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Trends in contraceptive prevalence in sub-Saharan Africa: The roles of family planning programs and education

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Over the past half century, the practice of contraception has spread rapidly through much of the developing world. The most rapid growth occurred in Asia and Latin America which reached contraceptive prevalence levels of 61 and 69%, respectively, by 2015.[1] Prevalence in sub-Saharan Africa increased at a much slower pace reaching only 25% in 2015.

An extensive literature includes general agreement that two factors have played a key role in raising prevalence. Conventional demographic transition theory suggests that as countries develop, income and education levels rise, leading couples to reduce their traditionally high desired family size. To implement these desires for fewer offspring contraception is practiced.

The second key factor is the family planning movement that started in the developing world in the 1950s. The choice of voluntary family planning programs as a policy instrument to meet people's reproductive needs and to accelerate fertility decline is based largely on the documentation of a substantial unsatisfied demand for contraception.[2,3] Large proportions of married women in the developing world report in surveys that they do not want a pregnancy at the time of the interview. A substantial proportion of these women (more than one-half in some countries) risk unintended pregnancy by not practicing effective contraception. Each year about 73 million unintended pregnancies occur in the developing world (of which 49% end in induced abortions) with detrimental health and economic effects for many women, children and families.[4]

It is therefore not surprising that past evaluations of family planning programs have found their impact on prevalence and fertility to be substantial. One of the best-known controlled experiments was conducted in rural Matlab district of Bangladesh in the late 1970s. The provision of high-quality services in the intervention area reduced fertility by 28% and raised contraceptive prevalence to 35% while little change occurred in the control area.[5] A recent review of the evidence concludes that the impact of voluntary family planning ranges up to 33% depending on the intensity and quality of the intervention.[6]

Yet, questions about the role of family planning programs versus the role of socioeconomic development in reducing fertility continue to be raised.[7] Proponents of family planning programs argue that these programs are essential to reproductive health and point to the high levels of unmet need and unplanned pregnancies as the key rationale for investing in these programs. Critics argue that socioeconomic development and especially female education is the main driver of changes in reproductive behavior and that family planning programs have only a minor impact on trends in contraceptive use. Some also argue that the experimental results such as from Matlab are not replicable at the country level because of the high expense of this experiment.[8]

This paper aims to shed light on this continuing controversy. The main objective is to assess the net impact of family planning programs on contraceptive prevalence after controlling for the effects of socioeconomic factors, most notably female education.

I. Materials and Methods

This study examines the determinants of trends in the use of contraception in sub-Saharan countries. The variables included in the analysis are as follows:

- *Independent variable:* contraceptive prevalence of modern methods (mCPR) among women aged 15-49 who are married or in union (MWRA). For simplicity this variable will be referred to as "prevalence."[9,1]
- *Socioeconomic explanatory variables*: 1) Education as measured by the average years of schooling among women aged 20-39 (women's educational attainment), 2) GNI/cap (PPP), 3) Percent urban and 4) Child mortality (ages 0-5). Education estimates are from the Wittgenstein Center for Demography and Global Human Capital and estimates of GNI per capita and percent urban and child mortality are taken from World Bank Development Indicators database.[10,11]
- *Family planning program indicator:* To measure the quality and scope of the government's public family planning program we rely on the "public-sector family planning program impact score" developed by Bongaarts and Hardee.[12] This score ranges from 0 in the absence of a government program to a theoretical value of 100 for the strongest programs. For simplicity we will refer to this variable as the "program score".

The analysis focuses on trends from 1990 to 2015 in 24 countries in sub-Saharan Africa with a population size above 5 million in 2015 and with at least two DHS surveys. Many smaller countries have high international migration levels which affect reproductive behavior. The exclusion of smaller populations also makes the unweighted regional averages of indicators more representative of the continent and makes the figures easier to interpret[i].

Regression analyses (ordinary least squares (OLS) and fixed effects models) are used to estimate the impact of the program score and socioeconomic variables on contraceptive prevalence. By using countries as their own controls, fixed effects models account for time-stable differences among countries, which may otherwise introduce bias into parameter estimation.

II. Results

Descriptive findings

To provide a first look at the relationship between socio-economic variables and prevalence, we plot in Figure 1 country specific prevalence levels by mean years of schooling of women aged 20-39. (As will be shown later, education is the most important of the socio-economic determinants). The figure contains 24 lines, one for each country, representing time series of five-year estimates from 1970 to 2015[2]. The size of the circle at the end of each line is proportional to the program score of the country at the time of the most recent survey (ca. 2013).

