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WIDER Working Paper 2016/43

Delayed marriage, contraceptive use, and breastfeeding

Fertility patterns over time and wealth quintiles in sub-Saharan Africa

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April 2016

United Nations University World Institute for Development Economics Research
wider.unu.edu

Abstract: The rate of fertility decline has been slow in sub-Saharan Africa (SSA). Using the Demographic and Health Surveys for 21 SSA countries between 1990 and 2014, we examine the within-country fertility patterns by wealth, applying the Bongaarts (2015) proximate determinants model. We find that overall, fertility has declined in SSA for the richest, but not for the poorest, and this translates to a slow decline in the national-level total fertility rate. We find that breastfeeding periods are generally declining, putting upward pressure on the fertility rate. Contraceptive use is increasing, particularly for the richest, reducing fertility for these quintiles alone.

Keywords: proximate determinants of fertility, contraceptive use, delay of marriage, breastfeeding, demographic dividend, sub-Saharan Africa
JEL classification: J11, J13

Tables and figures: at the end of the paper.

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ISSN 1798-7237 ISBN 978-92-9256-086-7

Typescript prepared by the Authors.

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The Institute is funded through income from an endowment fund with additional contributions to its work programme from Denmark, Finland, Sweden, and the United Kingdom.

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The views expressed in this paper are those of the author(s), and do not necessarily reflect the views of the Institute or the United Nations University, nor the programme/project donors.

1. Introduction

The decline in the total fertility rate in sub-Saharan Africa (SSA) has been slow relative to the rest of the world (Figure 1). In the seminal work by Bongaarts, the stall in the fertility decline in some SSA countries was identified as a result of a "deceleration in the trends in contraceptive use" (Bongaarts 2006) at the aggregate level. Others (Onuoha 1992, Sibanda, Woubalem et al. 2003, Blacker, Opiyo et al. 2005, Spoorenberg 2009, Ndahindwa, Kamanzi et al. 2014, Majumder and Ram 2015) have identified the varying role of the proximate determinants of fertility in driving change or stagnation in the country-level total fertility rate, such as delay of marriage and breastfeeding duration.

1.1 Fertility and economic development

In many cultures, and at various times in history, having many children was a signal of prosperity and wealth. Yet in the twentieth century much work has shown that high fertility rates are one of the factors that perpetuates poverty – both at the individual and country level. Global fertility rates have declined rapidly over the twentieth century, and the rapid decline in East Asia in the second half of the twentieth century is often flagged as a poster-child of the positive links between fertility decline and economic growth (Bloom and Williamson 1998, Bloom and Finlay 2008). But fertility in SSA has remained high and stagnant.

The interplay of population dynamics – triggered by a fertility decline – and economic outcomes has been conceptualized through the demographic dividend (Bloom, Canning et al. 2003). The theory of the demographic dividend emphasizes that a decline in fertility will increase income per capita as the growth of the working-age population relative to youth dependents increases. The income generated by the working-age population is shared over fewer dependents. Declines in fertility lead to higher quality education, higher female labor force participation (Bloom, Canning et al. 2009), and higher savings, reinforcing the positive effects of the decline in fertility on economic growth from the first demographic dividend. In these studies, the analysis is done at the country level, examining declines in the national (aggregate) level of fertility and how this then translates to increases in GDP per capita.

Globally we have observed differences in the rate and level of the decline in fertility – and thus differences in the timing and magnitude of the demographic dividend. But the variation exists not just at the cross-country level, but also within countries. Within countries there is also a difference in the decline in fertility by urban/rural, education status, and wealth status.

1.2 The proximate determinants of fertility

We follow Bongaarts (2015) model of the proximate determinants of fertility, an updated version of the Bongaarts (1982) and Stover (1998) models. In developing this framework, Bongaarts himself bases his final model on the one outlined by Davis and Blake (1956). In this model, they proposed the idea of intermediate variables through which social and economic factors affect

fertility. In the Bongaarts 1982 model, he shows that, empirically, this set of intermediate variables can be reduced to a concise list of four intermediate factors: proportion of women married; postpartum infecundability; contraception; and induced abortion. The idea is that fertility is lower than the biological maximum because of delayed marriage, the use of contraception or abortion, and postpartum infecundability due to breastfeeding or abstinence. Across time, if the total fecundity rate remains unchanged then changes in the total fertility rate can be attributed to changes in these four key variables. Extended periods of postpartum infecundability, abortion, contraceptive use, and delayed marriage all play a part in reducing the observed total fertility rate from the biological maximum.

Analyzing the proximate determinants of fertility is not the only mechanism for understanding fertility decline, and unmet need, fertility preferences, and socioeconomic determinants of fertility (Bongaarts 2006) play a role. Nonetheless, the proximate determinants model can be used as an identity, and the social, economic and cultural factors change these proximate (or intermediate) factors so that the observed total fertility rate is lower than the biological maximum.

Majumder and Ram (Majumder and Ram 2015) conducted a stratified analysis by wealth tertiles in the South Asia context. Using the proximate determinants model, they were able to identify that fertility was falling in the poor tertile due to increased uptake of contraception. We apply a similar stratification by wealth status to the SSA population.

In this paper we aim to 1) show the patterns in the level and trends of the total fertility rate across countries in SSA and within these countries by wealth quintiles; 2) show how the four proximate determinants of fertility have contributed to differences in fertility trends within countries over time; and, 3) discuss the implications for economic inequality in SSA and how this informs policy options.

2. Methods

2.1 Data

We focus on illustrating the fertility estimates using Bongaarts framework with a few adjustments for each country across time. The estimates show the total fertility rate and the contribution of non-exposure to sexual activity, contraceptive use, abortion and postpartum infecundability in reducing the observed fertility rate from the biological maximum.

We focus on the SSA countries, and those that have three or more surveys within the Demographic and Health Surveys (DHS). This covers 21 countries, which are: Benin, Burkina Faso, Cameroon, Cote d'Ivoire, Ethiopia, Ghana, Guinea, Kenya, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Tanzania, Uganda, Zambia, and Zimbabwe.

We use data from the DHS, which are data collected from over 90 low- and middle-income countries, including 44 SSA African countries. The data are nationally representative. From a

household roster, women aged 15-49 are identified for an in-depth interview, and there is detailed information on fertility, contraceptive use, and reproductive health of each woman. Since 1987 there have been six phases of the DHS. In some cases only married women were eligible for the detailed women's survey. Many countries have multiple surveys (note, repeated cross section, not panel), and in SSA there are 23 countries that have three or more DHS standard surveys. Wealth index information was collected from Phase II, and there are 21 SSA countries that have three or more surveys that include wealth information. In this analysis all women are included in the analysis if the information is available for each of the variables. For the final sample of 21 countries, the key determinants of inclusion in the study are availability of information for non-married women and wealth information.

2.2 Summary of Bongaarts model

In the Bongaarts model, the total fertility rate can be estimated to be a function of the biological maximum total fertility (TF), and lower than this rate due to delayed exposure to sexual activity (Cm), contraceptive use (Cc), abortion (Ca) and postpartum infecundability (Ci). Table 1 and Table 2 summarize these components including how each index is calculated.

$$TFRe = C_m \; x \; C_c \; x \; C_i \; x \; C_a \; x \; TF$$

Bongaarts showed in his paper (Bongaarts 1982) that the estimate of total fertility rate (TFRe) is a good approximation of the observed total fertility rate, and we use Bongaarts updated model (Bongaarts 2015). In the rest of the paper, TFR refers to the total fertility rate estimated from this model but using the fixed TF (see below).

2.3 The four proximate determinants and application of the model

Cm: Sexual Exposure Index

The index of marriage is equal to one if all women of reproductive age is sexually active, and equal to zero if no woman of reproductive age are sexually active. It expresses the reduction in fertility (from the biological maximum to the observed total fertility rate) that is attributed to women not being exposed to sexual activity throughout their entire reproductive lives. The index of marriage was updated by Stover (Stover 1998), to broaden the pool of women who are sexually active beyond those who are married, and Bongaarts 2015 updates his original estimate (of married women) to include women who are pregnant, report sex in the last month, or are postpartum infecund. The contribution of this factor in reducing the total fertility rate from the biological maximum will increase if marriage is delayed (marry at an older age) or sexual debut is delayed.

Cc: Contraceptive Index

The index of contraception is equal to one in the absence of contraception, and is equal to zero if all fecund women use contraception that is 100 percent effective. It expresses the reduction in fertility (from the biological maximum to the observed TFR) that is attributed to contraceptive use. The average effectiveness rates we apply are not age specific as the Bongaarts 2015 formula

suggests. We apply the effectiveness rates from Madhavan (2014) and Bongaarts and Potter (1983) as shown in Table 3. If the contraceptive use rate increases, or the contraceptive effectiveness increases, then the contribution of the contraceptive index in explaining observed fertility increases.

Ca: Index of abortion

The index of abortion is equal to one in the absence of induced abortion, and equal to zero if all women abort and there are no live births. It expresses the reduction in fertility (from the biological maximum to the observed TFR) that is attributed to induced abortions. An abortion averts births by reducing one birth, and also making the women insusceptible to another pregnancy while she is pregnant. To estimate the total abortion rate, we take region specific aggregate rates estimated by Sedgh, Singh et al. (2012) as country-level abortion rates are not available for our sample of countries.

Ci: Index of postpartum infecundability

The index of postpartum infecundability is one in the absence of postpartum amenorrhea and postpartum abstinence, and equal to zero if postpartum infecundability continues indefinitely with 100 percent effectiveness against pregnancy. The period of postpartum amenorrhea may be extended due to a longer period of intensive breastfeeding. To calculate this component, we used the greater of the number of months of amenorrhea or the months of abstinence relating to the most recent born child. Breastfeeding duration is not directly included in this calculation, but it is implied by postpartum amenorrhea.

TF: Total fecundity

We apply a biological maximum of 15.3. This is consistent with Bongaarts (1978), but diverges from the revised method in Bongaarts (2015). It should be noted that we estimated the trends in fertility and the proximate determinants using the method for TF that Bongaarts 2015 suggested. We found that when we allow the biological maximum to be estimated in the model, it shows a substantial fluctuation capturing a residual rather than the variation in the biological maximum per se. The estimated TF, which should reflect the biological maximum, oscillated from survey year to survey year at magnitudes that were improbable. This is the reason why we fixed the biological maximum at 15.3.

Residual

Using the Bongaarts 2015 model, as opposed to the 1978 model, we find that our estimated total fertility rates tended to be higher compared to those estimated using the German Rodriguez method with the birth histories, as well as the World Population Projection estimates. Using any Bongaarts model will yield an overestimation of the total fertility rate, as the proximate determinants that are included in the estimation are a comprehensive but incomplete list of determinants. This was well discussed by Bongaarts (1978, 1982). Thus there is also a residual that accounts for the difference between the Rodriguez estimate of the total fertility rate and the Bongaarts method. This residual, however, is larger in the 2015 Bongaarts estimates compared to the 1978 estimates. The source of this difference comes from differences in the estimation

strategy: estimates are now age specific; exposure to sexual activity is not exclusive to married women.

In Figure 2 we show how the Bongaarts model is represented in the paper. The illustration also helps interpret the individual country figures (Figure 4 series).

The navy blue line represents the TFR, which is the estimated total fertility rate by the Bongaarts 2015 model with fixed TF at 15.3, and as we explain it is often higher than the observed total fertility rate due to the residual component.

The red line represents the total marital fertility rate and is what the fertility rate would be if all women were exposed to sexual activity at the age of 15. The gap between the red and the navy blue lines is the contribution of delayed marriage and sexual debut to reducing fertility rates from the biological maximum (TF).

The dark green line represents the natural fertility rate and is what the fertility rate would be if all women were exposed to sexual activity at the age of 15 and did not use contraception. Thus the gap between the red and the dark green line represents the contribution of contraceptive use to reducing fertility from the biological maximum. A wider gap indicates greater contraceptive use, and an increasing wedge indicates an increasing proportion of the fertility decline is attributed to contraceptive use as oppose to the other proximate determinants.

The orange line represents what fertility would be if (all women were exposed to sexual activity, did not use contraception, and) no woman had an abortion. The gap between the orange and the dark green line is the contribution of abortion in reducing fertility from its biological maximum. By construction, this is a fixed rate in our estimates as we use a common estimate from Sedgh, Singh et al. (2012) that is constant within region (SSA) and over time.

The blue-grey line is set at 15.3, and represents the biological maximum as defined by Bongaarts 1978, 1982 (not Bongaarts 2015). This level, 15.3 represents what the total fertility rate would be if (every woman was exposed to sexual activity, did not use contraception, had no abortions, and) there was no postpartum infecundability (no breastfeeding nor postpartum abstinence). The gap between the blue-grey and the orange line is the contribution of postpartum abstinence and amenorrhea in reducing fertility from its biological maximum. If the breastfeeding period is shortened, then this wedge will decline.

