UNITED NATIONS UNIVERSITY
UNU-WIDER

WIDER Working Paper 2014/138

Growth, poverty and inequality in Rwanda

A broad perspective

Marijke Verpoorten*

October 2014

Abstract: This study focuses on growth, poverty and inequality in Rwanda. We take a broad perspective, in two respects. First, we consider a long time period so as to compare the current situation with the pre-war situation, allowing us to assess whether the recent successes can be attributed to a recovery from a very low post-war base or whether they mark 'real' progress. Second, we look beyond static measures of material welfare and study economic and social mobility as well as indicators of human development and subjective well-being.

Keywords: Rwanda, poverty, inequality, mobility, happiness
JEL classification: O12, O15

Acknowledgements: We thank UNU-WIDER for supporting this research. We are grateful to Macro International Inc. for making available the Rwandan DHS data used in this study. We thank MINAGRI (Rwandan Ministry of Agriculture and Livestock), Michigan State University and USAID for the use of the first round of the panel dataset, and Philip Verwimp for the tracing of the households in 1999/2000. Field research for the second round in 2002 was made possible by funding from DGOS (Belgian Development Cooperation) and VLIR (Flemish Interuniversity Council). The third round was financed by the Rwandan government and LICOS—Center for Institutions and Economic Performance (University of Leuven). We thank Jean Chrysostome Ngabitsinze for his involvement in implementing the third round, Judith Ooms and Koen Deconinck for their help in cleaning the data from the third round, and Andrea Guariso for his help sorting out Rwandan rainfall data. We owe thanks to Klara Claessens, Andrea Guariso, Bert Ingelaere, Omar McDoom, Andy McKay, Filip Reyntjens and Pieter Serneels for useful comments. All errors and opinions expressed remain our own.

IOB, Institute of Development Policy and Management (University of Antwerp) and LICOS, Center for Institutions and Economic Performance (University of Leuven); marijke.verpoorten@ua.ac.be.

This study has been prepared within the UNU-WIDER project 'Reconciling Africa's Growth, Poverty and Inequality Trends: Growth and Poverty Project (GAPP)', directed by Finn Tarp.

ISSN 1798-7237 ISBN 978-92-9230-859-9

Typescript prepared by Judy Hartley for UNU-WIDER.

UNU-WIDER gratefully acknowledges the financial contributions to the research programme from the governments of Denmark, Finland, Sweden, and the United Kingdom.

UNU-WIDER, Katajanokanlaituri 6 B, 00160 Helsinki, Finland, wider.unu.edu

1 Introduction

After the disastrous period of violent conflict in the mid-1990s, Rwanda experienced steady economic growth. Over the period 2000-12, Rwanda's real gross domestic product (GDP) per capita grew at an average annual rate of about 5 per cent (World Bank 2013b). By 2005, GDP per capita reached its pre-war level, and by 2012, it was about 50 per cent greater than GDP per capita prior to the armed conflicts of the 1990s. This is shown in Figure 1, which also reveals that this post-war pattern of growth contrasts with a stagnation of GDP per capita in the 1980s.[1]

Poverty was estimated as high as 70 per cent at the end of the armed conflicts (UNDP 2007). In 1999/2000 it had fallen to 59 per cent, but then declined only slowly to 57 per cent in 2005 while inequality peaked, reaching a Gini coefficient of 0.52. Recent trends in poverty and inequality are, however, encouraging. The third Integrated Household Living Conditions Survey (EICV3) points to a poverty reduction of 12 percentage points compared to EICV2, from 57 per cent in 2005/06 to 45 per cent in 2010/11, and a decrease in the Gini coefficient of inequality from 0.52 to 0.49 (GoR 2012a).

These figures indicate that Rwanda's recent economic growth can be labelled pro-poor (Ravallion and Chen 2003). At the occasion of the release of EICV3, Paul Collier commented that Rwanda pulled off a rare 'hat trick' of rapid growth, sharp poverty reduction and reduced inequality, and called this achievement 'deeply impressive'.[2] Furthermore, Christiaensen and Devarajan (2013) showcase Rwanda as an example of a resource-poor Sub-Saharan African country that achieves broad-based economic growth.

Attempting to explain the sources of Rwanda's economic success story, Booth and Golooba-Mutebi (2012) stress the aspect of governance, arguing that Rwanda is a developmental authoritarian state that actively promotes private sector development and keeps the most detrimental forms of rent-seeking in check with 'a set of arrangements for managing economic rents in a centralized way and deploying them with a view to the long term' (Booth and Golooba-Mutebi 2012: 9).

Others have argued that post-war catch-up may play a role—that is, the recovery from a post-war low to a (new) steady state growth path (Guariso and Verpoorten 2013a; Serneels and Verpoorten 2013). Guariso and Verpoorten (2013a), studying data from three consecutive coffee censuses, show that in 1999 and 2003, farmers in highly war-affected regions invested little in new trees and in the maintenance of existing trees compared to farmers in less affected regions. By 2009—fifteen years after the 1994 genocide—the gap had closed, indicating considerable post-war catch-up at the farm level in the period 2003-09.

In an analysis of the specific determinants of growth drawing on data from three consecutive nationwide household surveys (EICV1, 1999/2000, EICV2, 2005/6 and EICV3, 2010/11), the World Bank (2013a) stresses the role of non-farm self-employment in rural areas, effective productivity-enhancing measures in agriculture (such as the increased use of fertilizer), increased commercialization of agricultural output and the entry into the last phase of the demographic transition. The study further points out that the decline in inequality is driven by relatively strong

[1] Other indicators improved in the course of the 1980s. For instance, child mortality decreased from 213 deaths per 1,000 live births in 1980 to 156 in 1990 (World Bank 2013b).

[2] 'A Roaring Economic Engine', The Independent, 21 February 2012. Available at: http://allafrica.com/stories/201202220765 (accessed July 2013).

consumption growth of the poorest 20 per cent of Rwandans, which in its turn is attributed to the implementation of the second poverty reduction strategy that puts an emphasis on reducing extreme poverty, through investments in agriculture and social protection.

Although the sources of growth need further investigation, at this point it would be safe to say that several factors are likely to play a role in the Rwandan success story: massive aid; increased budget shares for health, education and agriculture; the fertility transition; post-war catch-up; and yes—also the rise in international commodity prices. Over the period 2003-11, the world market price for coffee increased by 427 per cent, driving up producer prices for the estimated 500,000 coffee farmers, as well as export earnings of Rwanda's number one export product—from US$15 million in 2003 to US$52 million in 2011 (Guariso et al. 2012).

Many studies have looked at specific sectors that feature in the success story. Guariso et al. (2012) discuss the transformation of the Rwandan coffee sector; Ayalew et al. (2011) study the impact of land tenure regularization on investment, maintenance of soil conservation measures, and women's land access; Basinga et al. (2010) study the impact of the introduction of performance-based financing in the healthcare sector; Nkurunziza et al. (2012) analyse the introduction of free primary education; Saksena et al. (2011) study the introduction of mutual health insurance; and Westoff (2012) as well as Kabano et al. (2013) and Muhoza et al. (2013) look at the fertility transition.

We could add many more papers to this list because research papers on Rwanda have multiplied, trying to keep up with the ever-growing list of policy measures, including among others the 1999 new inheritance law that grants equal rights to male and female children, the new constitution of 2003 that introduces gender quotas at all levels of decision-making and free and mandatory primary education, the introduction of performance-based financing for healthcare centres in 2006 as well as performance contracts between each district and the central government (*Imihigo*), an intense family planning campaign in 2007, and mandatory health insurance in 2008.

Despite the large literature on Rwanda, several questions remain. Does the recent poverty and inequality reduction represent a true reversal of a trend? How can the data be reconciled with contrasting findings from qualitative fieldwork at the local level? Can economic growth continue to outpace population growth? Can development in Rwanda be sustained if the country continues to score very low on voice and accountability? This paper focuses on the first two questions. The latter two questions cannot, however, be left untouched (because they are central to understanding the collapse of Rwanda in the 1990s). We will briefly discuss them at the end of this paper.

The decline in poverty and inequality came to the surprise and even disbelief of some of the regime's critics. Part of the disbelief stems from the observation that the EICV3 data 'contradict all field research conducted at the local level during the past years' (Reyntjens 2012: 115). For instance, Sommers (2012)—in his book *Stuck* which is based on intensive qualitative fieldwork — paints a very bleak outlook for the Rwandan society, in particular its youth. Furthermore, Ansoms (2011) criticizes the 'social engineering of the rural sector' which is said to leave 'little room for traditional smallholder agriculture' (Ansoms 2011: 240). She argues that 'The elite push for rapid modernization and "professionalization" of the agricultural sector risks increasing both poverty and inequality' (Ansoms 2011: 248). Especially the land consolidation and crop intensification policies (involving mono-cropping and regional crop specialization) are heavily criticized for threatening to undermine agricultural productivity and food security (Ansoms et al. 2010; Higgins 2009). The villagization policy is also said to have 'reduced economic security and quality of life' (Newbury 2011: 235).

Indeed, this critical body of literature does not align well with the success story that emerges from the most recent data. For instance, it is difficult to reconcile the fierce criticism of the agricultural and land policies of the Government of Rwanda with the recent figures showing rural poverty reduction and a boom in agricultural production; rural headcount poverty is estimated to have declined from 62 per cent to 49 per cent over the period 2005/06 to 2010/11, and the production of cereals, pulses and roots is reported to have increased by 135 per cent, 21 per cent and 95 per cent, respectively (GoR 2012a; World Bank 2013a). Trying to reconcile both worlds, Reyntjens (Reyntjens 2012: 115) argues that 'the consumption figures are a snapshot that might be determined by the output, strongly influenced by climate, of the agricultural season preceding the survey'. There may be some ground for this argument as total annual rainfall in 2010 was 50 per cent higher than in 2005 (1200 mm compared to 800 mm) (SSEE 2011).

On the other hand, if part of the rural growth would be due to a good agricultural season in 2010/11, the puzzle remains, because Rwanda also made great strides in other development indicators that are much less prone to weather fluctuations. For instance, the net attendance ratio (NAR) for primary schooling as measured by the Demographic and Health Survey (DHS) increased from 72 per cent in 2000 to 87 per cent in 2010. Over the same period deliveries at a healthcare facility (of life births in the last three years preceding the survey) tripled from 26 per cent to 78 per cent.

One could still argue that these improvements reflect the 'cosmetic upgrading of rural life', which 'hides the true extent of poverty and inequality' (Ansoms 2011: 247). This criticism is based on the coercion that accompanies many of the developmental measures, institutionalized in a system of fines—for not sending children to school, for walking barefoot or for consulting a traditional healer without authorization, among others (Ingelaere 2011).[3] Ingelaere argues that these fines may make rural dwellers 'look' less poor, even though they are likely to 'be and feel' as poor, or even poorer, as before (Ingelaere 2011: 73). Regarding the performance-based financing of health services, Kalk et al. (2010) argue that the sticks and carrots that are designed to increase the use of health services may lead to a quantity-quality trade-off.[4]

It is possible that Rwandans adapt their behaviour, or their survey responses, to the public discourse; and the existence of a quantity-quality trade-off in both health and education is also plausible. However, even if authoritarian implementation and public transcripts account for part of the progress observed, the progress clearly goes beyond cosmetic upgrading.[5] For instance, the sharp increase in deliveries at a health facility is accompanied by an equally impressive decrease in maternal mortality from 1071 in 2000 to 476 in 2010; and the suddenly sharp decrease in the reported ideal number of children (from 4.3 in 2005 to 3.3 in 2007)—even though clearly responsive to the 2007 three children campaign—is matched by an equally impressive decline in actual fertility (see below).

But maybe these trends can be attributed to catch-up from a very low base after the devastating armed conflicts? In Section 2 of this paper, we show that even though catch-up plays a role, the recent strides made in health and educational outcomes represent genuine progress that exceeds

[3] Following criticism of the fines by donors (and by the Rwandan population), their actual implementation may have decreased in recent years (personal correspondence with Ingelaere).

