

## Research Article

# Changes in Fertility Decline in Rwanda: A Decomposition Analysis

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After having stalled in the 1990s, fertility in Rwanda resumed its downward trajectory between 2005 and 2010. The total fertility rate declined from 6.1 to 4.6 and modern contraceptive use increased. However, it is unclear which determinants lay behind the previous stall and the recent strong drop in fertility. This paper contributes to an ongoing debate on the impact of social upheavals on fertility decline. We use a decomposition analysis, focusing on the change in characteristics and reproductive behaviour of women and their contributions to levels of fertility during 1992–2000 and 2000–2010. Results show that due to widowhood and separation the proportion of women who were married decreased between 1992 and 2000, but their fertility increased in the same period due to replacement fertility and an unmet need for family planning. After 2000, postponement of marriage and lower infant mortality contributed to lower fertility, but the most important effect is the overall lower fertility due not only to improved family planning provision but perhaps also to the sensitizing campaigns of the Rwandan government.

## 1. Introduction

Rwanda is a recent success story of rapid fertility decline in Sub-Saharan Africa. The total fertility rate (TFR) dropped from 6.1 children per woman in 2005 to 4.6 in 2010. The use of modern contraception among women living in a union increased from 10 to 45% in the same period. This impressive decline came after a period of stalled fertility levels in the 1990s, like many other countries in Sub-Saharan Africa [1, 2]. Although the stall of fertility was evident, it is not yet clear precisely which determinants lay behind it. The lack of a clear explanation also applies to the recent strong drop in fertility.

A detailed analysis of the causes that contributed to changes in fertility in Rwanda, and the extent of their impact, is beyond the scope of this paper. We focus rather on changes in the composition (endowments) of the female population and in their reproductive behaviour (effects) and the contributions of both sources to the level of fertility. We will distinguish two periods in the analysis: the period of limited change in the TFR, using available data from the

Rwanda Demographic and Health Surveys of 1992 and 2000, and the period of the recent decline, for which we use the RDHS of 2000 and 2010. To present a clear picture of the changes in the effect of selected explanatory variables on fertility, we use a decomposition analysis. This method allows a comparison between two different periods. It also expresses the contributions of all the included explanatory variables in terms of changes in composition and in terms of the change in the effects of those characteristics [3–5].

The Rwandan context differed substantially during the two periods under study. The 1990s are on record as a black page in Rwanda's recent history, marked by civil war, genocide, mass movements of refugees, and economic deterioration. The first decade of the new millennium can be characterized by an impressive improvement and recovery of the political and economic situation of the country. For that reason we start with an overview of the relevant background followed by a presentation of the theoretical framework based on results from other studies on the relation between changes in socioeconomic contexts and fertility.

## 2. Background

Rwanda is still a poor country with an economy based on agriculture. Its Human Development Index, however, improved impressively from 0.313 in 2000 to 0.425 in 2010. During the 1980s and 1990s the country's development was hampered by political tensions, environmental stress, and economic deterioration. The Rwandan civil war and genocide (1994) came not out of the blue but were rooted in the country's historical, colonial, political, and economic experience. Conflicts were already in place before the achievement of Independence in 1962 (after the 1959 revolution, when Hutu deposed the Tutsi elite, thousands of Tutsi were killed and hundreds of thousands fled the country for the first time. Again in 1963 and 1973 large numbers of Tutsi became exiles as a result of ethnic violence and oppression. These refugees were the so-called "old-case load of Rwandans living in exile," as defined during the negotiations in Arusha in the early nineties) and have continued ever since [6]. Processes of exclusion, unequal and changing power relations, and alternating elites that controlled access to resources, in particular access to land, are amongst others at the base of these tensions and conflicts [7]. The ethnic group in power and comprising the elite has changed several times in Rwanda's modern history [6], but the poor Rwandans living scattered on the hilly countryside had to face a daily struggle for subsistence. More than 90 percent of the working population earned a living by cultivating small and fragmented plots that, as a result of high population growth, decreased substantially over the generations [7].

Economic stress characterised the prelude of the social upheaval. During the late 1980s Rwanda suffered from a severe economic crisis that deteriorated the living conditions of its people. That profound economic crisis has been linked with the decline of fertility between 1983 and 1992, when the total fertility rate fell from 8.3 to 6.2 and the desired family size from 6.3 to 4.2 children per woman [8, 9]. Rwanda seems to have followed a pattern of crisis-led fertility decline in the 1980s and early nineties.