3. Results

Figure 3 shows that over time and across countries, the total fertility rate is declining for the richest wealth quintile, but has remained constant for the poorest quintile. This shows that in general, fertility decline has been experienced by the richest. Moreover, we go further to analyze the proximate determinants of fertility to examine the shifting contributions of each of the proximate determinants within countries, by wealth quintile, over time. We examine the trends in the proximate determinants by wealth quintile, and then we consider the gap between richest and poorest in the proximate determinants.

Table 4 summarizes the data used in this analysis. The data are nationally representative but are not a complete census of the country. Looking at the trends we see that for the poorest wealth quintiles, 14 of the 21 countries experienced a decline in fertility, but for the richest quintiles all 21 countries experienced a decline in fertility.

On average, the contribution of exposure to reducing fertility from the biological maximum slightly increased for both the poorest (Table 5) and the richest (Table 6) quintiles. The contribution of exposure to reducing fertility from the biological maximum increased for 14 of the 21 poorest quintiles (Table 5) and 13 of the 25 richest quintiles (Table 6). In the latest surveys it contributes between 8 percent (Namibia) and 36 percent (Senegal) for the richest quintile in explaining the observed fertility rate in SSA.

Contraceptive use plays an increasing positive role for fertility decline. For the poorest quintiles in every country the contribution of contraceptive use in reducing fertility has increased over time. On average for SSA, the contribution increased to 10 percent from 4 percent for the poorest quintiles over time. In Zambia, for example, in the earliest survey 6 percent of the reduction in fertility was explained by contractive use and in the most recent survey this is now 20 percent (Table 5). For the richest quintiles in each country, the contribution of contraceptive use in explaining the observed fertility was higher than for the poorest, on average increasing to 28 percent from 22 percent between the latest and earliest surveys. In Zambia again, for the richest quintile, the contribution of contraceptive use in explaining observed fertility went from 25 percent in the earliest survey to 33 percent in the most recent survey (Table 6). For Nigeria, in the richest quintile, the contribution of contraception in explaining observed fertility increased from 15 percent in the earliest survey to 32 percent in the most recent survey (Table 6).

It is difficult to meaningfully discuss the role of abortion given that we use rates that are an average across the continent and are not country, nor wealth quintile, specific.

Postpartum infecundability plays a dominant role of all the proximate determinants, particularly for the poorest, but this relative contribution to bringing fertility down from the biological maximum is declining rapidly over time, likely reflecting a systematic decrease in breastfeeding duration. As age of exposure increases, and contraceptive use increases (putting downward pressure on the observed total fertility rate), breastfeeding is decreasing over time for both the poorest and the richest, and this has an effect of elevating the observed total fertility rate. For the poorest quintile in each country, the average decline is less than in the richest quintiles (6 percent and 8 percent respectively). In Burkina Faso, for the poorest quintile, it went from explaining 85 percent of the observed total fertility rate in the earliest survey to explaining 71 percent in the latest survey (Table 5). But for the richest quintile in Burkina Faso the contribution of breastfeeding in explaining observed fertility dropped by a greater margin, going from 66 percent to 45 percent between earliest and latest surveys (Table 6).

In Tables 5 and 6, we look at trends within the wealth quintiles over time for the poorest and the richest quintiles, respectively. Table 7 looks at the gap between the richest and the poorest at the earliest survey for each country, and then consider how this gap between richest and poorest changes over time by examining the latest surveys as comparison. In the case of Nigeria (Table

7), in the earliest survey the contribution of exposure to reducing fertility from the biological maximum was 3 percentage points higher for the richest quintile compared to the poorest. Contraceptive use contribution was 15 percentage points higher for the richest, by postpartum infecundability contribution was 18 percentage points lower for the richest than the poorest. Over time, by the latest survey, these gaps between rich and poor had widened. The contribution of exposure to reducing fertility was now 12 percentage points higher for the richest than for the poorest (up from 3 percentage points), the contribution of contraceptive use was 31 percentage points higher in the richest, and the contribution of postpartum infecundability was 45 percentage points lower for the richest than the poorest. The gap between richest and poorest widened on all three counts: the richest relying more on delayed marriage and contraception and less on breastfeeding over time.

We also represent each country individually to illustrate trends over time and comparing across the wealth quintiles within countries (Figure 4 series).

4. Discussion

Overall, the total fertility rate has declined more significantly for the richest quintiles than for the poorest quintiles.

Exposure to sexual activity plays a varying role in determining the fertility rate, but this contribution has not changed much over time across all the wealth quintiles. Contraceptive use plays an increasingly positive role for fertility decline, particularly for the richest. Postpartum infecundability plays the dominant role of all the proximate determinants of fertility, particularly for the poorest, but its relative contribution is declining rapidly over time potentially reflecting a systematic decrease in breastfeeding periods. Where fertility rates fell, the increase in contraceptive use appear to outweigh the decrease in breastfeeding.

4.1 Africa's inclusive growth

Fertility decline is linked to positive economic growth through the theory of the demographic dividend. A decline in fertility means that there are fewer dependents to workers to support, and income per capita increases if productivity per worker remains constant. At the household level, if fertility remains high in poorer households compared to richer households, then within the poorer household the working-age household members are supporting more dependents perpetuating poverty within that household. By this, the rich get richer and the poor get poorer.

At the aggregate level, however, there may be spillover effects of a decline in fertility that is concentrated in the richer quintiles over to people in the poorer quintiles. As aggregate fertility declines, even if only amongst the richest quintiles, then in the aggregate the ratio of working-age individuals to youth dependents will decline. Young dependents belong to cohorts that are shrinking in size (once population momentum irons out), and even if youths belong to households with many siblings (in the poorer households) at the national level they belong to a

smaller cohort. For them, competition for education and jobs is less intense, and aggregate resources generated by the working-age are shared across the entire population.

We know little of the within-country variation in fertility decline affecting economic inequality. This paper takes the first step in identifying the variation in fertility decline within a country across wealth quintiles.

Looking across time within a country, a few trends stand out. The fertility rate was declining across all wealth groups in South Asia, but this is not the case in SSA (Majumder and Ram 2015). The postpartum infecundability plays a bigger role to reducing fertility from the biological maximum in SSA than in South Asia This could be due to a number of factors: breastfeeding periods may be longer in SSA, postpartum abstinence may be longer in SSA, or in SSA women may have a longer period of amenorrhea. In some (not all) SSA countries delayed exposure to sexual activity plays a role in reducing fertility from the biological maximum, but in the South Asian countries this is not the case. This may be due to the low age of marriage in the South Asian countries. Third, contraception plays a very small role in SSA, and a minor role in the South Asian countries in the aggregated (wealth quintiles pooled) reflecting the relatively low prevalence of modern contraceptive use in SSA.

When looking at the plots, it seems that there are five different types of countries: those where changes in fertility and the determinants is only amongst the richest quintile (Mali, Mozambique, Niger); those countries where only the richest and rich quintiles saw any change in fertility and its determinants (Benin, Burkina Faso, Cote d'Ivoire, Guinea, Zimbabwe); those countries where the richest show the strongest declines in fertility and increase in contraceptive use but there is evidence of these trends creeping into the rich and middle (and sometimes the poor and poorest) quintiles (Cameroon, Madagascar, Nigeria, Senegal, Tanzania, Uganda); those countries where the richest show the strongest declines in fertility and increase in contraceptive use but there is evidence of these trends creeping into the rich, middle, and poor (Ethiopia, Ghana, Kenya, Malawi, Namibia, Zambia); and then this is one country that looks equal across the wealth quintiles (Rwanda).

4.2 Limitations

There are some limitations to the analysis that should be recognized so that interpretation of the results can be made with caution. The residual is often high, and we do not fully understand its composition. Misreporting of contraceptive use, potentially under-reporting, which would downplay the contribution of contraception to the determination of the observed total fertility rate. The abortion rate is for the entire region, and not country and age specific as the other components have been calculated. This means that our interpretation of abortion is not specific to countries or wealth quintiles.

4.3 Policy implications

To utilize these results to offer policy recommendations, there are two approaches. One is to capitalize on the observed, and the other is to create policies that target the shortfall in trends. Age of marriage/exposure is constant over time, and policies that promote the delay of first marriage/exposure will have an effect of decreasing fertility across all of the wealth quintiles. Contraceptive use is increasing among the richest and rich quintiles, but policies promoting contraceptive use among the middle, poor, and poorest quintiles will help the poorer women in the country benefit the same as their richer counterparts.

We can apply the methods we have used in this paper to other countries, other sub-groups within populations (for example education or urban/rural), so that we may understand the variability in the trends and determinants of fertility change. The results we present here are not designed to be generalizable to other populations, the aim was to comment on the specific nature of population dynamics within these countries, and the results highlight the heterogeneity across and within countries in SSA on the trends and determinants of fertility.

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Tables:

Table 1: Age-specific proximate determinants model and equations

Index	Equations	Variables
Age-specific model:	$f(a) = C_m^*(a)C_c^*(a)C_i^*(a)C_a^*(a)f_f^*(a)$	* Represents revised measures
Sexual exposure index	$C_m^*(a) = m(a) + ex(a)$	$m(a)$: proportion married/union $ex(a)$: extramarital exposure
Contraceptive index	$C_c^*(a) = 1 - r^*(a)(u^*(a) - o(a))e^*(a)$	$u^*(a)$: contraceptive prevalence (exposed women) $o(a)$: overlap with postpartum infecundability $e^*(a)$: average effectiveness $r^*(a)$: fecundity adjustment
Postpartum infecundability index	$C_i^*(a) = \frac{20}{18.5 + i(a)}$	$i(a)$: average duration of postpartum infecundability
Abortion index	$C_i^*(a) = \frac{f(a)}{f(a) + b^* ab(a)}$ $b^* = \frac{14}{18.5 + i(a)}$	$ab(a)$: abortion rate

Source: Reproduced from Bongaarts (2016).

Table 2: Aggregate proximate determinants model and equations

Index	Equations	Variables
Revised aggregate model	$TFR = \sum_a C_m^*(a)C_c^*(a)C_i^*(a)C_a^*(a)f_f^*(a)$ $= C_m^* C_c^* C_i^* C_a^* TF^*$	TF^*: revised total fecundity rate $f_f^*(a)$: revised fecundity rate
Sexual exposure index	$C_m^* = \sum_a C_m^*(a)w_m(a)$ $w_m(a) = \frac{f_m^*(a)}{\sum_a f_m^*(a)}$ $f_m^*(a) = C_c^*(a)C_i^*(a)C_a^*(a)f_f^*(a)$	$f_m^*(a)$: fertility rate, exposed women a: age
Contraceptive index	$C_c^* = \sum_a C_c^*(a)w_c(a)$ $w_c(a) = \frac{f_n^*(a)}{\sum_a f_n^*(a)} \approx \frac{f_f^*(a)}{\sum_a f_f^*(a)}$ $f_n^*(a) = C_i^*(a)C_a^*(a)f_f^*(a)$	$f_n^*(a)$: natural exposed fertility a: age
Postpartum infecundability index	$C_i^* = \sum_a C_i^*(a)w_i(a) \approx C_i$	
Abortion index	$C_a^* = \sum_a C_a^*(a)w_a(a) \approx \frac{TFR}{TFR + b^* TAR}$	

Source: Reproduced from Bongaarts (2016).

Table 3: Classification of contraceptive methods and effectiveness

Modern	Effectiveness	Traditional	Effectiveness
Pill	0.92	Periodic abstinence	0.50
IUD	0.96	Withdrawal	0.50
Injections	1.00	Other	0.10
Diaphragm	0.81	Abstinence	1.00
Condom	0.81	Specific method	0.10
Female sterilization	1.00		
Male sterilization	1.00		
Implants/Norplant	1.00		
Lactational amenorrhea	1.00		
Female condom	0.81		
Foam or Jelly	0.91		
Oher modern method	0.91		

Source: Bongaarts (1978), Madhavan (2014), Bongaarts (2015).

