

# **Armed conflict, sex ratio and marital outcomes:**

## **Evidence from Rwanda**

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We use armed conflict in Rwanda as a natural experiment to study the impact of a decrease in the sex ratio on the marriage market. Combining detailed information on conflict intensity with pre- and post-war individual-level data, we find several effects of the shortage of middle-aged men in the marriage market. First, fewer men remained single in the post-war period, while more middle-aged women did. Second, we find that the age at first marriage increases for both women and men. Third, the share of informal marriages increases among men and women of all ages, without registration or transfer of bride price. Fourth, we find a rather large increase in the number of children born out-of-wedlock, who – lacking customary and statutory land rights – are likely to add to the number of landless youth. This finding raises concerns as unequal land access is said to have contributed to the intensity of the genocide.

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## 1. Introduction

The family is a human institution that goes back to pre-modern times and still plays a crucial role in the lives of individuals today. Whether extended or nuclear, the family affects economic decisions related to labor supply, fertility, insurance, saving, schooling and other types of investment. Families are even more important in developing countries, where subsistence agriculture and home-based production widely prevail and markets operate imperfectly. Family formation is based on marriage, which is centered on the recognitions of the rights and duties of parenthood, as well as the reciprocal, economic obligation between husband and wife. Hence, when the marriage market is distorted by shocks, families and the embedded social and economic obligations and rights are likely to be affected.

More than any other economist, this insight was developed by Gary Becker, who brought the analysis of marriage to the attention of economists in a series of articles and selected chapters in his book *Treatise on the Family* (Becker 1973, 1974, 1981). In his marriage market models, the sex ratio, defined as the ratio of men to women in the population, affects the bargaining power of women relative to men both inside and outside marriage. For instance, upon a decrease in the sex ratio, the price of husbands is predicted to increase, which is most clearly materialized in an increase in dowry relative to bride price. Also, as men are scarce, women may enter into a polygamous marriage, or – when polygamy is legally prohibited – engage in an extramarital relationship; or men, whose relative bargaining power increases, may feel less pressured to make legally binding commitments. As a result, out-of-wedlock births may increase. Moreover, women may settle for less, i.e. they may marry partners whose advances they would

normally have declined, for instance much older men, or men with schooling levels and other endowments that are low relative to theirs. Finally, since women are competing for husbands, they may try to increase their attractiveness as a spouse, for instance by earning more income, accumulating savings or investing in schooling. This is also true for women inside marriage, who – knowing that their husbands have better outside options – may contribute more to household production, and may settle for a smaller share of the household budget.

Derived from the theoretical apparatus of neoclassical economics – rational and utility maximizing behavior in a marginal-cost and marginal-benefit framework – these predictions have often been frowned upon by opponents of ‘economic imperialism’. The idea of putting a price tag on husbands has been debated and other mechanisms have been suggested to play a role in the adjustment of the marriage market, such as rules of thumb or passive responses to social or cultural norms rather than an active economic calculus (Pollak 2003).

To find out exactly how relevant the predictions are, several studies have put Becker’s models to an empirical test, analyzing how the sex ratio affects marital outcomes and related socio-economic outcomes.<sup>3</sup> To overcome the major drawback of the endogeneity of the sex ratio (the sex ratio may itself be determined by the marriage market or the socio-economic context), researchers typically have looked for natural experiments that create exogenous variation in the sex ratio. For instance, Angrist (2002) uses changes in migration laws in the US as a source of exogenous variation in sex ratios within migrant communities; Charles and Luoh (2010) make use of changes in policies

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<sup>3</sup> See Angrist (2002) for a review of this literature.

on the criminalization and punishment of drug offenses in the US which affect incarceration rates among men; Wei and Zhang (2011) exploit the one child policy in China; while Rao (1993) uses the demographic transition in India to study the impact of a female marriage squeeze. In general, these studies find empirical evidence in line with Becker's predictions.<sup>4</sup>

Recently, researchers have also made use of armed conflict as a natural experiment to study the impact of a drop in the sex ratio, drawing on the fact that most forms of armed conflict result in higher excess mortality among men than among women (Buvinic, et al. 2012). For instance, the impact of war-induced male scarcity on marital outcomes has been analyzed for WWI in France (Abramitzky, et al. 2011), WWII in Bavaria (Bethmann & Kvasnicka 2012) and in Russia (Brainerd 2008), the genocide in Cambodia (Heuveline & Poch 2006), and the civil war in Tajikistan (Shemyakina 2011b). Again, results from these studies are consistent with the predictions of the marriage market model.

Despite the high prevalence of armed conflict in Africa, there is no such analysis on Africa.<sup>5</sup> Our paper aims to fill this gap by studying the case of Rwanda, which experienced several forms of violence in the nineties, among which the 1994 genocide stood out as the most devastating in terms of lives lost. As a result of the conflicts, the sex

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<sup>4</sup> Based on these results, the marriage market model cannot be rejected. However, this is different from providing evidence in support of the underlying mechanism in Becker's model, i.e. a rational economic calculus. The same outcomes may result from other mechanisms.

<sup>5</sup> An exception is the study by Jayaraman et al. (2009), which also focuses on the impact of the Rwandan genocide on marriage, using women's age at first marriage and age at first birth as outcome variables of interest. However, the study by Jayaraman et al. does not examine the change in the sex ratio as one potential driver of marriage outcomes. Also, their analysis is solely based on post-genocide data, which does not allow separating the effects of the genocide from other confounding time trends. This is particularly an issue given that their estimation does not control for fixed effects across geographic regions.

ratio among Rwandans aged 20-60 years dropped from 0.94 in 1991 to 0.77 in 2002,<sup>6</sup> providing us with a natural experiment to explore the impact of the sex ratio on the marriage market.

Our analysis exploits variations in the sex ratio across both time and space, which can be related to detailed conflict intensity data across Rwanda's 145 administrative communes. The outcome variables stem from a large number of individual-level observations from before and after the genocide, taken from the 1991 and 2002 population census as well as the 1992 and 2005 Rwanda Demographic and Health Surveys (DHS). This set-up is used to study how a change in the sex ratio affects the probability for men and women across different age groups to remain single or engage in an informal relationship instead of formally marrying. Furthermore, we evaluate the probability of out-of-wedlock births, as well as changes in the age at first marriage and assortative matching.

Our study contributes to the literature on the marriage market in two ways. First, our study stands out because we can rely on a wealth of data. In contrast to the country- or regional-level data that are used in most of the studies in this field, we use large individual-level datasets from before and after the genocide, which allow us to control for individual characteristics (such as age, education, migration background, and wealth status), explore heterogeneous effects across these characteristics, and study various outcomes variables (marriage rates, types of marriages, child births to informal relationships, and assortative matching). We also have access to exceptionally detailed conflict intensity measures across Rwanda's 145 administrative communes, i.e. the 1991

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<sup>6</sup> We exclude individuals living in institutions, such as prisons, in this calculation, as will be discussed in more detail in Section 4A.

commune-level share of Tutsi in the population and the commune-level share of genocide suspects in the population. This commune-level data make it possible to instrument for the potential endogeneity in the sex ratio, an approach that has been taken only in a few studies in this field (examples are Abramitzky, et al. 2011; Bethmann & Kvasnicka 2012; and Charles & Luoh 2010).

Second, it is the first study on the impact of conflict on the marriage market in Africa. Such analysis is relevant because many African countries experienced civil war and excess mortality of men, and at the same time are still very much traditional societies, in which kinship and childbearing are very important and womanhood can only be achieved through marriage and motherhood. In addition, because of the dominant patrilineal system, marriage is often the only channel through which women in Africa can have access to property, most importantly land. Thus, while marriage is important everywhere in the world, it is easy to argue that in Africa, it is more important than average. For instance, one of the most grave insults in Rwanda means ‘May you die childless’, while at the same time pre-marital pregnancy is considered an abomination (Uwineza, et al. 2009). Furthermore, women in Rwanda depend on men for their access to land. According to customary law, unmarried women as well as women without sons have no claim over family property (Burnet and RISD 2003). In this context, a disturbance of the marriage market is likely to have far-reaching implications.

Besides the economic literature on marriage, our study relates to an emerging field that analyzes the micro-level impact of armed conflict. Research in this area has focused, amongst others, on the effects of conflict on poverty and well-being (Miguel & Roland 2011), labor market outcomes (Kondylis 2010), displacement (Ibáñez & Vélez

2008), education (Shemyakina 2011a), and health outcomes (Akresh, et al. 2012; Minoiu & Shemyakina 2012)<sup>7</sup>. Within this body of literature, a number of articles have studied the legacy of armed conflict in Rwanda. Focusing on economic performance, Serneels and Verpoorten (2012) find that households living in communities that were heavily affected by violence still lagged behind in their consumption expenditures eight years after the end of massive violence<sup>8</sup>. There is also a demonstrated negative impact on quality of life indicators, with lower educational attainments for both boys and girls exposed to the genocide (Akresh & de Walque 2008), lower height for age for children exposed to the Rwandan civil war (Akresh, et al. 2011), and lower height among adult women who were exposed to the genocide during childhood and adolescence (Agüero & Deolalikar 2012). Another group of studies discusses how violence affected fertility in the post-war period (Schindler & Brück 2011) and following displacement (Verwimp & Van Bavel 2005). A further focus on gender issues is provided by Schindler (2011), who shows that a shortage of men in post-genocide Rwanda affects the intra-household division of labor; and by La Mattina (2012), who demonstrates that women who married after the genocide and who live in communes heavily affected by genocidal violence are more likely to become victim of domestic violence.

The next section provides a review of studies that use armed conflict to analyze the relation between sex ratios and marital outcomes. Section 3 sketches the Rwandan context, with a focus on marriage and armed conflict in Rwanda. Section 4 presents the

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<sup>7</sup> For a review see Blattman and Miguel (2010).

<sup>8</sup> Further studies examining the economic performance measured on the basis of income or assets in Rwanda include Lopez and Wodon (2005), Verpoorten (2009), Justino and Verwimp (2008) and Verpoorten and Berlage (2007). Overall, these studies find a negative effect of violence on economic indicators. In contrast, McKay and Loveridge (2005) show how national nutrition levels had recovered completely by 2000 to their 1992 levels.

data as well as descriptive tables and figures. Section 5 lays out the econometric framework. Section 6 presents the regression results. Section 7 concludes.

## **2. War, sex ratio and marital outcomes: a review of the literature**

Armed conflict typically creates an exogenous shock to the sex ratio, resulting in a tragic but unique context for studying marriage markets. In the following, we discuss studies which made use of econometric analysis, excluding a larger number of studies that rely on descriptive methods.<sup>9</sup>

Abramitzky et al. (2011) explore the demographic impact of WWI on marriage market outcomes and assortative matching in post-war France. They use regional-level census data and an individual-level dataset compiled from marriage certificates from before and after the war. The authors find that in regions with high military mortality, more women and fewer men remain single after the war, a higher proportion of children is born out-of-wedlock, and divorce rates among young adults decline. Furthermore, relying on military mortality rates as an instrument for the regional sex ratio, Abramitzky et al. present evidence that in heavily affected regions after the war, the age gap between spouses narrows and men marry women of higher social class. This suggests that the relative scarcity of men improved men's relative position in the post-war marriage market.

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<sup>9</sup> Examples of the latter are Henry (1966) on France after WWI, de Walque (2006) on Cambodia, Anderson and Silver (1985) on the USSR after WWII, and Jones and Ferguson (2006) on Colombia. Moreover, Valente (2011) and Jayaraman et al. (2009) examine the impact of the Maoist insurgency in Nepal and the Rwandan genocide, respectively, on marriage outcomes with econometric methods, but their focus is not on the conflict-driven change in the sex ratio.

