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Abstract

With about five children born per woman and a population growth rate of 2.5 per cent per year, sub-Saharan Africa has been the world's fastest growing region over the last decade. Economists have often argued that high fertility rates are mainly driven by women's demand for children (and not by family planning efforts) with low levels of unwanted fertility across countries (and hence with little room for family planning efforts to reduce population growth). We study the relationship between wanted fertility and number of children born in a panel of 200 country-years controlling for country characteristics and global trends. In general, we find a close relationship between wanted and actual fertility, with one desired child leading to one additional birth. However, our results also indicate that in the last 20 years the level of unwanted births has stayed at two across sub-Saharan Africa whereas it has decreased from one to zero in other developing countries. Hence, women in African countries are less able to translate child preferences into birth outcomes than women in other developing countries, i.e. leaving plenty of room for family planning efforts; and forces other than fertility demand have been important for fertility declines in other developing countries. Family planning efforts only partly explain the observed temporal and spatial differences in achieving desired fertility levels.

Key Words: Fertility, Population Growth, Development, Population Policies.
JEL: J10, J13.

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1. Introduction

With about five children born per woman and a population growth rate of 2.5 per cent per year, sub-Saharan Africa has been the world's fastest growing region over the last decade. Various studies are concerned that this rapid population growth might slow down the economic development of sub-Saharan Africa (see, e.g. Bloom and Sachs, 1998; Birdsall et al., 2001; Alexandratos; 2005; Bloom and Cunning, 2008; Brown, 2011), as well as speed-up global climate change (see, e.g. Bongaarts. 1992; Jiang and Hardee, 2009; Shi, 2002). Moreover, in recent years the fertility rate in sub-Saharan Africa has been decreasing at a much slower pace than initially expected (Bongaarts, 2008): while the average decline of fertility in all developing countries was 0.09 births per year (and woman) between 1965 and 1990 (United Nations, 2007), it has slowed down to a reduction of only 0.02 births per year in Africa since 2000.

In his seminal paper of 1994, Lant Pritchett has empirically shown that fertility across countries is mainly driven by differences in fertility and not by differences in family planning effort programs and/or contraceptive access. The study therefore suggests that the high fertility rates of African countries should be addressed by changes in fertility demand - driven by general (economic) development (including higher incomes, better female education, and lower child mortality). The study has been highly influential, both academically as well as for policy making. When the world population reached 7 billion in 2011, it was still the main reference in *Science* to support the theory that development – and not family planning – is the best "pill" (Kaiser, 2011). Some have even claimed that Pritchett's (1994) study was one of the reasons (besides women's rights initiatives, the HIV epidemic and growing conservative opposition) behind a drop in international financing for family planning efforts after the United Nations International Conference on Population and Development in 1994 (Boongarts and Sinding, 2011; Kaiser, 2011): between 1995 and 2008, international aid for family planning efforts dropped by 30 percent (Boongarts and Sinding, 2011).

Regressing actual number of children born on women's preferred number of children across 50 surveys Pritchett has empirically shown that nearly all of the variation in fertility across countries can be explained by differences in fertility desire, with one desired child leading to one additional birth. Furthermore, Pritchett's analysis has indicated that in the best-case scenario, fertility planning can on average reduce fertility rates by not more than one child per women across countries: the estimated constant in Pritchett's regression not being explained by fertility

desire. He therefore concludes that *"countries move from high fertility to low fertility not because unwanted fertility goes down but because desired fertility goes down*" (Pritchett, 1994b). Last, he has shown that improvements in family planning and contraceptive access only had a minor, independent effect on fertility outcomes. Lifting countries with zero family planning to observed (world-wide) average fertility planning efforts (FPE) would only reduce the number of children born by 0.22-0.37 births per women in these countries. This seems to be a marginal reduction in comparison with the average number of five children per woman in most sub-Saharan African countries in the 2000s.

After its publication, the study was critically discussed by Bongaarts (1994). His major arguments (among others), include that Pritchett retrospectively finds a close relationship between desired fertility and overall fertility *because* family planning programs were implemented in countries with decreasing desired fertility. Moreover, he claims that Pritchett (1994) does not find a large independent effect of family planning programs on fertility outcomes because they not only provide access to contraceptives to influence fertility outcomes, but they also affect fertility preferences, through information, promotion, and the lower cost of contraceptives (which is taken into account in women's stated fertility desire). He also argues that the employed family planning index (FPE) was collected differently in the 70s in comparison to the 80s, making the analysis of data sets comprising information from these two decades highly problematic. Surprisingly, no prominent mention was made of omitted variable bias, which might be an additional (severe) problem of Pritchett's cross-country analysis.

Since the publication of Pritchett's paper in 1994, various micro-level studies have supported his findings; either showing only modest impacts of family planning programs on fertility (e.g. Molyneaux and Gertler, 2000; Angeles et al., 2010; Miller, 2010; Bongaarts, 2011); or highlighting the importance of socio-economic characteristics, such as (mothers') education or wealth, to explain fertility variations (e.g. Castro Martin, 1995; United Nations, 1995; Kravdal, 2002; Bongaarts, 2010). These later studies usually (but not always) assume that increasing education and income increase the opportunity costs of fertility and, hence, lower fertility demand.

However, almost 20 years after Pritchett's publication, the question of whether development or family planning programs are more effective in driving down fertility in sub-Saharan Africa is still open for debate. Family planning advocates (mainly found within the field

of demographers) argue that unwanted childbearing (the difference between actual and wanted fertility) is substantial in high-fertility societies and can be addressed by family planning programs. Skeptics (mainly found within the field of economists) argue that fertility can only be brought down in sub-Saharan Africa through further economic development that increases the opportunity costs of raising children. Or as Pritchett (1994b) puts it: if looking at the supply (contraceptive access) versus the demand side (driven by development), economists argue "*that it is much more like a 5-95 supply demand split than the 50-50 division that much of the older family planning literature seems to convey*" (see also Bongaarts, 1994b).