Table 4: Summary data and regression time trends in estimated TFR for poorest and richest

Country name	Sample size of women per country	Earliest survey year	Latest survey year	Estimated Total Fertility Rate from latest survey	Poorest wealth quintile: OLS regression coefficient on the time trend	WQ 1 time trend p-value	Richest wealth quintile: OLS regression coefficient on the time trend	WQ5 time trend p-value
Benin	38,199	1996	2011	7.3	-0.05	(0.0858)	-0.01	(0.626)
Burkina Faso	35,405	1992	2010	7.5	0.01	(0.515)	-0.05	(0.154)
Cameroon	28,930	1991	2011	6.9	-0.01	(0.728)	-0.08	(0.00877)
Cote d'Ivoire	17,563	1994	2011	7.5	0.01	(0.831)	0.00	(0.975)
Ethiopia	30,443	2000	2010	5.2	0.07	(0.539)	-0.09	(0.143)
Ghana	18,790	1993	2008	5.9	-0.04	(0.0490)	-0.10	(0.356)
Guinea	20,359	1999	2012	7.2	0.04	(0.236)	-0.05	(0.425)
Kenya	29,082	1993	2008	5.0	-0.06	(0.0491)	-0.03	(0.204)
Madagascar	30,229	1992	2008	6.4	-0.09	(0.148)	-0.02	(0.683)
Malawi	41,605	1992	2010	5.2	-0.09	(0.0552)	-0.14	(0.00585)
Mali	44,687	1995	2012	8.6	-0.01	(0.262)	-0.01	(0.722)
Mozambique	29,503	1997	2011	7.3	-0.05	(0.570)	-0.09	(0.451)
Namibia	23,626	1992	2013	4.4	-0.09	(0.159)	-0.05	(0.417)
Niger	29,087	1992	2012	8.8	0.02	(0.546)	0.05	(0.133)
Nigeria	76,737	1990	2013	7.4	0.04	(0.0944)	-0.05	(0.00586)
Rwanda	24,307	1992	2010	3.7	-0.10	(0.0263)	-0.10	(0.0470)
Senegal	49,189	1986	2014	6.1	0.00	(0.954)	-0.02	(0.245)
Tanzania	32,920	1991	2009	6.3	-0.03	(0.0417)	-0.10	(0.00328)
Uganda	27,951	1988	2011	6.1	-0.09	(0.00929)	-0.10	(0.217)
Zambia	35,043	1992	2013	5.3	-0.05	(0.282)	-0.09	(0.0470)
Zimbabwe	30,853	1994	2010	4.4	-0.06	(0.257)	-0.04	(0.443)
Total	**694,508**							

Note: Estimated total fertility rate using the Bongaarts 2015 model with fixed biological maximum at 15.3

Source: Authors´ calculation based on DHS data.

Table 5: Poorest

Poorest														
	Earliest survey					Latest survey					latest - earliest			
	fCm	fCc	fCa	fCi		fCm	fCc	fCa	fCi		dfCm	dfCc	dfCa	dfCi
Benin	0.08	0.04	0.09	0.79		0.14	0.04	0.07	0.75		0.06	0.01	-0.02	-0.05
Burkina Faso	0.07	0.01	0.07	0.85		0.16	0.06	0.07	0.71		0.09	0.04	0.00	**-0.14**
Cameroon	0.09	0.02	0.10	0.80		0.18	0.02	0.09	0.71		0.09	0.01	0.00	-0.09
Cote d'Ivoire	0.10	0.02	0.11	0.78		0.12	0.07	0.09	0.72		0.02	0.05	-0.02	-0.06
Ethiopia	0.27	0.01	0.06	0.66		0.23	0.08	0.07	0.61		-0.04	0.07	0.02	-0.04
Ghana	0.16	0.07	0.09	0.68		0.22	0.08	0.06	0.64		0.06	0.01	-0.03	-0.04
Guinea	0.07	0.01	0.06	0.87		0.09	0.01	0.07	0.82		0.03	0.00	0.01	-0.05
Kenya	0.18	0.09	0.09	0.64		0.26	0.10	0.08	0.56		0.08	0.01	-0.01	-0.08
Liberia	0.12	0.04	0.07	0.77		0.13	0.12	0.08	0.67		0.01	0.08	0.01	**-0.10**
Madagascar	0.17	0.04	0.10	0.69		0.17	0.15	0.10	0.58		0.00	**0.11**	0.00	**-0.11**
Malawi	0.28	0.06	0.10	0.55		0.17	0.21	0.07	0.56		**-0.11**	**0.15**	-0.04	0.00
Mali	0.10	0.01	0.13	0.76		0.11	0.03	0.10	0.76		0.01	0.02	-0.03	0.00
Mozambique	0.15	0.01	0.14	0.69		0.17	0.03	0.09	0.71		0.02	0.01	-0.05	0.02
Namibia	0.27	0.05	0.05	0.62		0.15	0.29	0.04	0.52		**-0.12**	**0.23**	-0.01	**-0.10**
Niger	0.13	0.01	0.09	0.78		0.10	0.02	0.08	0.80		-0.03	0.01	-0.01	0.03
Nigeria	0.10	0.01	0.09	0.80		0.10	0.01	0.08	0.81		0.00	0.00	-0.01	0.01
Rwanda	0.30	0.08	0.07	0.55		0.28	0.16	0.06	0.51		-0.03	0.08	-0.01	-0.04
Senegal	0.13	0.01	0.08	0.78		0.14	0.10	0.07	0.70		0.02	0.08	-0.01	-0.09
Tanzania	0.12	0.05	0.09	0.75		0.15	0.14	0.09	0.62		0.03	0.09	0.00	**-0.12**
Togo	0.10	0.04	0.08	0.77		0.17	0.12	0.07	0.64		0.06	0.08	-0.01	**-0.13**
Uganda	0.11	0.04	0.12	0.74		0.19	0.09	0.07	0.65		0.08	0.05	-0.04	-0.09
Zambia	0.16	0.06	0.09	0.69		0.14	0.20	0.07	0.59		-0.01	**0.13**	-0.02	-0.09
Zimbabwe	0.19	0.20	0.10	0.51		0.14	0.26	0.10	0.50		-0.05	0.06	-0.01	0.00
Average	0.15	0.04	0.09	0.72		0.16	0.10	0.08	0.66		0.01	0.06	-0.01	-0.06

Source: Authors´ calculation based on DHS data.

Note fCm is the relative contribution of exposure to the reduction in fertility from the biological maximum. fCm the relative contribution of contraction, fCa the relative contribution of abortion, fCi the relative contribution of postpartum infacundability, dfCm is the change in the relative contribution of exposure between the earliest and latest survey, dfCc is the change in the relative contribution of contraception between the earliest and latest survey, dfCa is the change in the relative contribution of abortion between the earliest and latest survey, and dfCi is the change in the relative contribution of postpartum infecundability between the earliest and latest survey.

Table 6: Richest

Richest														
	Earliest survey					Latest survey					latest - earliest			
	fCm	fCc	fCa	fCi		fCm	fCc	fCa	fCi		dfCm	dfCc	dfCa	dfCi
Benin	0.16	0.19	0.13	0.51		0.25	0.19	0.11	0.45		0.09	0.00	-0.03	-0.06
Burkina Faso	0.11	0.15	0.09	0.66		0.16	0.30	0.10	0.45		0.05	**0.15**	0.01	**-0.21**
Cameroon	0.08	0.24	0.12	0.56		0.15	0.30	0.15	0.40		0.07	0.06	0.03	**-0.16**
Cote d'Ivoire	0.13	0.22	0.13	0.52		0.18	0.23	0.12	0.46		0.05	0.01	0.00	-0.06
Ethiopia	0.26	0.15	0.09	0.50		0.21	0.32	0.11	0.35		-0.05	**0.17**	0.03	**-0.15**
Ghana	0.18	0.22	0.15	0.45		0.28	0.24	0.13	0.35		**0.10**	0.02	-0.01	**-0.10**
Guinea	0.13	0.11	0.06	0.69		0.19	0.13	0.08	0.61		0.05	0.02	0.01	-0.08
Kenya	0.17	0.33	0.13	0.37		0.18	0.33	0.13	0.37		0.01	0.00	-0.01	-0.01
Liberia	0.13	0.20	0.14	0.53		0.14	0.24	0.13	0.48		0.01	0.05	0.00	-0.06
Madagascar	0.22	0.27	0.17	0.34		0.15	0.34	0.19	0.32		-0.07	0.07	0.02	-0.02
Malawi	0.20	0.21	0.11	0.47		0.17	0.34	0.10	0.39		-0.04	**0.13**	-0.01	-0.08
Mali	0.15	0.22	0.12	0.51		0.19	0.24	0.10	0.48		0.04	0.01	-0.02	-0.03
Mozambique	0.14	0.18	0.14	0.54		0.12	0.24	0.13	0.51		-0.02	0.06	-0.01	-0.03
Namibia	0.11	0.42	0.07	0.40		0.08	0.46	0.07	0.39		-0.02	0.04	0.00	-0.02
Niger	0.24	0.17	0.10	0.49		0.24	0.20	0.09	0.48		-0.01	0.03	-0.01	-0.01
Nigeria	0.13	0.15	0.10	0.62		0.21	0.32	0.11	0.36		0.08	**0.17**	0.01	**-0.26**
Rwanda	0.34	0.14	0.08	0.43		0.31	0.28	0.09	0.32		-0.03	**0.14**	0.01	**-0.11**
Senegal	0.34	0.15	0.09	0.42		0.36	0.17	0.08	0.39		0.02	0.02	-0.01	-0.03
Tanzania	0.11	0.23	0.12	0.54		0.18	0.34	0.12	0.36		0.07	**0.11**	0.00	**-0.17**
Togo	0.14	0.19	0.16	0.51		0.19	0.25	0.12	0.44		0.06	0.06	-0.04	-0.07
Uganda	0.15	0.26	0.13	0.46		0.18	0.34	0.12	0.36		0.03	0.08	-0.01	**-0.10**
Zambia	0.23	0.25	0.10	0.42		0.21	0.33	0.11	0.35		-0.02	0.08	0.01	-0.07
Zimbabwe	0.19	0.34	0.13	0.34		0.23	0.31	0.13	0.33		0.04	-0.03	0.00	-0.01
Average	0.18	0.22	0.12	0.49		0.20	0.28	0.11	0.41		0.02	0.06	0.00	-0.08

Source: Authors´ calculation based on DHS data.

Note fCm is the relative contribution of exposure to the reduction in fertility from the biological maximum. fCm the relative contribution of contraction, fCa the relative contribution of abortion, fCi the relative contribution of postpartum infacundability, dfCm is the change in the relative contribution of exposure between the earliest and latest survey, dfCc is the change in the relative contribution of contraception between the earliest and latest survey, dfCa is the change in the relative contribution of abortion between the earliest and latest survey, and dfCi is the change in the relative contribution of postpartum infecundability between the earliest and latest survey.

Table 7: Differences in the relative contribution of each component between the poorest and richest wealth quintiles