Bethmann and Kvasnicka (2012) study the effects of sex ratio imbalances induced by WWII on out-of-wedlock childbirths in the German state of Bavaria. Using county-level census data from 1939 and 1946, they show that counties that experienced a relatively sharp decrease in the sex ratio witness an increase in the share of non-marital births. This result remains when the sex ratio is instrumented with data on men missing in action or dead in combat. This result does not hold for another category of absent men, i.e. war prisoners. The authors propose that the decline in the sex ratio for counties with large proportions of prisoners of war is temporary because most prisoners eventually return home. Bethmann and Kvasnicka conclude that not only the current sex ratio imbalance, but also the future prospects of demographic imbalances influence out-of-wedlock births.

An increase in out-of-wedlock births is also found for Russia after WWII (Brainerd 2008). Regions and age cohorts with lower sex ratios experience lower marriage rates for both men and women, lower total fertility, but a higher share of out-of-wedlock births than regions and cohorts with higher sex ratios. Yet, the results have to be interpreted with caution as the analysis is based solely on cross-sectional regional-level census data from 1959, collected 14 years after the end of WWII. This raises concerns about the impact of confounding factors, such as work-related migration.

Heuveline and Poch (2006) investigate the risk of divorce in Cambodia over the time period 1975-2000 with proportional hazard models, using individual-level survey data. Time dummies are employed to distinguish between four periods that differed in the extent of sex ratio imbalances (as well as other trends). Given this crude proxy for sex

ratio imbalances, results should be taken cautiously. Heuveline and Poch find that sharp drops in the sex ratios during the Khmer Rouge regime did not increase divorce rates.

Shemyakina (2011b) studies the impact of the 1992-1998 civil war in Tajikistan on marriage outcomes. The analysis builds on cross-sectional individual-level survey data from 2003. Two mechanisms through which conflict affects marriage outcomes are tested: living in a conflict-affected region (calculated from conflict event data) and regional sex ratio imbalances (calculated from the 1989 and 2000 Tajik census). Results from a proportional hazard model suggest that women who are of marriageable age and who live in regions with high conflict intensity have a significantly lower probability of being married compared to women living in regions with lower conflict intensity. In contrast, sex ratio imbalances at the regional level do not have a significant impact on women's probability of entering into their first marriage.

Finally, a study by Francis (2011) explores the consequences of a large surplus of men of marriageable age on the island of Taiwan, following the flight of the defeated Chinese Nationalist Army from mainland China to Taiwan in 1949. The data used stem from an individual-level cross-sectional survey conducted among 3,800 Taiwanese women in 1989, which are combined with region-level sex ratios derived from annual population data. Francis finds, amongst others, an increase of the bride price relative to the dowry for women living in regions with a larger male surplus in the year they married, compared to women living in regions with a lower male surplus.

In sum, empirical evidence from war-affected countries provides strong evidence that a shock in the sex ratio affects marriage market outcomes. Furthermore, the effects are in line with the predictions of neo-classical theories of the marriage market.

### 3. 3. The Rwandan context <sup>10</sup>

#### A. Marriage, consensual union and women's access to land

The Rwandan proverb *'Umugore ntagira ubwoko, afata ubw'umugabo'* signifies 'A woman does not have an identity, she takes her husband's' (Burnet and RISD 2003: 189). It illustrates well the fact that Rwanda is a patriarchal society where men hold authority over women and children, and property is inherited by the male lineage. In Rwanda's agricultural-based economy, the patrilineal inheritance rights are important for land tenure rights, both in the customary and statutory system.

Most commonly, a woman's access to land is through marriage. In customary marriage, a set of rituals mark the transfer of a woman from her father's lineage to her husband's lineage, including the exchange of bridewealth paid by the husband's family to the bride's family.<sup>11</sup> According to customary practices, when widowed, a woman can retain usufruct rights on the land provided she has male children to pass it on to. If there are no male children, a widow can stay on the land through levirate marriage and have children with her brother-in-law, or else, she would often leave the land and return to her

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<sup>10</sup> For our overview of marriage, womanhood, and women's land access in Rwanda we rely on detailed descriptive studies, most importantly Burnet (2003), HAGURUKA (2003) and Sommers (2012). Jennie Burnet – an anthropologist with extensive experience on Rwanda – writes about women's access to land in Rwanda on the basis of field research with input from focus groups, communal officials, and members of local women's associations. HAGURUKA – a Rwandan NGO with a focus on women's rights – commanded a study on consensual union in Rwanda, of which the final report presents causes and consequences of consensual union relying on information obtained during interviews with over 15,000 individuals. Sommers – an internationally recognized expert on youth in war and post-war settings – released his book « Stuck » in 2012, in which he provides a discussion of the challenges to reach adulthood in post-war Rwanda on the basis of several months of field observations and interviews in rural and urban survey sites.

<sup>11</sup> The groom's family often gives livestock (or the equivalent in cash), banana beer and agricultural tools (hoe, machete) to the bride's parents, while the bride brings with her clothes and kitchen tools, as well as sorghum beer and food for the guests at the 'wedding party' (calculated from a small household survey described in Section 4B below).

own lineage. When neither customary nor civil marriage has taken place and a woman instead lives in consensual union, neither she nor her children have customary land rights. In her own lineage, she may receive land gifts from her father, but only when this land is not needed by her brothers or other male relatives of her own lineage. Upon land scarcity, the land gifts from fathers to daughters became less common (André & Platteau 1998).

The statutory law underwent major reforms during the years following the genocide. The 1999 *Law on Matrimonial Regimes, Liberalities, and Successions* entitled women to hold property and granted equal inheritance rights to male and female children for the first time in Rwanda's history. The law also granted inheritance rights to widows. Gender-equality was confirmed in the 2005 *Land Law*, which specifically addressed the issues of land inheritance. However, both laws only recognize civil monogamous marriages, leaving women in consensual union, in polygamous marriage,<sup>12</sup> and in unregistered customary marriage, as well as their children, without legal protection (Pottier 2006). Because of these shortcomings, Burnet and RISD (2003) conclude that for their access to land, the majority of Rwandan women are left vulnerable to the goodwill of their husband and their family in law.

In its report on the causes and consequences of consensual union, HAGURUKA (2003) mentions that, among its 15,140 interviewees, almost 70 percent report uncertainty over property rights as a severe adverse consequence of consensual union. An almost equally high share makes mention of the risk of random abandonment, which is

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<sup>12</sup> Polygamy is banned by the Rwandan law such that additional wives are considered as living in consensual union and also risk losing access to land upon widowhood. Polygamy was banned already in the early 1950s, and by the different Rwandan constitutions (1962, 1978, 1991, 2003), but is only recently repressed with vigor (HAGURUKA 2003; Sommers 2012). The proportion of women living in polygamous marriage decreased from 5.7 percent in 1991 to 3.8 percent in 2002. Given that polygamy is considered illegal, underreporting – particular in the 2002 census – is likely. Because of this caveat and the small number of reported polygamous marriages, we do not explicitly consider polygamy in our analyses.

perceived high for women in consensual union, as their ‘husbands’ – unconstrained by customary or statutory law – can take unilateral decisions at any moment they please.<sup>13</sup>

Finally, half of the respondents highlight the social and mental cost of consensual union, stemming from humiliation and lack of respect from the family in law, their own family or the society in general.<sup>14</sup>

Sommers acknowledges that the path to marriage for female youth is further hampered by the “shortage of men in the overall population due to post-genocide realities” (Sommers 2012: p. 9). Sommers also investigates in detail the social and mental costs of failure to marry. He writes: “Once unmarried women reach the age of twenty-eight, but perhaps just twenty-four or twenty-five (male youth and men debate the cut-off age), they are labeled ‘old ladies’ or ‘prostitutes’ and permanently forced onto the margins of society” (Sommers 2012: p. xvi). According to his research, the clock ticks less rapidly for men, but still “by his early thirties, a single male youth faces public embarrassment if his house is not completed and he still isn’t married” (Sommers 2012: p. xvi).

In sum, the consequences of the decline in legal marriage may be severe, in a material sense for women, and in a social and mental sense for both men and women.

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<sup>13</sup> According to HAGURUKA (2003), the risk of abandonment is especially high when a ‘husband’ is financially unable to take care of his ‘wife’ and ‘her’ children, or conversely, after the harvest of cash crops (coffee, tea, rice) when men have the means to attract other women.

<sup>14</sup> For instance, it is argued that the family of a woman living in consensual union sees itself deprived not only of the bride price, but also of the pride that accompanies the achievement of raising a daughter according to the social norms. In the worst case scenario, this may lead the family to ban the woman from her lineage, preventing her to return when faced with ‘marital’ problems.

### *B. Reported reasons for the rise in consensual union*

If the costs are so high, why is consensual union on the rise? Over 80 percent of respondents in the HAGURUKA (2003) study mention poverty as a cause for consensual union. Burnet and RISD (2003) highlight the high cost associated with marriage ceremonies in Rwanda, including the cost of wedding parties at the occasion of both the customary and civil marriage, the exchange of bridewealth (both for customary and civil marriages) and the administrative costs for the marriage certificate (for civil marriages).<sup>15</sup> Moreover, before marrying, men in pre-genocide Rwanda had to give prove they had a house and sufficient land for sustaining a family. André and Platteau (1998) observe that in areas with extreme land scarcity, this practice led young men to increasingly postpone marriage.<sup>16</sup> The requirement to be the owner of a house is discussed at length by Sommers (2012). The *imidugudu* villagization scheme, enacted in 1996, imposed a further constraint on young men who seek to get married, requiring them to build houses of certain size, certain construction materials and in certain locations.<sup>17</sup>

Besides poverty, land scarcity and housing policies, the imbalanced sex ratio is also mentioned as a cause of the rise in consensual unions. According to the HAGURUKA study, women accept consensual union because of ‘survival’ (23 percent) and ‘prolonged singlehood’ (22 percent). It is argued that, in order to survive – e.g. have

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<sup>15</sup> Burnet and RISD (2003) also argue that there are cultural or social reasons for not marrying according to civil law, which requires going to the commune office and taking an oath on the Rwandan national flag in the presence of local government officials, an act that may not come natural to recently repatriated Rwandans.

<sup>16</sup> For instance, in the rural community studied by André and Platteau (1998), between 1988 and 1993, the share of women and men aged 20 to 25 still living with their parents increased from 39 percent to 67 percent and from 71 percent to 100 percent, respectively.

<sup>17</sup> *Imidugudu* are agglomerations of houses or villages that are to replace the traditional scattered mode of living. Banana leaves as a roof topping have been forbidden, while at the same time the local production of tiles has been banned, following which prices of tiles sky-rocketed (Sommers 2012). The *imidugudu* villagization scheme was the Government’s response to the pressing shortage of housing and land.

access to land – women are dependent on men and prefer to engage in a consensual union rather than remaining single. ‘Prolonged singlehood’ refers to the fact that many women engage in consensual union as the second best option to avoid the social stigma associated with remaining single. For men, consensual union has an advantage over marriage since it does not come with the same obligations of fidelity and responsibility. Along the same lines Burnet and RISD argue that, partly because of the low male-to-female sex ratio, women are not demanding in their relationship with men because “they feel lucky that they have fiancés” (Burnet and RISD 2003: p. 197).

### *C. Implications for children, youth (and peace)*

While women disproportionately suffer from the lack of legal marriage, their children share in the burden. In fact, according to Rwandan tradition, women who gave birth outside marriage were to be banned or killed, and their children were to be banned as well or left to die.<sup>18</sup> Today, these traditional punishments no longer apply, but children born from single mothers or mothers in consensual union still suffer from social stigma and do not have inheritance rights.<sup>19</sup>

The implications of the rise in consensual union and the lack of inheritance rights for women in these unions and their children may stretch further than individual welfare effects. After all, a large pool of landless and jobless youth may pose a threat to the society, and particularly so under certain conditions, such as lack of off-farm employment

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<sup>18</sup> This infamous tradition is known as “Kwohera” in Rwanda. Even the parents of the woman were to drink a magic potion to protect them from the evil that could occur to them following the behavior of their daughter (HAGURUKA 2003).