[4] More precisely, Kalk et al. (2010) point to the risks of a 'crowding-out' effect (diminishing or erasing of intrinsic motivation due to external rewards) and 'gaming' (too much focus on indicators that are in the system thereby neglecting non-rewarded indicators or falsification of results to maximize reward).

[5] The claim that 'the progress goes beyond cosmetic upgrading' is based on the assumption that the EICV and DHS data have not been manipulated by the government bodies involved in their collection.

pre-war levels. Relying on five waves of DHS data across the period 1992–2010, we also show that overall these recent strides represent inclusive development, reducing the gap between poor and rich. Section 2 therefore concludes that, while there is evidence for the use of coercion in the implementation of measures, raising concern that some of the progress may pick up 'cosmetic' rather than 'real' changes, there is also robust evidence for real improvements in quality of life measures.

These findings need not indicate that the largely pessimistic conclusions of much of the qualitative field research conducted at the local level are wrong. Even when many development indicators are on the rise, and inequality declines, one may still feel more poor because of the presence of coercion, the lack of voice and accountability, and rapid social transformation that leads to winners and losers (in absolute or relative terms).

To illustrate this point, Section 3 turns to an analysis of economic mobility, social mobility and happiness. Relying on a small panel dataset of households interviewed in 2000 and 2008, the analysis reveals a great deal of movement of households up and down the income distribution, much less movement across social categories, and a strong correlation of mobility with subjective well-being. In contrast, income *levels* are uncorrelated with happiness. Land ownership, on the other hand, emerges as a factor that strongly correlates with income and social mobility, and as the single most determining factor for social categories and happiness. Section 3 therefore concludes that there may be a mismatch between subjective measures of well-being and static measures of material welfare, especially in a context of rapid transformative changes that leads to winners and losers (in relative terms) and affects the traditional land-based livelihoods.

In Section 4 we discuss our main findings, point to directions for future research, and reflect on the two remaining questions raised in this introduction: Can economic growth continue to outpace population growth? Can development in Rwanda be sustained if the country continues to score very low on voice and accountability?

2 A true reversal in trend? An analysis of Rwandan DHS data, 1992–2010

Exploiting five rounds of DHS data, this section paints a picture of past and current trends in human development. Taking a long time perspective allows assessment of whether the recent successes can be attributed to a recovery from a very low post-war base or whether they mark *real* progress. Besides average time trends of human development indicators, we present the heterogeneity in these trends across wealth quintiles and across space.

2.1 Data

So far, Rwanda has implemented five DHS surveys: in 1992, 2000, 2005, 2007 and 2010. The first two surveys bracket a period of armed conflicts, namely the 1991–94 civil war, the 1994 genocide, and the 1994–98 refugee crisis and (counter-)insurgency operations. The more recent surveys were implemented in a period in which various government interventions took place, most importantly performance-based financing (PBF) of health services, performance contracts between each district and the central government (*Imihigo*), the introduction of obligatory health insurance, an increase in the share of government expenditures for the health sector, the introduction of free primary education, an intensive family planning campaign and the promotion of gender equality. Figure 2 gives a timeline of important events and DHS survey rounds.

The questionnaire design is broadly similar across the survey rounds, but the 2007 round only enquired about a limited number of indicators, leaving out for instance educational attainment.

The first four surveys were designed to be representative at the level of the 12 provinces (in place before the 2006 administrative reform), while the latest survey is representative at the level of the 33 districts (which were created during the administrative reform). Our analysis accounts for the DHS survey design, and population weights are used as recommended by the data providers.

2.2 Average time trends in selected indicators

We present an overview of trends in indicators belonging to the following broad categories: housing characteristics and ownership of durable goods, fertility and reproductive health, other health outcomes, and education. Tables 1 to 4 provide summary statistics.

Housing characteristics and ownership of durable goods

For two housing characteristics the answer categories are comparable across the survey rounds: electricity in the home and the construction material of the floor. Both indicators improved over time, especially across the latest three rounds (2005, 2007 and 2010). In 2010, 9.7 per cent of households had *electricity* in their home, up from 4.8 per cent in 2005, and 2.3 per cent in 1992. In 2010, 16.9 per cent of households had a finished floor (instead of earth or sand), compared to 13.0 per cent in 2005 and 11.0 per cent in 1992.

Household ownership of durable goods also increased over time, with 62.6 per cent of households owning a radio in 2010, compared to 32.3 per cent in 1992. Likewise, bike ownership almost doubled over the period 1992–2010, from 6.4 per cent to 15.2 per cent. The ownerships of a television, motorcycle or private car also increased, but remained low in 2010, at 5.3 per cent, 1.1 per cent and 0.8 per cent, respectively.

Fertility and reproductive health

Fertility declined from 6.2 in 1992 to 4.6 in 2010. Most of the change occurred during the periods 2005-07 and 2007-10. In contrast, between 1992 and 2005, fertility hardly declined.[6]

In line with declining fertility over the period 2005-10, there was a marked increase in the use of contraceptives. For instance, the use of modern contraceptives increased from 10.3 per cent in 2005 to 45.1 per cent in 2010. At the same time, the unmet need for contraceptives declined considerably, from 37.9 per cent in 2005 to 20.8 per cent in 2010.

Delivery at a health facility (instead of at home) increased impressively, from below 30 per cent in and prior to 2005 to almost 80 per cent in 2010. Less than 40 per cent of deliveries were assisted by trained medical staff in and prior to 2005, compared to almost 70 per cent of deliveries in 2010. The maternal mortality ratio remains high in Rwanda, although it shows a steady decline over the period 2000-10. It stood at 476 deaths per 100,000 live births in the 2010 DHS, down from 750 in 2005, and 1,071 in 2000.

Other health outcomes

The infant mortality rate, as calculated from the five-year period preceding the survey, dropped from 83 in 2005 to 50 in 2010. In contrast, during the period of armed conflict, infant mortality increased from 85 in 1992 to 109 in 2000. Similarly, the under-five mortality rate increased between

[6] Schindler and Brück (2011) attribute this status quo to the war and genocide in the 1990s.

1992 and 2000, from 151 to 196, but declined in the subsequent periods, to 152 in 2005, 103 in 2007 and 76 in 2010.

The decline in infant and under-five mortality went hand in hand with improvements in other child health outcomes. For instance, child nutritional indicators improved, with stunting and wasting decreasing over the period 2005-10. The prevalence of diarrhoea and fever for children under five years old in the two weeks preceding the survey also decreased.

The decrease in child mortality and illness may reflect a better outreach of basic preventive healthcare measures. As such, vaccination coverage and bed net ownership increased. Vaccination coverage was already high in 1992 at 86.3 per cent, but then declined to 76.0 per cent in 2000 and further to 75.2 per cent in 2005, most likely because of violent conflicts. By 2010, vaccination rates had recovered, reaching 90.1 per cent. Only 6.6 per cent of households owned a bed net in 2000, but this share steadily increased to 18.2 per cent in 2005, 59.2 per cent in 2007 and 82.7 per cent in 2010.[7]

Education

Educational attainment improved over time. The share of males (aged six or older) with no formal education decreased from 29.4 per cent in 1992 to 24.9 per cent in 2000, to 19.4 per cent in 2005 and 13.0 per cent in 2010. The corresponding figures for females are 40.4 per cent, 32.6 per cent, 27.7 per cent and 20.2 per cent. The mean years of education of the active population (aged 15-65) increased from 3.9 in 1992 to 4.6 in 2010 for males, and from 3.0 in 1992 to 4.0 in 2010 for females.

The NAR for primary school increased over the period 1991–2000 from 61.5 to 72.0, despite the violent conflicts.[8] In 2005 it stood at 80.1 to increase further to 87.5 in 2010. The NAR for secondary school dropped from 5.7 in 1992 to 5.0 in 2000, because violence caused slow progress through primary school delaying secondary school initiation, but also because violence reduced enrolment in secondary school (Akresh and de Walque 2008; Guariso and Verpoorten 2013b). It dropped further to 4.0 in 2005, but more than recovered by 2010, when it reached 14.4. The figures are very similar for boys and girls.

Gross attendance ratios (GAR)[9] for primary school increased greatly from 84.6 in 1992 to around 100 in 2000, close to 130 in 2005, and to approximately 140 in 2010. These figures indicate that a large share of overage children enrolled in primary school, a result of slow grade progression during armed conflict, which is further explained in Appendix 1. The GAR for secondary school decreased from 16.6 in 1992 to 7.9 in 2000, but then recovered to 8.2 in 2005 and further to 26.1 in 2010.

[7] The ownership of bed nets was not recorded in 1992.

[8] NAR indicates participation in schooling among those of official school age, which is age 6-11 for primary school and 12-17 for secondary school (DHS various years).

[9] GAR indicates school attendance among young people of any age, from age 5 to 24, and is expressed as a percentage of the school age population for that level of schooling (DHS various years).

2.3 Heterogeneity in the indicators

Health and education across wealth quintiles

To investigate whether there is an improvement in healthcare for the poorest households and increased access to education, we study how health and education relate to proxies of permanent household income, and whether this relation changes over time. Lacking data on income in the DHS, we use a weighted sum of asset ownership and housing characteristics as a cue for household wealth, with the weights determined by principal component analysis, as proposed by Filmer and Pritchet (2001).[10]

Figure 3 shows the time trends in eight human development indicators, depicting the averages for observations in the lowest (q1) and highest (q5) wealth quintiles. The lines show broadly similar trends for the bottom and top wealth quintiles. To determine inequality and whether there is convergence or divergence over time we calculate a simple measure—that is, the ratio of the indicator between the top and bottom wealth quintiles of the sample population.

The results, given in Table 5, show that the disparity between the highest and lowest wealth quintiles is smallest and most stable over time for primary school enrolment and vaccination coverage. For the other indicators, the general pattern during the period of armed conflict (1992–2000) is one of sharply increasing disparities. For instance, in 2000, deliveries at a healthcare facility were almost four times more likely among the wealthiest quintile than among the poorest, compared to only 2.1 times in 1992. Between 2000 and 2005 inequality decreased for all but one indicator (secondary NAR), but it remained far above the pre-war levels. It is only by 2007 that levels of disparity declined to reach pre-war levels. Disparities then further declined to reach even lower levels by 2010.

Rural-urban gap and heterogeneity across provinces

The trends in inequality in the selected indicators may stem from a divergence or convergence between urban and rural areas. Table 6 repeats Table 5, but now focusing on the distinction between urban and rural respondents. We observe basically the same pattern of rising disparity during the period of armed conflict (except for vaccination and primary NAR), followed by decreasing disparity in the post-war periods. By 2010, the rural-urban gap was lower than it was prior to the armed conflicts. Thus, part of the inequality trends of Table 5 relate to urban-rural divergence in the period 1992–2000 and urban-rural convergence in later periods.

Although Rwanda is a small country, it is marked by considerable inter-province variation in altitude, rainfall and temperatures. In addition, as documented by Verpoorten (2012a) the different provinces experienced different forms of armed conflict and may therefore have experienced different trajectories in human development.[11] Figure 4 visualizes the province-specific trajectories for the eight health and schooling indicators. In general we do not spot diverging trends across provinces, even when taking into account Kigali City. Although Kigali City performs better across

[10] The resulting indices are given by Measure DHS for each round; and are constructed on the basis of a set of variables that vary across survey rounds. For instance, the 2005 and 2010 indices include information on mobile phone ownership, a variable that was only introduced in 2005. In addition, for some variables the answer categories varied between rounds, for example source of drinking water and type of toilet facilities.

[11] These provinces no longer exist as such. In 2002, an administrative reorganization replaced the 12 provinces with five regions.

the different indicators, the trend over time is one of convergence between the capital city and the rest, except for secondary NAR.

Since close to 90 per cent of the Rwandan population is rural, we also investigate inter-province differences over time for the sub-sample of rural respondents. For this purpose, we regress the indicators of each DHS round separately on the full set of province dummies, using Rural Kigali as a base category (but excluding Kigali City). Appendix 2 shows the results. Gikongoro province lags behind, especially in the area of reproductive health and bed net ownership. The gap between the rural population of Gikongoro and the other provinces was highest in 2007 and reduced somewhat by 2010. Kibuye also has a relatively poor performance. It lags behind especially in the area of education, but this was already the case prior to the armed conflicts. There are no provinces which consistently score better than others throughout the entire period, although Gitarama experienced upward mobility in its relative performance.