With this study we contribute to this discussion by extending the original paper of Pritchett (1994). Since 1994, many more Demographic and Health Surveys (DHS) have become available which allow us to extend his initial analysis of 47-66 surveys across 38-48 countries to 204 surveys across 77 countries, more than tripling the sample size and doubling the number of countries studied. Moreover, and in contrast to Pritchett (1994), we can control for global trends and (time-invariant) country characteristics, as well as analyze differences in the elicited relationship between fertility desire and outcome across space and time. We do not aim to address all of the critical points of Pritchett's (1994) initial approach as outlined by Bongaarts (1994) or Knowles et al. (1994); and several of the previous methodological limitations apply to our study as well. Our major objective is to analyze whether fertility outcomes can still be mostly explained by fertility preferences (and not by family planning efforts) if we used a more comprehensive data set on the one hand, and sub-sets on the other, and if we controlled for time invariant country characteristics and global trends. Moreover, we provide a more refined analysis of the effect of family planning efforts (FPE), not only analyzing its (independent) effect on fertility outcomes, but also studying its impact on improving the capability of women translating fertility desire into number of children born.

The paper is organized as follows: Section 2 describes the data and variables analyzed and Section 3 the estimation approach. Section 4 presents our major results and discussion and Section 5 concludes.

2. Data and Variables

To analyze fertility preferences and their impact on actual fertility, we use the Demographic and Health Surveys (DHS). DHS are standardized surveys that have been undertaken by *ICF International* (usually in cooperation with local authorities and funded by USAID) since 1985 in a selected sample of 204 developing countries. For most countries more than one survey and up to six surveys are available. Women aged 15 to 49 are interviewed within a national representative sample of households. The average sample size of each survey is 5,000 to 30,000 women, and in total, the DHS contains information of more than 2 million women. For this analysis we pool the data by country and year, which provides us with a total sample of 204 surveys and 77 countries and an (unbalanced) country panel between 1985 and 2011 of 176 surveys and 49 countries for which at least two periods are available (as of August 2012).[3,4] 35 countries and 100 surveys are available for sub-Saharan Africa compared to 42 countries and 104 surveys for the rest of the developing world. The considerable number of surveys for various developing regions and years allows an analysis of the differences in the relationship between stated fertility demand and number of children born across time and space.

To measure the number of children born in a given year, and in line with Pritchett (1994), we construct the 'total fertility rate' (TFR), which is the most widely used measure of a country's period fertility. The TFR can be defined as the average number of births a woman would have during her reproductive age if she had experienced the age-specific fertility rates observed in a specific year (Bongaarts and Feeny 1998, Myrskylä et al. 2009). Hence, the TFR is a hypothetical period fertility measure for a synthetic cohort of women; no observed group of women has experienced this particular fertility rate (Bongaarts and Feeney 1998). Using a period measure of fertility instead of a cohort measure of fertility has the advantage that it is a measure of current fertility levels, which can be updated on a yearly basis (Bongaarts and Feeny 1998). The shortcomings of TFR are related to changes in the timing of childbearing which can lead to large fluctuations of TFR over time in low-fertility countries (see e.g. Sobotka, 2005; Lutz et al., 2003), and maternal mortality which might lead to an underestimation of TFR in high-fertility countries (see e.g. Sneeringer, 2009). To calculate the TFR by country and year, we use the

[3] We exclude Botswana, Afghanistan, and Angola due to missing information on fertility. We exclude Cape Verde, Eritrea, Mauritania, and Samoa due to data restrictions.
[4] The data is available from the authors on request.

information on retrospective birth histories of women aged 15 to 49 from each DHS survey.[5]

To calculate indicators of fertility preferences, we use DHS information (a) on the ideal number of children (variable v614), and (b) on desire for future children (variable v605). Similar to Pritchett (1994), we use two indicators of fertility preferences. The first measure we apply is 'desired total fertility rate' (DTFR), as proposed by Lightbourne (1985) and Westoff (1991). The DTFR is calculated similar to the TFR but takes into account the women's ideal number of children. For each woman, the ideal number of children is compared to the actual number of children of the respective survey year. If the actual number of living children exceeds the desired fertility of a particular woman, these births are subtracted from the numerator of the age-specific fertility rate. The DTFR is then calculated as the sum of the age-specific 'desired fertility rates'.[6] Hence, the DTFR can be interpreted as a function of the TFR adjusted for excess fertility. It reflects the number of wanted births a woman would have over her reproductive life (Lightbourne 1985).