<sup>19</sup> Rwandan law does give the possibility to the father of the ‘natural’ child to recognize the child, which would give the child the same inheritance rights as children born in a legal marriage. This possibility also exists for children born in a polygamous marriage with the additional complication that the legal wife (usually the first wife) also has to give her consent for the legal recognition of the child (Pottier 2006).

and a politically tense climate. For instance, André and Platteau (1998) provide evidence that due to extreme land scarcity in Rwanda and unequal access to off-farm jobs, intra-community tensions were rising in the years preceding the genocide and becoming increasingly difficult to settle. Furthermore, Verpoorten (2012b) demonstrates that in areas where more men remained single because of land scarcity and unequal land access, a larger share of the Tutsi population was killed. Sommers also warns of landless unmarried young men as a vehicle for social discontent and rebel recruitment, especially given that “Rwandan male youth have an established history of being directly involved in violence” (Sommers 2012: p. 8).

#### *D. Rwanda’s conflict cycle*

This study focuses on the violence that took place in Rwanda in the nineties, the roots of which go back many decades.<sup>20</sup> Following independence in 1962, ethnically motivated violence and political campaigns against Tutsi resulted in waves of Tutsi fleeing Rwanda for neighboring countries (the so-called *old caseload refugees*). Attempts by these exiled Tutsi to return to Rwanda and regain power posed a constant threat to the Hutu-dominated government, which further increased tensions between the two groups. In late 1990, the Rwanda Patriotic Front (RPF), an army founded by Tutsi refugees, invaded Rwanda from the North. This led to a period of intermittent hostilities and negotiations with the Rwandan government until a peace agreement was reached in 1993.

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<sup>20</sup> The recent history of Rwanda and the genocide is described in more detail in Prunier (1999), Mamdani (2001), and Desforges (1999).

In April 1994, the plane carrying President Habyarimana was shot down and genocide broke out. Extremist Hutu militia known as *Interahamwe*, the Rwandan Armed Forces (FAR) and Rwandan police forces organized massacres against the Tutsi minority and, to a lesser degree, moderate Hutu intellectuals who were opposed to the regime. The civil war between the RPF and the Rwandan government, which had been halted the year before, restarted and intensified. By the end of June 1994, the RPF had taken control of the country and had put an end to the ethnic cleansing of Tutsis. Relative peace was established, although militias from the old regime (FAR and *Interahamwe*) continued with insurgencies in the North-West for some time (African Rights 1998).

Rwanda thus experienced distinct forms of violence, which were concentrated in different geographical areas and had different consequences. The map in Figure 1 roughly illustrates the geographical spread, with the civil war taking place in most of the northern and eastern provinces, as well as in the Centre, the genocide being most intense in the South, and the (counter-)insurgencies concentrated in the northwestern provinces. Verpoorten (2012a) maps the spatial pattern of excess mortality in Rwanda. She finds it corresponds well with the different forms of violence, with an especially large concentration of high excess mortality in the South and the Northwest, reflecting respectively the high direct death toll of the genocide (up to 800,000 deaths, about 10 percent of the total 1991 population), and the indirect death toll of the civil war and the (counter-)insurgency, caused by a variety of factors including a prolonged period of insecurity and limited access to food and health care (Verpoorten 2012a).

### *E. The impact of conflict on the sex ratio in Rwanda*

While the weakest segments of the population may have been most vulnerable to indirect death causes, the genocidal violence was targeted against the male Tutsi population of prime age (de Walque & Verwimp 2010). It is estimated that between 70-75 percent of the Tutsi population was killed in 1994 (Verpoorten 2005). A smaller number of male soldiers died in combat between the FAR and the rebel army, the RPF, which eventually stopped the genocide and took power.

The genocide-induced drop in the sex ratio was not uniform across the country, and also varied within provinces. For instance, based on a detailed analysis for Gikongoro province, Verpoorten (2005) finds large variation in the survival rate of Tutsi men and women, around their respective average survival rates of 21 percent and 29 percent. Explaining the heterogeneity in the survival rates for women, Desforges argues that the killing of Tutsi women during the genocide was determined by local contingencies as well as changing directions from the orchestrators of the genocide:

*“In many communities women and children who had survived the first weeks of the genocide were slain in mid-May. In the past Rwandans had not usually killed women in conflicts and at the beginning of the genocide assailants often spared them. When militia had wanted to kill women during an attack in Kigali in late April, for example, Renzaho (Colonel, and prefect of Kigali) had intervened to stop it. Killers in Gikongoro told a woman that she was safe because ‘sex has no ethnic group’. The number of attacks against women, all about at the same time, indicates that a decision to kill women had been made at the national level and was implemented in local communities. Women who had been living on their own as well as those who had been kept alive to serve the sexual demands of their captors were slaughtered.”* (Desforges 1999: p. 296)

Immediately after the genocide, about 2 million Rwandans, the so-called *new caseload refugees*, fled to the Democratic Republic of Congo and Tanzania in fear of

revenge by the RPF and persecution of their crimes. Among the new caseload refugees were perpetrators of the genocide, who were mostly male, as well as many innocent civilians. About 600,000 new caseload refugees returned from Congo to Rwanda and another 500,000 refugees returned from Tanzania to Rwanda in late 1996 (World Bank 2003). A smaller portion of the new caseload refugees, mostly former militias, became involved in the Congo wars and were repatriated to Rwanda in the period 1997-2000 (Verwimp & Van Bavel 2005). In addition, about 700,000 old caseload refugees returned to Rwanda from exile in Uganda shortly after the genocide (Newbury 2005).

In the post-war period, the new RPF-led government in place sought to prosecute genocide suspects. Besides the International Criminal Tribunal for Rwanda in Arusha, which indicts the organizers of the genocide, the majority of genocide suspects are judged by community-level transitional justice courts called *gacaca*. The population census collected in 2002 established that about 110,000 individuals were in prison in 2002, of which 97 percent were male. This fact mirrors the findings of previous studies showing that perpetrators of genocidal violence were predominantly (although not exclusively) male (Verwimp 2005).

In sum, the targeted violence during the genocide, the escape of perpetrators to the Congo, as well as the imprisonment of genocide suspects affected more men than women. Consequently, there was a scarcity of men on the marriage market in post-war Rwanda, which we document in the next section.

#### 4. Data description

##### *A. Commune-level sex ratio and conflict intensity measures*

For the calculation of the sex ratio, we rely on a 10 percent sample of the 1991 population census (N=742,918) and the entire 2002 population census (N=8,128,550). The sex ratio that we use in our baseline estimations is calculated at the commune<sup>21</sup> level for the population aged 20-60 years who live in ‘private’ households.

We purposefully exclude individuals residing in ‘institutions’, such as prisons, military camps, and convents from the calculation of the sex ratio.<sup>22</sup> In 2002, institutionalized individuals make up 1.97 percent of the total population, with its largest subgroup (about 66 percent) being prisoners. Between 1991 and 2002, the number of prisoners increased more than tenfold, from about 8,300 individuals (0.11 percent of the population) in 1991 to 110,000 individuals (1.3 percent of the population) in 2002. In both years, prisoners are predominantly male (97 percent). The average age of prisoners in 2002 is 40 years. As regards their marital status, 29 percent of prisoners are single, 18 percent live in consensual union, and 42 percent are married. Prisons are concentrated in a small number of communes across Rwanda, while less than 19 percent of prisoners previously lived in the commune in which the prison is located. Therefore, including the population of prisoners (as well as other institutionalized individuals) would falsely inflate the sex ratio in those communes.

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<sup>21</sup> In 1991, Rwanda was divided into 10 préfectures, 145 communes (of which 6 entirely urban) and 1,565 sectors. A commune had an average size of 173 square kilometer and counted on average 48,605 inhabitants. In 1996, an administrative reform replaced the 10 préfectures with 12 provinces, adding Kigali City and Umutara. In 2002, a further administrative reform replaced the 145 communes with 30 districts and the 12 provinces with 5 regions.

<sup>22</sup> Ideally, we would only exclude prisoners from the calculation of the sex ratio. Unfortunately, this is not possible due to data constraints: The individual-level census data only permits us identifying individuals who live in institutions, but not by type of institution.

In the age group of 20-60 year olds, including the institutionalized population, the sex ratio dropped from 0.94 in 1991 to 0.85 in 2002. When restricting the sample to individuals living in private households, the decrease in the sex ratio is even larger, from 0.94 in 1991 to 0.77 in 2002. There is a large variation in the sex ratio across administrative communes. This fact is important for our identification strategy, as we argue that the spatial variation in the sex ratio relates to the spatial variation in violence.

Figure 2 presents the distributions of the 1991 and 2002 sex ratios across communes, showing a sharp decrease in the mean sex ratio and a large variation around the means. Figure 3 plots the change in the sex ratio on a commune-level administrative map of Rwanda. A simple comparison with Figure 1 shows that the spatial variation in the change in sex ratios is related to the spatial pattern of conflict in Rwanda, with sharp drops in the sex ratio in the South, where genocide was most severe, as well as in the Northwest, where the civil war continued for several years in the form of (counter-) insurgencies. Figure 4a and 4b visualize the relationship in scatter plots between the change in the sex ratio against two commune-level measures that proxy the intensity of the genocide: the 1991 proportion of Tutsi per commune as recorded in the 1991 population census and the proportion of genocide suspects per commune. The latter are taken from official records compiled by *gacaca* courts.<sup>23</sup> Both scatter plots show a strong negative relationship between the genocide intensity and the change in the sex ratio. The

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<sup>23</sup> *Gacaca* is the transitional justice system for genocide crimes. In 2005, the *gacaca* courts were stepping in the first phase of their activities, i.e. the phase of collecting information. During weekly sessions with compulsory attendance of all community members, lists were made of victims, suspects and survivors. Part of the results achieved during this phase were made public in the course of 2007. Verpoorten (2012) gives a detailed overview of the data and discusses its reliability. She argues that under-reporting of genocide suspects is especially problematic in areas with few survivors. Therefore, given a certain share of Tutsi in the population in 1991, we expect the number of genocide suspects to be relatively low in communes where almost all Tutsi were killed, both men and women, and relatively high in communes where Tutsi women were left to survive.

linear fit indicates that the change in the sex ratio decreased on average by  $x$  when the conflict intensity measures increased by  $x$  and  $y$  percentage points, respectively.

### *B. Individual-level marital outcomes*

We rely on two different datasets with individual-level observations on marital outcomes. First, we use a 10 percent sample of the 1991 population census and the entire 2002 population census. The census questionnaires have a comparable design, recording a respondent's sex, age, citizenship, language spoken, marital status, religion, employment status, birthplace, location and duration of previous and current residence and survival status of parents. We regroup respondents' marital status into five categories: single (i.e., never married); consensual union; married (custom, civil, or religious); divorced or separated; and widowed. For women, information is also included on the number of children born alive (in total and during the past 12 months) and the number of children still alive (in total and during the past 12 months). The census data also include a number of household assets as well as the quality of housing. Only the 1991 census provides information on ethnicity. This information was not collected in 2002, because, in line with a national unity campaign and the public rhetoric after the 1994 genocide, it became politically incorrect in Rwanda to talk about ethnicity. In fact, even in 1991 ethnicity was highly politicized. In relation to this, Verpoorten (2005) demonstrates that the Rwandan census data are very reliable except for the recording of ethnicity.<sup>24</sup> Our analyses mostly consider the prime age population, aged 19-49 years.