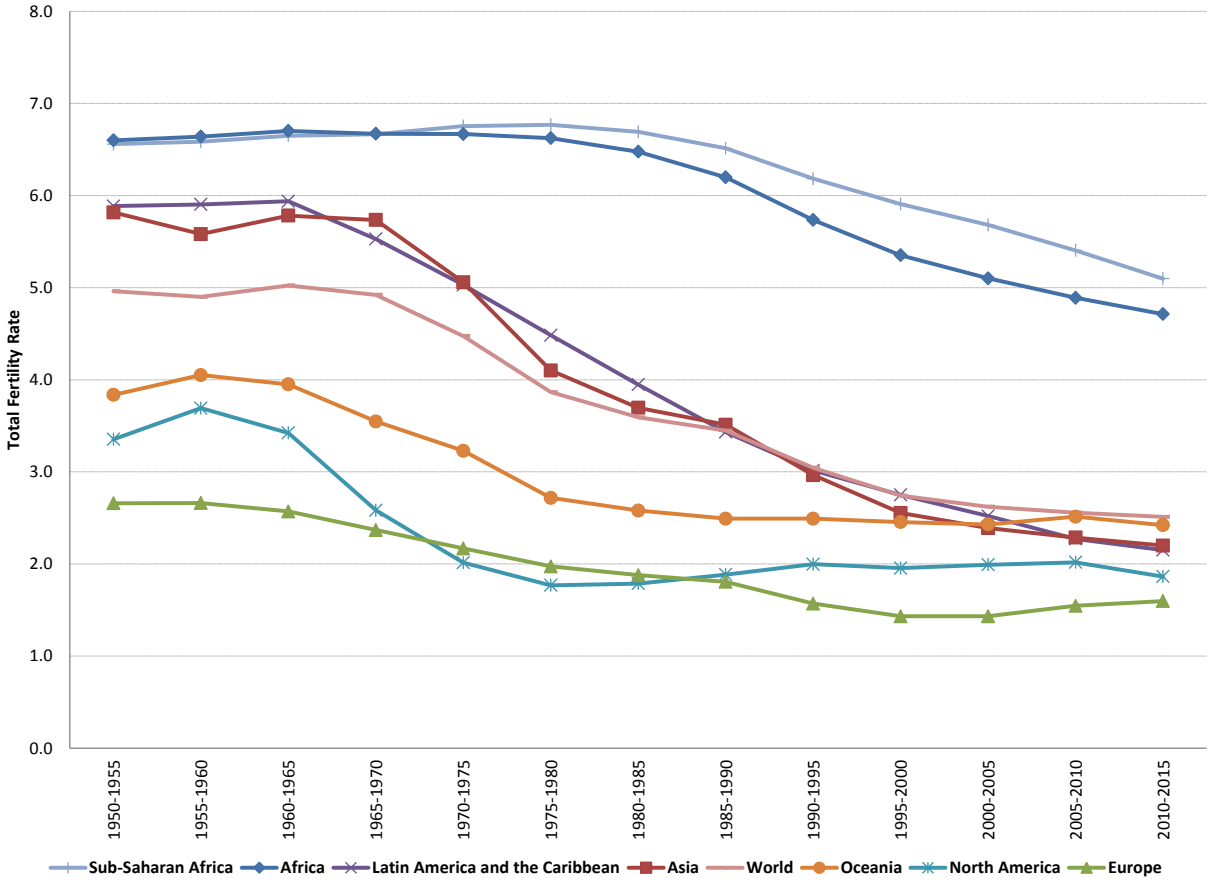
	Earliest Survey: Richest - Poorest					Latest Survey: Richest - Poorest					(Latest Survey: Richest - Poorest) - (Earliest Survey: Richest - Poorest)			
	Cm	Cc	Ca	Ci		Cm	Cc	Ca	Ci		Cm	Cc	Ca	Ci
Benin	0.08	0.16	0.04	-0.28		0.10	0.15	0.04	-0.29		0.03	-0.01	0.00	-0.02
Burkina Faso	0.04	0.14	0.02	-0.19		0.00	0.24	0.03	-0.27		-0.04	0.10	0.01	-0.07
Cameroon	-0.01	0.22	0.02	-0.24		-0.03	0.27	0.06	-0.31		-0.02	0.05	0.03	-0.07
Cote d'Ivoire	0.03	0.20	0.02	-0.26		0.06	0.16	0.03	-0.26		0.03	-0.04	0.01	0.00
Ethiopia	-0.01	0.14	0.03	-0.16		-0.02	0.24	0.04	-0.26		-0.01	0.10	0.01	**-0.10**
Ghana	0.02	0.15	0.06	-0.22		0.05	0.16	0.07	-0.29		0.04	0.01	0.01	-0.06
Guinea	0.07	0.10	0.01	-0.18		0.09	0.12	0.01	-0.22		0.02	0.01	0.00	-0.04
Kenya	-0.01	0.23	0.04	-0.27		-0.08	0.22	0.05	-0.19		-0.07	-0.01	0.01	0.08
Madagascar	0.05	0.23	0.06	-0.35		-0.02	0.19	0.08	-0.26		-0.07	-0.04	0.02	0.09
Malawi	-0.08	0.15	0.01	-0.08		0.00	0.13	0.04	-0.17		0.08	-0.02	0.03	-0.09
Mali	0.05	0.21	-0.01	-0.25		0.08	0.20	0.00	-0.29		0.03	-0.01	0.01	-0.03
Mozambique	-0.01	0.16	0.00	-0.15		-0.05	0.21	0.04	-0.20		-0.05	0.05	0.04	-0.05
Namibia	-0.17	0.37	0.01	-0.22		-0.07	0.18	0.03	-0.13		**0.10**	**-0.19**	0.01	0.08
Niger	0.12	0.16	0.01	-0.29		0.14	0.18	0.01	-0.32		0.02	0.02	0.00	-0.04
Nigeria	0.03	0.15	0.01	-0.18		0.12	0.31	0.03	-0.45		0.09	**0.16**	0.02	**-0.27**
Rwanda	0.04	0.06	0.01	-0.12		0.04	0.12	0.03	-0.19		-0.01	0.06	0.02	-0.07
Senegal	0.21	0.14	0.01	-0.37		0.22	0.08	0.01	-0.31		0.01	-0.06	0.00	0.06
Tanzania	-0.01	0.18	0.04	-0.21		0.03	0.20	0.03	-0.26		0.04	0.02	-0.01	-0.05
Uganda	0.04	0.22	0.01	-0.28		0.00	0.25	0.04	-0.29		-0.05	0.02	0.04	-0.01
Zambia	0.07	0.19	0.01	-0.27		0.07	0.13	0.04	-0.24		0.00	-0.05	0.03	0.02
Zimbabwe	0.00	0.14	0.02	-0.17		0.08	0.06	0.03	-0.17		0.08	-0.08	0.01	-0.01

Source: Authors´ calculation based on DHS data.

Note Cm exposure; Cc contraception; Ca abortion; Ci postpartum infecundability.

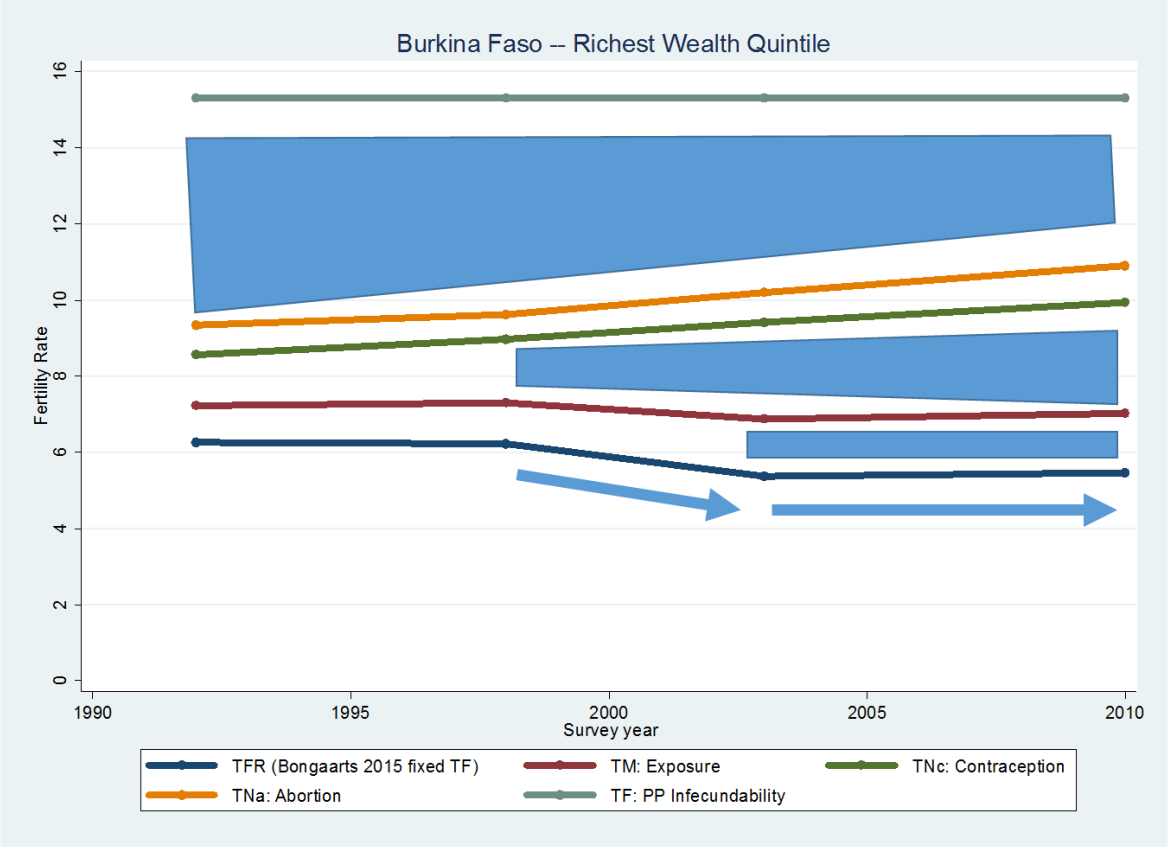
Figures:

Figure 1: Total fertility rate by region



Source: UN World Population Prospects: The 2015 Revision.

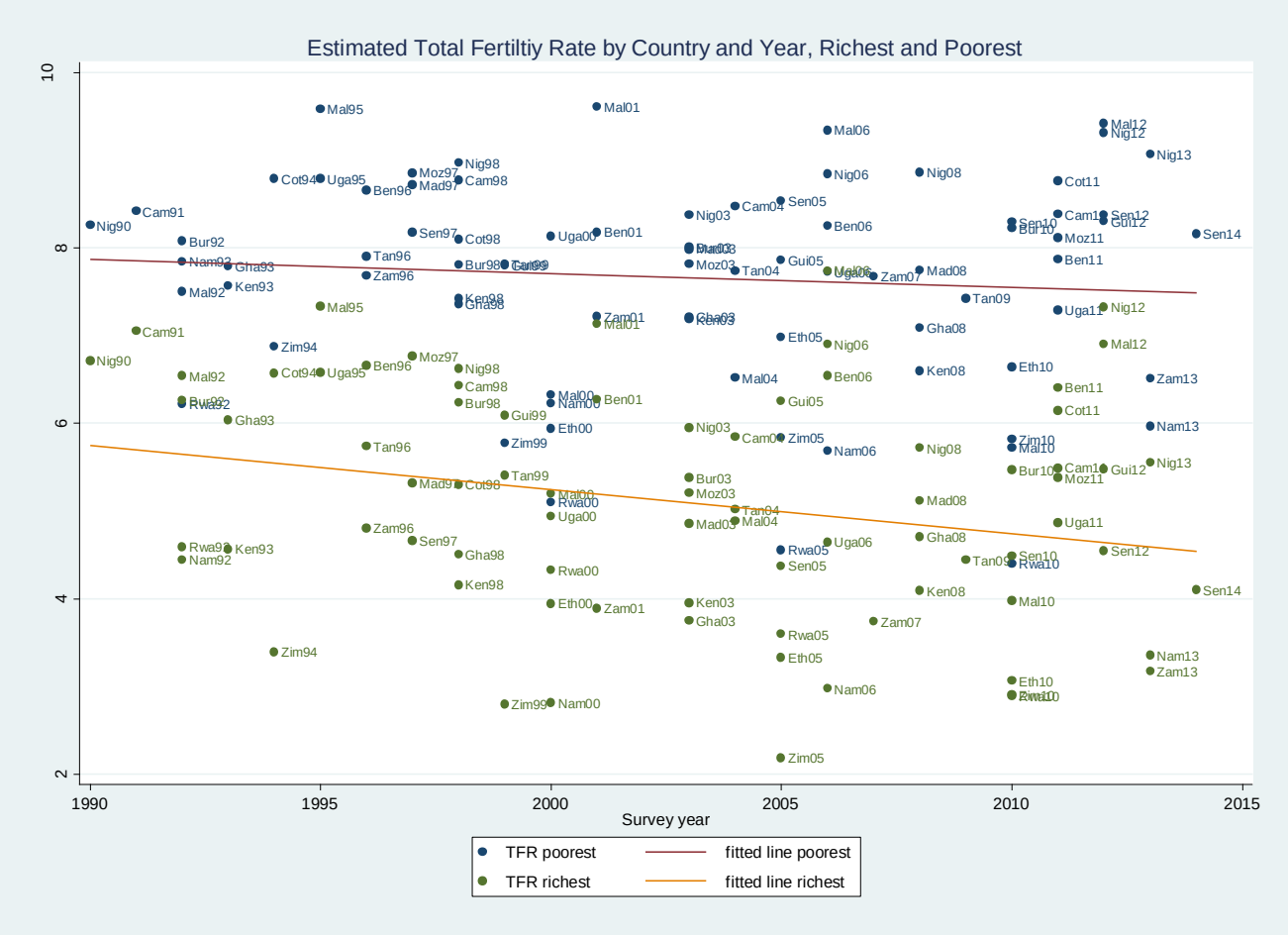
Figure 2: The proximate determinants of fertility



Source: Authors´ calculation based on DHS data and additional illustration.

Note: TFR is the estimated total fertility rate by the Bongaarts 2015 model with fixed total fertility (TF) at 15.3. TM is the total marital fertility rate, and is what the fertility rate would be if all women were exposed to sexual activity at the age of 15. The gap between TM and TFR is the contribution of delayed marriage and sexual debut to reducing fertility rates from the biological maximum. TNc is the natural fertility rate (contraception) and represents what the total fertility rate would be if all women were exposed sexual activity by the age of 15 and did not use contraception. The gap between TM and TNc is the contribution of contraception in reducing fertility from the biological maximum to the observed fertility rate. TNa is the natural fertility rate (abortion) and represents what the total fertility rate would be if all women were exposed sexual activity by the age of 15, did not use contraception, and there were no abortions. The gap between TNa and TNc is the contribution of abortion in reducing fertility from the biological maximum to the observed fertility rate. TF is the total fecundity rate, 15.3, and is the biological maximum for the woman. It represents what the total fertility rate would be in the absence of delayed marriage, contraception, abortion, and postpartum abstinence and amenorrhea.

Figure 3: Total fertility rate for poorest and richest. Fitted line by wealth quintile.



Source: Authors´ calculation based on DHS data.

Figure 4 series

Source: Authors´ calculation based on DHS data.