The DTFR is, however, affected by problems of ex-post rationalism and measurement error. Ex-post rationalism means that women tend to make adjustments to their reported desired number of children to be closer to the actual number of births. In case of unwanted births, this can lead to an overestimation of wanted fertility. Second, the question is subject to measurement error. Women might be unable or unwilling to respond to the question on the desired number of children. A considerable proportion of women report that the ideal number of children is ‚God's decision', and therefore, have to be excluded from the analysis. In this case, the average number of wanted children might be underestimated if the desired number of children among women

[5] The TFR is calculated as the sum of the age-specific fertility rates (ASFR). The ASFR cover all women aged 15 to 49 in seven five-year age groups. The ASFR is the quotient of the number of births that occurred in the three years before the survey to women in the respective age group and the number of women-years of exposure in the three years before the survey in the respective age group. Some DHS only interview ever-married women at individual level. These DHS countries are: Bangladesh, Egypt, India (1992, 1994), Indonesia, Jordan, Maldives, Morocco (1987), Pakistan, Sri Lanka, Sudan, Thailand, Tunisia, Turkey (1993), Vietnam, and Yemen, Rep. For these DHS, the number of women in the denominator of the total fertility rate is inflated by the proportion of ever-married women from the household module to take into account all women in the sample (Bongaarts, 1990). For surveys with only ever-married women it is, hence, assumed that never-married women have not given birth. The variables used to calculate the TFR for each country are b3 (birth date of child), v008 (date of interview), and v011 (birth date of mother). We apply the TFR2 (Schoumaker, 2012) Stata command. TFR2 is a command allowing the calculation of age-specific fertility rates and TFRs. The TFR2 command allows replication of the official DHS total fertility rates.

[6] In particular, and similar to the calculation of the TFR, the DTFR analyzes women aged 15 to 49 years in the same seven five-year age groups. The age-specific wanted fertility rates are calculated as the quotient of the number of *wanted* births - a child is considered to be wanted if the number of children at the time of conception (date of birth minus 9 months) is less than the reported ideal number of children - that occurred in the three years before the survey to women in the age group and the number of women-years of exposure in the three years before the survey of women in the age group. A birth is considered to be 'wanted' if the number of living children at the time of conception of this birth is less than the desired number of children.

giving non-numeric responses exceeds the average of the population, resulting in an underestimation of wanted fertility rates.[7]

We therefore apply a second – and our preferred - measure of fertility demand: 'wanted total fertility rate' (WTFR) as proposed by Bongaarts (1990). Compared to DTFR, the WTFR has the advantage that it does not rely on women reporting the desired number of children and is hence less prone to problems of ex-post rationalism and measurement error. The WTFR uses the question on future desire for children in the DHS to identify previous births and current pregnancies as being wanted or unwanted. First, the TFR is recalculated along the following lines: if a woman reports that she wants another child at the time of the survey, her previous birth is classified as wanted, otherwise as unwanted (and not counted for the wanted TFR). In the second step, this WTFR is adjusted by a factor that takes into account that this WTFR underestimates the 'true' wanted fertility rate because some of the previous births of women who reported no desire for future children might have been wanted (Bongaarts, 1991).[8]

Our last variable of interest is the family planning effort index, originally developed by Lapham and Mauldin (1984) and refined by Ross and Stover (2001).[9] The family planning effort (FPE) index is based on 30 different indicators of family planning efforts which are grouped along 4 dimensions: policy, services, evaluation, and availability (Ross and Stover, 2001). See Table A1 in the Appendix for the list and grouping of the 30 indicators. 10–15 expert observers in each country grade these 30 measures of effort on a scale from 1 to 10. Seven cycles of the index are available (1972, 1982, 1989, 1994, 1999, 2004, and 2009). The 1972, 1982, 1989, 1994, and 1999 cycles are available from Ross and Stover (2001). The 2004, and 2009 cycles are available from Ross and Smith (2010). The FPE index is available for 158 out of 204 country-years of our sample. For nine countries, no information on the FPE is available; for 37 country-years, information on the FPE is available for the respective country, but not for all survey years. For the country-years where one or several years of the family planning cycles do not perfectly match the survey years of the DHS, we use the value of the closest family index cycle preceding

[7] Additional shortcomings are related to child mortality, gender preferences, and voluntary and involuntary fertility limitations.

[8] In particular, the final WTFR is defined as "final WTFR"=WTFR+1-c, where c=WM(40-44). WM(40-44) is equal to the proportion of all married women aged 40 to 44 who want more children (Bongaarts, 1990). Whereas (25) uses 2 years before the survey as the period to calculate the WTFR, we use 3 years in line with our measure of TFR and DTFR. WTFR and DTFR are calculated with application of the TFR2 command (Schoumaker, 2012) after the adjustments for unwanted births are made as described above.

[9] To proxy contraceptive access, Pritchett (1994) further analyzes the impact of contraceptive use on TFR. Due to severe problems of endogeneity (contraceptive use is not only a function of contraceptive access but is to the same extend influenced by WTFR or DTFR) we refrain from using this variable.

the year of the DHS year. However, if the difference is larger than 4 years we dismissed information on FPE and treated FPE as missing for this particular DHS year.[10] Results reported in Section 4 do not change qualitatively by applying different cut-off periods. For 15 percent of the sample, the difference between the DHS years and the family planning index year is zero. The average difference is 2 years.

3. Estimation approach

The starting point for our empirical approach can be formalized by the simple equation:

$$TFR_{it} = \alpha + \beta X_{it} + \varepsilon_{it}. \qquad (1)$$

The dependent variable TFR_{it} is the total fertility rate of mothers aged 15 to 49 of country i at year t. X_{it} is the indicator of fertility desire (DTFR, or WTFR) of women aged 15 to 49 in country i at year t. ε_{it} is an error term capturing unobservable survey characteristics. Based on the findings of Pritchett (1994), we expect $\beta > 0$, which means that fertility desire positively influences total fertility of women. Moreover, Pritchett (1994) has shown that β is not significantly different from unity and α is between 1 and 1.5. In other words, the average number of unwanted children (number of children born – number of children wanted), or number of children born not explained by variations in fertility desire, is about 1-1.5 across countries and each additional child born is explained by a mother's actual desire to have another child.