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<sup>24</sup> Comparing the 1991 Rwandan population census with 1990 population data from the local administration, Verpoorten (2005) finds an almost exact match of the numbers of women and men. However, the share of Tutsi in the population in the census data is 40 percent lower than in the local

Second, we make use of cross-sectional DHS surveys from 1992 and 2005, which contain much less respondents than the census data, but record the date of marriage (which is lacking from the population census). The latter information allow us to study age at first marriage and assortative matching. The data in each DHS wave is representative of households at the national and at the provincial level, based on a stratified survey design. Altogether, 126 communes were covered in both DHS waves. In every selected household, all women of age 15-49 years who were either usual household members or who were present in the household on the night before the interview were eligible for interviewing. The questionnaire design is broadly similar across the survey waves and includes detailed information on women's socio-economic characteristics, including age, schooling, marital history, child births, and labor market participation, as well as households' physical asset endowments. We restrict the sample of the 2005 DHS to women who married postwar, between July 1994 and 2005. In the 1992 DHS, we consider marriages that occurred in a time window of similar length, between 1981 and 1992. This restriction on the timing of marriages leaves us with a sample of 1,655 women surveyed in 1992 and 2,260 women in 2005. The average age of women included in the restricted DHS sample is 26 years, while very few women are older than 35 years. Therefore, in all analyses based on DHS data, we calculate the sex ratio for a smaller age range, i.e. for the population living in private households who are aged 15-45 years.<sup>25</sup> The commune-level sex ratio derived from the population census of 1991 is matched with

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population data. Two criticisms have been put forward. First, to avoid discrimination, an undetermined number of Tutsi registered as Hutu. Second, the Habyarimana regime is said to have deliberately under-reported the number of Tutsi in order to keep their school enrolment and public employment quotas low.

<sup>25</sup> For individuals in private households aged 15-45 the sex ratio decreased from 0.96 in 1991 to 0.83 in 2002.

the 1992 DHS and the sex ratio calculated on the basis of the 2002 population census is matched with the 2005 DHS.

### *C. Descriptive figures on marital outcomes*

We use the census data to study three different outcome variables: (1) men and women who are single (S) as a share of the sum of men and women who are single (S), who live in consensual union (C), and who are formally married (M), thus  $S/(S+C+M)$ ;<sup>26</sup> (2) consensual unions as a share of total unions, or  $C/C+M$ ; and (3) children born outside legal marriage as a share of total children born to single mothers, mothers in consensual union, and married mothers, thus children  $(S+C)/(S+C+M)$ . We use the DHS data to study women's and men's age at first marriage as well as age and educational differences between spouses.

Figures 5-9 give a first glance at the data. Figure 5a shows an increase in the share of single women between 1991 and 2002, especially among middle-aged women. In contrast, singlehood for men decreased (Figure 5b). Figure 6a and 6b display a pronounced increase in the share of consensual unions, both for women and men. In line with these results, a larger share of children is born out-of-wedlock (Figure 7) and this holds for mothers of all ages. As regards age at first marriage, there appears to be divergent trends for women and men: while women tend to marry at slightly older age after the genocide (Figure 8a), the age at first marriage for men decreases (Figure 8b). The mean difference in age between spouses declined from 6.57 years in 1992 to

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<sup>26</sup> The share of widows increased sharply after the genocide. Therefore, we exclude widowed as well as divorced or separated individuals, assuming that they are not on the marriage market.

5.22 years in 2005 (Figure 9), while the educational difference between spouses was somewhat higher for post-genocide marriages (Figure 10).

To conclude, these figures indicate that over the period 1991-2002 there were large shifts in marital outcomes. However, this does not need to be the result of a drop in the sex ratio, but may be driven by other unrelated changes, such as increased poverty in the post-war period, or by a time trend of ‘modernization’ or ‘emancipation’. After all, in many other parts of the world as well as other African countries, the share of single women, consensual unions and out-of-wedlock births is likely to be on the rise. In fact, the only two results that clearly go against a global trend are the decrease in single men and the lower age at first marriage for men. In order to distinguish between time trends (whether global or Rwanda-specific), other confounding variables (such as war-induced poverty), and a causal effect of the drop in the sex ratio, we now turn to a multivariate regression framework.

## 5. Econometric framework

To identify the impact of a relative scarcity of men on marital outcomes, we exploit the variation in the sex ratio over time (prewar and postwar) and across administrative communes. Put differently, we compare the change in marital outcomes over time across communes which experienced a larger change in the sex ratio due to violence and communes with a smaller war-induced change in the sex ratio. Formally, the empirical model can be written as follows:

$$M_{i,t,c} = \alpha_1 postwar_t + \alpha_2 sexratio_{t,c} + \alpha_3 X_{i,t,c} + \eta_c + \varepsilon_{i,t,c} \quad (1)$$

where  $i$  indexes individuals,  $t$  time (before or after the genocide), and  $c$  communes. The variable  $M_{i,t,c}$  denotes our individual-level outcome variables,  $postwar_t$  is an indicator variable equal to one for individuals surveyed after the genocide, and  $sexratio_{t,c}$  denotes the commune-level sex ratio in time period  $t$ . We control for a number of individual-level covariates, denoted by vector  $X_{i,t,c}$ . These include age and religion fixed effects (Protestant, Catholic, Muslim, and other religion); years of education; an indicator variable equal to one if the individual migrated in the past 10 years;<sup>27</sup> an index of household assets that proxy a household's long-term wealth;<sup>28</sup> an indicator variable equal to one if the individual lives in an *imidugudu* village scheme; and an indicator variable equal to one if the place of residence is urban. For data collected before 1994, we also include an indicator variable taking the value one if the respondent is Tutsi to control for differences in marriage behavior between the Tutsi and Hutu population. Omitting this control could bias our results since approximately 75 percent of Tutsi were killed in 1994, and therefore the post-genocide population may not be comparable with the pre-genocide population. Finally,  $\eta_c$  denotes commune fixed effects, which capture time-invariant differences across communes in demographic characteristics and local customs of marriage.  $\varepsilon_{i,t,c}$  is the standardized error term. In order to account for a potential correlation of these errors within communes, we cluster the

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<sup>27</sup> The migration variable is meant to capture the potential difference in outcome variables across individuals who never lived outside of their native commune and individuals who migrated after 1994. The latter group encompasses both new caseload refugees who temporarily fled Rwanda in the mid-1990s in fear of persecution of genocide crimes and retaliation by the RPF and old caseload refugees who returned to Rwanda after spending years in exile, mostly in Uganda.

<sup>28</sup> Components of the index include various measures of quality of housing and durables (see Table 1). The different asset variables are normalized and then transformed into a single wealth index through principal component analysis (Kolenikov & Angeles 2009). The wealth-index is likely to indicate the long-term economic well-being, since many of the durables are typically held by households for many years and are not frequently replaced (Sahn & Stifel 2000).

standard errors at the commune level. All variables are summarized in Table 1. The estimated coefficient of interest is  $\alpha_2$ , which captures the change in marital outcomes that can be attributed to the war-induced change in the sex ratio in a given commune.

Since several outcome variables are categorical, we have the option between two different estimation strategies. We can maintain the categorical nature of the variables and estimate a probit or ordered probit model. Alternatively, we can estimate our empirical model by OLS, treating the categorical answer as if they were part of a continuous scale. We opt for the latter approach since a linear probability model is more tractable and flexible in handling unobserved heterogeneity, and it allows for a straightforward interpretation of coefficients, both in OLS and IV (de Janvry, et al. 2006).<sup>29</sup>

The above framework implicitly assumes that the change in the sex ratio is exogenous, which may not hold if unobserved characteristics affect commune-level changes in marriage market outcomes as well as changes in the sex ratio. Next, using a similar approach as Abramitzky et al. (2011), we employ an instrumental variable strategy to account for the potential endogeneity in the change in the commune-level sex ratio. We instrument the sex ratio with our two measures of commune-level genocide intensity that were presented in Section 4A: The proportion of Tutsi per commune as recorded in the 1991 population census and the proportion of genocide suspects per commune obtained from the 2005 *gacaca* information round.

To be relevant, the instruments should be strongly correlated with the change in sex ratio. To be valid, they should not be correlated with unobserved factors affecting

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<sup>29</sup> We replicate the estimations using probit and ordered probit as a robustness check. Results remain very similar.

marriage market outcomes. There is a strong indication that the two instruments meet these criteria. When regressing the sex ratio on the two instruments, the estimated coefficients of the instruments are economically meaningful and individually as well as jointly statistically significant at the 0.01 level. The instruments explain more than 20 percent of the variance in the change in sex ratio. Given that we have an overidentified model, we can formally test for the validity of instruments, using the Hansen test. Based on this test, we cannot reject the null hypothesis that both instruments are valid.

In a first step, we regress the sex ratio on the two instruments (each interacted with the postwar dummy) as well as individual-level covariates  $X_{i,t,c}$  and commune-level fixed effects  $\eta_c$ :

$$\begin{aligned} \text{sexratio}_{t,c} = & \alpha_1 \text{postwar}_t + \alpha_2 \text{tutsiprop}_c * \text{postwar}_t + \alpha_3 \text{suspectsprop}_c * \\ & \text{postwar}_t + \alpha_4 X_{i,t,c} + \eta_c + \varepsilon_{i,t,c} \end{aligned} \quad (2)$$

In a second step, the outcome variable of interest is regressed on the instrumented sex ratio and the same set of exogenous variables as included in (1) above:

$$M_{i,t,c} = \alpha_1 \text{postwar}_t + \alpha_2 \widehat{\text{sexratio}}_{t,c} + \alpha_3 X_{i,t,c} + \eta_c + \varepsilon_{i,t,c} \quad (3)$$

Ideally, we should estimate the empirical model separately for those who were not married at the time of the genocide and those who were. Lacking data on the year of marriage in the population census, we take an alternative approach. We estimate the above equations for different age cohorts of women and men to distinguish between those included in the 2002 census who were likely to have been married before 1994 and others who were likely to marry after 1994. Panel A of Table 2 presents the share of women who are single across four age cohorts: 10-18 years (A), 19-27 years (B), 28-36 years (C), and 37-45 years (D). Both in 1991 and 2002, more than 95 percent of women in age

cohort A were single, while only about 10 percent of women in age cohort D were single. This means that the large majority of women, over 80 percent, marries when aged 19-36, i.e. in age cohort B and C. Women in age cohort B in 2002 were aged 11-19 in 1994, so unlikely to be married in 1994; women in cohort D in 2002 were aged 29-37 at the time of the genocide, so likely to be married; and women in cohort C were aged 20-28 in 1994, and half of them were likely to be married. We run separate regressions for women of age cohort B (unlikely to be married in 1994), cohort C (somewhere in between) and cohort D (likely to be married in 1994). For men we take a similar approach, but since men marry on average later (see Panel B of Table 2), we run the regressions for men for the following age cohorts: 23-31 years (cohort B; unlikely to be married in 1994), 32-40 years (cohort C; somewhere in between), and 41-49 years (cohort D; likely to be married in 1994).

## **6. Regression results**

### *A. Census-based results: The impact of male scarcity on marital status and out-of-wedlock births*

Results from the OLS and IV estimations on the probability of being single are shown in Table 3. For young women, aged 19-27 (cohort B) the war-induced male scarcity has no significant effect on the probability of being single in the postwar period. For women in age cohorts C and D, a decrease in the sex ratio significantly increases the likelihood that a woman remains single, holding other factors constant. For instance, a 10 percentage point decrease in the commune-level sex ratio raises the probability that a woman aged 28-36 years (cohort C) is single by 1.4 percentage points in the OLS specification and by

3 percentage points in the IV specification, compared to a prewar share of single women of 10 percent. The effect is opposite for young men. Men aged 23-31 years (cohort B) who live in a commune with a 10 percentage point decrease in the sex ratio have a 1.4 (in OLS) and 6.3 percentage points (in IV) lower likelihood of being single compared to men living in a commune with a status quo in the sex ratio. There is no significant effect for men in cohort C. Results for men in the oldest age cohort (D, 41-49 years) are surprising: a drop in the commune-level sex ratio leads to a higher probability of singlehood among older men. We do not have a ready explanation for this finding, but a possible reason could be that a large number of men in this age group are stigmatized as perpetrators of violence because they were aged 33-41 in 1994. This is consistent with the finding of Verwimp (2005), who shows that men around age 38 had the highest probability of being a perpetrator.