2.4 Summary of DHS analysis

Most of the selected indicators improved substantially across the period 2000-10, mainly because of progress during the two latest sub-periods 2005-07 and 2007-10. During the sub-period 1992–2000, bracketing violent conflicts, most of the indicators declined. The period shortly after the violence, 2000-05, is characterized by mixed patterns, with most of the indicators returning to their pre-war levels, or surpassing them, while others declined further compared to their pre-war levels.

The indicators that declined further several years after the violence are stock variables, such as educational outcomes, for which the impact of a negative shock has a long shadow. In contrast, flow indicators such as the health condition of children in the two weeks prior to the survey (prevalence of cough, fever, diarrhoea) show a steady improvement over time, across all DHS rounds.

Across the latest three DHS rounds, we noted converging trends across wealth quintiles, as well as decreasing disparities across rural and urban areas. The opposite patterns were observed across the first two DHS rounds, bracketing the period of armed conflicts. The different provinces displayed broadly similar trends, and the pattern that emerges is one of inter-province convergence rather than divergence. Although the performance of Kigali City stands out, the gap between the capital city and the rest seems to be decreasing over time. Gikongoro remains a province that is lagging behind somewhat, while Gitarama experienced upward mobility.

While part of the improvements observed in the post-war period can be attributed to catch-up with pre-war levels, there is also real progress, as for all indicators considered the 2010 levels outperform the pre-war levels of 1992, and 2010 disparities are smaller than pre-war disparities.

Our findings can be summarized in six highlights:

- All welfare indicators considered improved across the period 1992–2010;
- Progress took place mostly during the two latest sub-periods 2005–07 and 2007–10;
- During the period 1992–2000, bracketing violent conflicts, most of the indicators declined;
- The disparities across wealth quintiles and across rural and urban areas decreased between 1992 and 2010;
- During the period of armed conflicts (1992–2000) disparities increased sharply;
- The general pattern is one of inter-province convergence in the selected indicators.

3 Household-level economic mobility, social mobility and happiness

The dynamic and subjective dimensions of household well-being may not be unimportant in Rwanda given its violent history and profound social transformation. In this section, we analyse income growth, inequality and income mobility across the period 2002-08, in a small household panel dataset. Income mobility is triangulated against households' self-reported social mobility experience and happiness. We give special attention to the role of land as a determinant of mobility and happiness.

The panel dataset is not representative for the Rwandan rural population, not only because of its small size but also because the households were selected several years ago; they may therefore be at a particular stage in their life cycle.[12] Therefore, this analysis is only a first step towards further insight into mobility and subjective well-being and results cannot be generalized to the Rwandan population.

After giving an overview of the dataset and some key summary statistics, we turn to the analysis of economic mobility, social mobility and happiness.

3.1 The panel dataset

The panel dataset considered includes two rounds of data from surveys implemented in 2002 and 2008 in two Rwandan provinces, Gikongoro and Gitarama. Figure 5 shows the location of the provinces and the selected household clusters.[13]

The 2002 round was collected as part of a study for DGOS. It included 258 households; among which 160 households (ten clusters) in Gitarama province and 98 (six clusters) in Gikongoro province. The survey collected information on subsistence production, crop sales, livestock production, non-farm income, beer brewing, transfers, land ownership, household composition and schooling. Additionally, recall information was collected about war-related shocks, other adverse income shocks, and household consumption shortfalls, among others.

The 2008 round was collected on a grant from the Rwandan government and LICOS (Center for Institutions and Economic Performance, University of Leuven). It relied on a survey design similar to that used in the previous round and set out to interview the 258 households who were interviewed in 2002. Four of the 258 households interviewed in 2002 could not be found, while 13 households could not be considered as the same because all former household members had been replaced by distant family or by neighbours. In our panel data analysis, we consider the 241 remaining households. Analysing attrition across the 2002 and 2008 rounds, we find little evidence that household characteristics drive attrition. Only the number of active members in a household turns up significant, which is very intuitive: the smaller the household size, the more likely that none of the original household members can be found.

Among the 241 households, 176 were also interviewed in 1990 in what constituted the first round of the panel data. This is further explained in Appendix 3, which also presents summary statistics

---

[12] In addition, the initial sampling comprised only rural households with landholdings, leaving out the landless. Furthermore, the sample neither includes so-called old caseload refugees—that is, Tutsi who fled Rwanda between 1959 and 1990 and came back when the Rwandan Patriotic Front (RPF) seized power.

[13] In 2002, an administrative reorganization reduced the number of provinces from 12 to five. Gikongoro and Gitarama are located in what is now the Southern province.

for the 176 households across the three rounds. We do not include this round in our analysis below because we do not have information on social categories and happiness for the 1990 round.

3.2 Summary statistics

To get a sense of the extent of economic growth and inequality in the period 2002-08, we calculate income and asset ownership for the households in our sample (there are no data on expenditures). Appendix 4 details the method used for calculating income from the survey data. Table 7 shows a comparison of the levels of income, the income sources, land ownership, livestock and household composition across 2002 and 2008, focusing on the 241 households that were surveyed in both years.

The summary statistics indicate strong income growth between 2002 and 2008, with real income per adult equivalent (in 2008 prices) increasing from Rwandan Franc (RWF)[14] 54,614 in 2002 to RWF 60,725 in 2008, corresponding to an 11.2 per cent increase over the six-year period. This income growth took place despite a sharp drop in average farm sizes from 0.89 ha in 2002 to 0.54ºha in 2008. Livestock ownership, expressed in tropical livestock units (TLU), was very similar in both years.

In terms of income composition, we note a decline in the share of own agricultural production (from 60.0 per cent to 56.7 per cent) and a rise in the contribution of non-farm wage employment (7.2 per cent to 7.6 per cent) and non-farm self-employment (9.4 per cent to 10.1 per cent). These changes are however small and insignificant. The moderate decline in the contribution of agricultural production, in spite of the substantial decline in land sizes, suggests that agricultural productivity increased; possibly through the increased use of fertilizer as highlighted by the World Bank (2013a), or—more trivially—by better agricultural weather conditions.

The information on household composition in 2002 and 2008 indicates a decrease in the dependency ratio, defined as the ratio of dependent to active household members (from 121 to 109). This could be related to the life cycle of households, with children growing older. The proportion of female-headed households is high in both years (above 45 per cent), which results from the large number of male casualties and prisoners[15] as well as from the oversampling of genocide survivors (mainly widows) in 2002 (see Appendix 3 for details on sampling).

The Gini coefficients show that income inequality is high at 0.57 but stable over the two years considered. While we observe a strong increase in land inequality (from 0.51 to 0.62), inequality of

[14] Using a purchasing power parity (PPP) conversion rate of 300, the corresponding amounts in US$ are US$182 and US$202.

[15] Three out of four households who lost a member owing to violence became female-headed, and seven out of ten households who had a member in prison in 2002 were female-headed.

livestock decreased (from 0.52 to 0.39).[16] This is also clear from Figure 6, which gives the kernel densities[17] for land and livestock in 2002 and 2008.

3.3 Economic mobility, 2002-08

Measuring mobility

To obtain insight into the movement of households through the income distribution, we turn to an analysis of economic mobility. Economic mobility can be measured in different ways (Amiel and Bishop 2003). We present inter-temporal transition matrices and a measure of time dependence—that is, the extent to which a household's current economic position is determined by its position in the past. The more the households move through the income distribution, the lower the time dependence.

Table 8 shows quintile transition matrices for income, income per adult equivalent, land and livestock. The rows of the 5x5 matrices correspond to wealth quintiles of the base period while the columns represent the wealth quintiles of the final period. The entries in the transition matrix indicate the fractions of households in the base period quintile, which ended up in a certain final period quintile. Between brackets the absolute numbers are given. For example, cell (l,l) of Matrix A indicates that 28.6 per cent of households that belonged to the lowest income quintile in 2002 remained in that quintile in 2008, whereas cell (1,5) indicates that 8.2 per cent of households in the lowest quintile in 2002 reached the top quintile in 2008. Economic mobility of the poorest is lower for asset ownership. Cell (1,1) in Matrix C indicates that 32.7 per cent of households in the smallest land quintile in 2002 remained in that quintile in 2008. For livestock, the cell (1,1) gives a share as high as 46.1 per cent (Matrix D).

From the transition matrix, we calculate the immobility ratio. This is the fraction of households that remain in the same quintile over time—that is, the sum of the elements on the diagonal as a percentage of all households. We obtain an immobility ratio of approximately 26 per cent for income and income per adult equivalent, 27 per cent for land, and 34 per cent for livestock ownership. These results are comparable with the findings on time dependence of income and assets by other authors, although the immobility ratio for land is on the low side, suggesting that shifts in land ownership were relatively high in Rwanda across this period.[18]

---

[16] It is tempting to attribute the decline in livestock inequality to the 'one family-one cow' policy that was launched in 2006 (UNICEF 2011). Effective distribution of livestock started however only in 2010. Another conjecture, that better fits the time frame, is related to the scarcity of pasture land and restrictions on grazing cattle on common land. These constraints may have forced cattle owners to keep their cattle stabled, which is costly in terms of the investment in the stable and the labour time needed to feed and water the stabled cattle. The cattle owners may have therefore opted to share this burden as well as the fruits of livestock ownerships with households who owned fewer or no cattle (Verpoorten 2009; personal correspondence with Bert Ingelaere).

[17] Kernel density estimators approximate the density function f(x) from observations on x, giving the probability of observing xi (land or livestock of household i) in the sample. Consequently, the estimates of f(x) integrate to 1. As opposed to frequency tables, kernel density estimates have the advantage of being smooth and independent of the choice of origin. More formally, the data are divided into intervals and estimates of the density at the centre of the interval are produced. The intervals are allowed to overlap. The smoothness of the figure depends on the width of the interval chosen.

[18] For example, for India, Lanjouw and Stern (1991, 1993) found an income immobility ratio of 25.7 per cent over a twelve-year period. Using land ownership, Swaminathan (1991a, 1991b) found an immobility ratio of 48.2 per cent over eight years for a sample of Indian households. For a detailed overview of the results of mobility matrices, we refer to Baulch and Hoddinott (2000).

In order to control for mobility stemming from local weather variability and other community-level characteristics, we use a regression analysis, regressing material welfare in 2008 on material welfare in 2002 and commune dummies (for the 16 clusters in our sample). The results presented in Table 9 show significant time dependence for all four material welfare indicators. For instance, the estimates indicate that a 1 percentage point higher income in 2002 is related to a 0.38 percentage point higher income in 2008, and that a 1 percentage point higher livestock ownership in 2002 is associated with 0.43 percentage point higher TLU in 2008.

A final illustration of time dependence is provided by Figure 7 which gives simple scatter plots with baseline wealth on the horizontal axis and end line wealth on the vertical axis. The fitted lines are upward sloping, indicating positive correlation of material wealth over time.

Explaining mobility

To explain income and income mobility, we take a production function approach, relating income to the production factors land, labour and schooling. In addition, we add an indicator variable that takes 1 for female-headed households, as women may face several constraints that reduce productivity, such as limited land tenure security or access to credit. To control for local weather shocks, we add commune fixed effects, μ_i. Our empirical equation can be written as follows:

$$Log(Income)_{it} = \alpha_0 + \alpha_1 log(land)_{it} + \alpha_2 log(labour)_{it} + \alpha_3 log(schooling)_{it} + \alpha_4 female_{it} + \mu_i + \varepsilon_{it}$$

Land of household *i* in year *t* is measured by the natural logarithm of the land area owned (expressed in ares),[19] labour by the natural logarithm of household members aged 15 to 65, and schooling by the natural logarithm of the years of schooling of the household head.

We estimate the equations separately for each year. Table 10 shows the results. The return to land is positive and strongly significant, with point estimates of 0.268 in 2002 and 0.355 in 2008. The return on labour is also positive and highly significant, at 0.838 in 2002 and 0.638 in 2008. The return to schooling of the household head is not significantly different from zero. Female-headed households perform markedly worse in 2002, which may reflect the shocks of war and genocide and their association with the death or imprisonment of male household heads. In 2008, their underperformance is no longer statistically significant.