Our first estimations (Table 2) start with an analysis of the original sample used by Pritchett (1994) to replicate his results, applying a simple cross-sectional OLS regression. These results serve as a benchmark. We then analyze the total sample of countries and years available in 2012, again applying a simple (cross-sectional) OLS regression. In a next step, we introduce country and survey wave fixed effects to the sample of countries for which at least two surveys are available to control for country and time unobservables, which leads to a slight adjustment of equation (1):

$$TFR_{it} = 0 + \beta X_{it} + \gamma_i + \delta_t + \varepsilon_{it}, \qquad (2)$$

[10] The data is available from the authors on request.

where γ and δ indicate country and survey wave fixed effects respectively. Survey waves are the official survey wave numbers of the DHS (1-6).[11] We do not use year fixed effects to take into account that countries are not equally distributed across time and that each country has only been surveyed once during each DHS wave. Note that the sample size is reduced due to the panel analysis from 204 to 175 surveys. For 29 countries, only one survey year is available. We set the constant to 0 for a straightforward comparison of time and country fixed effects with Pritchett's initial constant α in equation (1), which can be interpreted as an average of the time and country fixed effects of equation (2). Furthermore, we analyze differences in the relationship between desired and actual fertility by region, applying both equations (1) and (2).

Last, we analyze the impact of family planning (FPE) on TFR, controlling for desired fertility (and country and survey wave fixed effects). We assume that the impact of FPE on TFR is dependent on the level of wanted fertility. We hence estimate the following specification

$$TFR_{it} = 0 + \beta_1 X_{it} + \beta_2 FPE_{it} + \beta_3 FPE_{it} * X_{it} + \gamma_i + \delta_t + \varepsilon_{it}, \qquad (3)$$

where FPE_{it} is the recorded family planning effort for a specific country and year, β_2 is the impact of FPE on TFR dependent on (the sample quintiles of) WTFR (or DTFR). $FPE_{it}*\beta_3$ measures the effect of family planning on translating fertility preferences into actual fertility. FPE is centered at its sample mean. WTFR (or DTFR) is centered at the means of the sample quintiles.

4. Results

Table 1 shows the means for TFR, WTFR, DTFR, and FPE across time and space. Note that we have an unbalanced panel so that the composition of countries in this descriptive table changes somewhat over time. Interestingly, TFR dropped by about 1.2 children in both African and non-African countries between the late 80s and the late 00s. However, whereas for African countries the drop in desired fertility (WTFR and DTFR) was equally high, it was only about 0.5 for other developing countries, which means that about half of the drop in fertility in non-African countries is not explained by changes in desired fertility. This also means that the gap between fertility desire and outcome has closed in most developing countries, except for sub-Saharan

[11] DHS wave 1 is from 1985 to 1990, DHS wave 2 is from 1990 to 1992, DHS wave 3 is from 1993 to 1998, DHS wave 4 is from 1998 to 2005, DHS wave 5 is from 2005 to 2009, and DHS wave 6 is from 2009 to 2011.

Africa. Last, it is interesting to see that sub-Saharan Africa saw a considerable increase in family planning efforts between the 80s and the 90s that stagnated afterwards. A similar but much weaker trend can be observed for other developing countries. The FPE across countries and time is on average about half (47) of the theoretical maximum (100) and two-thirds of the observed maximum (84) attained by the countries with the highest efforts.

Table 1: Aggregate TFR, DTFR, WTFR and FPE

	TFR		WTFR		DTFR		FPE	
Africa (n=100)								
1985-1992 (DHS I,II)	6.31	(0.63)	5.33	(0.80)	5.13	(0.68)	28.38	(13.15)
1993-2004 (DHS, III, IV)	5.41	(0.89)	4.46	(1.03)	4.39	(0.85)	48.15	(9.38)
2005-2011 (DHS V, VI)	5.16	(1.01)	4.07	(1.12)	4.17	(0.93)	45.46	(9.59)
Non-Africa (n=104)								
1985-1992 (DHS I,II)	4.05	(1.10)	2.69	(0.72)	2.87	(0.88)	48.59	(17.44)
1993-2004 (DHS, III, IV)	3.30	(0.85)	2.36	(0.43)	2.38	(0.54)	56.24	(12.73)
2005-2011 (DHS V, VI)	2.84	(0.99)	2.25	(0.60)	2.20	(0.69)	52.10	(7.89)

Note: TFR=total fertility rate; DTFR=desired total fertility rate; WTFR=wanted total fertility rate; PE=family planning effort. Averages are based on the (unbalanced) country panel sample. Mean values are shown with standard errors in parenthesis; n is the number of observations; roman numerals are the respective DHS survey waves.
Source: Demographic and Health Surveys; data for the family planning index are taken from Ross and Stover (2001) and from Ross and Smith (2010). Calculations by the authors.

Table 2, Columns 1-2 show the replicated results of Pritchett's (1994) analysis.[12] Table 2, Columns 3-4 show that the initial results of Pritchett (1994) hold if we add more surveys in a cross-sectional analysis: The level of unwanted children and the coefficients of desired fertility on actual fertility are not statistically different from unity (see also Figure 1). The unity relationship between wanted and actual fertility still holds pretty well when time and country fixed-effects (Table 2, Columns 5-6) are included. However, for both measures of wanted fertility (DTFR and WTFR), the time-constant is significantly higher than one until the mid-90s and only decreases to unity after 2000 (see also Figure 2). This means that the average level of unwanted births across countries has significantly decreased over time. Or in other words, fertility declines over the last 20 years were also driven by a decline in unwanted fertility,

[12] Note that the estimated coefficients in Table 1 of Pritchett (1994) are slightly different from the results in Figure 1 of his paper and the results presented here (Table 2). This difference has previously been mentioned by Knowles et al. (1994).

independent of changes in fertility desire.