OLS and IV estimates on the determinants of living in a consensual union are presented in Table 4. The results are very strong, and all point in the same direction. For women and men of all age groups, a more pronounced male scarcity increases the likelihood to live in consensual union. Among women, this effect is strongest in age cohort B (aged 19-27 years), with a 10 percentage points decrease in the sex ratio leading to a 5 (OLS) to 19 (IV) percentage points higher likelihood to live in a consensual union (compared to a prewar share of women in consensual union of 43.3 percent). This effect is almost as equally strong for men in age cohort B (aged 23-31), which indicates that the strong effect for women is not mainly explained by an increase in polygamy (which is prohibited by law and hence considered as consensual union). Instead, this finding

suggests that the genocide-induced male scarcity leads women to accept the less binding commitments made by men.

As the above findings show that the decline in the sex ratio leads to an increased share of consensual unions and middle-aged single women, we expect an increase in the share of children born out-of-wedlock. Table 5 shows that for mothers of age cohort B (aged 19-27), a 10 percentage point decrease in the commune-level sex ratio significantly increases the share of illegitimate children by 17 percentage points from a prewar share of 0.48 percent. For women in cohort C (28-36) the effect is stronger, but only significant for the IV estimates; for women in cohort D (37-45) the effect is also strong, but not significant. We obtain qualitatively similar results when using the share of illegitimate newborns (who are born in the 12 months before each census wave) as an alternative dependent variable (columns 7-12).

A potential concern with these findings is that they may capture the impact of war-induced poverty. Without adequate controls for poverty, our IV strategy would be invalid as the conflict intensity proxies used as instruments would capture the war-induced impact of poverty rather than isolating the impact of the war-induced decrease in the sex ratio. This would bias our results since poverty directly affects marital outcomes. For instance, the reports cited above of Burnet and RISD (2003), Sommers (2012) and HAGURUKA (2003) all argue that the social expectations attached to marriage, such as exchanging gifts and providing housing, pose a barrier to the poor to get married in a socially acceptable manner. To address this concern we control for poverty with a household asset index, which indeed has the expected sign indicating that the poor are

less likely to engage in formal marriage and more likely to still be single when in their thirties.

*B. DHS-based results: The impact of male scarcity on age at first marriage and assortative matching*

How do trends in age at first marriage and assortative matching relate to male scarcity?<sup>30</sup> Table 6 presents results from OLS regressions.<sup>31</sup> Results show that a scarcity of men after the genocide significantly increases the age at first marriage for both women (column 1) and men (column 2). The magnitude of the effect is relatively large: Women in postwar Rwanda who live in a commune in which the sex ratio decreased by 10 percentage points marry 0.35 years later on average than women living in a commune with a status quo in the sex ratio, holding other factors constant. For men in postwar Rwanda, the effect of living in a commune with a 10 percentage point decrease in the sex ratio increases the age at first marriage by 0.93 years. Before the genocide, the average age at first marriage was 20.7 years for women and 26.9 years for men.<sup>32</sup>

While the data at hand do not allow us to test for specific underlying mechanisms at play, we suggest that two explanations may possibly drive our results. First, it appears likely that the commune-level sex ratio captures not only the effect of excess male deaths,

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<sup>30</sup> Results presented in this section refer to women and men who are either legally married or live in consensual union. Given the relatively small sample size, distinguishing between these two types of relationship is not feasible.

<sup>31</sup> For all DHS-based regressions, the Durbin-Wu-Hausman test does not reject the null hypothesis that the commune-level sex ratio is exogenous. The robust p-value computed by the test is above 0.29 for all regressions discussed in this section. In this case, the IV estimator would be less efficient than the OLS estimator and we therefore only present results from OLS estimations. Also, the sample size of the pooled DHS data is much smaller than the population census data, which would impose additional limitations to an IV estimation.

<sup>32</sup> We obtain very similar results when using year of marriage fixed effects instead of age fixed effects.

but also a more general breakdown of family support networks induced by violence. In the absence of senior kin members, it may take young men longer to meet the cultural expectations before marrying – providing for an appropriate homestead and sufficient land, as has been discussed in Section 3B. Second, for men, the prospects of eventually getting married are relatively good in communes in which the sex ratio is low (i.e. there is a surplus of women). This may lead young men to feel less pressured to hurry getting married. Overall, our results fit well into the observation by Jayaraman et al. (2009), who find that women in postwar Rwanda living in a primary sampling unit characterized by a higher share of respondents' sibling deaths in 1994 postpone both the age at first marriage and age at first birth compared to women living in a primary sampling unit with a lower share of sibling deaths.

Given that men living in locations with higher conflict intensity postpone marriage more than women, the mean age difference between husband and wife increases in communes in which men became scarcer in the post-war period (column 3). Yet, this effect is not statistically significant. Also, we do not find any significant effect of male scarcity on the educational difference between spouses (column 4).<sup>33</sup>

## **7. Robustness checks**

To ascertain that our results are driven by the conflict-induced change in the sex ratio – and not by some other effects that may correlate with the commune-level change in sex ratios – we conduct two tests. First, we estimate our baseline model based on prewar data

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<sup>33</sup> The same result holds when we use alternative definitions of the educational difference between spouses, such as a dummy variable taking the value one if the partner has lower or higher education than the respondent.

only and include as test variable the prewar-postwar change in the sex ratio for each commune. As it is no longer possible to include commune fixed, we instead control for commune-level characteristics and province fixed effects. The prewar marriage market should not be affected by this change in the sex ratio. Second, we estimate equation (1) for the youngest age cohort (A) with the population census data. For women and men of the youngest age cohort, the sex ratio should have no significant impact on the probability of being single, given that this cohort is not yet on the marriage market.

Further, we explore the robustness of the sex ratio variable and repeat all regressions with alternative definitions of the sex ratio. First, we include institutionalized individuals (including prisoners) in the calculation of the commune-level sex ratio (Table A3). In line with expectations, the magnitude of the impact of the sex ratio on outcome variables is smaller. Second, we calculate the sex ratio for different age groups, such as the number of men aged 18-59 years divided by the number of women aged 15-49 years living in private households (Table A4). Results are robust to using alternative definitions of the sex ratio.

Moreover, our estimation may suffer from an omitted variable bias given that ethnicity was not recorded in any of the post-1994 data. To explore this possibility in more detail, we use the pre-1994 data to explore whether Hutu and Tutsi differed in their marriage outcome before 1994.<sup>34</sup> In fact, the share of single women is xx percentage points lower for Tutsi women than for Hutu women, the share of women in consensual union is xxx percentage points lower for Tutsi women than for Hutu women, Tutsi women tended to marry 1.69 years later than Hutu women (all differences are statistically

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<sup>34</sup> However, the following tests can only be considered a rough approximation, given that there is evidence in both the 1991 population census and the 1992 DHS for an underreporting of Tutsi (see Section 4B).

significant at the xxx percent level). Yet, there was considerable degree of intermarriage, with about xxx percent of couples consisting of spouses of mixed ethnic background. Despite these differences between Hutu and Tutsi, we are confident that the omitted ethnicity variable in the post-1994 is not a major concern to our findings. First, an estimated 75 percent of the Tutsi population was killed during the genocide, which would reduce the magnitude of the differences across ethnic groups. Second, we repeat all regressions based on a restricted sample of individuals: From the pre-1994 data, we drop all Tutsi and from the post-1994 data, we drop all individuals who migrated after 1994 (thereby excluding all potential old caseload refugees who mostly have a Tutsi background). Repeating all regressions based on the restricted sample reveals very similar results (Table A5). This underlines the fact that our findings are not driven by ethnicity or by the individual-level exposure to violence, but rather capture aggregate effects of an exogenous change in the sex ratio on the marriage market.

Lastly, we crosscheck our specification in a series of tests,<sup>35</sup> in which we use non-clustered standard errors instead of clustered, or standard errors corrected for spatial correlation; in which we employ probit and ordered probit instead of OLS when the outcome variable of interest is categorical; in which we use different samples, dropping urban communes with very high sex ratios; in which we drop ethnicity from our set of controls; in which we use an alternative control for household wealth; in which we use alternative classifications of age groups (with population census data); and in which we test the sensitivity of our results to the inclusion of other controls. Our qualitative conclusions remain valid.

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<sup>35</sup> Available from the authors upon request.

## 8. Discussion

We have shown that the genocide-induced drop in commune-level sex ratios affected the marriage market in several ways. Our findings are fivefold. First, we provide evidence for adjustment mechanisms that compensate for the supply deficit of middle-aged men: more middle-aged Rwandan women remain single. Second, we find that the age of first marriage increases for both women and men. This may follow either from a war-induced breakdown of family support networks, which may lead young men to struggle longer on their own to meet the material requirements of getting married; alternatively, given their good marriage prospects, young men may feel less pressured to get married quickly. Third, the share of informal unions increases among men and women of all ages. Given that informal unions are very inconvenient for women and their rights to land, this is in line with marriage market models that predict a decreased bargaining power for women upon a drop in the sex ratio. Fourth, our analysis also points to a second-generation effect with an increase in the share of children born out of wedlock, adding to the pool of youngsters deprived of legal inheritance. Finally, as the age at first marriage increases more strongly for men than women, we find evidence for an increased age gap between husbands and wives.

Besides the sex ratio, poverty proved to be an important determinant of marriage market outcomes. For instance, prolonged singlehood is predominantly a characteristic of the poor, as well as consensual union and out-of-wedlock births. Adding poverty as a control variable does however hardly change the estimated coefficient of the sex ratio, making us confident that our results do not pick up the impact of war-induced poverty.

The possible implications of these findings are large, as changes in marital outcomes may affect fertility, land access and distribution, intra-household bargaining, sexually transmitted diseases, female labor market participation, schooling, domestic violence, etc. Further research is needed on these issues, but many of these implications are likely to be negative for women in the short run. So, while men are disproportionately killed in armed conflict, women are left to survive, often suffering from trauma, and the conditions on the marriage market are likely to add to their suffering. However, what may lead to suffering in the short run may have positive effects in the longer run. For instance, more female labor market participation may lead to female emancipation and in time to changing gender norms with women assuming new roles and responsibilities (Kumar, 2001). The process of changing gender norms may also be accelerated by several NGOs that emerged in the aftermath of the genocide, with the objective to improve the lives of survivors, among whom were many widows. When the need for emergency assistance faded, many of these NGOs broadened their agenda but kept a gender focus, advocating for more women rights and their active involvement in economic decision making. Concrete achievements towards more gender equality in post-genocide Rwanda include the accordance of inheritance rights to women and daughters, as well as an astonishing increase in female political participation. For instance, while the share of elected women in the Parliament never exceeded 18 percent before the nineties, it had increased to 25.7 percent by 2003, and with the introduction of a gender quota in 2003, increased further to a world record high of 51,8 percent in 2012.<sup>36</sup>

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<sup>36</sup> From Inter-Parliamentary union website [www.ipu.org/wmn-e/classif.htm](http://www.ipu.org/wmn-e/classif.htm) (accessed January 2012).

Thus, while this paper has shown that conflict affects the marriage market through a change in sex ratios, which – following the logic of the neoclassical marriage market models – may have a negative impact on women’s welfare, the relation between armed conflict and gender outcomes is likely to be much more complex, and may lead to very different welfare outcomes in the short run than in the longer run. Several aspects of this relation merit further research. To give just one example, one could exploit the discontinuity generated by the introduction of gender quota in 2003 to investigate whether a change in the gender composition of elected candidates has an actual impact on policy making and outcomes in Rwanda. In 2002, there were more than xxx illegitimate children who were born after the genocide. The sheer size of this group raises concerns about their future land security, given that illegitimate children are not entitled to inherit land from their fathers.