Figure 4-1. Benin

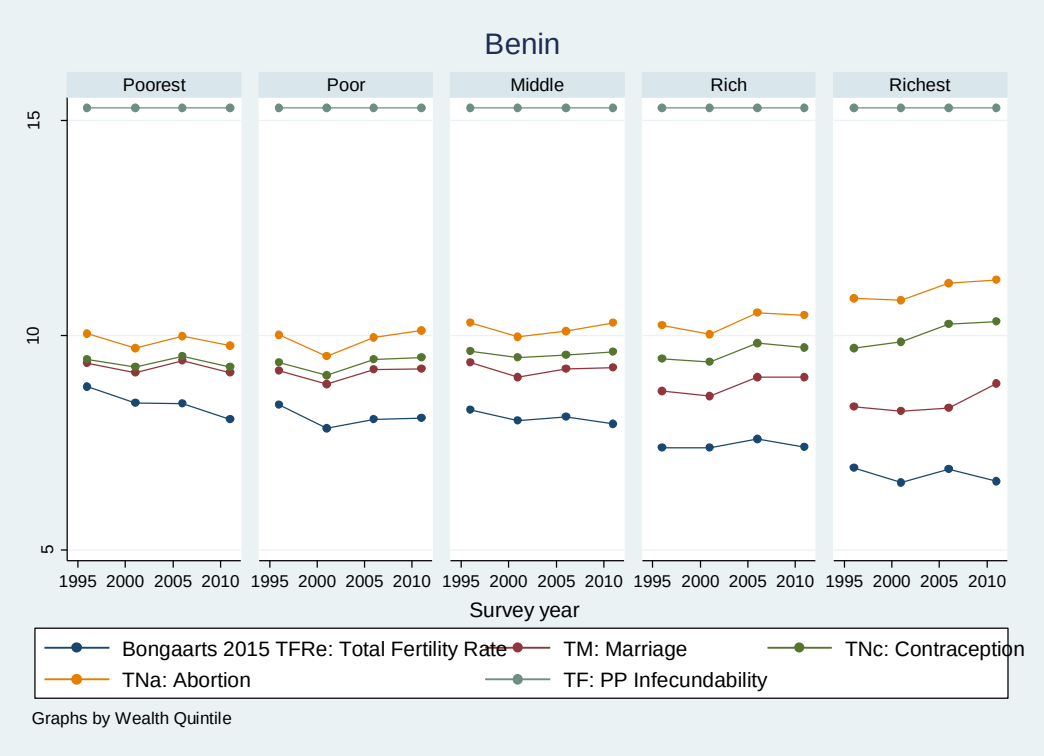


Figure 4-2. Burkina Faso

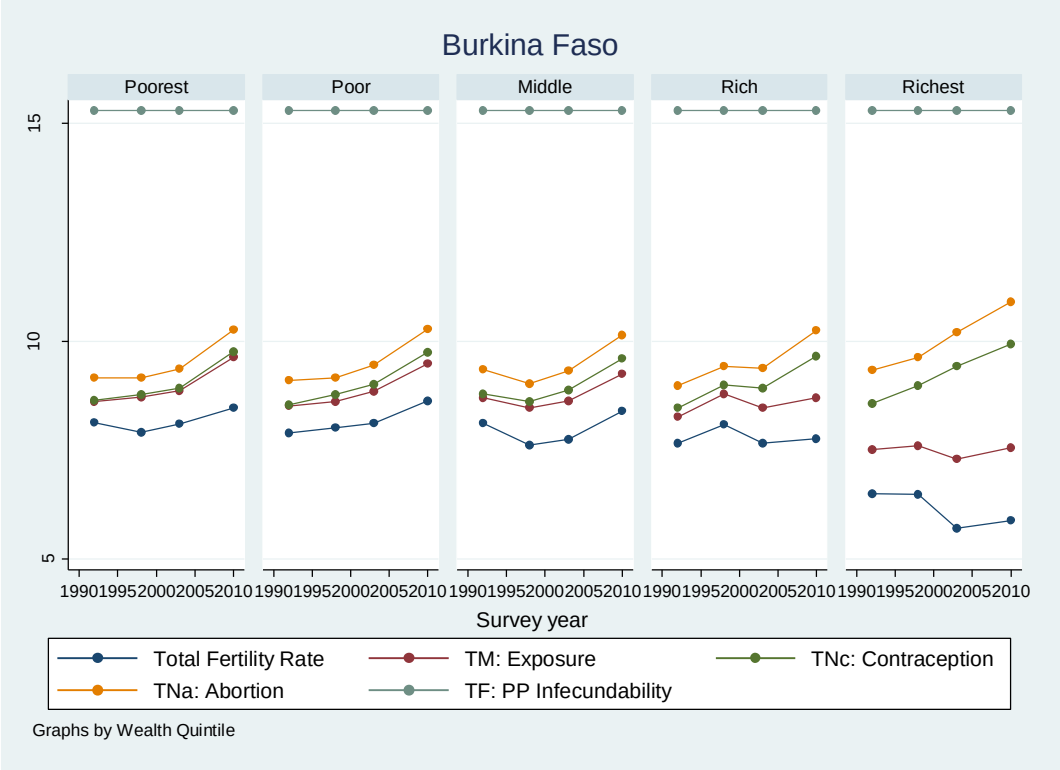


Figure 4-3 Cameroon

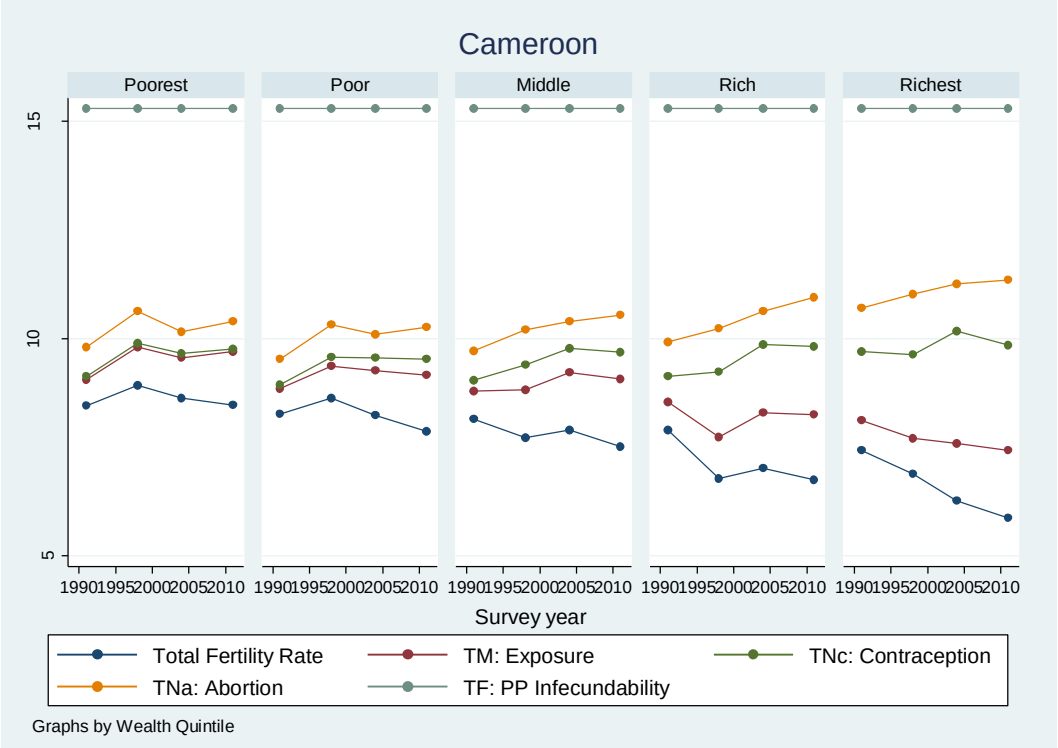


Figure 4-4. Cote d´Ivoire

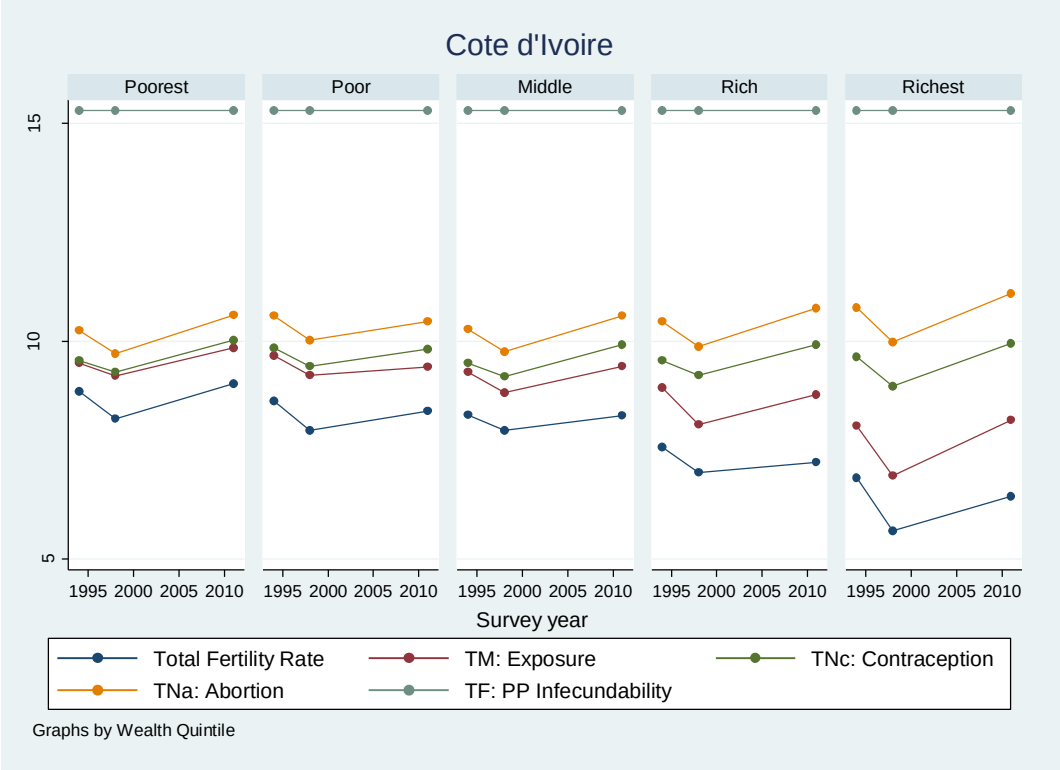


Figure 4-5. Ethiopia

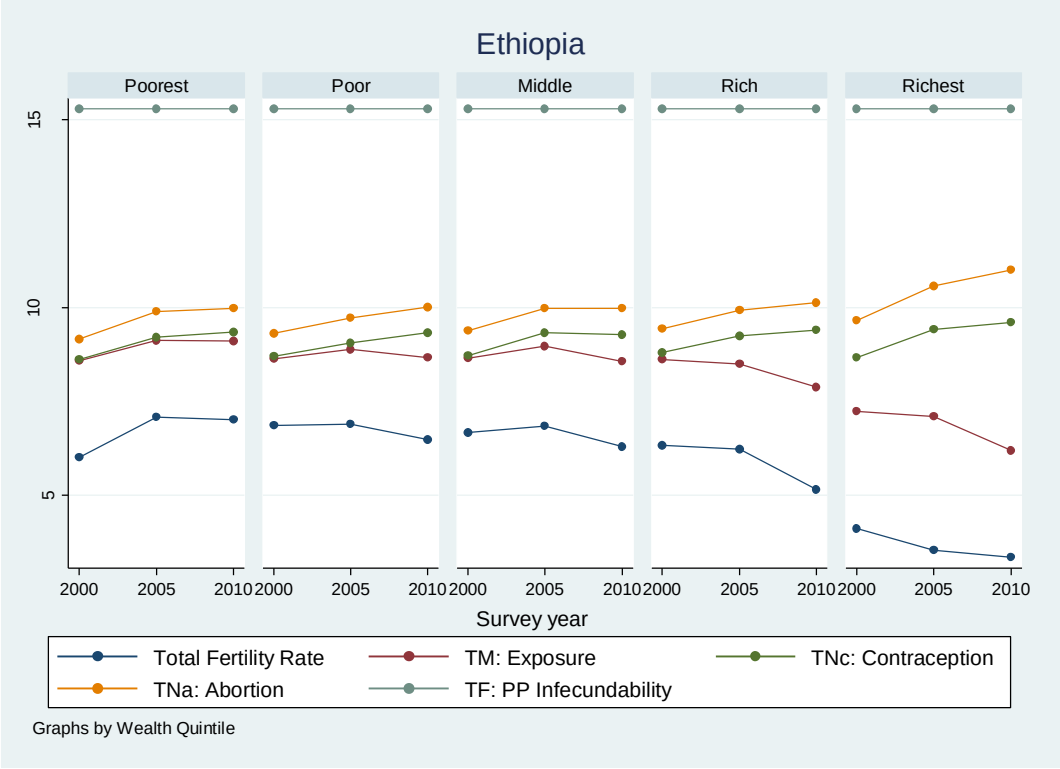