Table 2: Total Sample – OLS and Panel

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: TFR	Pritchett (1994) sample (OLS)	Pritchett (1994) sample (OLS)	Total sample (OLS)	Total sample (OLS)	Total sample (Panel)	Total sample (Panel)
DTFR	0.882***		1.077***		0.952***	
	(0.0367)		(0.0233)		(0.0528)	
WTFR		0.903***		0.986***		0.754***
		(0.0646)		(0.0315)		(0.0740)
Constant	1.372***	1.565***	0.729***	1.016***		
	(0.171)	(0.261)	(0.0861)	(0.117)		
1985-1989					1.567***	2.080***
					(0.202)	(0.297)
1990-1992					1.376***	1.783***
					(0.186)	(0.277)
1992-1997					1.271***	1.674***
					(0.166)	(0.243)
1998-2004					1.145***	1.511***
					(0.157)	(0.230)
2005-2008					1.090***	1.396***
					(0.153)	(0.227)
2009-2012					1.002***	1.298***
					(0.157)	(0.231)
Country FE	NO	NO	NO	NO	YES	YES
Observations	66	47	201	204	174	174
R-squared	0.900	0.813	0.915	0.829	0.999	0.998

Note: TFR=total fertility rate; DTFR=desired total fertility rate; WTFR=wanted total fertility rate; Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Wave fixed effects refer to the official survey waves of the DHS (1-6). Country fixed effects are shown in Figure 1 (left out category is Bangladesh).
Source: Demographic and Health Surveys, Pritchett (1994) Data Appendix (for columns 1 and 2); calculations by the authors.

Table 3 replicates the estimations of Table 2, but separately for sub-Saharan Africa and other developing countries. Columns 1, 2, 5 and 6 are OLS regressions based on the pooled sample of all countries and years of available DHS surveys. Columns 3, 4, 7, and 8 are based on the (unbalanced) country panel survey for countries where at least two surveys are available. The results indicate that Pritchett's results are also confirmed for non-Africa countries (Columns 5-8), whereas for sub-Saharan African countries (Columns 1-4) the relationship between desired and achieved fertility is much weaker, and the level of unwanted births much higher. First, the impact of wanted on achieved fertility is smaller than one for sub-Saharan African countries (Columns 3-4), and one for non-African countries (Columns 7-8). Hence, in non-African countries women seem to be living in an environment that is more supportive of translating the

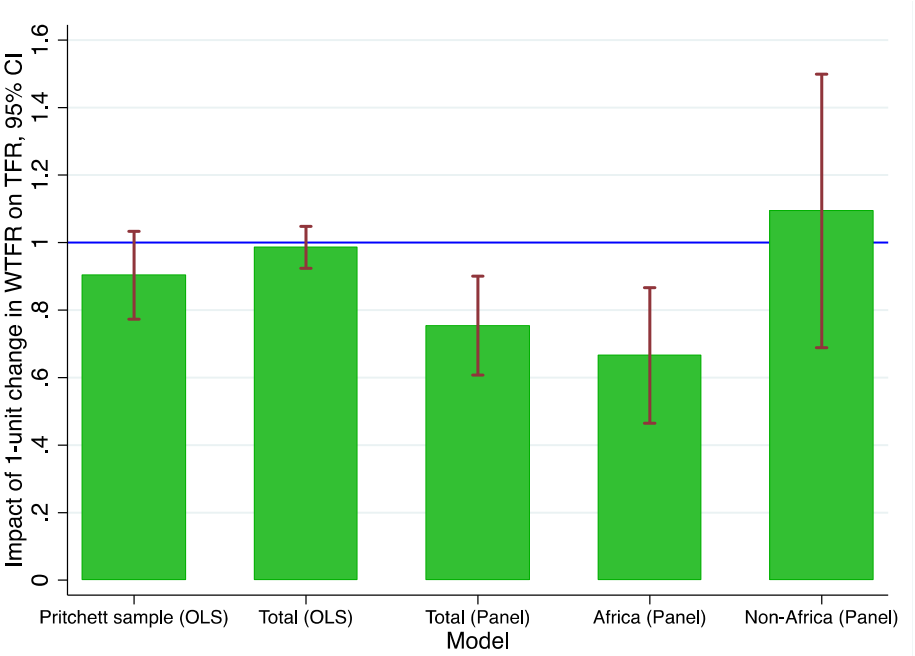
desired number of children into actual fertility (see also Figure 1). Moreover, whereas the level of unwanted births has decreased from one to even zero for most developing countries over the last 20 years, it has stayed at a level of about two for most African countries (see also Figure 2).

Table 3: Africa and Non-Africa – OLS and Panel

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: TFR	Africa sample (OLS)	Africa sample (OLS)	Africa sample (Panel)	Africa sample (Panel)	Non-Africa sample (OLS)	Non-Africa sample (OLS)	Non-Africa sample (Panel)	Non-Africa sample (Panel)
DTFR	0.971***		0.885***		1.284***		1.031***	
	(0.0408)		(0.0905)		(0.0619)		(0.113)	
WTFR		0.769***		0.665***		1.434***		1.094***
		(0.0440)		(0.100)		(0.104)		(0.202)
Constant	1.190***	2.043***			0.232	-0.114		
	(0.187)	(0.205)			(0.159)	(0.260)		
1985-1989			2.025***	2.934***			1.416***	1.161**
			(0.519)	(0.626)			(0.306)	(0.548)
1990-1992			1.811***	2.560***			1.252***	1.010*
			(0.481)	(0.592)			(0.302)	(0.537)
1992-1997			1.694***	2.475***			1.119***	0.810
			(0.448)	(0.539)			(0.270)	(0.500)
1998-2004			1.609***	2.418***			0.971***	0.589
			(0.432)	(0.513)			(0.246)	(0.471)
2005-2008			1.630***	2.443***			0.850***	0.363
			(0.426)	(0.502)			(0.227)	(0.455)
2009-2012			1.523***	2.263***			0.657***	0.157
			(0.415)	(0.496)			(0.240)	(0.465)
Country FE	NO	NO	YES	YES	NO	NO	YES	YES
Observations	99	100	90	90	102	104	84	84
R-squared	0.854	0.758	0.999	0.999	0.811	0.649	0.998	0.997