After the war and genocide in 1994, food production fell drastically, the public service infrastructure of the country was severely disrupted, and large numbers of the population were on the move. Around two million Rwandans (political leaders, the army, the "Interahamwe" civilian militia, and ordinary civilians who participated in the killings of Tutsi and even some kidnapped women) sought protection in refugee camps in neighbouring countries, while another million became internally displaced persons [10, 11]. After mid-1994, when the Rwanda Patriotic Front (RPF) established a new order, refugees started to return—particularly the so-called old-case load that had fled the country during former conflict periods (as agreed upon between RPF and the Habyarimana regime during the Arusha Peace Negotiations in 1992 and 1993. The number of returnees was estimated to be 600,000 for the year after the genocide). However, 1.7 million refugees of the new-case load stayed in camps at least till 1996 [11]. In the remaining years of the decade Rwanda had to incorporate substantial waves of returnees (in the last months of 1996 a massive flow of more than one million returnees

(new-case load) was seen as a consequence of the decreasing international support for refugee camps and the changed attitude (violence) in the host countries towards the refugees), who often found their houses and land destroyed or occupied. Within the country internal migration flows continued to be strong as well: return of internally displaced persons, rising rural-urban migration to the capital city, and resettlement in the frameworks of the new government's Imidugudu (a low cost housing program introduced in Rwanda soon after the Genocide, with the aim of resettling the thousands of people who returned, mostly from neighbouring countries, as well as those who were internally displaced. Among them were also the "old" groups of refugees who had spent up to 35 years in exile) programme launched in 1996/7 [12].

The gravity of all these disruptive events had far-reaching consequences in other fields of society and politics as well as those related to demography. Firstly, the composition of the population by sex and age had changed. The Rwandan society feminized as substantially more men than women died in battle actions or fled the country [13, 14]. Although many men returned after a while, the sex ratios among adults stayed skewed as the census of 2002 and the latest DHS surveys clearly illustrate. Social and family relations altered, which is often seen as attendant effects of social upheaval [13, 15]. The number of female-headed households rose, and increasingly women were invited by new government policy to participate in public activities.

Secondly, the population policy that started after 1981 under donors' pressure to tackle the high rate of population growth (family planning was not among the priorities of the Habyarimana regime [14]), with the creation of the National Office of Population (ONAPO) [16], faded into the background in the second half of the 1990s. Building up the new society and restoring peace and reconciliation became more important policy foci than population growth reduction. Only some years afterwards could the government reformulate population and public health policies.

The fundamental change in Rwandan development began in 2000–2001 with the creation of Vision 2020, through a broad-based, participatory consultative process. The development strategy presented as Vision 2020 aimed at the reconstruction of the nation, its social capital, and its regional and global integration, which were seen as mandatory for sustainable development [17]. In 2003 the National Reproductive Health Policy specified policies related to the health sector consistent with the Cairo Conference on population and development (1994), the Beijing Conference on women (1995), and the international discussion of Millennium Development Goals. Several policies geared toward development objectives were initiated, including better access to health services by the introduction in 2001 of the community-based insurance scheme [18]. Serious concerns about the rapid increase of the population arose after the publication of the 2005 RDHS results, which showed that the TFR was even higher than in 2000, rising from 5.8 to 6.1 children per woman. Since 2000, the struggle to reduce fertility in Rwanda has been characterised not only by new policies, such as the family planning policy in 2006, but also by the strong commitment of the government and parliamentarians

to this aim. Successive initiatives that may be considered as important events in addressing population challenges in Rwanda include the creation in 2003 of the Rwandan Parliamentarians' Network for Population and Development, the presentation in 2005 by the Futures Group of the RAPID Model (computer model which combines socioeconomic and demographic data to make scenarios demonstrating the effect of population growth on other sectors) in the Parliament, and the inclusion of population challenges in the second generation of the Economic Development and Poverty Reduction Strategy 2008–2012 (EDPRS). A large sensitisation campaign in family planning was financially boosted by the support of partners such as UNFPA, USAID, and Twubakane Project. This allowed the construction of "secondary posts" for reproductive services close to religiously affiliated health facilities, more training of staff, and increased the supply and access to family planning commodities [19].

