2005	0.12
MEX	10.1	2010	0.16	ZAF	16.5	2001	0.14
NIC	7.7	2005	0.13	ZMB	12.6	2010	0.12
PAN	10	2010	0.11	IDN	12.1	1998	0.16
PER	10.6	2007	0.12	KHM	4.3	2008	0.23
SAL	8.4	2007	0.12	THA	16	2000	0.24
URY	10.9	1996	0.11	VNM	9.4⋆		0.17
VEN	9.2	2001	0.11	WBG	1.4	1998	0.13
CAM	11.6	2007	0.13				
GHA	12.5	2012	0.08	**All**	**11.1**		0.15

⋆ value for the region (Table 3a in Montenegro and Patrinos (2014)).

Table 25: Different values of the return to schooling ρ (column 2) for given years (column 3) and estimates for the degree of assortativeness in marriage, λ (column 4).

	Benchmark	higher ρ	machist marriage	assortative matching
Parameters - Global value				
β	0.278	0.207	1.067	0.273
ν	6.773	5.747	8.519	7.074
$\hat{c}$	0.345	0.137	0.494	0.338
μ	0.230	0.147	0.063	0.243
α	0.797	0.782	0.998	0.803
ϕ	0.207	0.214	0.167	0.199
δ^m	0.262	0.126	0.356	0.229
δ^f	0.080	0.261	-0.101	0.090
$\underline{\theta}$	0.722	0.794	0.855	0.794
ρ	0.050	0.111	0.050	0.050
λ	0	0	0	0.15
Fit				
$f(p)$ global	0.929	1.472	17.709	0.992
R^2	0.967	0.967	0.578	0.955
Development and Childlessness				
∂ voluntary/∂ schooling	0.57	0.56	-0.02	0.55
∂ pov. driven/∂ schooling	-0.75	-0.71	-0.65	-0.77
Decomposition of Childlessness				
Voluntary	2.13	1.75	2.96	1.79
Poverty driven	3.83	4.65	4.93	4.26
Mortality driven	0.66	0.33	0.12	0.66
Natural sterility	1.90	1.90	1.88	1.90
Policy Experiments				
Education $\Delta F/F$	-3.60	-3.36	1.97	-3.63
Education $\Delta F_p/F$	0.05	2.90	3.28	0.22
Planning $\Delta F/F$	-13.63	-8.35	-0.38	-14.06
Planning $\Delta F_p/F$	-15.00	-8.57	-0.55	-15.31
Health $\Delta F/F$	4.10	7.84	9.64	4.22
Health $\Delta F_p/F$	5.69	7.41	8.13	5.78
Empowerment $\Delta F/F$	-11.88	-6.12	-2.29	-11.45
Empowerment $\Delta F_p/F$	-8.46	-5.15	-1.98	-8.71

Table 26: Results under Different Assumptions