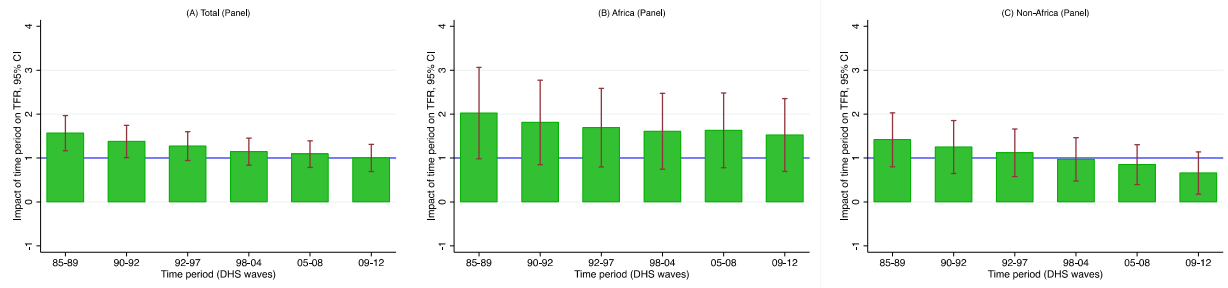
Note: TFR=total fertility rate; DTFR=desired total fertility rate; WTFR=wanted total fertility rate. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Wave fixed effects refer to the official survey waves of the DHS (1-6). Country fixed effects are shown in Figure 1 (left out category is Benin for Africa, and Bangladesh for non-Africa).
Source: Demographic and Health Surveys; calculations by the authors.

Figure 1: Impact of 1-unit change in WTFR on TFR



Note: The green bars show the effect of 1-unit change in WTFR on TFR (see also Table 2 and 3). Red lines show the 95% confidence interval.

Figure 2: Time Fixed Effects of Panel Regressions – WTFR on TFR

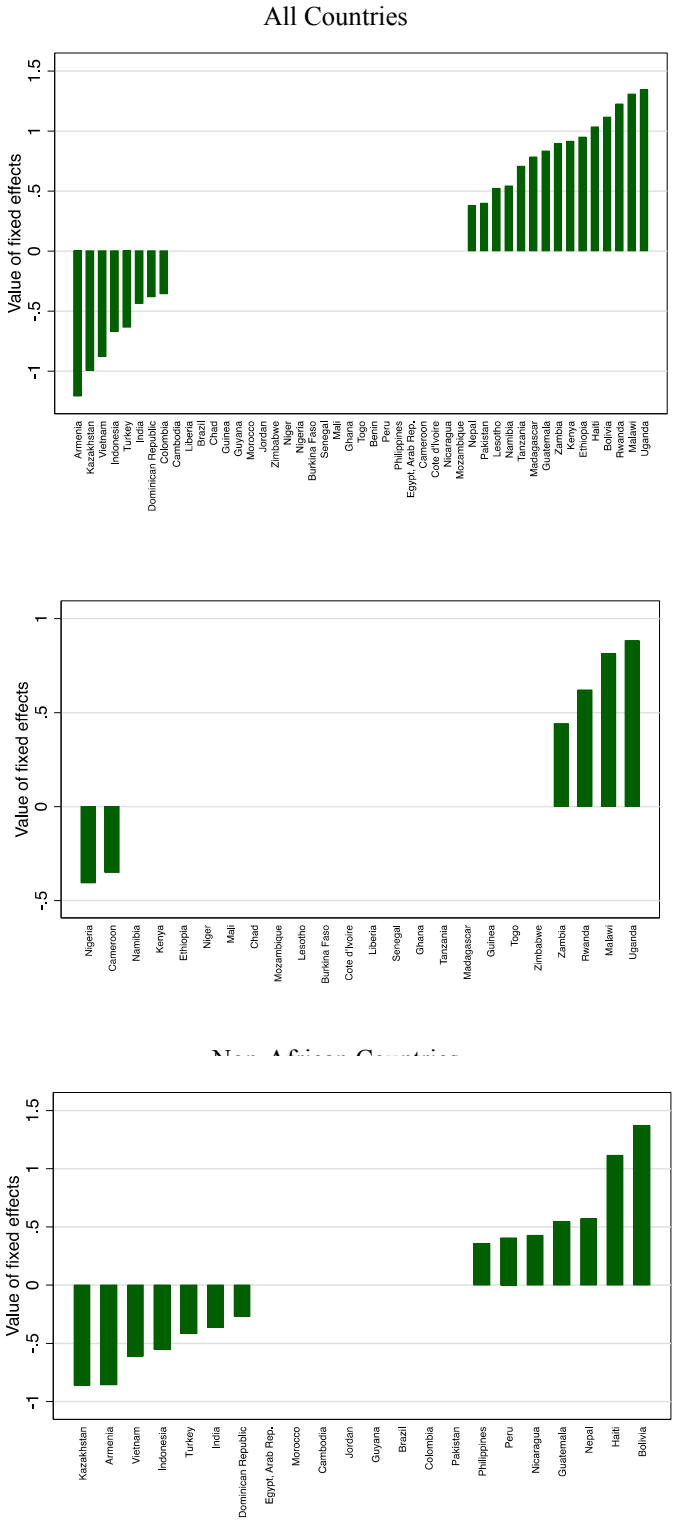


Note: The green bars show the impact of the DHS time period on TFR controlled for WTFR and country fixed effects (see also Table 2 and 3). Red lines show the 95% confidence interval.