These estimates indicate that households that increased their production factors over time, are likely to have experienced income growth. This is made explicit in Panel C of Table 10, which shows the results of a regression of income in 2008 on income in 2002 and the changes in production factors between 2002 and 2008.

$$Log(Income)_{it+1} = \beta_0 + \beta_1 \log(income)_{it} + \Delta_{t,t+1}(labour, land, schooling, female_i) + \mu''_i + \varepsilon''_{it}$$

This regression is based on the following intuitive reasoning about mobility: a household's income in *t*+1 is a function of its income in t and the change in production factors between *t* and *t*+1

[19] Ares, the equivalent of 100 m^2 or 0.01 ha.

(making abstraction of changes in productivity). We find that income in 2008 significantly depends on income in 2002 and on changes in labour and land between 2002 and 2008.

Social categories and social mobility

Survey measures of income are prone to measurement error, and may vary greatly from year to year depending on rainfall and other temporary shocks. Households' perceptions of their social category and social mobility are less prone to such temporary fluctuations, and may therefore better reflect the households' mobility experience.

In 2008, households were asked to rank themselves in one of the six social categories that emerged from the 2001 nationwide participatory poverty assessment (*Ubudehe)* implemented nationwide in a sample of administrative sectors.[20] The categories range from 'the abject poor' (*Umutindi nyakujya*) to 'the money-rich' (*Umukire*). The intermediate categories are 'the very poor', 'the poor', 'the resourceful poor', and 'the food-rich' (*Umutindi*, *Umukene*, *Umukene wifashije, Umukungu*, *Umukire*). These categories, joint with their main characteristics, are given in Table 11 (taken from GoR 2002).

Table 12 gives the distribution of our sample households across the different social categories for the survey years 2002 and 2008, with the distribution of 2002 based on recall information asked in 2008. We find that both in 2002 and 2008 close to 3 per cent of the households in our sample self-reported to be in the lowest social category. In 2002, we find about 13 per cent in the second category and 43 per cent in the third category, compared to 11 per cent and 37 per cent in 2008. While the lowest three categories make up almost 59 per cent of the sample in 2002, their share stands at 51 per cent in 2008, thus marking a decline in poverty.

According to Howe and McKay (2007) the first two categories represent chronic poor in Rwanda, and chronic poverty is said to be characterized by no or very limited land and livestock ownership. We check whether the social categories indeed depend on the land, livestock and income base of the households. The results are given in Table 12 and in the box-and-whisker plots in Figure 8, and clearly show that the higher the self-reported social category, the higher income, income per adult equivalent, land ownership and livestock ownership, on average. Most strikingly, land ownership amounts to less than 0.2 ha in the lowest social category compared to over 1 ha in the two highest categories.

Howe and McKay (2007) argue that the third and fourth categories are likely to include many transitory poor. We therefore expect mobility to be concentrated in categories three and four. Table 13 shows the mobility matrix across categories between 2002 and 2008. Whereas six out of the seven respondents in category 1 remained stuck in category 1, there is quite some upward mobility of the second and third categories to categories three and four, respectively. The overall immobility ratio is however very high at 70 per cent. This contrasts sharply with the low immobility ratios that we reported for income and assets.

Regarding the reasons for income and asset mobility, we highlighted the role of production factors, but there may be many other determinants of mobility that go undetected in a production function approach. Each household was asked to list two reasons for its experience of social mobility. The

[20] In each sector, facilitators consulted with a large number of community members (about 300), aiming to identify different social categories as seen by Rwandans themselves. The characteristics of these groupings were defined as well as the reasons for moving up or down the social ladder, and for being stuck in poverty (Niringiye and Ayebale 2012).

wide variety of reasons is apparent from Figure 9, which summarizes the self-reported reasons for downward and upward social mobility during the period 2002-08. The top three reasons for both downward and upward mobility relate to land and agricultural production. Other frequently mentioned reasons relate to livestock, support from the authorities, better health and access to health.

Happiness

We derive the happiness of household heads interviewed in 2008 from the twelfth question of the GHQ-12, the General Health Questionnaire, developed by Goldberg and Blackwell (1970):[21] 'Have you recently been feeling reasonably happy all things considered?'. Respondents select their level of agreement using the following response categories: 'strongly agree', 'agree', 'disagree' and 'strongly disagree'. We coded these responses as 4-3-2-1.

Table 14 shows the distribution of the answers: about 10 per cent of household heads strongly agreed, 57 per cent agreed, 21 per cent disagreed and 12 per cent strongly disagreed. Clubbing together the two latter categories, we may conclude that close to one out of three household heads felt unhappy. Looking at the distribution of income, assets and mobility across the answer categories, we find happiness to be weakly correlated with income, but strongly correlated with income mobility (both measured and self-reported). Strikingly, even the unhappy experienced a positive income change (RWF +31,000 vs. RWF +85,000 for the happy), suggesting that it is not levels nor absolute changes in income that matter, but relative changes.

Happiness also strongly correlated with land ownership. Those who report being happy have about 75 per cent more land than 'the unhappy' (0.38 ha vs. 0.65 ha). Women tend to own less land, and report in general lower levels of happiness. We therefore verify whether the relationship between landholdings and happiness holds for the sub-sample of male household heads. The difference shrinks somewhat but remains significant when considering only male household heads (0.40 ha vs. 0.68 ha for 'unhappy' and 'happy' respectively). The average decline in landholdings was also larger among the unhappy than among the happy (0.53 ha vs. 0.25 ha). This difference is significant and holds also in the sub-sample of male-headed households.

The finding of the importance of relative wealth and landholdings align well with those of Van Landeghem et al. (2011) who, studying subjective well-being (SWB) of farm households in the context of land reform in Moldova, conclude that:

> … household land holdings have a positive effect on SWB but neighbors' average land holdings have a negative effect on SWB. People, regardless of the land distribution and even given the relatively low living standards of these households, rate their welfare by looking at how much other people possess.

The importance of relative wealth for SWB has also been underlined by Fafchamps and Shilpi (2008), Kingdon and Knight (2007), and Luttmer (2005), among others.

---

[21] The GHQ has been translated into many languages. It was cross-culturally validated as part of a World Health Organization project on mental illness conducted in both developing and developed countries (Goldberg et al. 1997). During the preparation phase of the 2008 round of the panel data, we let the GHQ-12 be translated from English to Kinyarwanda and then back from Kinyarwanda to English by two different translators (double-blinded). We compared the re-translated English version with the original one to spot problems, which were then discussed in detail with both translators until a consensus on an accurate translation was reached. We acknowledge input from Pieter Serneels in this process.

These are merely correlations and future work needs to properly account for confounding factors and identify causal relationships.

3.4 Summary of small panel data analysis

We measured considerable income growth between 2002 and 2008, despite a strong decline in landholdings. Similarly, income inequality remained stable despite a strong increase in land inequality. Increases in land productivity as well as income diversification towards the non-farm sector may have counterbalanced the effect of declining farm sizes. The more equal distribution of livestock that we observed in the data may also have moderated income inequality.

We noted considerable mobility in income, land and livestock ownership. Self-reported social mobility was much lower. In particular, the lowest social category ('the abject poor' or *Umutindi nyakujya*) experienced very little upward mobility, while a fair share of the other poor (categories 2 and 3) reported upward social mobility.

Changes in production factors (land, labour) were found to be determinants of income mobility. Land ownership and land productivity turned up as important factors among the self-reported reasons for social mobility, next to support from the authorities, livestock ownership and better access to healthcare, among others.

About one-third of household heads reported being unhappy. Happiness was only weakly related to income levels and the household's current social category, and instead seemed to be driven by relative changes in income (both measured and self-reported), as well as levels and changes in land ownership.

Land emerges as an all-important factor in the different parts of this analysis, as is clear from the following six points that highlight the main findings of this section:

- Income increased substantially between 2002-08;
- Land ownership decreased substantially and became much more skewed;
- Income mobility was large, while social mobility was much lower;
- Land emerged as an important determinant of income and income mobility;
- The top three self-reported reasons for social mobility concerned land and its productivity;
- Land and changes in land were strongly correlated with measure of happiness.

4 Discussion

The trends in health and education across the five different DHS rounds indicate progress beyond mere post-war catch-up. Furthermore, while the coercive implementation of some policies raises concern about 'cosmetic' changes, there is robust evidence for real improvements in quality of life measures. Finally, converging trends across wealth quintiles in the last three DHS rounds resulted in a decline in inequality compared to the pre-war situation.

A number of factors may account for the real progress in health and education indicators observed since 2005:

First, health expenditure per capita increased by a factor of 2.5 between 2004 and 2010 (Figure 10, Panel A) and public health expenditure as a share of government expenditure increased by a factor

of 1.6 (from 14.6 per cent to 23.3 per cent) over the same period. Furthermore, the new constitution of 2003 introduced free and mandatory primary education.

The surge in expenditures is partly financed by aid flows to Rwanda that have increased steeply and steadily since 2004 to a level twice as high as prior to the war (Figure 10, Panel B). Even when accounting for population, the surge in aid flows is substantial, from US$31 per capita in 2004 to US$52 per capita in 2010.[22] A large part of aid is allocated to the health sector, which received more than 30 per cent of all aid flows in 2011, and the social sectors in general, receiving over 50 per cent.

The aid flows find reasonably fertile soils in Rwanda, as the worst forms of corruption are kept in check and government services are in general technically capable to manage programmes effectively (Booth and Golooba-Mutebi 2012).

One such programme is PBF in healthcare. Introduced in 2006, PBF sets out to improve the quality of healthcare delivery by providing financial incentives to health centres. The first assessments of PBF are largely positive (Basinga et al. 2010; Meessen et al. 2011). Other scholars note that it is difficult to evaluate to what extent progress can be attributed to PBF, and warn about the risk of a quality-quantity trade-off (Kalk et al. 2010).

Also, outside the health sector, increased upward accountability from the local to the central government level may have played a role in triggering economic growth and improvements in health and education. Since 2006, the local authorities have been required to sign a performance contract (*Imihigo*) with the central government (Ingelaere 2011). The contract acts as a yearly action plan, including specific indicators and targets. Every July the results are evaluated during a presidential ceremony and broadcasted on radio and television and published in newspapers. To the best of our knowledge, there exists no rigorous impact evaluation of *Imihigo*.

The Rwandan government also instituted a system of mutual health insurance (MHI), both to promote broad access to healthcare and improve the financial situation of health establishments. In 2008, MHI was made obligatory for the entire population. The share of households with at least one member covered by MHI stood at 78 per cent in 2010, up from 68 per cent in 2007–08. While Kalk (2008) asserts that 'the Mutuelle system corresponds more to an additional tax for health than to a proper insurance system', Saksena et al. (2011) present a positive evaluation of MHI, finding MHI coverage to be associated with an increased utilization of health services.

All these factors may have contributed to the improvements in the selected human development indicators, although—in order to firmly establish this—careful impact evaluations are needed.

In addition, since economic growth was broad-based, it may have increased the ability of households to invest in better health, nutrition and education. But the causality runs both ways: better health and education are key determinants of an individual's productivity, and therefore likely to lead to higher income. The causation from health to income implies that policies that reduce the likelihood of sickness or shorten its duration may narrow income inequalities, provided that these policies also benefit the relatively poor in society (Deaton 2003). A similar argument can be made for the impact of more equal access to education on income inequality.

[22] As the increase in Official Development Assistance (ODA) coincided with a period of rapid economic growth, ODA as a share of gross national income declined from 10.6 per cent in 2004 to 9.8 per cent in 2010.

Because of this multi-way causation, it is not surprising that the improvements in human development as inferred from the DHS data are in line with the poverty and inequality trends that emerge from data on consumption expenditures. But how can this evidence of pro-poor growth be reconciled with the much more pessimistic findings of mostly qualitative fieldwork at the local level?