If female education were the only determinant of mCPR, observations for all countries and all years would fall on a single line. This is clearly not the case, indicating an impact of programs and other factors. In general, the higher the level of women's educational attainment and the higher the program score, the higher the prevalence. The six countries in the upper oval have the strongest program scores (>35). The ten countries in the second oval all have program scores above 15 and in the third oval all countries have scores below 15. At any level of women's educational attainment, prevalence varies widely. For example, in the three countries with schooling levels between six and seven years, prevalence ranges from 10% in DR Congo to 29.9% in Uganda to 56.9% in Malawi. As will be shown below, the differenecs among these countries with similar levels of women's educational attainment are mostly due to program differences. The findings in Figure 1 suggest that education and program score both have a substantial effect on prevalence, but the estimation of the magnitudes of these effects requires regression analysis.

Regression analysis

Although country-level data on five explanatory variables are available, it is desirable to reduce this number in order to reach more stable regression results. To identify which explanatory variable(s) to retain we first estimated separate bivariate OLS regressions of mCPR on each of the explanatory variables at the time of the last DHS survey with countries as the unit of analysis (N=24). The results show a strong and highly significant correlation ($P<0.000$) in the expected direction between mCPR and three of the explanatory variables: women's educational attainment, child mortality and program score. In contrast, the correlations between prevalence and GNI/cap and percent urban were not significant ($P>0.05$). Thus, GNI/cap and percent urban are excluded from the remaining regressions.

Second, we estimated multivariate OLS regressions using mCPR data for the year of the latest DHS survey with women's educational attainment, child mortality and program score as the independent variables. The coefficients for education and program score are statistically significant, while the coefficient for child mortality is not.

Finally, we estimated the effect of education level and program score on contraceptive prevalence using fixed effects models to better control for time-invariant confounding variables using all available DHS surveys for the 24 countries (N=98). The results, shown in panel 1 of Table 1, again show no statistically significant effect of child mortality. Thus, we dropped the child survival variable. Panel 2 in Table 1 presents the fixed effect regression results using only women's educational attainment and program score as explanatory variables.

This regression confirms that women's education and family planning programs have a highly significant impact on contraceptive prevalence.

Country estimates of the roles of education and program score
The fixed effect regression results allow the estimation of the separate effects of women's schooling and the program on the mCPR in the 24 countries at the most recent survey, using observed values of these explanatory variables[ii]. Figure 2 plots estimates of women's educational attainment and program components of the mCPR in each country at the time of the latest survey (ordered from lowest to highest mCPR). The program impact exceeds 30% in Zimbabwe, Malawi, Kenya, Rwanda, Zambia and Ethiopia.

Table 1: Results of fixed effects regression models of contraceptive prevalence on socioeconomic variables on in 24 Sub-Saharan Africa countries.

Panel 1			**Panel 2**		
Variable	Coefficient	P	Variable	Coefficient	P
Education	3.320	0.000	Education	2.814	0.000
Program score	0.696	0.000	Program score	0.640	0.000
Child mortality	0.027	0.069	C2nstant	7.460	0.000
Constant	-14.17	0.001	N	98	
N	98		R^2adj	0.888	
R^2adj	0.892				

The two components vary widely in size with one dominating the other in several countries. For example, the program effect is substantially larger than the women's educational attainment effect in Malawi, Rwanda and Ethiopia, while the reverse is observed in Cameroon, Nigeria and DR Congo. Effects are approximately equal in Kenya, Uganda, Tanzania and Ghana.

To examine trends in the effects we calculate the recent pace of change in the impacts of women's education and program score. Figure 3 plots the annual changes in the program effect and in the women's education effect by country. These pace estimates are calculated for the period between the first and last DHS survey[iii]. For example, for Ethiopia the program impact rose from 7% in 2000 to 33% in 2016, yielding an annual pace of 1.6% per year.

The most rapid increases (above 1% per year) occurred in Rwanda, Zambia, Malawi, Ethiopia, Madagascar, and Burkina Faso. In contrast, in half of the countries the pace of program improvement is slow or negligible (<0.5% per year). The pace of improvement in the impact of women's education shows less variation among countries and is on average lower than the pace of improvement in program impact.

III. Discussion

The findings of Figure 3 are of interest to policy makers because they indicate that expanding FP programs can have a rapid and substantial effect on the mCPR. The improvements in program impact in six countries (Rwanda, Zambia, Malawi, Ethiopia, Madagascar and Burkina Faso) stand out because they are larger than the effects of improving education. How did these countries achieve such rapid progress, and can this success be replicated elsewhere?

The common theme among these successful countries is that they all have exhibited political will and commitment to FP from the highest to lowest political leaders, thus creating a chain of responsibility and accountability. Changes in the laws have removed obstacles to FP promotion and provision. Although these countries are dependent on donor funding, they have worked to increase domestic expenditures on FP and to ensure that contraceptives are reliably available, including long acting and permanent methods. FP services have expanded through community-based services. Demand creation and social behavior change have also been given priority, as has meeting the needs of young people. Program documents, including FP Costed

Implementation Plans developed to reach goals set as part of the FP2020 partnership, reinforce FP as a human right.