### 3. Theoretical Framework

In general theories on fertility decline, fertility is linked to gradual, fundamental, and structural changes in a society. Disrupting events like wars and revolutions can have a temporary, disruptive effect on the course of the decline as is shown in analyses using historical or contemporary data. Examples of a temporary drop in births followed by a rebound shortly after the disrupting events as a result of the reunification of spouses and of resumed celebrations of marriages leading to more conceptions in the year after are found in cases all over the world [15, 20, 21].

After the disrupting events or in case the turmoil continues for a longer period, the fertility level can follow various courses. The fertility decline might stall or even go in an opposite direction as observed among Iranian and Palestinian couples in the cases of conflicts in the Middle East [22]. Some researchers suggest that another scenario is also possible, notably that of a crises-induced sustained fertility decline [23]. In this case changes in fertility are probably intentional and a response to deteriorating living circumstances. Lindstrom and Berhamu [24] found that for Ethiopia during its crises of 1974–1991. Marital fertility stayed high but fluctuated (drop and rebound) during the first years of the crisis. However, from the 1980s onwards, marital fertility declined due to ongoing political and economic insecurity. According to the authors [24, 259] the "multidimensionality of the Ethiopian crisis may be the key factor in explaining the fertility decline" that was not observed in other Sub-Saharan countries. A few years later this alternative route of fertility decline was discussed also for Eritrea by Woldemicael [25] who found that the border war with Ethiopia indeed contributed to a large drop in TFR of around 2.5 children between 1995 and 2002 and possibly contributed also to the decline in marital fertility in the longer run that had already set in before the disturbing event.

The impact of a social upheaval on demography depends on the phase of the crisis. During each stage of the conflict

demographic behaviour will be influenced by voluntary as well as involuntary forces. Randall [26] has grouped these forces in five groups: biological, biosocial, psychological, socioeconomic, and political. Each force may have an upward or downward effect on actual fertility depending on the stage of the conflict. The characteristics of the affected population and the events that they have been exposed to will also be an important determinant of the effects of humanitarian crises on actual fertility [20].

We assume that actual fertility levels are an outcome of fertility preferences and fertility control and that the severe social upheavals in Rwanda that occurred in the early nineties affected both. Following Caldwell [15] who stated that great social upheavals tend to depress fertility decline for a decade or longer at the early transition stage, while it accelerates the decline in case of crises in the late transitional phase; we expect a stagnating fertility decline in Rwanda during the 1990s and a continuation of the decline after the turn of the millennium. The short run or immediate effects of the disturbing events were higher mortality, deferred marriages, mass migration, and huge refugee flows. The indirect or longer term effects were the disruption of families due to the separation of spouses and the destruction of reproductive health services.

Most births in Rwanda occur in formal unions; births outside wedlock are rare. Consequently, the disruption of family cohesion, deferred marriages, or separations due to death or migration as a result of the disturbing events have played an important role in decreasing the fertility during or shortly after 1994 as the proportion of married couples decreased. The breakdown of reproductive health facilities will have an opposite effect, just as coerced sexual intercourse. Early marriages [27] as a survival strategy may have contributed (to a lesser extent) to the increase of unwanted pregnancies and possibly higher fertility. Access to modern family planning methods was problematic after 1994 and caused more unplanned births. The observed developments in attitudes and practices concerning family planning between 1983 and 2005 show a disruption of the positive trends during the 1990s. While the percentage of women with a steady partner that was using contraceptives (modern and traditional) doubled between 1983 and 1992, the number diminished dramatically between 1992 and 2000 (RDHS 1992, 2000).

Fertility preferences will also change in the wake of disruptive events. Probably as a result of the loss of children or other family members during the 1990s, the desired family size increased temporarily. The change in ideal number of children women would like to have during their reproductive life between 1992 and 2000 is particularly the result of higher percentages of women wanting five children or more as this proportion went, respectively, from 33.5% to 51.6% (RDHS 1992, 2000). The sensitizing campaign by the Rwandan government proclaimed three children as the ideal family size. The effects of such campaign are hard to measure, but the fact is that the proportion of women whose ideal number is five children or more decreased substantially to 12.5% in 2010.

This may end up changing the actual fertility.