This question gave rise to our analysis of dynamic and subjective measures of household well-being, which relied on a small panel dataset. The response to the question 'Have you recently been feeling reasonably happy all things considered?' turned out to be unrelated to income levels. Instead, 'happiness' was found to correlate strongly with relative income changes and landholdings.

This finding suggests that subjective measures of well-being do not necessarily align well with objective measures of well-being; and that the mismatch may be considerable in Rwanda as the country embarked on rapid and profound social transformations in the area of politics, justice and economics; leading to winners and losers (in relative terms) and affecting the traditional land- and subsistence-based livelihoods. I point out some issues that relate to the rapid economic transformation.[23]

One of the main objectives for change, made explicit in Rwanda's Vision 2020, is to 'transform agriculture into a productive, high value, market oriented sector, with forward linkages to other sectors' (GoR 2000: 4). In view of this goal, an increasing share of the government budget is channeled to agriculture.[24] While more funding to the agricultural sector may have accounted for rural growth and poverty reduction in recent years, it has also served to implement policies that peasants find difficult to adapt to, such as land consolidation and mono-cropping.

One of the reasons why adaptation to these changes may prove difficult relates to the rapid pace of the transformations. It is unlikely that the pace will slow down in the near future, if only because Rwanda's population is very dense and still growing. While the Rwandan population density had dropped to 247 inhabitants per km^2 by the end of 1994 (from 283 prior to the genocide), with refugees returning and fertility remaining high, it quickly bounced back to a density of 322 inhabitants per km^2 in 2002 (GoR 2003). The estimates of the 2012 census point to a population density of 416. The projected density for 2012 is 513; while for 2050 it is as high as 861, three times as large as on the eve of the genocide (GoR 2009, 2012b). In the face of such population densities, subsistence agriculture is a dead-end street and rapid transformations are required.

One could in fact argue that a lack or too slow pace of transformative changes contributed to the violence in Rwanda. Throughout the 1970s, 1980s and 1990s demographic pressure did not lead to a wide adoption of agricultural innovations. Instead, when all marginal lands were taken up for cultivation, it gradually led to a reduction in food production per capita (Clay 1996). A number of studies have demonstrated that the deteriorating economic conditions and land scarcity played a role in the scale and intensity of the 1994 killings (André and Platteau 1998; Verpoorten 2012b).

To reduce the burden of rapid population growth on its economy and society, the Rwandan government set out to reduce fertility, targeting a total fertility rate (TFR) of 4.5 for 2020 (GoR 2000). The target was set in 2000, when the TFR stood at 5.8. While fertility first increased to 6.1 in 2005, it then started a rapid decline to 5.5 in 2007/8 and 4.6 in 2010, very close to the target set for 2020. While in part the decline is a continuation of a trend that started in the 1980s and was

[23] For transformations in politics and justice I refer to the book edited by Straus and Waldorf (2011).

[24] In 2011/12 the Rwandan government allocated 7 per cent of its national annual budget to the agricultural sector, up from 3.5 per cent in 2007 (GoR 2011).

interrupted by the violent events, it results to a large extent from active government policy and rapid changes in the environment (Westoff 2012). For instance, gender equality was actively promoted, both in sensitization campaigns and in legislation; in 2007, Rwanda launched a campaign to promote three-children families, and infant and child mortality declined rapidly from its high in 2000.[25]

The sharp decline in fertility marked the beginning of the last phase of the demographic transition for Rwanda. Still, even in a scenario with low fertility, Rwanda's population will grow to reach over 20 million by 2050, with a population density of over 800 inhabitants per km^2. This will inevitably require further transformative changes, bringing about (relative) winners and losers, and the grievances that go with that. The probability that grievances escalate is likely to be larger if the changes involve coercive measures and the process leading up to the changes is top-down instead of being carried by the communities they concern. This brings us to the Achilles heel of the Rwandan success story: 'voice and accountability'.

Although the technically capable government is well under way to reach several of the Millennium Development Goals,[26] Rwanda's path to development remains controversial, because of the sharp contrast between the impressive economic progress and the standstill in 'voice and accountability', one of the six Kaufmann et al. (2010) governance indicators. The allegations made against President Kagame and the RPF-led government are not minor, including severe and hardly concealed political and societal repression in Rwanda and the fuelling of violence across the border with Congo (Reyntjens 2012). These allegations cast a shadow over the regime's economic successes and leave the scholar and donor community deeply divided on how to approach Rwanda.[27]

While the authoritarian approach may be instrumental in bringing about transformative changes without much overt protest, there is a danger that any positive achievement this may yield will be undone. A lack of voice and accountability may compromise a level playing field and open dialogue, not only leading to economic but also to political grievances. The combination of political and economic grievances may lead to a dangerous cocktail, of which the potential impact can hardly be ignored in Rwanda, considering the intensity and extent of the 1994 genocide and other forms of violence that ravaged the country in the 1990s. Rwanda's history should make observers especially attentive to evolutions in social, political and economic exclusion. This argument is further developed in Ingelaere and Verpoorten (2014).

Taken all together, on the economic front Rwanda is doing more than well. If poverty and inequality can be further reduced in the country's growth process, and relative winners and losers do not align with a group identity, economic grievances may be kept in check, perhaps sufficiently so to counterbalance political grievances. This is however a dangerous bet, and the first best would probably be to aim at an improvement of economic as well as governance indicators.

---

[25] A further decline in the near future is possible. This can be seen from Figure 11. Setting out both the TFR and the ideal number of children over time, it shows that the ideal number of children has decreased rapidly over time, and stalled at 3.3 in 2007/08 and 2010. As 3.3 is quite a bit lower than the actual fertility at 4.6 in 2010, there still is room for further decline, the more so because the gap between TFR and the ideal number of children remains non-negligible, at 1.3 (down from 2 in 1992).

[26] See, www.unrwanda.org/undp/rwamdg_indicators.pdf (accessed 3 October 2014).

[27] Following renewed allegations mid-2012 on Rwanda's role in supporting armed groups in the Democratic Republic of Congo (DRC), some donors pulled out or reduced their effective payments, leading to an estimated 20 per cent reduction in Official Donor Assistance in 2012 (World Bank 2013a).

This research points to the following directions for future research:

- Rigorous impact evaluations of the different policies and events that may account for the progress in health and schooling;
- A careful study of various subjective measures of well-being and their determinants;
- A thorough analysis of the different agricultural policies, and how they affect land and income inequality, and SWB;
- Research aimed at increasing agricultural productivity of very small landholdings;
- Research on the capacity of the non-farm sector to absorb more labour, skilled and unskilled;
- A study on the identity of relative winners and losers in the transformative changes.

References

Akresh, R., and de Walque, D. (2008). 'Armed Conflict and Schooling: Evidence from the 1994 Rwandan Genocide'. Policy Research Working Paper 4606. Washington, DC: World Bank.

Amiel, Y., and Bishop, J.A. (2003). *Inequality, Welfare and Poverty: Theory and Measurement*. Oxford: Elsevier Science.

André, C., and Platteau, J.P. (1998). 'Land Relations under Unbearable Stress: Rwanda Caught in the Malthusian Trap'. *Journal of Economic Behavior and Organization*, 34: 1-47.

Ansoms, A. (2011). 'Rwanda's Post-Genocide Economic Reconstruction. The Mismatch between Elite Ambitions and Rural Realities'. In S. Straus and L. Waldorf (eds), *Remaking Rwanda. State Building and Human Rights after Mass Violence*. Madison, WI: The University of Wisconsin Press.

Ansoms, A., Verdoodt, A., and Van Ranst, E. (2010). 'A Green Revolution for Rural Rwanda: Reconciling Production Growth with Small-Scale Risk Management'. A paper prepared for the 'Ten Years of War against Poverty' conference, 8–10 September, Manchester, UK. Available at: http://www.chronicpoverty.org/page/publications (accessed 16 October).

Ayalew, A.D., Deininger, K., and Goldstein, M. (2011). 'Environmental and Gender Impacts of Land Tenure Regularization in Africa: Pilot Evidence from Rwanda'. Policy Research Working Paper Series 5765. Washington, DC: World Bank.

Basinga, P., Gertler, P.J., Binagwaho, A., Soucat, A.L.B., Sturdy, J.R., and Vermeesch. C.M.J. (2010). 'Paying Primary Health Care Centers for Performance in Rwanda'. Policy Research Working Paper 5190. Washington, DC: World Bank.

Baulch, B., and Hoddinott, J. (2000). *Economic Mobility and Poverty Dynamics in Developing Countries*. London: Frank Cass Publishers.

Booth, D., and Golooba-Mutebi, F. (2012). 'Developmental Patrimonialism? The Case of Rwanda'. *African Affairs*, 111(444): 379-403.

Christiaensen, L., and Devarajan, S. (2013). 'Making the Most of Africa's Growth'. *Current History,* May: 181-87.

Clay, D.C. (1996). 'Fighting an Uphill Battle: Population Pressure and Declining Land Productivity in Rwanda'. MSU International Development Working Paper 58. East Lansing, MI: Department of Agricultural Economics, Michigan State University.

Clay, D.C., and Kampayana, T. (1997). 'Inequality and the Emergence of Non-farm Employment in Rwanda'. In N.E. Johnson, and Ch-L. Wang (eds), *Changing Rural Social Systems: Adaptation and Survival*. East Lansing, MI: Michigan State University Press.

Deaton, A. (2003). 'Health, Inequality, and Economic Development'. *Journal of Economic Literature,* XLI March: 113–58.

Demographic and Health Surveys (DHS) (1992, 2000, 2005, 2007, 2010). MEASURE DHS Project. Available at: www.measuredhs.com (accessed 16 October 2014).

Fafchamps, M., and Shilpi, F. (2008). 'Subjective Welfare, Isolation, and Relative Consumption'. *Journal of Development Economics*, 86: 43–60.

Filmer, D., and Pritchett, L. (2001) 'Estimating Wealth Effects without Expenditure Data—or Tears: An Application to Educational Enrollments in the States of India'. *Demography*, 38: 115–32.

Goldberg, D., Gater, R., Sartorious, N., Ustun, T., Piccinelli, M., Gueje, O., and Rutter, C. (1997). 'The Validity of Two Versions of the GHQ in the WHO Study of Mental Illness in General Health Care. *Psychological Medicine*, 27(1): 191-97.

Goldberg, D.P., and Blackwell, B. (1970). 'Psychiatric Illness in General Practice: A Detailed Study Using a New Method of Case Identification'. *British Medical Journal*, 1: 439-43.

Government of Rwanda (GoR) (2000). 'Vision 2020'. Kigali: Ministry of Finance and Economic Planning.

GoR (2002). 'Poverty Reduction Strategy Paper'. Kigali: Ministry of Finance and Economic Planning.

GoR (2003). 'Recensement Général de la Population et de L'Habitat Rwanda: 16-30 Août 2002: Rapport sur les Résultats Préliminaires'. Kigali: Service National De Recensement, Ministère des Finances et de la Planificiation Économique.

GoR (2005). 'Consumer Price Index'. Kigali: Statistics Department, Ministry of Finance and Economic Planning.

GoR (2009). 'National Population Projection 2007–2022'. Kigali: National Institute of Statistics of Rwanda.

GoR (2011). 'Rwanda's Progress CAADP Post-Compact'. Kigali: Ministry of Agriculture and Animal Resources.

GoR (2012a). 'The Evolution of Poverty in Rwanda from 2000 to 2011: Results from the Household Surveys (EICV)'. Kigali: National Institute of Statistics of Rwanda.

GoR (2012b). 'Population and Housing Census: Provisional Results'. Kigali: National Institute of Statistics of Rwanda.

Guariso, A., Ngabitsinze, C.J., and Verpoorten, M. (2012). 'The Rwandan Coffee Sector: Out of the Ordinary'. In F. Reyntjens, S. Vandeginste, and M. Verpoorten (eds), *L'Afrique des Grands Lacs. Annuaire 2011–2012*. Paris: L'Harmattan.

Guariso, A., and Verpoorten, M. (2013a). 'Aid, Trade and Post-War Recovery of the Rwandan Coffee Sector'. Unpublished Manuscript.