Figure 4-6. Ghana

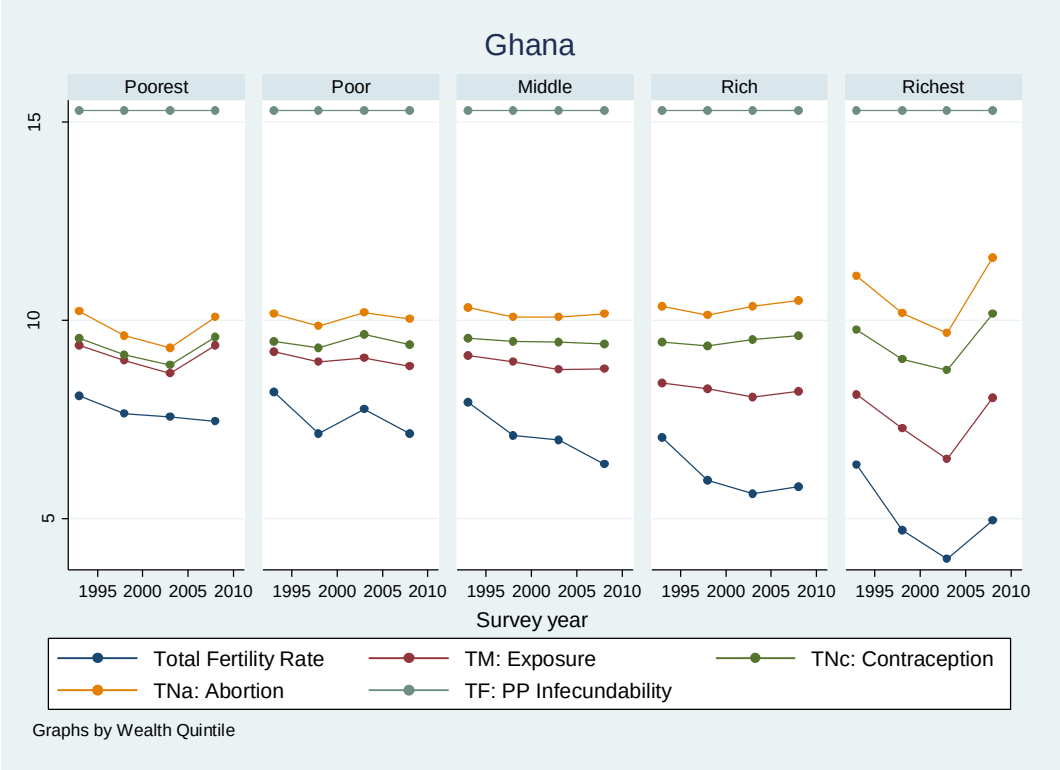


Figure 4-7. Guinea

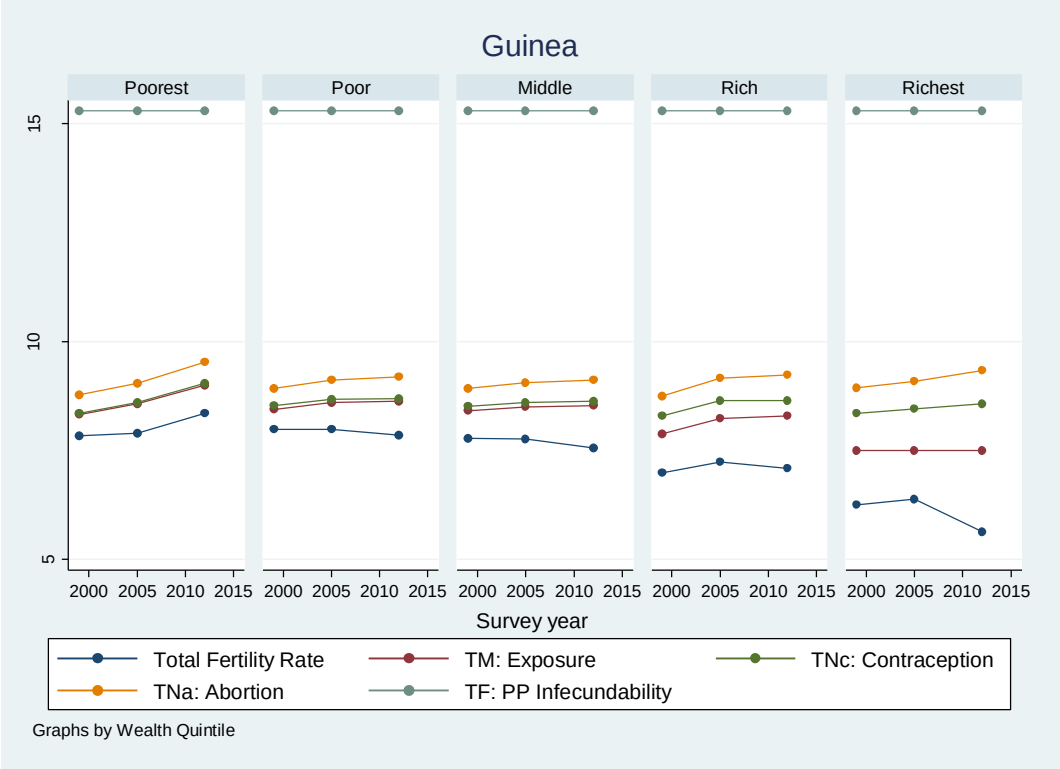


Figure 4-8 Kenya

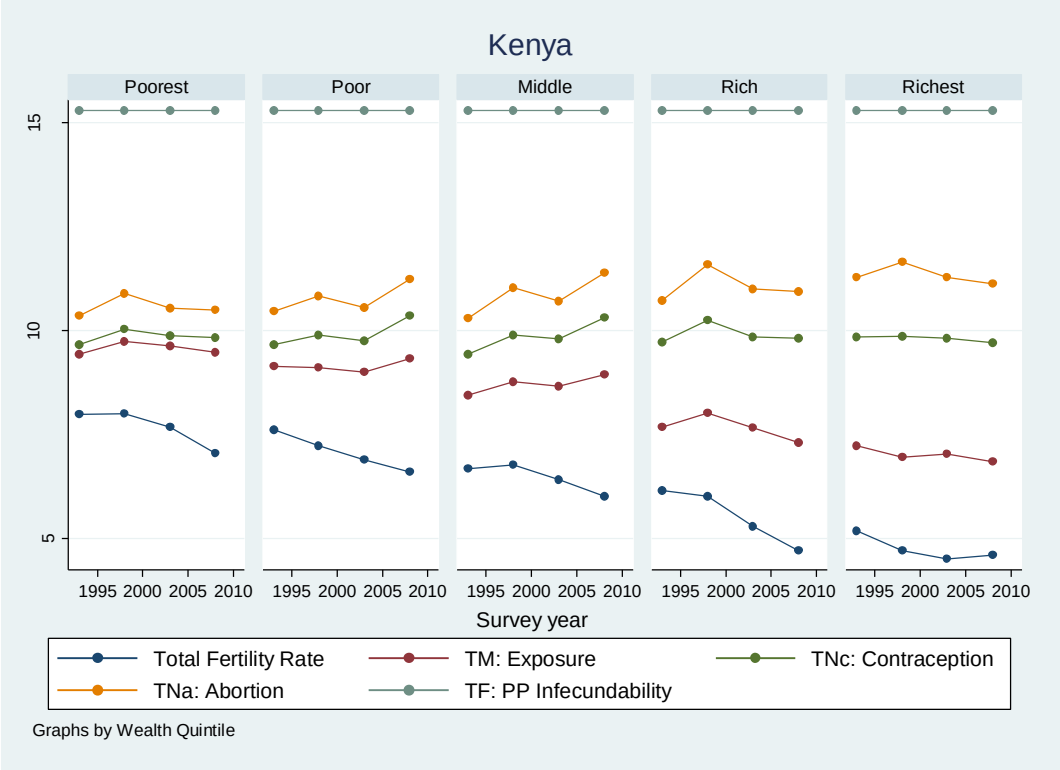


Figure 4-9. Madagascar

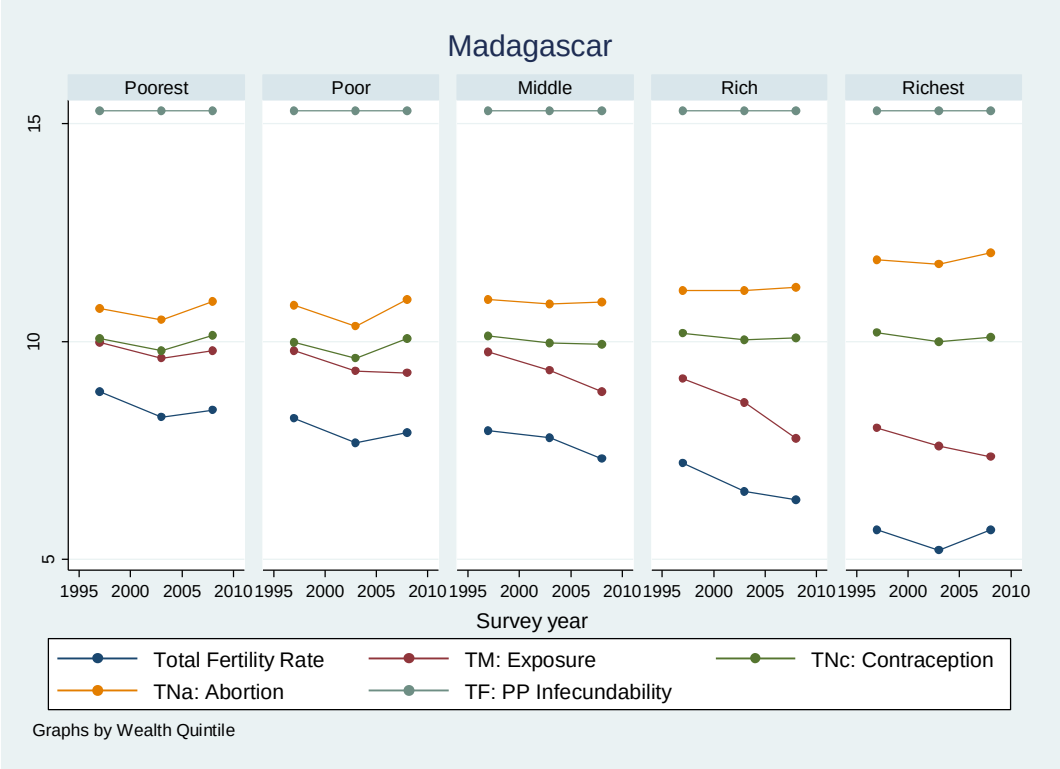


Figure 4-10. Malawi

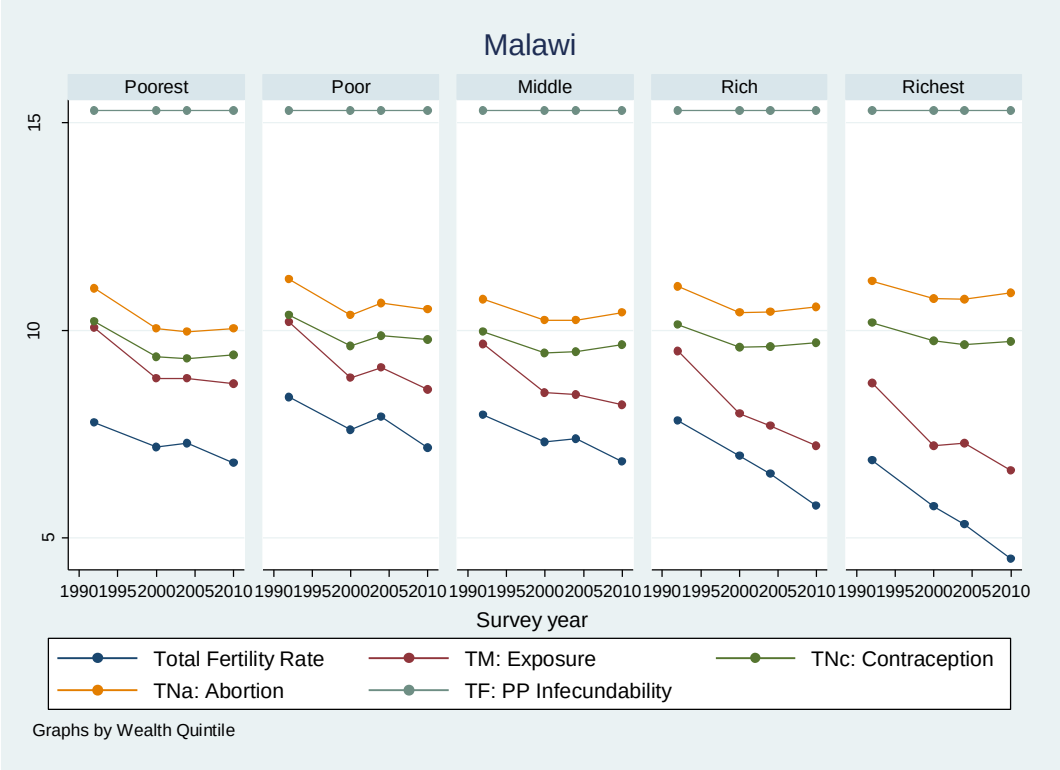