## 4. Data and Methods

*4.1. Data.* We used three Rwanda Demographic and Health Surveys (RDHS) of 1992, 2000, and 2010 that include data on women aged 15 to 49 years old. The quality of DHS data in collaboration with Macro International has greatly improved since the 1980s and all the country reports have tables on data quality assessment [28]. Critiques remain for the use of retrospective data, such as the likelihood of censoring effects, date misreporting due to memory lapses or due to unprofessional interviewers who shift children outside the calendar period to reduce their workload on time-consuming questions related to children's health [29–31]. Despite those critiques, the data gathered in the Rwanda DHS surveys meet the required standards for avoiding biases.

We excluded women aged 15–19 from the analysis as they were either too young or not sexually active to change the general trend in actual fertility outcomes. The remaining samples included 5079 women for RDHS 1992, 7694 women for RDHS 2000, and 10708 women for RDHS 2010.

In defining the outcome variable we started with the total number of pregnancies that occurred during the 24-month period prior to the surveys which resulted in a birth and the pregnancies recorded at the moment of the interview. However, the low number of women who had more than one pregnancy in these two years led us to transform this dependent variable into a dummy variable of either yes or no (experience of a pregnancy during 24 months before the interview) as an indicator of actual fertility.

The explanatory variables of interest that are likely to influence the number of pregnancies women had in this period are marital status, whether or not the woman experienced the death of one or more children, the number of living children they had before our observation period, and the contraceptive use at the moment of the interview. Woman's age, education, and place of residence were used as control variables. All these variables are used in order to decompose the changes in fertility between the two periods and isolate the contribution of the change in the composition of the population from the change which is due to shifts in the behaviour of the population.

*4.2. Methods.* As we are interested in identifying characteristics that may explain the difference in actual fertility between 1992 and 2010 in Rwanda, the appropriate technique is the decomposition analysis. We used the Oaxaca decomposition model in STATA (version 11.2). This method allows the decomposition of changes over time in levels of an outcome variable into those due to differences in observable characteristics (*endowments*) and those due to the different effects of these characteristics (*coefficients*). The method decomposes differences in means using the classical linear model, as well as differences in proportions using logit or probit models, with options to provide normalized solutions for dummy variables, covariate grouping, weighing, and survey design adjustments [3, 32]. As our dependent variable is binary we applied the logit model to analyse the changes in actual fertility between 1992 and 2000 and between 2000 and 2010.

The Oaxaca module in STATA enables us to distinguish clearly the part of the difference in actual fertility between 1992 and 2000 on the one hand and 2000 and 2010 on the other hand explained by compositional effects (endowments), by behavioural effects (coefficients), and by combined interaction effect.

## 5. Descriptive Statistics

Tables 1 and 2 present the changes over time in the statistics of some demographic characteristics of the sample populations that are important for our analysis. The results illustrate that during the two periods under study (1992–2000 and 2000–2010) opposing demographic changes occurred.

*5.1. Marital Status.* During the period of the genocide and its aftermath changes occurred in the marriage and cohabitation patterns.

The percentage of women being widowed or separated is much higher in 2000 than in 1992 and the percentage of women in a union, which are more at risk of becoming pregnant, is much lower. These changes are expected to have a negative effect on total fertility rates. After 2000 the composition of the female population according to marital status changed again. Most striking is the increase in percentage of never married women, which is due to the skewed sex ratio and a practice of later marriage.

*5.2. Child Mortality.* Based on the fact that the procreation behaviour of a couple may be influenced by mortality experience [33] we analysed the trends in mortality of children reported by women during the last seven years before the date of the interview. The proportion of women that experienced the death of one or more children went up between 1992 and 2000 (we consider only deaths that occurred in the last seven years without including the ones happening in the last twenty-four months. With this we intend to capture the deaths that may be related to the genocide period with the 2000 RDHS dataset). After 2000 the opposite trend occurred—child mortality decreased; only 8.5% had suffered the loss of a child in 2010 as opposed to 23.3 in 2000. All other things kept equal; in 1992–2000 these changes will have led to an increase in actual fertility as couples might want to replace the deceased or reproduce more to make sure some will survive. The drop in child mortality in 2000 will have a downward effect on fertility as couples feel more confident about the survival of their offspring.

*5.3. Contraceptive Use.* The change in percentages of women using contraception also changed remarkably during the two study periods. The use of contraception was still limited in 1992, but the situation deteriorated further and in 2000 only a very limited number of women used effective modern methods. However in 2010 (Table 1), this proportion increased more than seven times from 4.4% (2000) to 31.7% (2010). This shift in the use of contraception patterns may have contributed a lot in the change in actual fertility in the two periods.