Figure 3 shows that – controlling for global trends - the level of unwanted births highly varies across countries, with the lowest levels found for Armenia, Kazakhstan, Vietnam (with close to zero unwanted births for 2010)[13], and the highest levels found for Uganda, Malawi, Rwanda, and Bolivia (with more than 2.5 unwanted births per woman). It is also interesting to see that the level of unwanted births does not differ considerably across African countries, with the notable exception of Uganda, Malawi, Rwanda, and Zambia.[14]

[13] Adding the fixed effects reported in Figure 1 to the time dummy of 2009-2012.
[14] Despite the tremendous recent drop in fertility in Rwanda: http://blogs.worldbank.org/africacan/is-rwanda-set-to-reap-the-demographic-dividend.

Figure 3: Country Fixed Effects of Panel Regressions – WTFR on TFR



Note: Insignificant fixed effects are treated as zero. The left out category for the total sample and non-African countries is Bangladesh. The left out category for African countries is Benin.

Last note that - once we split the sample into different regions - the adjusted R^2 of the cross-sectional OLS estimation becomes significantly lower than for the whole sample. This means that even if fertility desire and a constant can explain 90 percent of the observed variations in fertility worldwide (Table 2), it only explains about 75 percent of fertility in sub-Saharan Africa or other developing countries. The high R^2 for the entire sample hence seems to be partly driven by the large gap in (desired and achieved) fertility between sub-Saharan Africa and other developing countries.

To conclude, the relationship between wanted and actual fertility is not as close and stable as initially claimed by Pritchett. First, the level of unwanted births highly varies across continents with about 2-3 unwanted births (out of 5 children born) in sub-Saharan Africa, and 0-1 unwanted births (out of 3 children born) in other developing countries. This leaves a much greater leverage for family planning to reduce fertility in sub-Saharan Africa than initially suggested by Pritchett's results. This does, of course, not necessarily mean that FPE have an effect on the level of unwanted births.

Second, our results indicate a global trend of decreasing fertility, which is independent of fertility preferences - explaining at least half of the drop in fertility over the last 20 years in non-African countries. See also Caldwell (2011) on the globalization of fertility behavior. We show that for African countries this time trend has been much weaker, in addition to generally higher levels of unwanted births and the lesser ability of women to translate desired number of children into fertility outcomes.

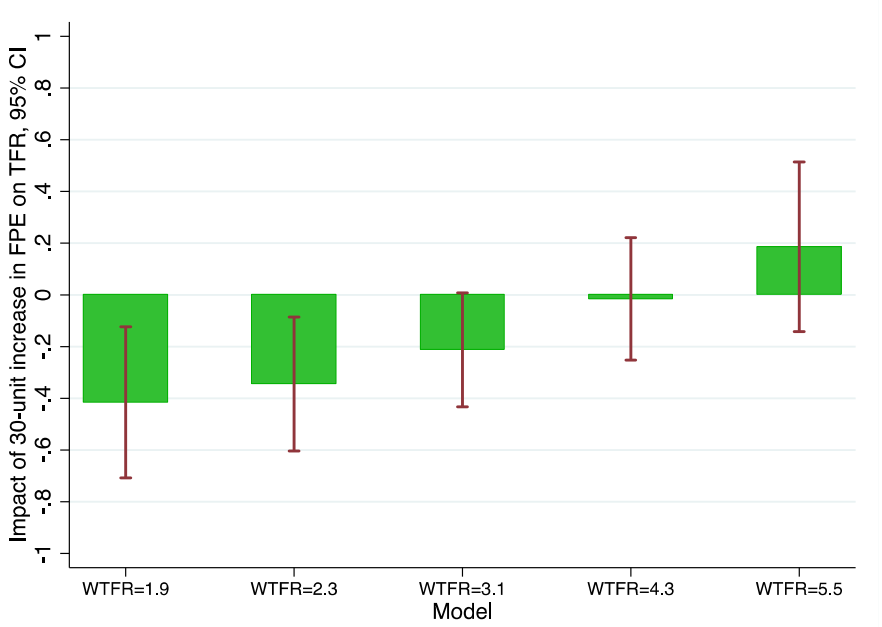
The important question remains whether lower levels of unwanted births in non-African countries and recent years is due to higher family planning efforts in non-African countries and over time. The obtained results could also be driven by increased education, wealth, women's rights, or any other development that either enables women to better reach their fertility targets using family planning services (which are already accessible) more effectively (see also Lam, 2011 for a similar argument), or that have a negative influence on the number of children born, irrespective of women's own preferences, e.g. through social norms and/or learning (see e.g. Canning et al., 2013, Ashraf et al., 2012).