Guariso, A., and Verpoorten, M. (2013b). 'Armed Conflict and Schooling: Digging Deeper'. LICOS Discussion Papers 343. Leuven: LICOS (Centre for Institutions and Economic Performance), University of Leuven.

Howe, G., and McKay, A. (2007). 'Combining Quantitative and Qualitative Methods in Assessing Chronic Poverty: The Case of Rwanda'. *World Development*, 35(2): 197–211.

International Monetary Fund (IMF) (2013). 'World Economic Outlook Database'. Washington, DC: International Monetary Fund.

Ingelaere, B. (2011). 'The Ruler's Drum and the People's Shout: Accountability and Representation on Rwanda's Hills'. In S. Straus and L. Waldorf (eds), *Remaking Rwanda. State Building and Human Rights after Mass Violence*. Madison, WI: The University of Wisconsin Press.

Ingelaere, B., and Verpoorten, M. (2014). 'Rwanda: Could State-led Mass Killings ever Happen Again?' *African Arguments*. Available at: http://africanarguments.org/2014/06/02/rwanda-could-state-led-mass-killings-ever-happen-again-by-bert-ingelaere-marijke-verpoorten/ (accessed 16 October 2014).

Kabano, I.H., Broekhuis, A., and Hooimeijer, P. (2013). 'Fertility Decline in Rwanda: Is Gender Preference in the Way?'. *Population Studies*, 52(3): 345-56.

Kalk, A. (2008). 'Rwanda's Health System: Some Concerns'. *The Lancet*, 372: 1729.

Kalk, A., Paul, F.A., and Grabosch, E. (2010). 'Payment for Performance in Rwanda: Does it Pay Off?' *Tropical Medicine and International Health*, 15(2): 182-90.

Kangasniemi, J. (1998). 'People and Bananas on Steep Slopes: Agricultural Intensification and Food Security under Demographic Pressure and Environmental Degradation in Rwanda'. PhD Dissertation. East Lansing, MI: Michigan State University.

Kaufmann, D., Kraay, A., and Mastruzzi, M. (2010). 'The Worldwide Governance Indicators: Methodology and Analytical Issues'. Policy Research Working Paper 5430. Washington, DC: World Bank.

Kingdon, G.G., and Knight, J. (2007). 'Community, Comparisons and Subjective Well-Being in a Divided Society'. *Journal of Economic Behavior & Organization*, 64: 69–90.

Lanjouw, P., and Stern, N. (1991). 'Poverty in Palanpur'. *World Bank Economic Review*, 5: 23–55.

Lanjouw, P., and Stern, N. (1993). 'Agricultural Change and Inequality in Palanpur, 1957–84'. In K. Hoff, A. Braverman, and J. Stiglitz (eds), *The Economics of Rural Organization*. Oxford: Oxford University Press.

Luttmer, E.F.P. (2005). 'Neighbours as Negatives: Relative Earnings and Well Being'. *Quarterly Journal of Economics*, 120(3): 963–1002.

McKay, A., and Loveridge, S. (2005). 'Exploring the Paradox of Rwandan Agricultural Household Income and Nutritional Outcomes in 1990 and 2002'. MSU Staff Papers 11582, Michigan State University. East Lansing, MI: Michigan State University, Department of Agricultural, Food and Resource Economics. Available at: http://purl.umn.edu/11582 (accessed 16 October 2014).

Meessen, B., Soucat, A., and Sekabaraga, C. (2011) 'Performance-based Financing: Just a Donor Fad or a Catalyst towards Comprehensive Health-Care Reform?' *Bulletin of the World Health Organization*, 89: 153-56.

Muhoza, D.N., Rutayisire, P.C., and Umubyeyi, A. (2013). 'Measuring the Success of Family Planning Initiatives in Rwanda: A Multivariate Decomposition Analysis'. DHS Working Papers 49. Calverton, MD: ICF International.

Newbury, C. (2011). 'High Modernism at the Ground Level: The Imidugudu Policy in Rwanda'. In S. Straus and L. Waldorf (eds), *Remaking Rwanda. State Building and Human Rights after Mass Violence*. Madison, WI: The University of Wisconsin Press.

Niringiye A., and Ayebale, C. (2012). 'Impact Evaluation of the Ubudehe Programme in Rwanda: An Examination of the Sustainability of the Ubudehe Programme'. *Journal of Sustainable Development in Africa*, 14(3): 141-54.

Nkurunziza, J., Broekhuis, A., and Hooimeijer, P. (2012) 'Free Education in Rwanda: Just One Step towards Reducing Gender and Sibling Inequalities'. *Education Research International*, Article ID 396019, 11 pages.

Ravallion, M., and Chen, S. (2003). 'Measuring Pro-Poor Growth'. *Economic Letters*, 78(1): 93-9.

Reyntjens, F. (2012). 'Elite Ambitions: Engineering a New Rwanda and New Rwandans'. In C. Panella (ed.), *Lives in Motion, Indeed: Interdisciplinary Perspectives on Social Change in Honour of Danielle de Lame*. Tervuren: Royal Museum for Central Africa.

Saksena, P., Antunes, A.F., Xu, K., Musango, L., and Carrin, G. (2011). 'Mutual Health Insurance in Rwanda: Evidence on Access to Care and Financial Risk Protection'. *Health Policy*, 99(3): 203-09.

Schindler, K., and Brück, T. (2011). 'The Effects of Conflict on Fertility in Rwanda. Background Paper to the 2012 World Development Report on Gender Equality and Development'. Policy Research Working Paper 5715. Washington, DC: World Bank.

Serneels, P., and Verpoorten, M. (2013). 'The Impact of Armed Conflict on Economic Performance: Evidence from Rwanda'. *Journal of Conflict Resolution*. Forthcoming.

Sommers, M. (2012). *Stuck: Rwandan Youth and the Struggle for Adulthood*. Athens: University of Georgia Press.

Smith School of Enterprise and Environment (SSEE) (2011). *Rwanda's Climate: Observations and Projections*. Oxford: University of Oxford.

Straus, S., and Waldorf, L. (2011). *Remaking Rwanda. State Building and Human Rights after Mass Violence*. Madison, WI: The University of Wisconsin Press.

Swaminathan, M. (1991a). Measuring Mobility in Wealth: Some Estimates from a South Indian Village. *Oxford Bulletin of Economics and Statistics*, 53: 171-83.

Swaminathan M. (1991b). Gainers and Losers: A Note on Land and Occupational Mobility in a South Indian Village, 1977–1985. *Development and Change*, 22: 261–77.

UNDP (2007). *Turning Vision 2020 into Reality. From Recovery to Sustainable Development*. National Human Development Report. Kigali, Rwanda: United Nations Development Programme.

UNICEF (2011). 'Case Study on Narrowing the Gaps for Equity. One Cow per Poor Family: Reaching the Most Marginalized in Rwanda'. Nairobi: Eastern & Southern Africa Region Office.
Available at: www.rwandapedia.rw/.../workspace%253A%252F%252FSpacesStore%2 (accessed 16 October 2014).

Van Landeghem, B., Swinnen, J., and Vranken, L. (2011). 'Land and Happiness: Land Distribution and Subjective Well-Being in Moldova'. *East European Economics*, 51(1): 61-85.

Verpoorten, M., and Berlage, L. (2007). 'Economic Mobility in Rural Rwanda: A Study of the Effects of War and Genocide at the Household Level'. *Journal of African Economies*, 16: 349-92.

Verpoorten, M. (2009). 'Cattle Sales in War and Peacetime: A Study of Household Coping in Rwanda, 1991–2001'. *Journal of Development Economics*, 88(1): 67-86.

Verpoorten, M. (2012a). 'Detecting Hidden Violence: The Spatial Distribution of Excess Mortality in Rwanda'. *Political Geography,* 31(1): 44-56.

Verpoorten, M. (2012b). 'Leave None to Claim the Land A Malthusian Catastrophe in Rwanda?' *Journal of Peace Research*, 49(4): 547-63.

Westoff, C. (2012). 'The Recent Fertility Transition in Rwanda'. *Population and Development Review*, 38 (Supplement): 169–78.

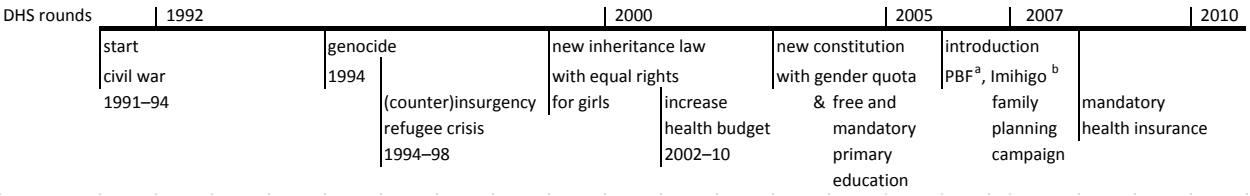
World Bank (2013a). *Rwanda Economic Update. Maintaining Momentum. With a Special Focus on Rwanda's Pathway out of Poverty*. Washington, DC: World Bank.

World Bank (2013b). 'World Development Indicators 2013'. Available at: http: //data.worldbank.org/data-catalog/world-development-indicators/wdi-2013 (accessed July 2013.

Figure 1: GDP per capita, PPP (constant 2005 international US$)[28]

Source: World Bank (2013b).

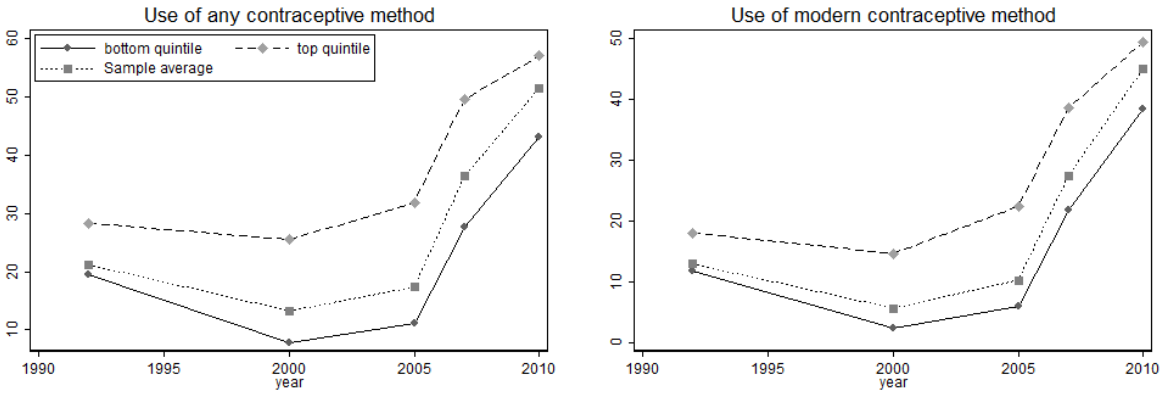
Figure 2: Timeline of DHS rounds, major events and policies



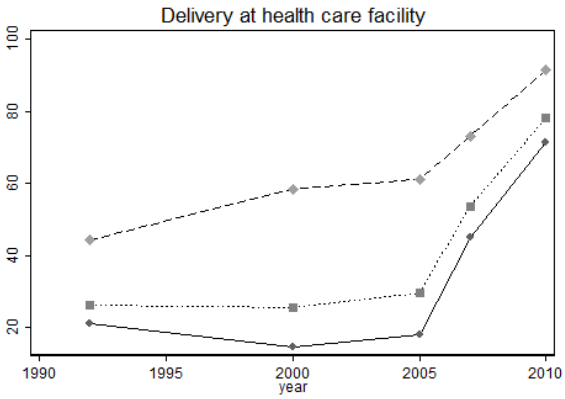
Notes: [a] Performance-based financing (in healthcare); [b] *Imihigo* is a performance contract between each district and the central government.

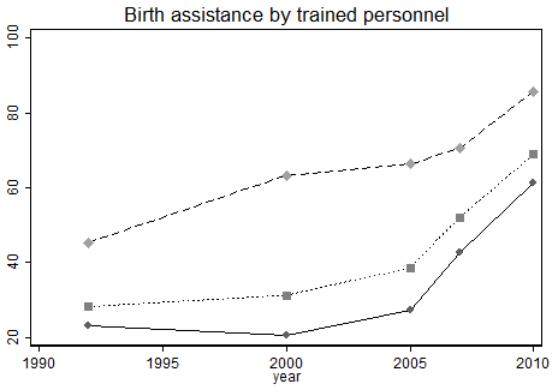
Source: Author's compilation.