TABLE 1: Percentage of women aged 20–49 according to selected characteristics and change between 1992 and 2000 and between 2000 and 2010, respectively.

Variable	Category	1992	2000	Change	2000	2010	Change
Marital status	Never married	15.3	14.6	−0.7	14.6	23.0	+8.4
	In a union	72.0	62.1	−9.9	62.1	63.2	+1.1
	Widowed	5.2	10.7	+5.5	10.7	6.9	−3.8
	Separated	7.4	12.6	+5.2	12.6	6.8	−5.8
Child mortality	None	83.1	76.7	−6.4	76.7	91.5	+14.8
	One or more	16.9	23.3	+6.4	23.3	8.5	−14.8
Number of living children 24 months prior to the interview	0–2	51.9	56.7	+4.8	56.7	59.2	+2.5
	3	12.4	12.0	−0.4	12.0	12.3	+0.3
	4	10.8	10.2	−0.6	10.2	10.6	+0.4
	5+	25.0	21.0	−4.0	21.0	17.9	−3.1
Contraceptive use	Not using	82.7	90.4	+7.7	90.4	64.2	−26.2
	Folkloric/traditional	6.6	5.2	−1.4	5.2	4.2	−1.0
	Modern	10.7	4.4	−6.3	4.4	31.7	+27.3
Woman's age	20–24	24.5	24.5	0	24.5	25.2	+0.7
	25–29	20.6	20.5	−0.1	20.5	23.3	+2.8
	30–34	20.3	16.3	−4.0	16.3	17.0	+0.7
	35–39	14.6	15.4	+0.8	15.4	13.3	−2.1
	40–44	12.1	13.4	+1.3	13.4	10.8	−2.6
	45–49	7.8	9.9	+2.1	9.9	10.4	+0.5
Education level	No education	42.9	34.5	−8.4	34.5	18.9	−15.6
	Primary	49.7	54.2	+4.5	54.2	67.1	+12.9
	Secondary/high	7.4	11.3	+3.9	11.3	13.9	+2.6
Place of residence	Urban	6.2	16.1	+9.9	16.1	15.0	−0.9
	Rural	93.8	83.9	−9.9	83.9	85.0	+2.1
Total		100%	100%		100%	100%	
Number of women		5079	7694		7694	10708	

**5.4. Actual Fertility.** The percentage of women being pregnant in the last 24 months prior to the date of the interview did hardly change between 1992 and 2000 in line with the expected stall in fertility decline in this period. Yet, there are marked differences in behaviour between categories. The (smaller) category of women in a union had far higher odds of being pregnant in 2000 than in 1992 (the odd ratio is 1.14—see Table 2). After 2000 this percentage drops dramatically; the odd ratio of 2010/2000 is only 0.65. The never married contribute little to the overall fertility in each year but show higher percentages of pregnancies in 2010 compared to 2000.

The effect of losing children also changes over time. Women that had lost at least one child in the seven years before 2000 have higher odds to be pregnant again at the time of the interview in 2000 than the same categories in 1992 and 2010. This might indicate that the cause of the death (more violent deaths in the period of the genocide, few violent deaths after 2000) affects the decision of replacement.

A striking result is the change in percentage of pregnant women that use contraceptives. In 1992 the ones that use a method (in particular modern method) have lower odds of being pregnant. Yet in 2000 there is no difference in actual fertility between women that are not using and those that

were using contraception regardless of the type of method applied. In 2010 contraceptive use is much more effective again in avoiding pregnancies, leading to a double effect on actual fertility of both wider (Table 1) and more effective use (Table 2).

For the period between 2000 and 2010 there is a remarkable change in terms of actual fertility as the number of pregnancies in the last 24 months for all women went down (all odd ratios are lower than 1) except for never married women and for separated women. This fact may indicate that social control on fertility behaviour is diminishing. A more in-depth analysis using a multivariate decomposition may bring more clarity in the contribution of each explanatory variable in terms of compositional or behavioural effects.

## 6. Results

The overall difference in actual fertility between 1992 and 2000 displays a relatively limited increase from 40.9 to 41.6 percent (the logit model produces proportions rather than percentages. We multiplied all coefficients by 100 for ease of interpretation and refer to it as percentages). The difference

TABLE 2: Percentage of women that were pregnant in the last 24 months and odds ratios by selected characteristics (1992, 2000, and 2010).