IV. Conclusion

Our analysis leads to three conclusions. First, women's educational attainment and program score are the main determinants of levels of contraceptive prevalence in sub-Saharan countries. FP programs can increase mCPR at all levels of female education. Second, the very rapid increases in prevalence in several countries since the 1990s are mainly due to the rapid strengthening FP programs and much less to rising education levels. Third, the improvements in FP programs are directly traceable to increases in government actions including stronger commitment from political leaders and increased funding.

Fig. 1: Contraceptive prevalence by mean years of schooling and program score (circle), 25 sub-Saharan countries 1970-2015

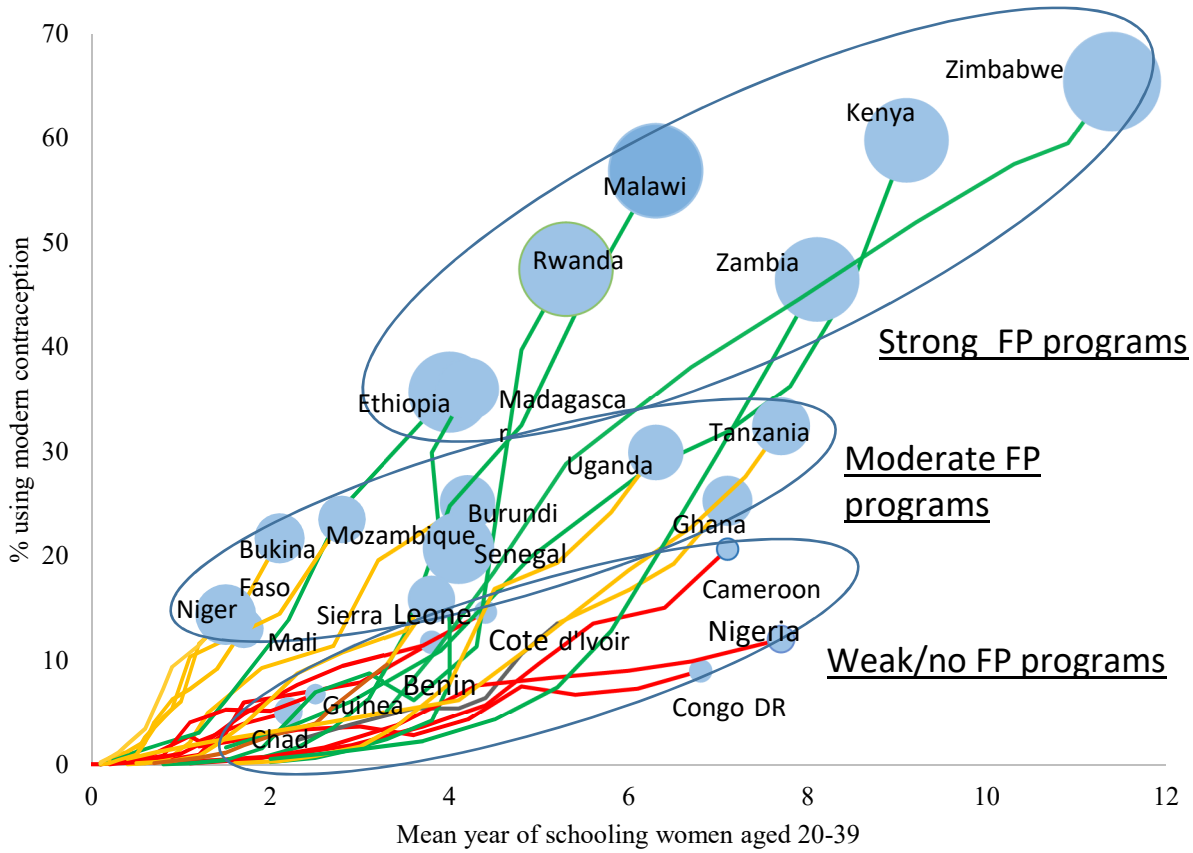


Figure 2: Model estimates of education and program effects on mCPR, year of latest survey