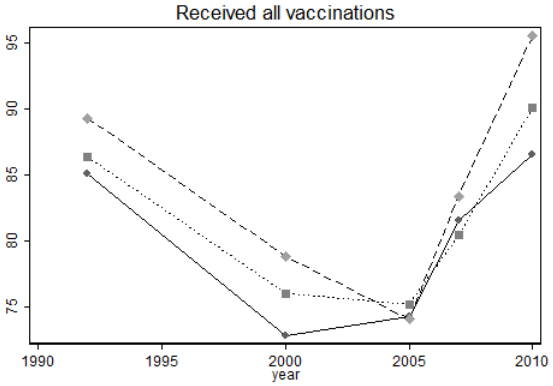
Figure 3: Health and education across DHS rounds, averages for total sample (dotted) and for respondents in the lowest (solid) and highest (dashed) wealth quintiles

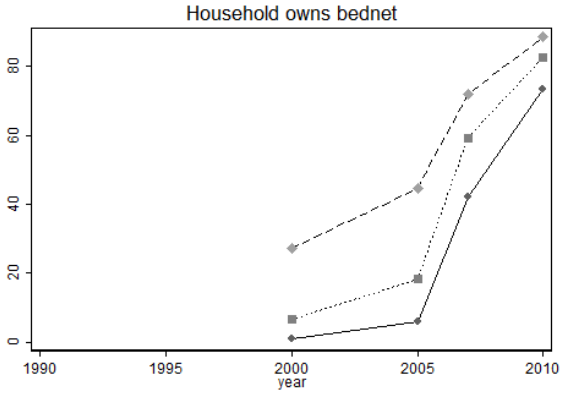


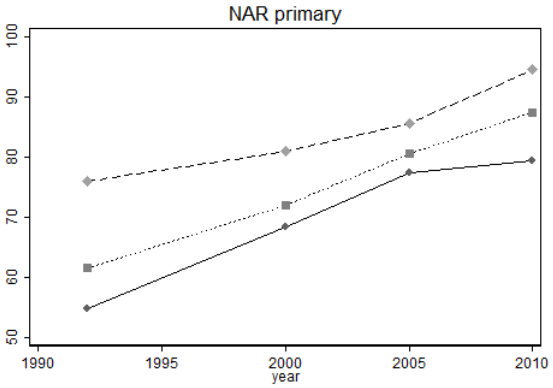
[28] 1 PPP dollar (or international dollar) has the same purchasing power in the domestic economy of a country as US$1 has in the US economy.

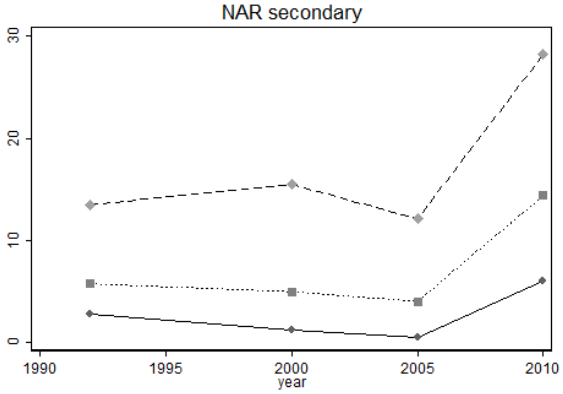










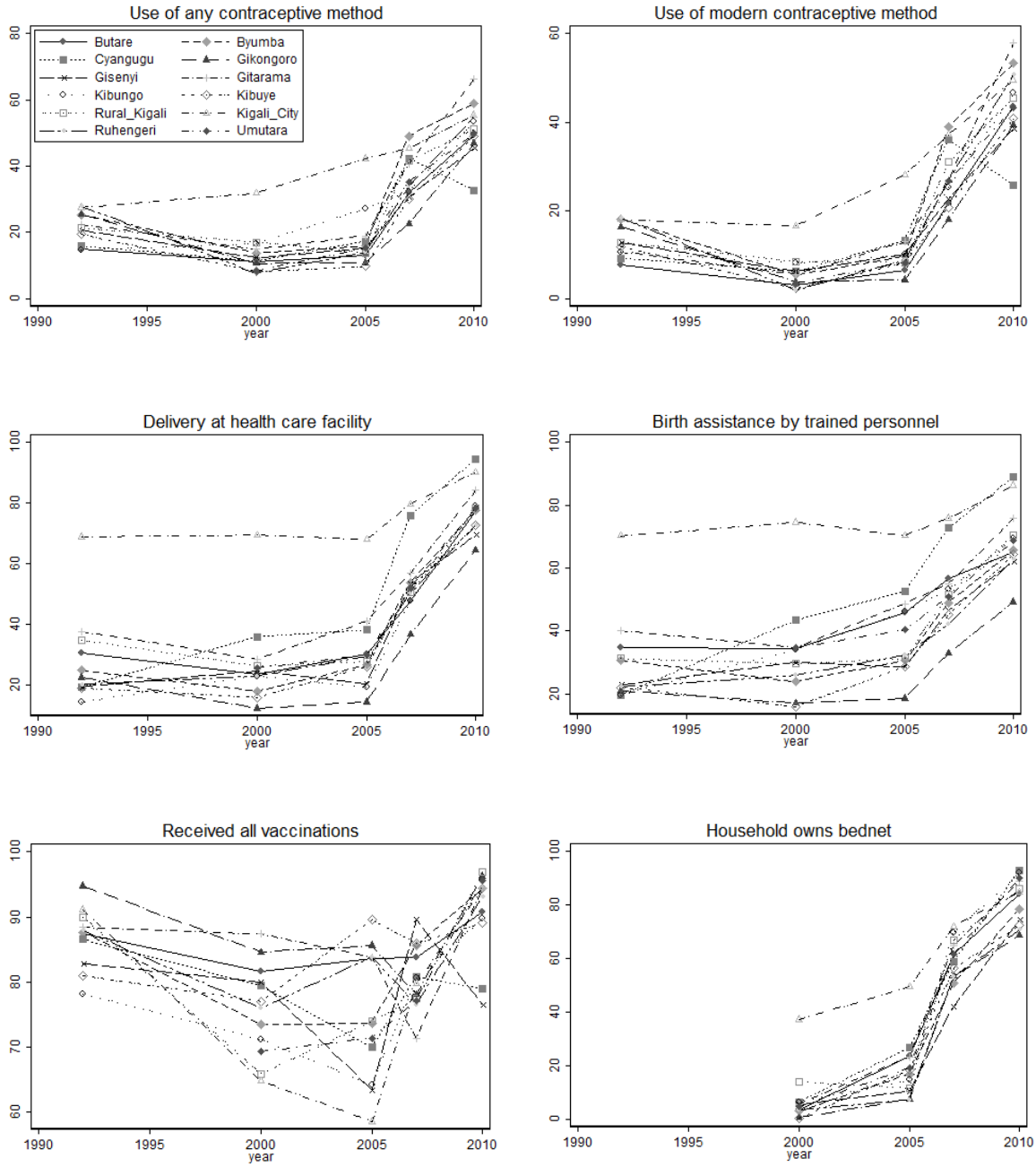


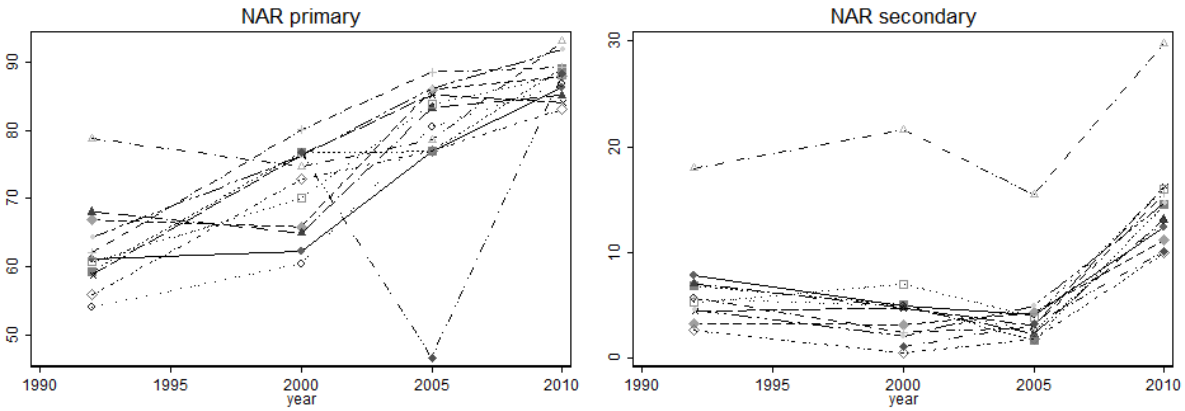
Notes: NAR = Net attendance ratio.

Source: Author's calculations from DHS data.

.

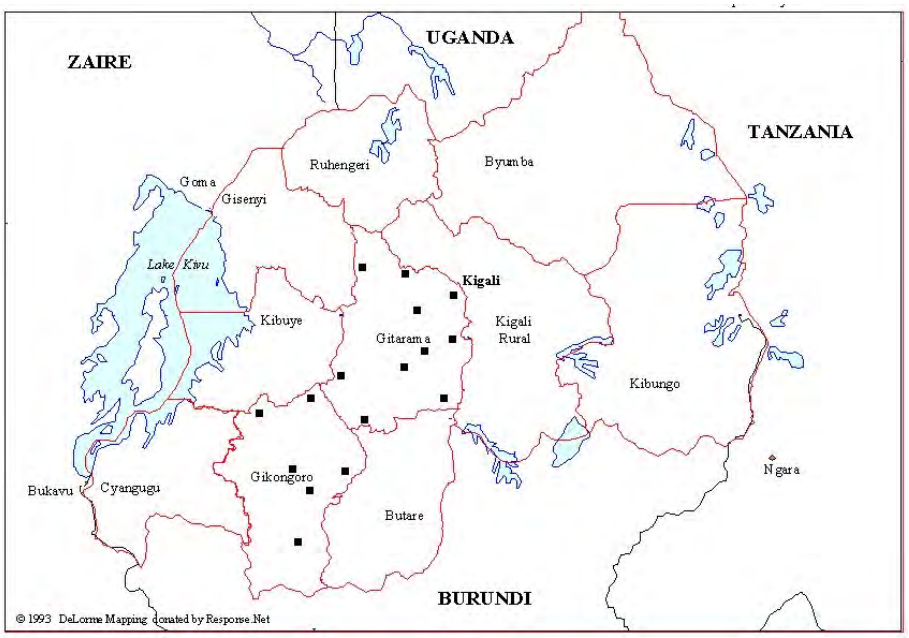
Figure 4: Inter-province differences in health and education across DHS rounds





Source: Author's calculations from DHS data.

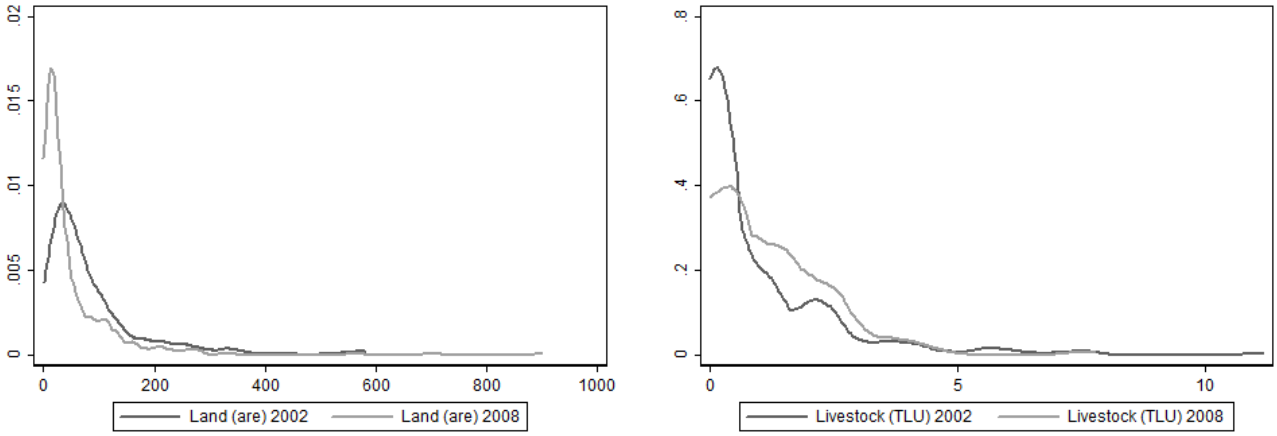
Figure 5: Location of sample clusters (on map with old administrative provinces)



Note: The dots on the map indicate the sample clusters.