Variable	Category	1992	2000	2010	2000/1992	2010/2000
		%	%	%	OR	OR
Marital status	Never married	6.1	5.4	8.8	0.89	1.63
	In a union	52.2	59.6	38.7	1.14	0.65
	Widowed	13.0	11.4	7.7	0.88	0.68
	Separated	21.8	19.8	22.4	0.91	1.13
Woman's child mortality experience	None	40.0	39.6	28.0	0.99	0.71
	One or more	45.2	47.8	34.0	1.06	0.71
Number of living children 24 months prior to the interview	0-2	42.3	44.8	32.8	1.06	0.73
	3	49.3	45.5	29.7	0.92	0.65
	4	42.0	41.2	22.1	0.98	0.54
	5+	33.3	30.7	17.4	0.92	0.57
Contraceptive use	Not using	43.7	41.6	31.3	0.95	0.75
	Folkloric/traditional	33.4	41.8	27.5	1.25	0.66
	Modern	23.4	41.0	23.0	1.75	0.56
Age	20-24	39.1	43.4	30.1	1.11	0.69
	25-29	53.3	56.9	41.3	1.07	0.73
	30-34	51.1	53.0	35.9	1.04	0.68
	35-39	41.9	41.4	25.0	0.99	0.60
	40-44	25.7	27.0	15.3	1.05	0.57
	45-49	8.6	6.5	2.5	0.76	0.38
Education level	No education	41.1	39.3	26.5	0.96	0.67
	Primary	42.0	43.8	30.9	1.04	0.71
	Modern	31.7	37.4	19.9	1.18	0.53
Place of residence	Urban	33.0	36.4	24.4	1.10	0.67
	Rural	41.4	42.5	29.3	1.03	0.69
Total number of women		5079	7694	10708		

TABLE 3: Mean value of fertility predicted between 1992 and 2000.

Overall	Coef. ( $\times 100$ )	Sig.
Group 1: 2000	41.553	0.000
Group 2: 1992	40.865	0.000
Total difference	0.688	0.459
Difference due to endowments	-2.543	0.000
Difference due to coefficients	4.948	0.000
Difference due to interaction	-1.717	0.000

in the mean between the two years is very small and not significant. However, this is a composite of a negative effect of the net compositional change and a positive effect of the net behavioural change. Stated differently, if the composition of the female population had remained the same between 1992 and 2000, fertility would have been 2.5 percent-points higher. If the behaviour had not changed, fertility would have been 5 percent-point lower. The latter effect is partly compensated by the interaction between the endowments and the coefficients (Table 3).

A closer look at the (multivariate) parameters reveals which categories contribute most to the opposing shift in actual fertility between the years.

The category of currently married women displays the highest share in explaining the fertility gap from endowments (Table 4). Their decrease in proportion has contributed much in lowering the actual fertility in 2000 if compared to 1992. Without this change in endowment fertility would have been 2.76 percent-points higher. Another category that has contributed significantly in terms of endowment is the increase in the share of women not using contraception and the decrease in the number that used modern contraceptives. All other effects are insignificant or small.

After controlling for the endowment effect, the coefficient effect becomes more pronounced (Table 4). The intercept (8.6) shows that there is an overall shift to higher fertility in 2000 if compared to how women behaved in 1992. Other things being equal, the shift in actual fertility between the two periods is even higher for currently married women and for women that are using modern contraceptive. The endowment effect of the decrease in the share of women in a union is more than offset by the coefficient effect of the shift in their behaviour. The model also shows the paradoxical

TABLE 4: Contribution of selected explanatory variables to the gap in actual fertility outcomes between 1992 and 2000.