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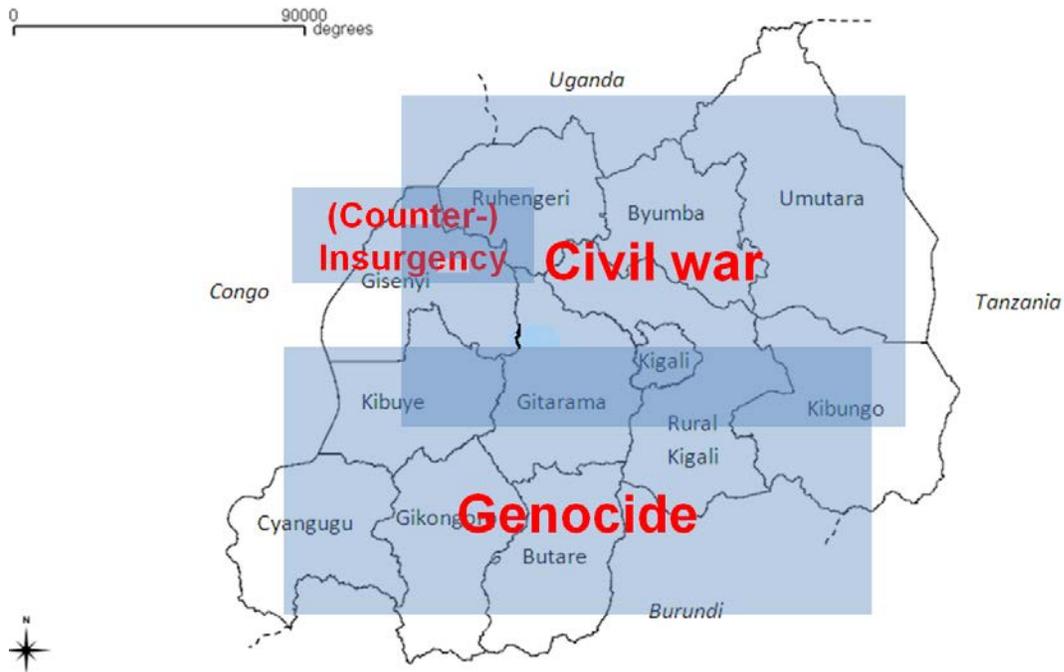
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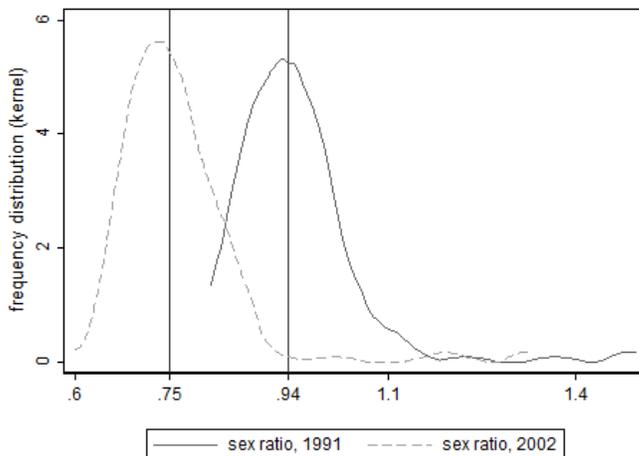
## Tables and Figures

**Figure 1: The spatial pattern of conflict in Rwanda**



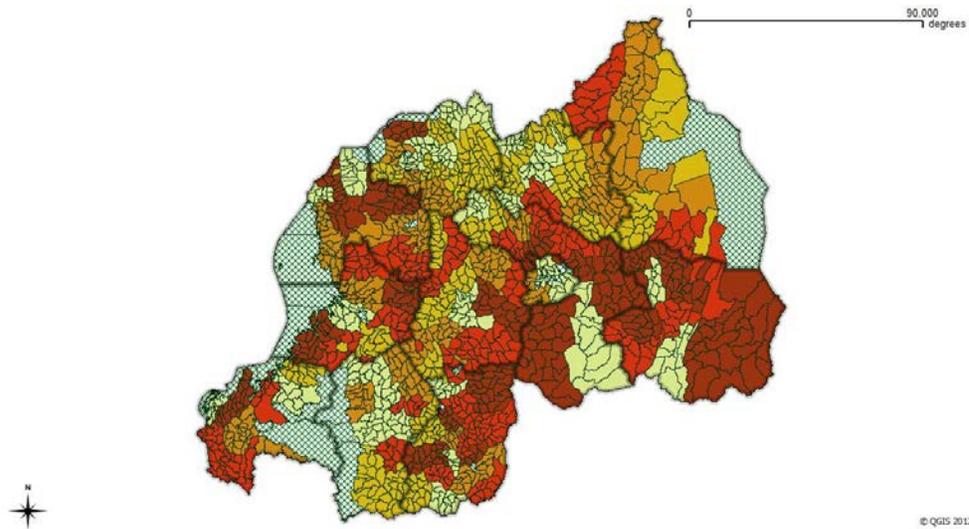
Notes: Map taken from a shape file of Rwandan provinces; location of different forms of violence based on event data

**Figure 2: Sex ratio by commune, 1991 and 2002**



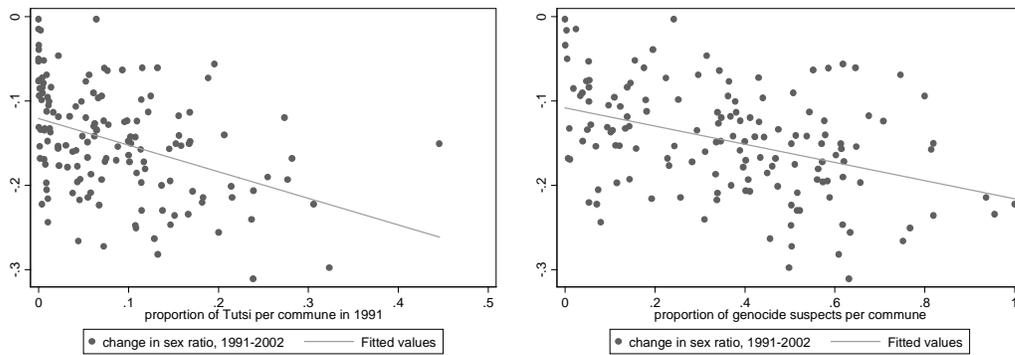
Notes: The commune-level sex ratios are calculated from the 1991 and 2002 population census. The sex ratio is defined for the population aged 20-60 years living in private households.

**Figure 3: Spatial pattern of the change in the commune-level sex ratio, 1991 and 2002**



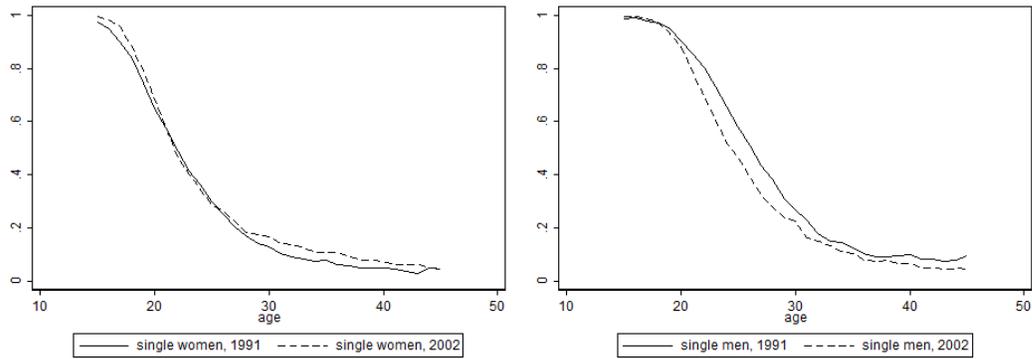
Notes: The commune-level sex ratios are calculated from the 1991 and 2002 population census. The sex ratio is defined for the population aged 20-60 years living in private households.

**Figure 4: Change in commune-level sex ratio plotted against the proportion of Tutsi per commune in 1991 and the proportion of suspects per commune**



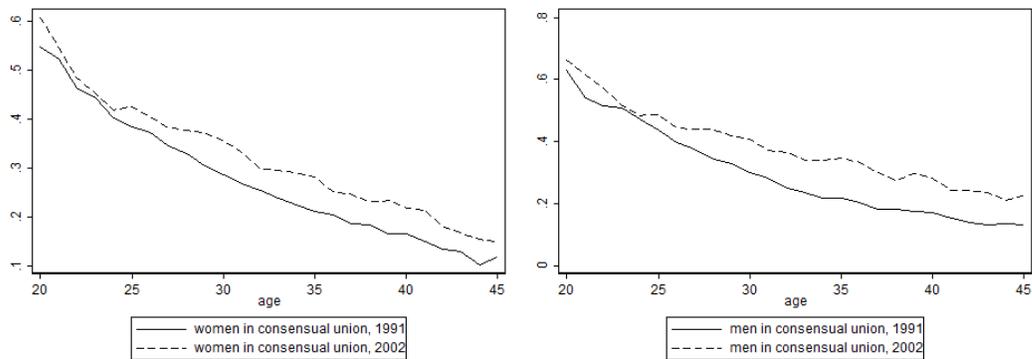
Notes: The change in the commune-level sex ratios is calculated from the 1991 and 2002 population census. The sex ratio is defined for the population aged 20-60 years living in private households. The share of Tutsi in 1991 is calculated from the 1991 census. The share of genocide suspects is taken from the *gacaca* information round.

**Figure 5: Share of single women and single men, by age and year**



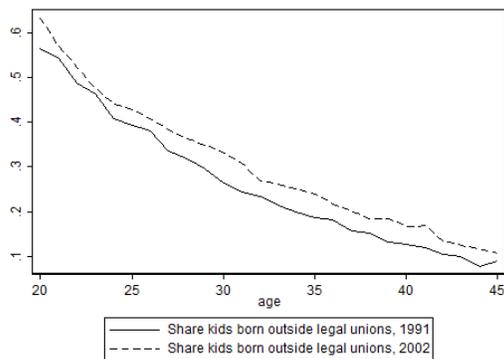
Source: Population census 1991 and 2002. Sample: Individuals who are single, in consensual union, or married.

**Figure 6: Share of women and men living in consensual union, by age and year**



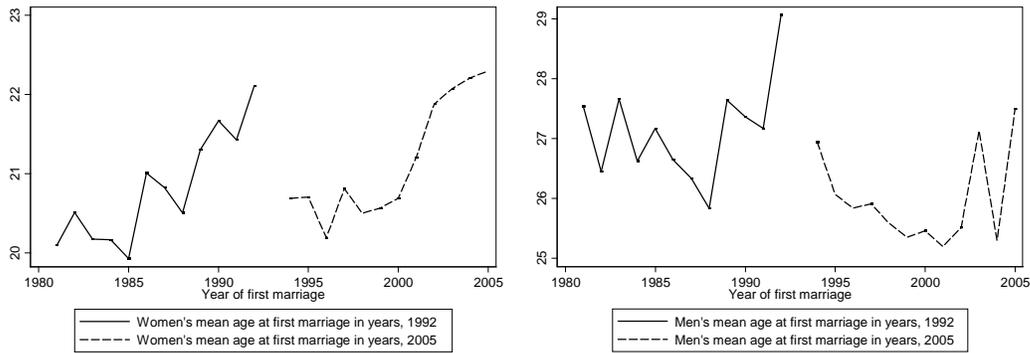
Source: Population census 1991 and 2002. Sample: Individuals who are in consensual union or married.

**Figure 7: Share of children who are born out of wedlock, by age of mother and year**



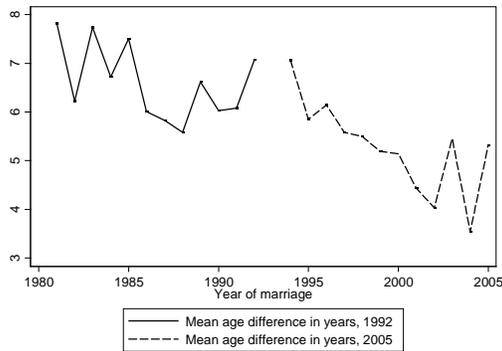
Source: Population census 1991 and 2002. Sample: Children born to mothers who are single, in consensual union, or married.