Figure 4-11. Mali

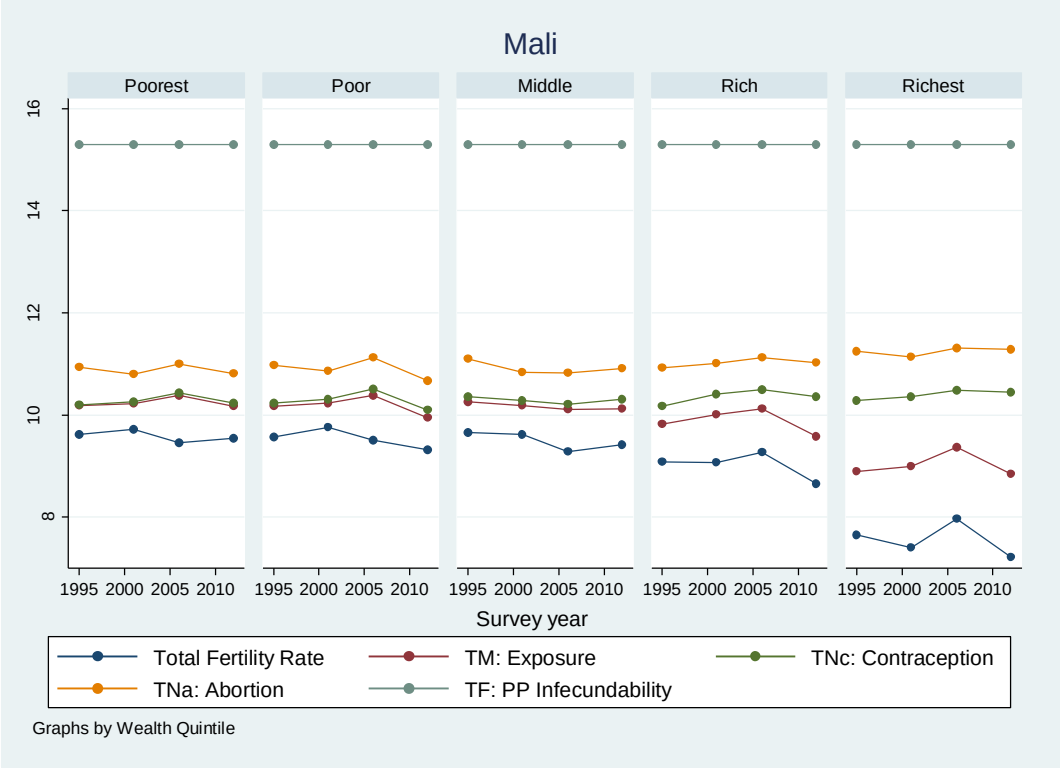


Figure 4-12. Mozambique

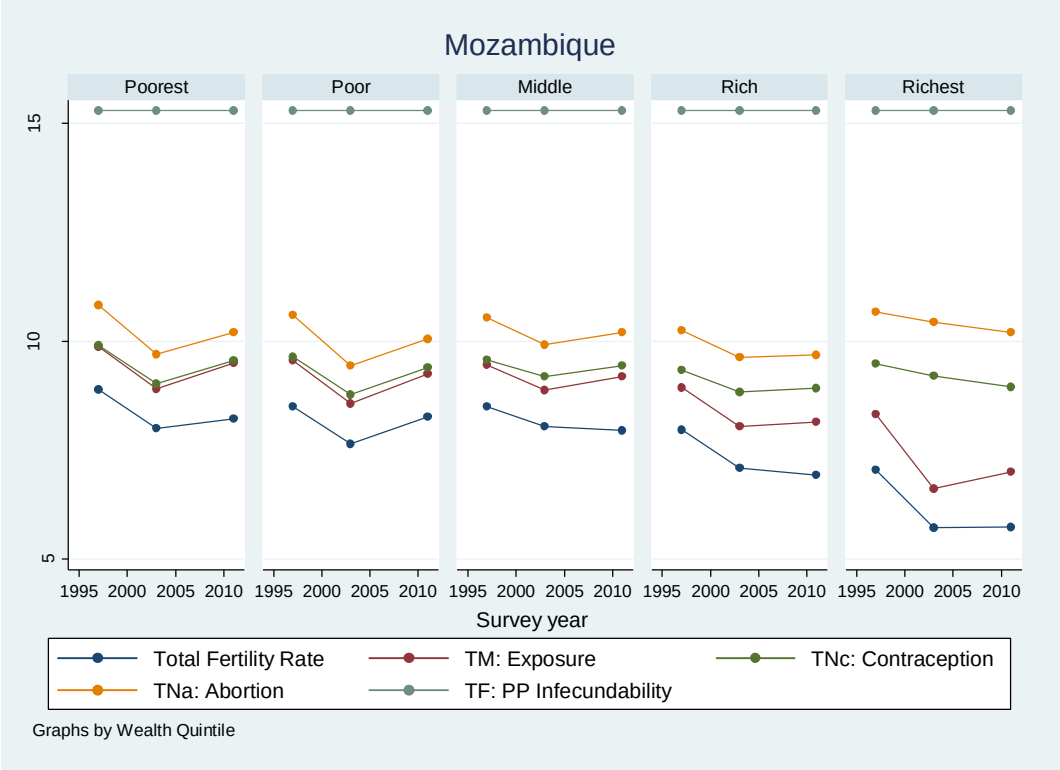


Figure 4-13. Namibia

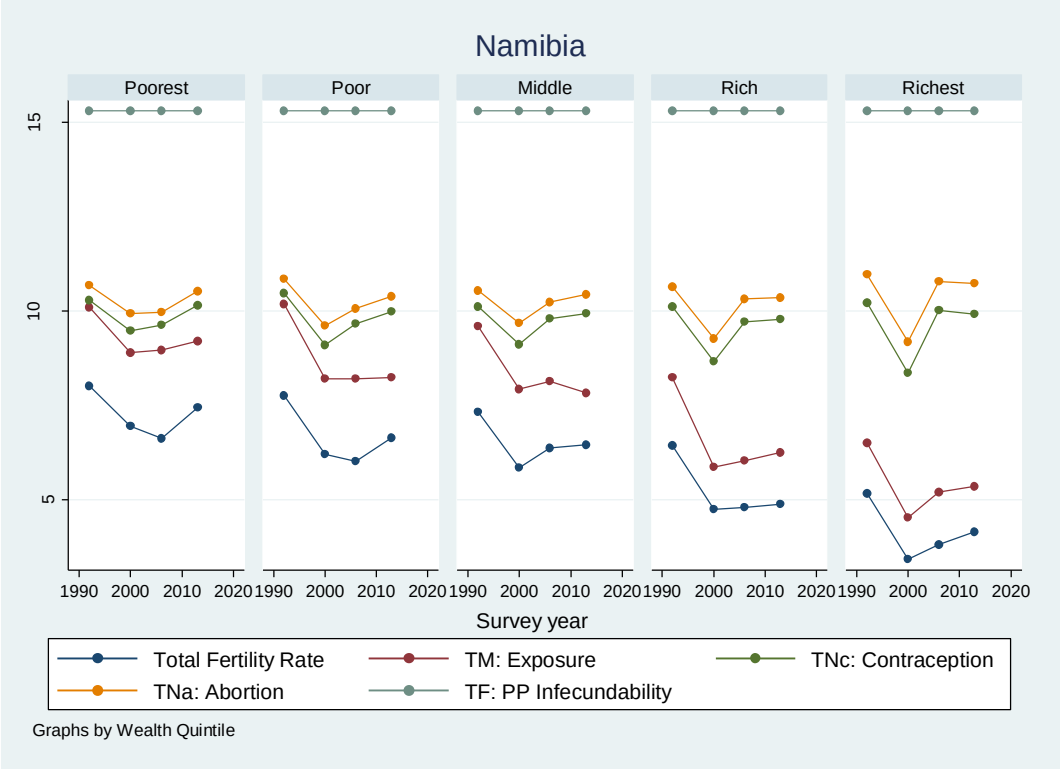


Figure 4-14. Niger

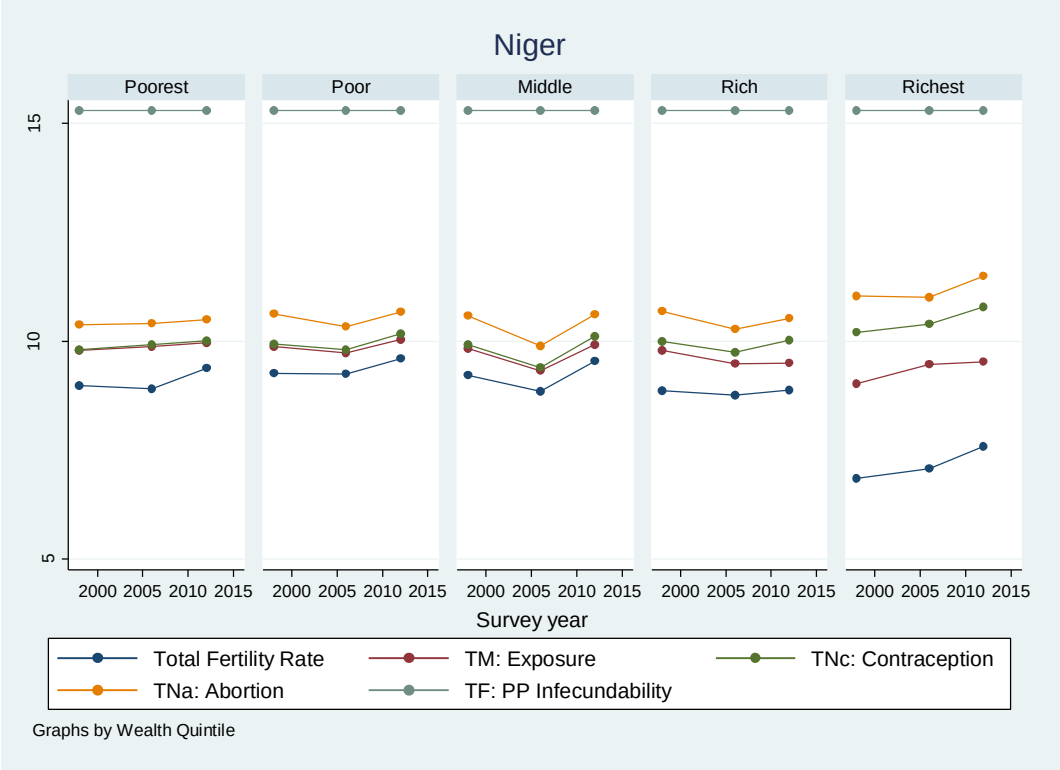


Figure 4-15. Nigeria

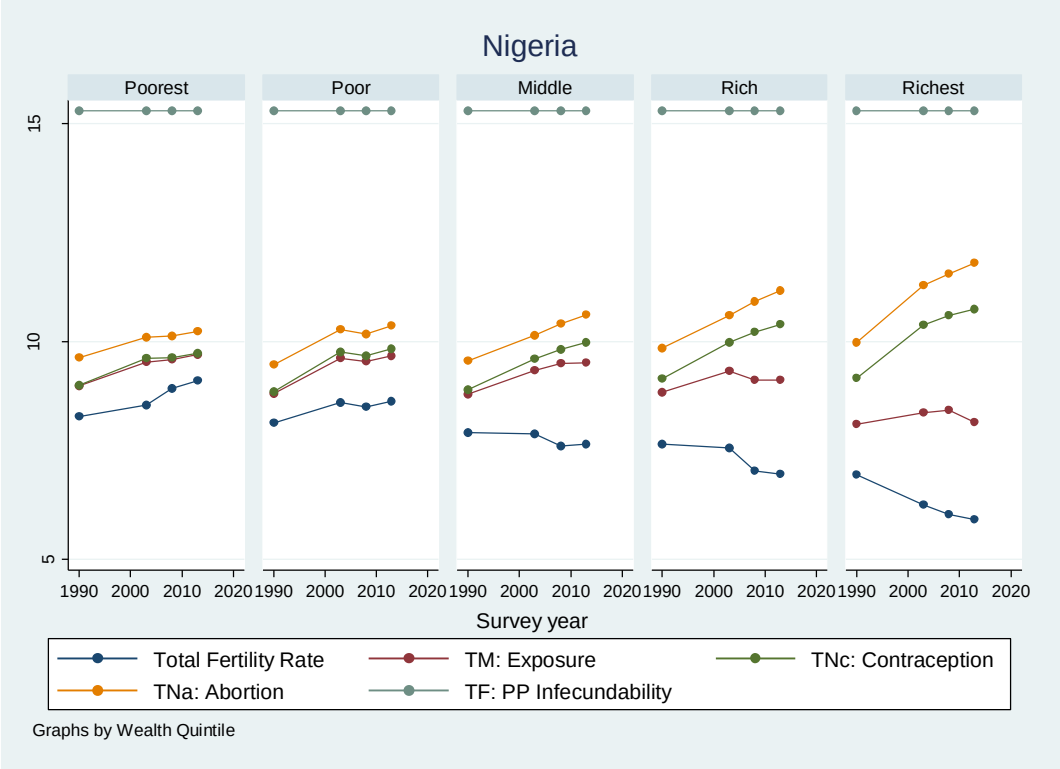


Figure 4-16. Rwanda