	Endowments		Coefficients		Interaction	
	Coef. (×100)	Sig.	Coef. (×100)	Sig.	Coef. (×100)	Sig.
<b>Marital status</b>						
Never married	0.226	0.273	-0.114	0.867	0.004	0.867
In a union	-2.764	0.000	4.701	0.027	-0.478	0.004
Widowed	0.007	0.960	-0.255	0.281	-0.196	0.265
Separated	0.137	0.183	-0.070	0.784	-0.036	0.787
<b>Child mortality</b>						
No death	0.031	0.522	-3.397	0.007	0.194	0.006
One or more	0.031	0.522	0.690	0.007	0.194	0.006
<b>Living children</b>						
0-2	-0.147	0.026	-1.959	0.116	-0.136	0.130
3	0.004	0.655	0.158	0.624	-0.003	0.728
4	-0.001	0.921	0.250	0.392	-0.011	0.507
5+	-0.166	0.007	0.045	0.944	-0.005	0.944
<b>Contraceptive use</b>						
Not using	1.002	0.000	-6.837	0.000	-0.474	0.001
Folkloric & traditional	0.023	0.321	-0.202	0.325	0.032	0.348
Modern methods	0.717	0.000	1.216	0.001	-0.530	0.001
<b>Age</b>						
20-24	0.001	0.997	1.473	0.086	0.000	0.997
25-29	-0.021	0.868	0.923	0.126	-0.004	0.868
30-34	-0.432	0.000	0.078	0.878	-0.011	0.878
35-39	0.008	0.521	-0.347	0.366	-0.013	0.496
40-44	-0.152	0.055	-0.067	0.859	-0.005	0.860
45-49	-0.744	0.000	-0.624	0.172	-0.122	0.138
Intercept			8.616	0.002		

Controlled for education and place of residence.

effect of the use of contraception. The larger share of women not using any means contributes to the higher fertility in 2000, but within this category the actual fertility stayed behind other categories. The smaller share of those using contraception also contributes to higher fertility in 2000, but the effectiveness of this use in avoiding pregnancies is lower, further contributing to higher fertility in 2000.

The coefficient effect of child mortality is negative for those not having lost children and positive for the ones that did, indicating that without the (violent) deaths fertility would have been lower and that replacement was more common in the period leading to 2000.

The comparison between the level of actual fertility in 2000 and the one in 2010 displays a completely different structure with an overall drop in fertility of 13 percent-points due to the endowment effects and the coefficient effects plus negative interaction effects of the two (Table 5).

As regards endowment effects (Table 6), the categories that contribute the most to the drop of actual fertility between 2000 and 2010 are the rising share of women that were never married, the decreasing share of women not using contraception, and rising share of women using modern contraceptive methods. As mortality experience was declining for the same period the compositional effect on actual fertility shows up

TABLE 5: Mean value of fertility predicted between 2000 and 2010.

	Coef. (×100)	Sig.
Overall		
Group 1: 2010	28.549	0.000
Group 2: 2000	41.553	0.000
Total difference	-13.004	0.000
Difference due to endowments	-5.226	0.000
Difference due to coefficients	-3.213	0.000
Difference due to interaction	-4.566	0.000

to be negative, due to lower levels of replacement fertility (Table 6).

Regarding the coefficient effects between 2000 and 2010 we see that there is an overall shift towards lower fertility (the intercept is -13.5). Opposed to the period 1992-2000 the women in a union are now much less inclined to become pregnant. The large drop in fertility was even larger in this group. The replacement effect also switches, indicating that women tend less to remedy the loss of a child by another pregnancy in 2010 compared to 2000, which is consistent with the opposed finding in the period 1992-2000.

TABLE 6: Contribution of selected explanatory variables to the difference in actual fertility outcomes between 2000 and 2010.

	Endowments		Coefficients		Interaction	
	Coef. (×100)	Sig.	Coef. (×100)	Sig.	Coef. (×100)	Sig.
<b>Marital status</b>						
Never married	-2.552	0.000	0.635	0.275	0.353	0.255
In a union	0.350	0.147	-6.532	0.006	-0.112	0.161
Widowed	0.119	0.074	0.223	0.600	-0.075	0.588
Separated	-0.112	0.147	0.515	0.156	-0.227	0.153
<b>Child mortality</b>						
No death	-0.478	0.000	2.907	0.015	0.539	0.012
One or more	-0.478	0.000	-0.884	0.015	0.539	0.012
<b>Living children</b>						
0-2	-0.136	0.007	6.500	0.001	0.273	0.009
3	-0.001	0.762	-0.114	0.679	-0.003	0.737
4	0.007	0.488	-0.649	0.023	-0.024	0.440
5+	-0.134	0.004	-0.869	0.113	0.126	0.110
<b>Contraception use</b>						
Not using	-1.821	0.000	7.856	0.002	-2.187	0.000
Folkloric & traditional	0.037	0.048	0.226	0.163	-0.042	0.184
Modern method	-0.903	0.045	-0.573	0.001	-3.411	0.000
<b>Age</b>						
20-24	0.152	0.328	-0.464	0.532	-0.012	0.592
25-29	0.536	0.000	-0.272	0.608	-0.036	0.599
30-34	0.077	0.226	0.112	0.759	0.005	0.770
35-39	0.011	0.658	0.672	0.067	-0.086	0.117
40-44	0.309	0.000	0.560	0.157	-0.105	0.179
45-49	-0.171	0.373	-0.598	0.204	-0.025	0.484
Intercept			-13.457	0.000		

Controlled for education and place of residence.