**Figure 8: Age at first marriage for women and men, by year of marriage and year**



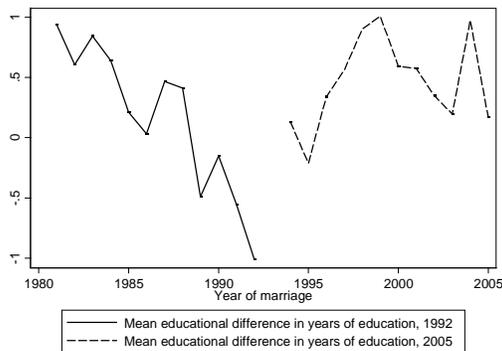
Source: DHS 1992 and 2005. Sample: Individuals in consensual union or married who started this relationship between 1981 and 1992 (DHS 1992) or between 1994 and 2005 (DHS 2005).

**Figure 9: Age difference between spouses, by year of marriage and year**



Source: DHS 1992 and 2005. Sample: Individuals in consensual union or married who started this relationship between 1981 and 1992 (DHS 1992) or between 1994 and 2005 (DHS 2005).

**Figure 10: Educational difference between spouses, by year of marriage and year**



Source: DHS 1992 and 2005. Sample: Individuals in consensual union or married who started this relationship between 1981 and 1992 (DHS 1992) or between 1994 and 2005 (DHS 2005).

**Table 1: Summary statistics**

Variable name	Variable description	Prewar		Postwar	
		Mean	St. Dev.	Mean	St. Dev.
<b>Population Census (1991, 2002)</b>					
<b>Commune-level variables</b>					
Sex ratio	Sex ratio among population 15-45 years (excl. population in institutions)	0.95	0.08	0.80	0.08
Tutsi (%)	Proportion of Tutsi in 1991	0.08	0.08		
Genocide suspects (%)	Genocide suspects taken from 2005 gacaca information round			0.37	0.24
<b>Household-level variables</b>					
Asset index	Household asset index	0.01	1.61	0.14	1.61
Umudugudu	Household lives is umudugudu			0.19	0.39
<b>Individual-level variables</b>					
Single / nevermarried	Women never married	0.21	0.41	0.29	0.45
	Men never married	0.26	0.44	0.24	0.43
Living in concensual union	Women in consensual union	0.20	0.40	0.22	0.41
	Men in consensual union	0.19	0.39	0.25	0.44
Born-out-of wedlock	All children	0.47	1.50	0.49	1.51
	Newborns (<= 1 year)	0.04	0.19	0.05	0.21
Age	Age	20.80	18.10	21.22	17.64
Tutsi (%)	Individual is Tutsi	0.08	0.28		
Years of schooling	Years of schooling	2.09	2.89	2.35	2.95
Migrant	Individual changed residence in past 10 years	0.20	0.40	0.22	0.41
<b>Demographic and Health Surveys (1992, 2005)</b>					
<b>Household-level variables</b>					
Asset index	Household asset index	-0.27	1.83	-0.09	1.78
Urban	Location is urban	0.06	0.38	0.16	0.42
<b>Individual-level variables</b>					
Age difference	Age difference between spouses	6.57	10.08	5.22	6.92
Age at first marriage	Women's age at first marriage	20.56	3.16	21.00	3.56
	Men's age at first marriage	26.91	9.94	25.78	7.26
Schooling difference	Educational difference between spouses	0.16	3.59	0.44	3.59
Age	Women's age	28.29	9.24	28.33	9.77
	Men's age				
Years of schooling	Women's years of education	3.50	3.83	4.15	3.26
	Men's years of education	3.85	3.77	4.60	3.75
Migrant	Woman has ever lived outside place of birth	0.62	0.48	0.62	0.48
Tutsi (%)	Woman is Tutsi	0.08	0.30		

Note: the asset index in the population census is composed of material of wall, roof, and floor; source of drinking water, lighting, and cooking fuel; type of toilet facility; and ownership of radio; th eone in the DHS is composed of source of drinking water and cooking fuel; material of floor; type of toilet facility; and ownership of radio, refrigerator, bike, motorbike, and car.

**Table 2: Single women and men, by age cohort and year**

	1991			2002		
	Total	Single (total)	Single (%)	Total	Single (total)	Single (%)
Females						
(A) Aged 10-18	78,853	75,685	96.0	97,019	94,150	97.0
(B) Aged 19-27	54,324	24,075	44.3	66,967	31,918	47.7
(C) Aged 28-36	43,566	4,336	10.0	41,310	5,293	12.8
(D) Aged 37-45	74,412	6,427	8.6	80,658	8,243	10.2
Males						
(A) Aged 14-22	61,612	58,022	94.2	83,613	77,071	92.2
(B) Aged 23-31	48,363	21,965	45.4	39,115	14,669	37.5
(C) Aged 32-40	35,283	4,372	12.4	28,259	2,700	9.6
(D) Aged 41-49	17,360	1,420	8.2	21,499	829	3.9

Source: Population census 1991 and 2002.

**Table 3: Impact of male scarcity on the probability of being single**

Dependent variable	Single / never married											
	Women						Men					
	B		C		D		B		C		D	
Age cohort	ols	iv	ols	iv	ols	iv	ols	iv	ols	iv	ols	iv
Model	ols	iv	ols	iv	ols	iv	ols	iv	ols	iv	ols	iv
Sexratio	-0.083 (0.072)	0.079 (0.140)	-0.146*** (0.048)	-0.301*** (0.093)	-0.149*** (0.037)	-0.381*** (0.091)	0.143** (0.058)	0.637*** (0.166)	-0.042 (0.035)	-0.115 (0.075)	-0.059** (0.027)	-0.230*** (0.071)
Post-war year	0.022 (0.014)	0.048** (0.024)	0.030*** (0.008)	0.005 (0.016)	0.015** (0.006)	-0.022 (0.015)	-0.050*** (0.012)	0.031 (0.027)	0.011** (0.006)	-0.001 (0.012)	0.004 (0.004)	-0.024** (0.012)
Asset index	0.027*** (0.002)	0.027*** (0.002)	0.001 (0.001)	0.001 (0.001)	-0.006*** (0.001)	-0.006*** (0.001)	0.022*** (0.002)	0.022*** (0.002)	-0.003** (0.001)	-0.003** (0.001)	-0.008*** (0.001)	-0.008*** (0.001)
Years of schooling	0.015*** (0.001)	0.015*** (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.012*** (0.001)	0.012*** (0.001)	-0.001 (0.000)	-0.001 (0.000)	-0.000 (0.001)	-0.000 (0.001)
Migrant	-0.237*** (0.013)	-0.238*** (0.013)	-0.094*** (0.005)	-0.093*** (0.005)	-0.045*** (0.003)	-0.045*** (0.003)	0.088*** (0.010)	0.083*** (0.009)	0.047*** (0.006)	0.047*** (0.006)	0.024*** (0.004)	0.024*** (0.004)
Umudugudu	-0.024** (0.010)	-0.021* (0.011)	-0.014* (0.007)	-0.017** (0.008)	-0.005 (0.006)	-0.010 (0.008)	-0.034*** (0.009)	-0.022* (0.012)	-0.005 (0.005)	-0.007 (0.005)	-0.006 (0.005)	-0.010** (0.005)
Tutsi (1991)	0.138*** (0.010)	0.134*** (0.009)	0.085*** (0.008)	0.087*** (0.008)	0.028*** (0.007)	0.032*** (0.007)	0.205*** (0.010)	0.197*** (0.010)	0.099*** (0.009)	0.100*** (0.009)	0.038*** (0.008)	0.041*** (0.008)
Constant	0.928*** (0.062)	0.787*** (0.124)	0.318*** (0.044)	0.454*** (0.082)	0.191*** (0.033)	0.393*** (0.079)	0.608*** (0.052)	0.175 (0.146)	0.191*** (0.030)	0.256*** (0.065)	0.085*** (0.023)	0.234*** (0.062)
Age fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Religion fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Commune fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	100,295	100,295	65,551	65,551	40,475	40,475	72,620	72,620	52,797	52,797	32,077	32,077
R-squared	0.260	0.260	0.070	0.069	0.039	0.037	0.201	0.199	0.039	0.039	0.017	0.015

Standard errors in parentheses, clustered at the commune level

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Source: Population census 1991 and 2002.

**Table 4: Impact of male scarcity on the probability of living in a consensual union**

Dependent variable	Living in consensual union											
	Women						Men					
	B		C		D		B		C		D	
Model	ols	iv	ols	iv	ols	iv	ols	iv	ols	iv	ols	iv
Sexratio	-0.502** (0.195)	-1.913*** (0.568)	-0.349** (0.137)	-1.163*** (0.355)	-0.286** (0.121)	-0.472** (0.208)	-0.342* (0.189)	-1.359*** (0.449)	-0.304** (0.128)	-0.776*** (0.295)	-0.307** (0.118)	-0.224 (0.201)
Post-war year	-0.050 (0.039)	-0.272*** (0.098)	0.014 (0.027)	-0.115* (0.061)	0.008 (0.023)	-0.022 (0.037)	0.015 (0.038)	-0.145* (0.080)	0.072*** (0.025)	-0.003 (0.051)	0.038* (0.021)	0.051 (0.034)
Asset index	-0.053*** (0.003)	-0.054*** (0.003)	-0.055*** (0.002)	-0.055*** (0.002)	-0.045*** (0.002)	-0.045*** (0.002)	-0.059*** (0.003)	-0.060*** (0.003)	-0.057*** (0.002)	-0.057*** (0.002)	-0.048*** (0.002)	-0.047*** (0.002)
Years of schooling	-0.014*** (0.001)	-0.014*** (0.001)	-0.010*** (0.001)	-0.010*** (0.001)	-0.007*** (0.001)	-0.007*** (0.001)	-0.013*** (0.001)	-0.012*** (0.001)	-0.008*** (0.001)	-0.008*** (0.001)	-0.007*** (0.001)	-0.007*** (0.001)
Migrant	0.068*** (0.008)	0.076*** (0.008)	0.040*** (0.006)	0.044*** (0.006)	0.030*** (0.005)	0.030*** (0.005)	0.060*** (0.013)	0.072*** (0.014)	0.036*** (0.011)	0.038*** (0.011)	0.039*** (0.011)	0.039*** (0.011)
Umudugudu	0.032 (0.034)	0.000 (0.038)	0.046* (0.027)	0.025 (0.030)	0.050*** (0.018)	0.045** (0.018)	0.043 (0.036)	0.019 (0.039)	0.042 (0.026)	0.031 (0.027)	0.056*** (0.019)	0.058*** (0.019)
Tutsi (1991)	-0.068*** (0.017)	-0.039** (0.017)	-0.052*** (0.009)	-0.041*** (0.009)	-0.014 (0.010)	-0.011 (0.009)	-0.067*** (0.017)	-0.049*** (0.017)	-0.029*** (0.010)	-0.022** (0.010)	-0.014 (0.011)	-0.015 (0.011)
Constant	1.154*** (0.175)	2.385*** (0.501)	0.692*** (0.121)	1.406*** (0.315)	0.515*** (0.106)	0.677*** (0.184)	0.810*** (0.167)	1.699*** (0.396)	0.622*** (0.114)	1.037*** (0.261)	0.493*** (0.103)	0.421** (0.177)
Age fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Religion fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Commune fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	54,638	54,638	58,429	58,429	38,515	38,515	45,030	45,030	48,376	48,376	30,908	30,908
R-squared	0.123	0.109	0.100	0.094	0.073	0.073	0.125	0.118	0.112	0.110	0.084	0.084

Standard errors in parentheses, clustered at the commune level

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Source: Population census 1991 and 2002.