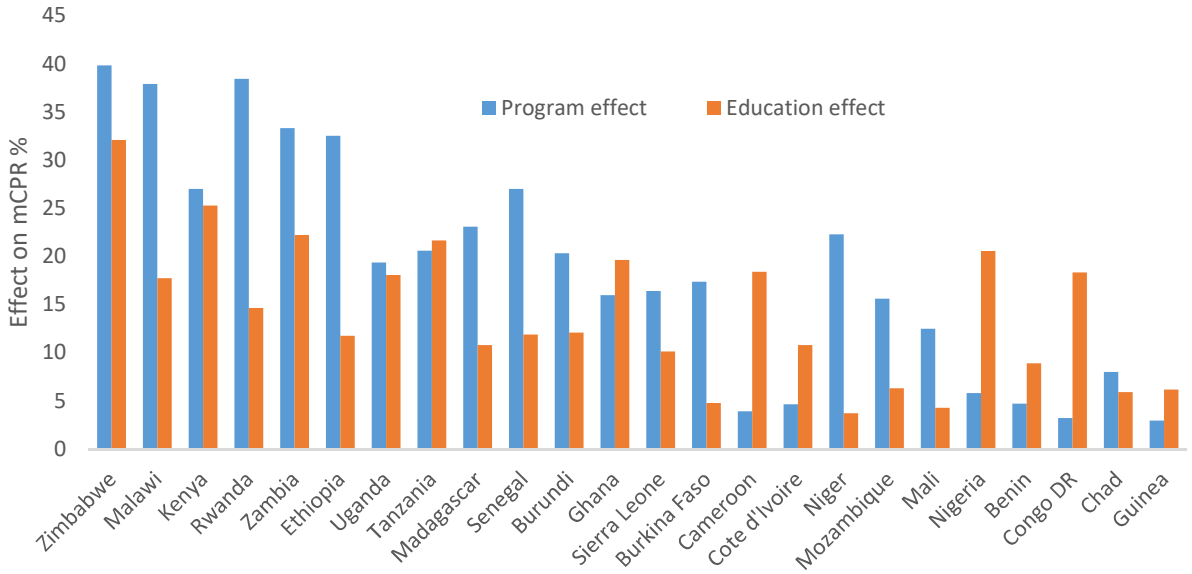
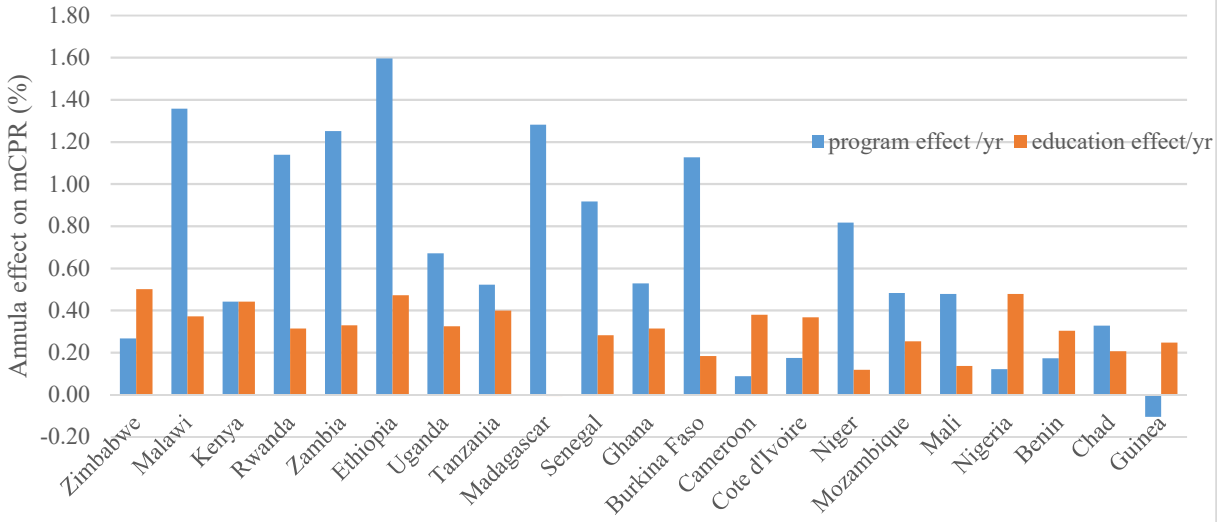


Figure 3 . Annual change in education and program effects on mCPR, between firts and last survey



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End notes

[i] Also excluded are the 2003 survey in Mozambique (because it occurred shortly after massive floods had devastated the country) and the 1993 survey in Burkina Faso (because the coding of traditional methods is not standard)

[ii] Regression results from the final fixed effects model (Table 1, panel 3) were used to estimate the separate effects of women's schooling and program score on the mCPR in each of the 24 countries. Specifically, the effect coefficient for education and program score, respectively, were multiplied by the observed mean education level and program score for each country, using data at the time of the latest survey. These results are summarized in Figure 4 which plots the estimated average effect of women's educational attainment and program score on mCPR for each country (ordered from lowest to highest mCPR).

[iii] To avoid large sampling errors in pace estimates only countries with at least 10 years between the first and last survey are included in Figure 5. Burundi, Congo DR, Sierra Leone are therefore excluded.

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