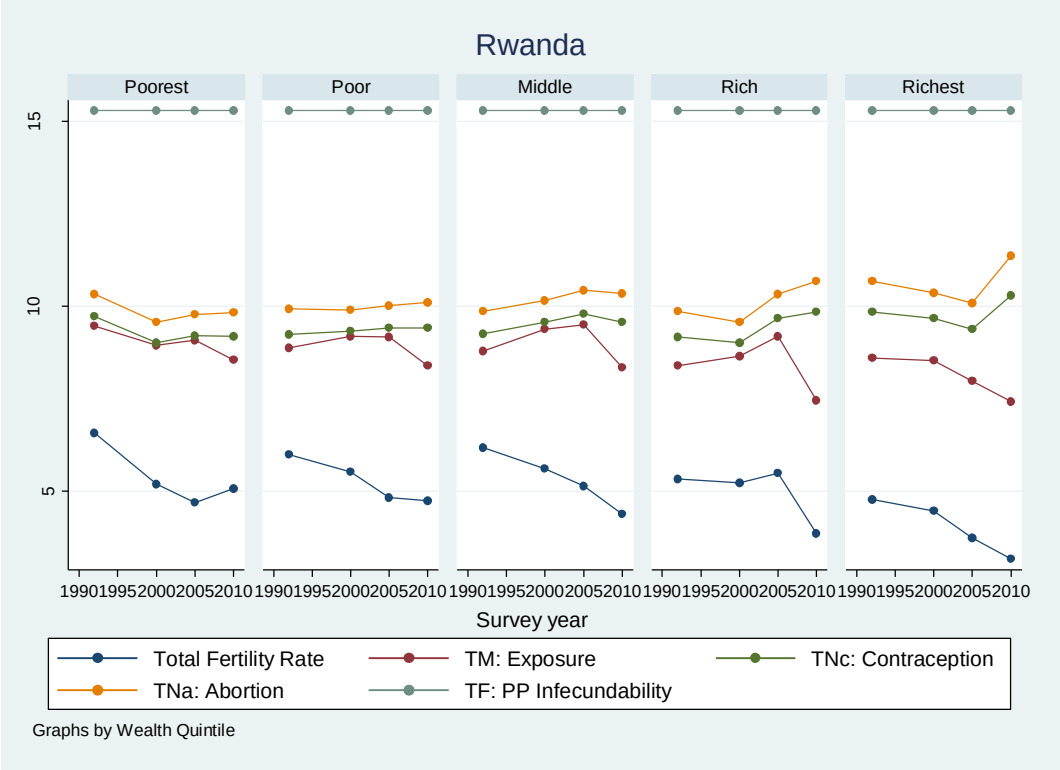


Figure 4-17. Senegal

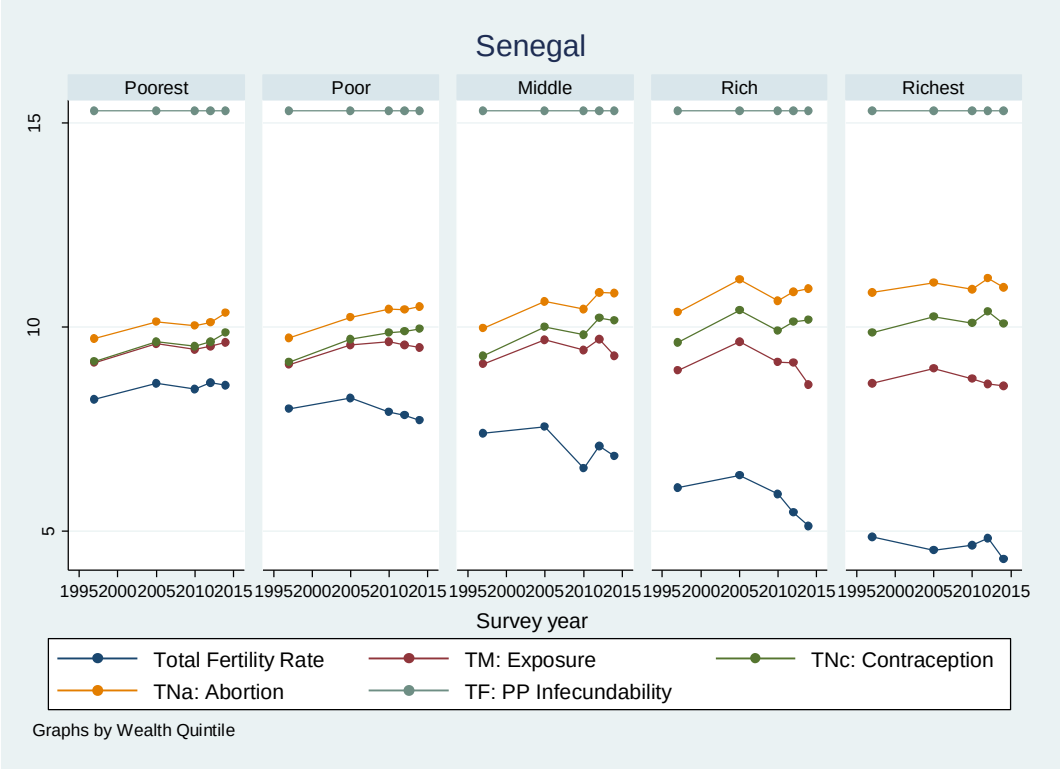


Figure 4-18. Tanzania

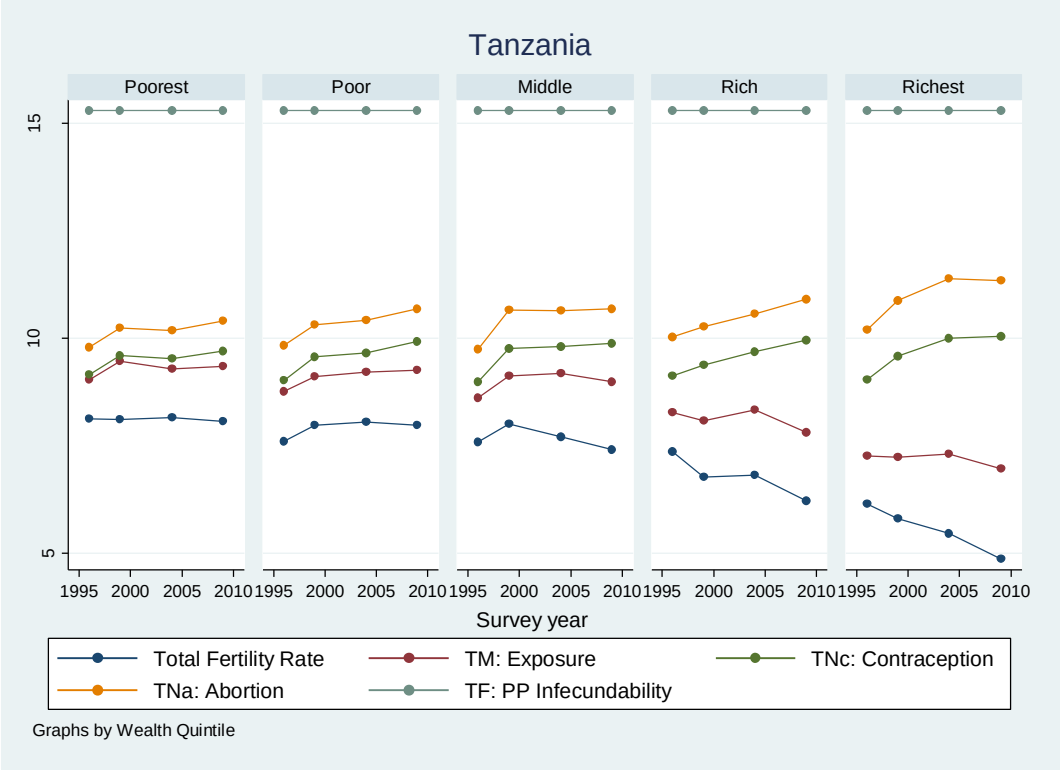


Figure 4-19. Uganda

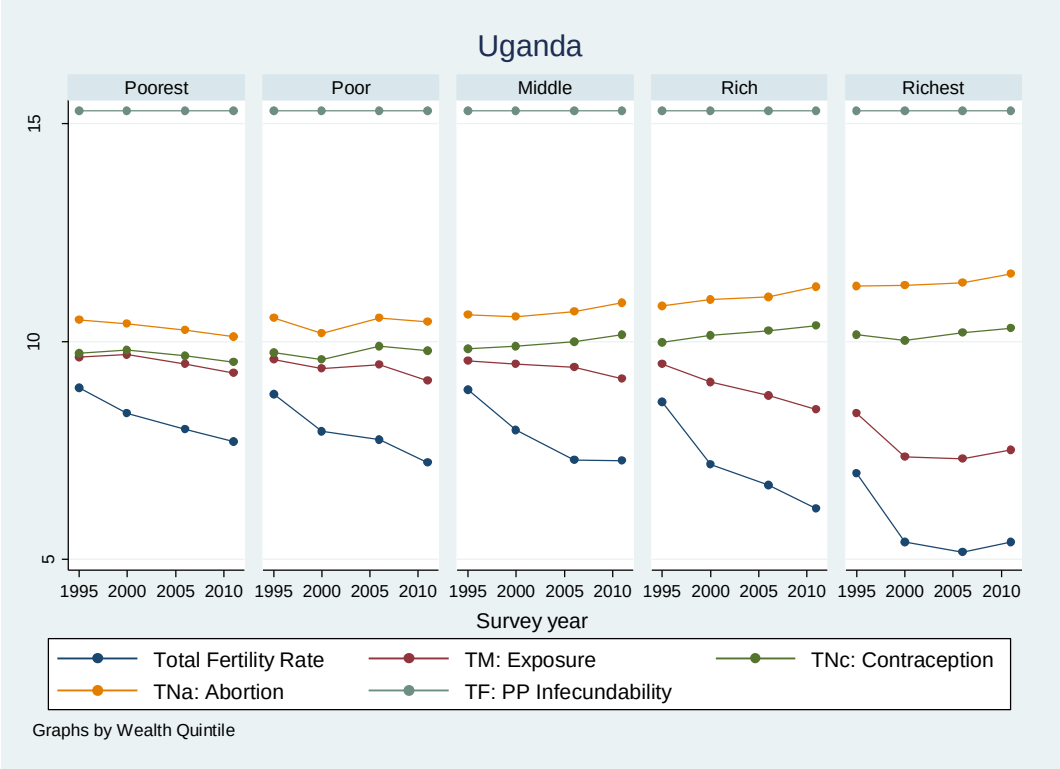


Figure 4-20. Zambia

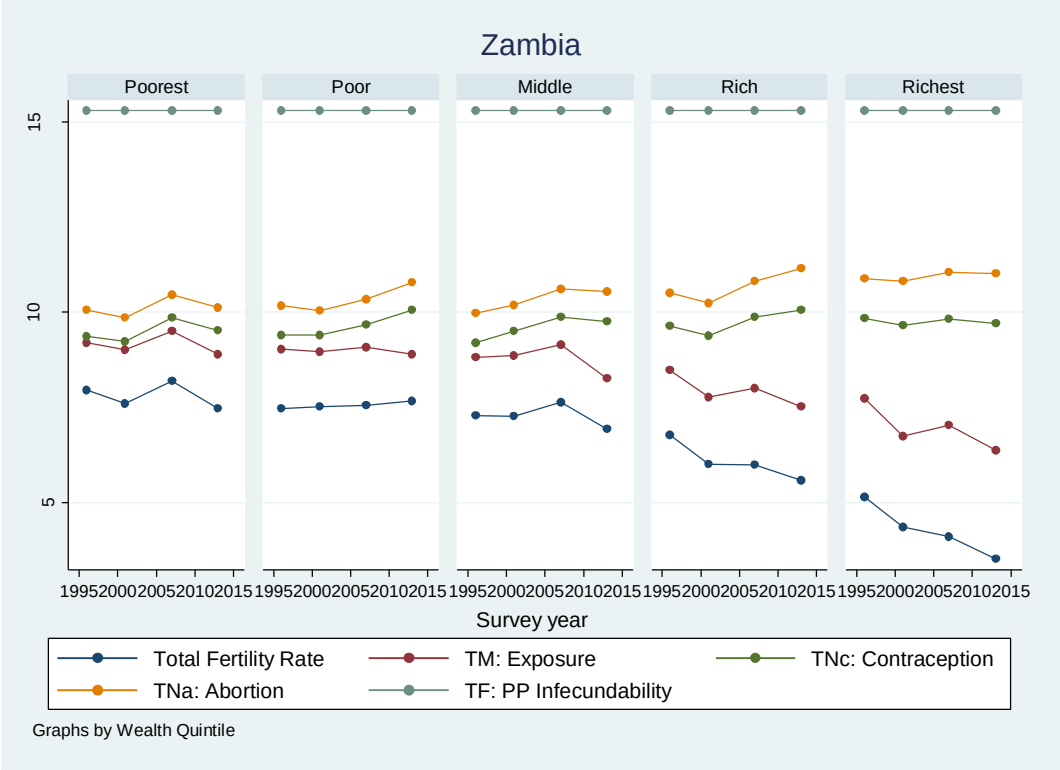


Figure 4-21 Zimbabwe