**Table 5: Impact of male scarcity on the number of children who are born out of wedlock**

Dependent variable	Born out-of-wedlock											
	All children						Only newborns (born in past 12 months)					
	B		C		D		B		C		D	
Age cohort	ols	iv	ols	iv	ols	iv	ols	iv	ols	iv	ols	iv
Model												
Sexratio	-0.354*	-1.758***	-0.531	-2.824**	-0.632	-1.305	-0.134***	-0.301***	-0.099**	-0.259***	-0.025	-0.062
	(0.199)	(0.603)	(0.443)	(1.132)	(0.577)	(1.061)	(0.038)	(0.102)	(0.043)	(0.080)	(0.016)	(0.038)
Post-war year	-0.036	-0.265**	0.016	-0.356*	0.030	-0.080	-0.008	-0.035*	0.005	-0.021	0.004	-0.002
	(0.042)	(0.105)	(0.090)	(0.203)	(0.112)	(0.192)	(0.008)	(0.018)	(0.008)	(0.014)	(0.003)	(0.007)
Asset index	-0.061***	-0.061***	-0.151***	-0.151***	-0.182***	-0.182***	-0.013***	-0.013***	-0.010***	-0.010***	-0.005***	-0.005***
	(0.004)	(0.004)	(0.008)	(0.008)	(0.010)	(0.010)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Years of schooling	-0.030***	-0.030***	-0.045***	-0.045***	-0.033***	-0.033***	-0.004***	-0.004***	-0.002***	-0.002***	-0.001***	-0.001***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Migrant	0.174***	0.183***	0.172***	0.183***	0.173***	0.174***	0.036***	0.037***	0.013***	0.014***	0.007***	0.007***
	(0.016)	(0.016)	(0.023)	(0.023)	(0.026)	(0.025)	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)
Umudugudu	0.048	0.018	0.098	0.045	0.137*	0.124	0.012	0.008	0.012	0.008	0.002	0.001
	(0.038)	(0.044)	(0.098)	(0.104)	(0.081)	(0.082)	(0.007)	(0.008)	(0.009)	(0.009)	(0.004)	(0.004)
Tutsi (1991)	-0.138***	-0.108***	-0.246***	-0.211***	-0.136***	-0.123**	-0.019***	-0.015***	-0.005	-0.002	-0.004	-0.004
	(0.018)	(0.016)	(0.035)	(0.034)	(0.052)	(0.050)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Constant	0.502***	1.727***	1.511***	3.520***	1.594***	2.182**	0.156***	0.302***	0.185***	0.325***	0.059***	0.092***
	(0.180)	(0.534)	(0.394)	(1.005)	(0.503)	(0.933)	(0.034)	(0.090)	(0.039)	(0.072)	(0.014)	(0.034)
Age fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Religion fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Commune fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	104,794	104,794	75,705	75,705	53,326	53,326	104,835	104,835	75,729	75,729	53,344	53,344
R-squared	0.112	0.109	0.054	0.051	0.035	0.035	0.027	0.027	0.020	0.020	0.015	0.014

Standard errors in parentheses, clustered at the commune level

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Source: Population census 1991 and 2002.

**Table 6: Impact of male scarcity on age at first marriage and assortative matching (OLS)**

Dependent variable	(1)	(2)	(3)	(4)
	Women's age at first marriage	Men's age at first marriage	Age difference between spouses	Educational difference between spouses
Sex ratio	-3.565*** (1.325)	-7.554** (3.682)	-4.071 (3.691)	-0.191 (1.855)
Post-war year	-0.461** (0.214)	-2.537*** (0.630)	-1.898*** (0.619)	0.490* (0.297)
Asset index	0.085* (0.044)	0.189 (0.121)	0.260** (0.124)	0.826*** (0.055)
Women's years of schooling	0.099*** (0.014)		-0.248*** (0.052)	-0.682*** (0.021)
Men's years of schooling		-0.020 (0.048)		
Migrant	0.055 (0.114)	1.014*** (0.383)	0.990** (0.384)	0.007 (0.139)
Tutsi (in 1991)	1.094*** (0.252)	-0.553 (0.551)	-1.518*** (0.526)	0.363 (0.316)
Urban	-0.030 (0.184)	1.232** (0.584)	1.544** (0.599)	-0.131 (0.278)
Constant	39.750*** (1.411)	48.913*** (3.875)	-2.270 (3.611)	4.142** (1.984)
Commune fixed effects	yes	yes	yes	yes
Age fixed effects	yes	yes	yes	yes
Observations	3,915	3,879	3,915	3,879
R-squared	0.534	0.085	0.067	0.347

Source: DHS 1992 and 2005. Population weights were used. Sample: women of age 15-49 years and their partner who are currently in a relationship (consensual union or marriage) and who started this relationship between 1981 and 1992 (DHS 1992) or between 1994 and 2005 (DHS 2005). The sex ratio is defined for the population aged 15-45 years living in private households.

## Appendix

**Table A1: Impact of change in sex ratio over time on age at first marriage and assortative matching in 1992 (OLS)**

Dependent variable	(1)	(2)	(3)	(4)
	Women's age at first marriage	Men's age at first marriage	Age difference between spouses	Educational difference between spouses
Change in sex ratio	1.923 (1.557)	8.796 (5.323)	6.561 (5.183)	-1.112 (2.059)
Asset index	0.039 (0.071)	0.115 (0.290)	0.415 (0.295)	0.943*** (0.108)
Women's years of schooling	0.134*** (0.022)		-0.404*** (0.086)	-0.697*** (0.036)
Men's years of schooling		-0.011 (0.100)		
Migrant	0.043 (0.183)	0.641 (0.866)	0.668 (0.868)	-0.072 (0.246)
Tutsi	1.146*** (0.281)	0.037 (0.597)	-0.854 (0.594)	0.526* (0.302)
Urban	0.266 (0.358)	3.165** (1.310)	2.941** (1.340)	0.592 (0.666)
Constant	34.323*** (0.686)	29.952*** (2.090)	-5.182** (2.403)	0.583 (0.737)
Province fixed effects	yes	yes	yes	yes
Commune-level controls	yes	yes	yes	yes
Age fixed effects	yes	yes	yes	yes
Observations	1,652	1,638	1,652	1,638
R-squared	0.507	0.027	0.057	0.364

Source: DHS 1992. Population weights were used. Sample: women of age 15-49 years and their partner who are currently in a relationship (consensual union or marriage) and who started this relationship between 1981 and 1992. The change in sex ratio is defined as the difference in the sex ratio between 2002 and 1991 for the population aged 15-45 years living in private households.

**Table A3: Impact of male scarcity on age at first marriage and assortative matching with alternative sex ratio (including institutionalized population) (OLS)**

Dependent variable	(1) Women's age at first marriage	(2) Men's age at first marriage	(3) Age difference between spouses	(4) Educational difference between spouses
Sex ratio	-0.605 (0.705)	0.865 (1.971)	2.074 (1.916)	1.059 (0.957)
Post-war year	0.011 (0.103)	-1.320*** (0.331)	-1.078*** (0.311)	0.627*** (0.149)
Asset index	0.081* (0.043)	0.185 (0.120)	0.260** (0.123)	0.827*** (0.056)
Women's years of schooling	0.098*** (0.014)		-0.248*** (0.052)	-0.682*** (0.021)
Men's years of schooling		-0.021 (0.048)		
Migrant	0.051 (0.114)	1.007*** (0.383)	0.986** (0.384)	0.007 (0.139)
Tutsi (in 1991)	1.067*** (0.255)	-0.571 (0.550)	-1.495*** (0.522)	0.383 (0.319)
Urban	0.005 (0.184)	1.291** (0.591)	1.565*** (0.605)	-0.136 (0.277)
Constant	37.033*** (1.094)	40.680*** (2.194)	-8.728*** (2.644)	2.969** (1.264)
Commune fixed effects	yes	yes	yes	yes
Age fixed effects	yes	yes	yes	yes
Observations	3,915	3,879	3,915	3,879
R-squared	0.533	0.084	0.067	0.347

Source: DHS 1992 and 2005. Population weights were used. Sample: women of age 15-49 years and their partner who are currently in a relationship (consensual union or marriage) and who started this relationship between 1981 and 1992 (DHS 1992) or between 1994 and 2005 (DHS 2005). The sex ratio is defined for the total population aged 15-45 years, including institutionalized individuals.

**Table A4: Impact of male scarcity on age at first marriage and assortative matching with alternative sex ratio (men 18-59 years to women 15-49 years) (OLS)**

Dependent variable	(1) Women's age at first marriage	(2) Men's age at first marriage	(3) Age difference between spouses	(4) Educational difference between spouses
Sex ratio	-3.392** (1.372)	-5.773 (3.728)	-2.377 (3.818)	-0.033 (1.936)
Post-war year	-0.549** (0.264)	-2.463*** (0.742)	-1.724** (0.745)	0.513 (0.368)
Asset index	0.085* (0.044)	0.189 (0.121)	0.259** (0.123)	0.826*** (0.055)
Women's years of schooling	0.099*** (0.014)	-0.020 (0.048)	-0.248*** (0.052)	-0.682*** (0.021)
Men's years of schooling				
Migrant	0.054 (0.113)	1.012*** (0.383)	0.988** (0.384)	0.007 (0.139)
Tutsi (in 1991)	1.091*** (0.253)	-0.566 (0.551)	-1.527*** (0.524)	0.363 (0.316)
Urban	-0.009 (0.183)	1.279** (0.586)	1.572*** (0.603)	-0.129 (0.278)
Constant	39.407*** (1.391)	46.959*** (3.825)	-4.034 (3.533)	3.985** (2.017)
Commune fixed effects	yes	yes	yes	yes
Age fixed effects	yes	yes	yes	yes
Observations	3,915	3,879	3,915	3,879
R-squared	0.534	0.085	0.067	0.347

Source: DHS 1992 and 2005. Population weights were used. Sample: women of age 15-49 years and their partner who are currently in a relationship (consensual union or marriage) and who started this relationship between 1981 and 1992 (DHS 1992) or between 1994 and 2005 (DHS 2005). The sex ratio is defined for men aged 18-59 years and women aged 15-49 years living in private households.

**Table A5: Impact of male scarcity on age at first marriage and assortative matching with restricted sample (Tutsi and migrants after 1994 excluded) (OLS)**

Dependent variable	(1) Women's age at first marriage	(2) Men's age at first marriage	(3) Age difference between spouses	(4) Educational difference between spouses
Sex ratio	-2.453 (2.537)	-7.815 (8.465)	-4.604 (8.507)	-0.038 (2.892)
Post-war year	-0.471 (0.431)	-2.734* (1.430)	-1.936 (1.415)	0.518 (0.510)
Asset index	0.058 (0.069)	0.010 (0.238)	0.249 (0.243)	0.897*** (0.084)
Women's years of schooling	0.148*** (0.019)		-0.381*** (0.080)	-0.689*** (0.030)
Men's years of schooling		-0.001 (0.080)		
Migrant	-0.121 (0.182)	0.878 (0.827)	1.040 (0.837)	0.007 (0.226)
Urban	0.143 (0.397)	1.758 (1.121)	1.808 (1.127)	-0.331 (0.552)
Constant	32.917*** (3.104)	32.178*** (8.695)	-3.543 (9.973)	5.404* (3.143)
Commune fixed effects	yes	yes	yes	yes
Age fixed effects	yes	yes	yes	yes
Observations	1,966	1,947	1,966	1,947
R-squared	0.514	0.084	0.100	0.414

Source: DHS 1992 and 2005. Population weights were used. Sample: women of age 15-49 years and their partner who are currently in a relationship (consensual union or marriage) and who started this relationship between 1981 and 1992 (DHS 1992) or between 1994 and 2005 (DHS 2005). The sex ratio is defined for the population aged 15-45 years living in private households.