There are two major exceptions to the overall drop in actual fertility, women that have less than three children and the ones not using contraception. It certainly looks that not using modern contraceptives in 2010 is a deliberate choice among those that want to get pregnant. The much lower coefficient effect among those having three children or more might indicate that the sensitizing campaign of three children as the ideal has found “fertile” grounds.

## 7. Discussion and Conclusion

The Blinder-Oaxaca decomposition model originates from analyses of the wage gap between men and women [32, 34, 35]. After controlling for the differences in endowments (hence the term) the resulting differences could be ascribed to unmeasured phenomena, like discrimination in the labour market, but other sources of unobserved heterogeneity could be more important. One is on solid statistical ground in interpreting endowment effects, but the interpretation of the coefficient effect remains speculative and relies more on plausibility than on proof. With this caveat in mind we nevertheless feel that our outcomes will contribute to a better understanding, not just of the compositional but also of the behavioural effects.

Although the proportion of currently married women decreased between 1992 and 2000 (-9.9%) their fertility increased in the same period. This can only partly be attributed to the decrease in the use of modern contraceptive as a result of voluntary behaviour or of unmet need for family planning as the government's efforts were focused on peace, repatriation, rehabilitation, and reconciliation, and programs for family planning were abandoned. Yet even after controlling for these effects we found behavioural change towards higher fertility in this period. We speculate that pronatalist attitudes were more common in 2000, which is supported by the higher ideal family size in this year.

Things changed after 2000 when the government decided to involve all the legislative and administrative authorities from the Senate to the level of the village in their sensitizing campaign and reproductive health policies. This shift is reflected in the behaviour of the people. By 2010 fertility was revised downward and having large families was little by little relegated as outdated behaviour. The declining fertility among married women and the low fertility that characterises women that have more than two living children support the idea that the combination of raising awareness and providing reproductive health services has been successful limiting the high population growth in Rwanda.



Mortality experience appears to be differentially related to the actual fertility. It appears that women that lost one or more children between 1992 and 2000 engaged more in replacing their loss than the ones that experienced that event between 2000 and 2010. We speculated that the cause of the loss might enter the decision of replacement, yet the overall decrease in mortality level after 2000 might also have made people more confident about the survival of their offspring and thus focus more on the quality of children than the quantity.

The results in this paper add to the theoretical debate on the impact of upheavals on fertility especially in the early phase of fertility decline. Our contribution shows the multidimensionality of this relation. On the one hand deaths, mass migrations, and refugee flows led to widowhood and separation and thus to less intercourse and pregnancies. On the other hand the high level of child mortality, the destruction of health facilities, and lack of supply of reproductive services contributed to higher fertility in the aftermath of the war and genocide. Yet the combined effects of these were not sufficient to explain the stall in fertility decline in this period. Other behavioural responses that contribute to higher fertility, probably the changing attitudes towards the ideal family size, should be taken into account as well.

This is even more pertinent in our analyses of the period after 2000/2005, when the fertility decline seems to have resumed its downward course. The lower level of child mortality and the revitalisation of (reproductive) health facilities can only account for part of the very rapid decline in actual fertility. Shifts in behaviour turned out to be more important than changes in the structure in explaining this decline. This could be related to the strong campaign to limit family size but might also be an effect of the social, economic, and political stability in the country. Decomposition analyses proved to be an effective instrument in detailing this multidimensionality, even if it does not provide direct insight into the causes of the behavioural change.

## Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

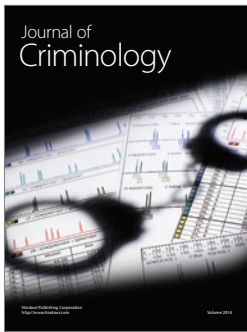
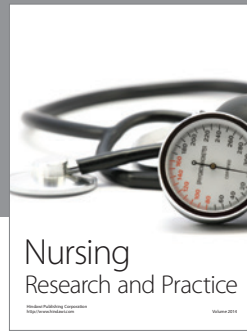
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