Figure 4 shows the effect of increasing family planning efforts by two standard deviations - equal to 30 points - on fertility outcomes (TFR) at various levels of wanted fertility

(WTFR), controlling for desired fertility and time and country fixed effects. Increasing family planning efforts by 30 points is equivalent to moving from a country like Bolivia (in the 2000s) to a country like Indonesia (in the 2000s), or moving a country like Ghana or Kenya from the late 1980s to the late 1990s, or moving a country from the mean to the maximum of FPE. According to our estimates, FPE can reduce the number of children born per woman by up to 0.4 at lower levels of wanted fertility. First, this result indicates that FPE is only effective in reducing birth rates once women wish for fewer children. Second, this result shows that FPE alone neither (fully) explains the substantial difference (of about 1-2 births) in unwanted births between Africa and other developing countries nor the decline of about one unwanted birth in other developing countries over the last 20 years. The difference in FPE between Africa and non-African developing countries is only 10-20 and the change in FPE over time in non-African countries is also below 10 (see Table 1).

However, the low estimated impact of FPE on number of children born could– at least partly – be driven by high measurement error in FPE, which is an index derived from experts' opinion for only a limited number of years. The effect of FPE on TFR is also underestimated if women take into account the level of FPE when reporting on WTFR. On the other hand, the effect of FPE on TFR might be overestimated if FPE is endogenous to the population's desire to limit fertility - even though FPE is lagged for more than 80 percent of the sample (see Section 2).

Figure 4: Impact of a 30-unit increase in FPE on TFR (dependent on WTFR)



Note: The levels of WTFR refer to the quintile means of the WTFR distribution of the sample. The green bars show the impact of FPE on TFR (dependent on WTFR). The red lines show the 95% confidence interval. Estimations based on all countries with at least two time periods and with available data on the FPE index (n=136).

5. Conclusion

In his seminal paper of 1994, Lant Pritchett has empirically shown that fertility across countries is mainly driven by differences in desired fertility and not by family planning effort programs and/or contraceptive access (Pritchett, 1994). His findings from a cross-sectional regression analysis of about 50 surveys would suggest that the high fertility rates of sub-Saharan Africa can only be addressed by changes in fertility demand, which is in turn driven by general economic development.

Although a large body of literature studying the effects of socioeconomic factors such as education and wealth on total fertility rates has hence emerged, the question of whether family planning or development is more effective in accelerating fertility declines in sub-Saharan Africa is still open for debate. This paper has contributed to this discussion by replicating and extending the original paper of Pritchett (1994) with over 200 country-years, thereby more than tripling the original sample size of Pritchett's analysis. This larger sample size also allows controlling for global trends and country characteristics, as well as an analysis of differences in the elicited

relationship between fertility desire and outcome for different regions and different time spans, which has not previously been done.

We find that the close link between wanted and actual fertility, as found by Pritchett, is robust to a larger sample size, and fairly stable to country and time fixed effects. However, we show that the level of unwanted births has significantly decreased by about 0.5 children from 1990 to 2010. Our results also suggest that women in sub-Saharan Africa are less capable of translating child preferences into birth outcomes than women in other developing countries: in sub-Saharan Africa the level of unwanted births has stayed at almost two births across time, whereas it has decreased from one to zero between 1990 and 2010 in other developing countries. These results indicate, first, that fertility has been declining to some extent independently of fertility preferences in many developing countries (pointing to a possible role of family planning) and, second, that - at least in sub-Saharan Africa - there is considerable scope for family planning programs (or other policies) to decrease unwanted births and to improve the transformation of fertility preferences in fertility outcomes. The stagnating family planning efforts in sub-Saharan Africa over the last 10 years might therefore seem worrisome.

However, we also show that an increase of two standard deviations in FPE only leads to a decrease of up to 0.4 children per women. This result indicates that variations in FPE can only explain a small portion of the higher levels of unwanted children in sub-Saharan Africa, which calls for further research. The low impact of FPE on number of children born - despite considerable variations in unwanted children across time and space - could be driven by high measurement error in FPE. On the other hand, differences in birth rates unrelated to fertility preferences across countries and decades could also be generated by increased education, wealth, women's rights, marriage patterns, or any other broader development that either enables women to better reach their fertility targets using (already existing) family planning services more effectively, or that have a negative influence on the number of children born, irrespective of women's own preferences, through social norms (see e.g. Canning et al., 2013) and/or men's fertility preferences that might be different and higher than women's preferences (see e.g. Ashraf et al., 2012). However, note that according to the UN population projections, even a reduction of only half a birth per woman in sub-Saharan Africa would already reduce the population by 0.25 billion from 2 billion in 2050 (Bongaarts and Sinding, 2011).

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Appendix

Table A1: Composition of Family Planning Effort (FPE) Index.

Policy and Stage-Setting Activities	1. Government's official policy concerning family planning
	2. Favorable statements by leaders
	3. Level of family planning program leadership
	4. Age-at-marriage policy
	5. Import laws and legal regulations regarding contraceptives
	6. Advertising of contraceptives in the mass media allowed
	7. Other ministries/government agencies involved
	8. In-country budget for program
Service and Service-related Activities	1. Involvement of private sector agencies and groups
	2. Civil bureaucracy used Community-based distribution
	3. Social marketing
	4. Postpartum programs
	5. Home-visiting workers
	6. Administrative structure
	7. Training programs
	8. Personnel carry out assigned tasks
	9. Logistics and transport
	10. Supervision
	11. Mass media for information, education, and communication
	12. Incentives/disincentives
Recordkeeping and Evaluation	1. Recordkeeping
	2. Evaluation
	3. Management use of evaluation findings
Availability and Accessibility of Fertility Control Methods	1. Female sterilization
	2. Male sterilization
	3. Pills
	4. Injectables
	5. Condoms, diaphragm, spermicide
	6. Intrauterine devices
	7. Safe abortion

Source: Ross and Smith (2010).