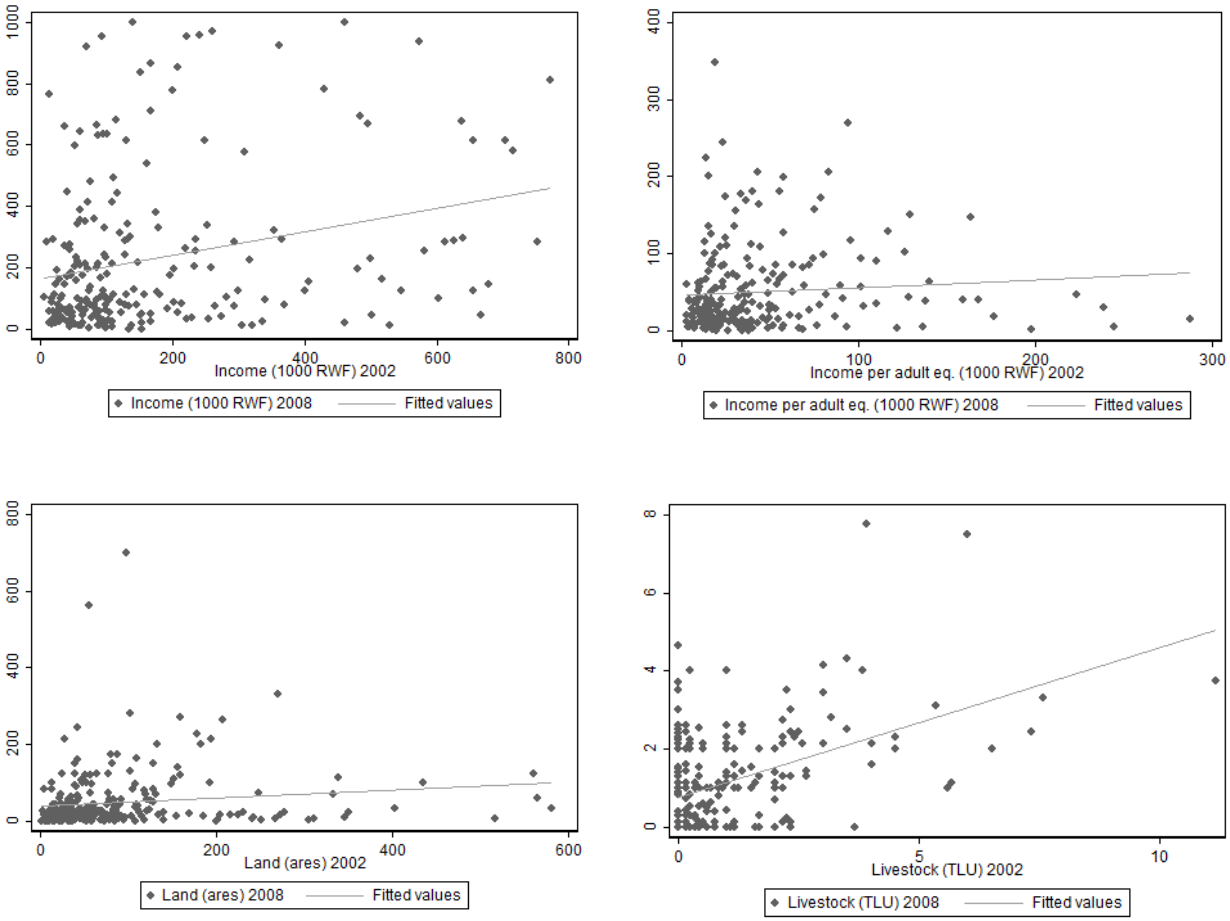
Source: DeLorme mapping donated by Response.Net.

Figure 6: Kernel density distributions of land and livestock in 2002 and 2008



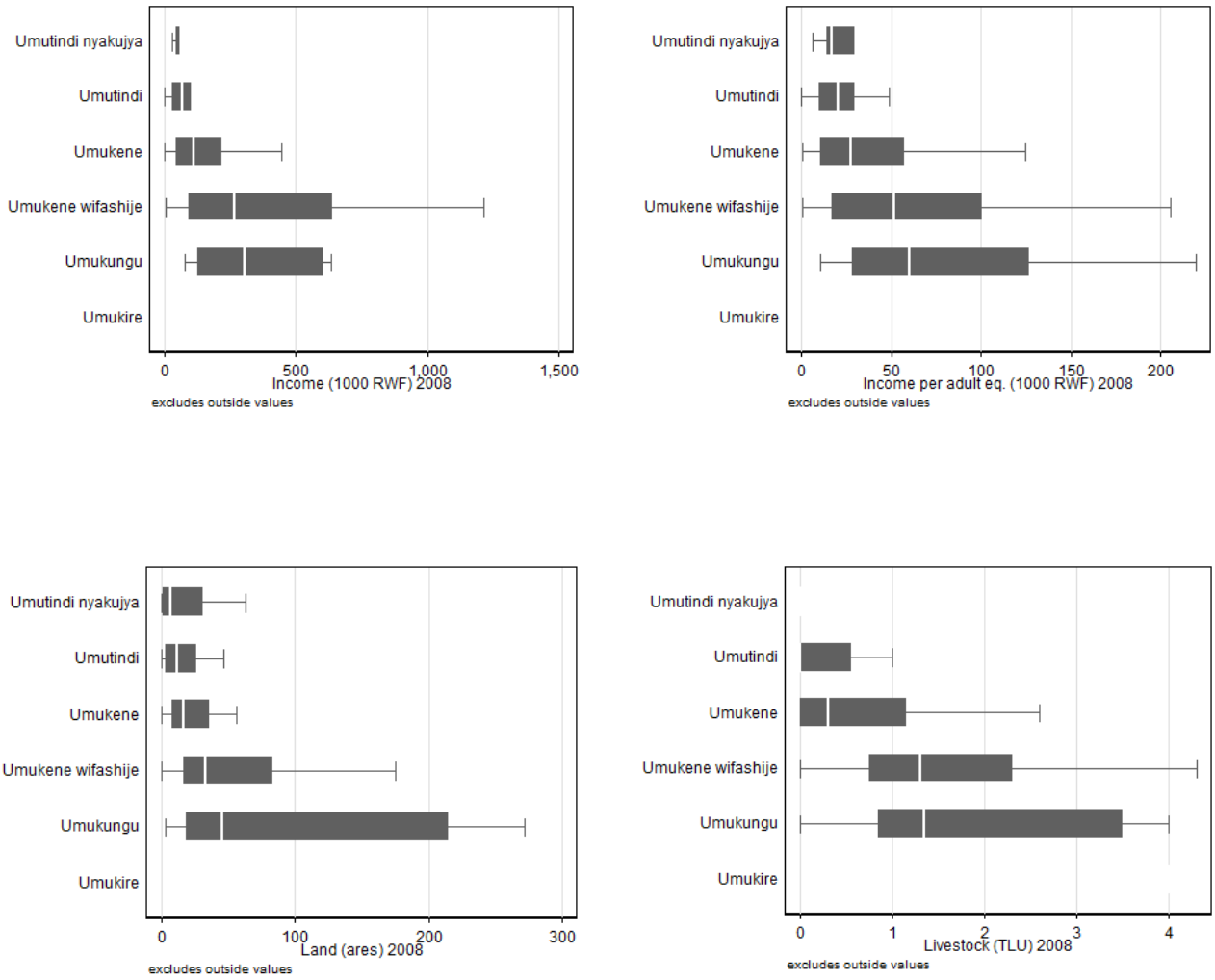
Source: Small panel dataset.

Figure 7: Scatter plots showing time dependence in material welfare indicators



Source: Small panel dataset.

Figure 8: Box-and-whisker plots of material welfare by self-reported social categories

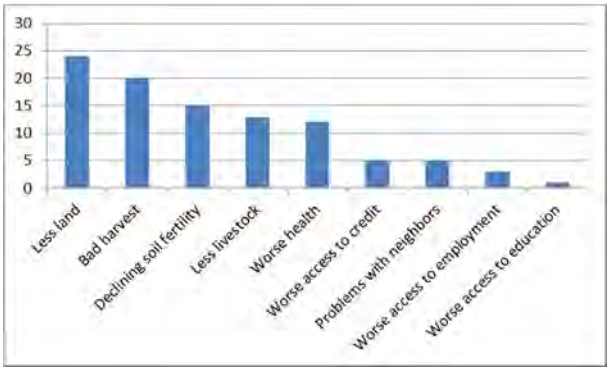


Notes: The different categories correspond to the abject poor (*Umutindi nyakujya*), the very poor (*Umutindi*), the poor (*Umukene*), the resourceful poor (*Umukene wifashije*), the food-rich (*Umukungu*) and the money-rich (*Umukire*).

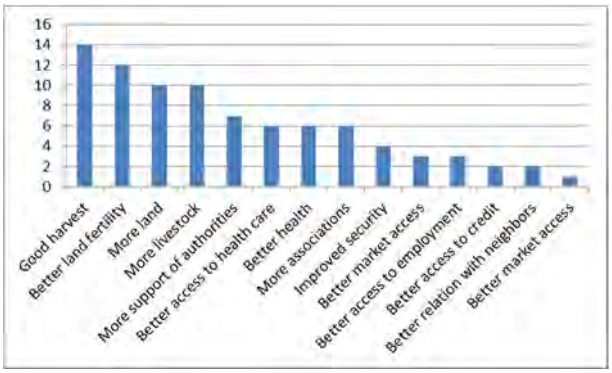
Source: Small panel dataset.

Figure 9: Self-reported reasons for social mobility

Reasons for downward mobility

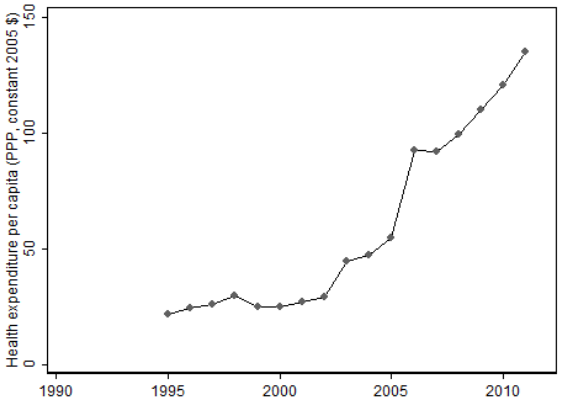


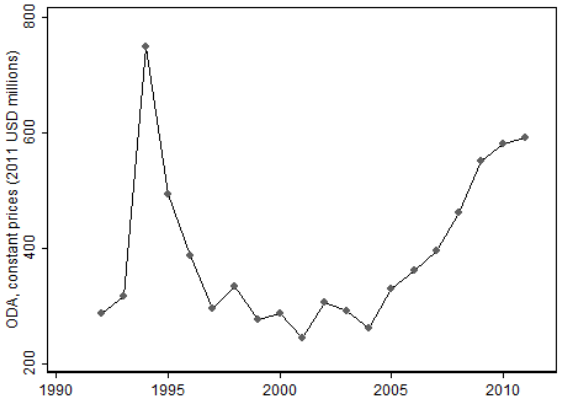
Reasons for upward mobility



Source: Small panel dataset.

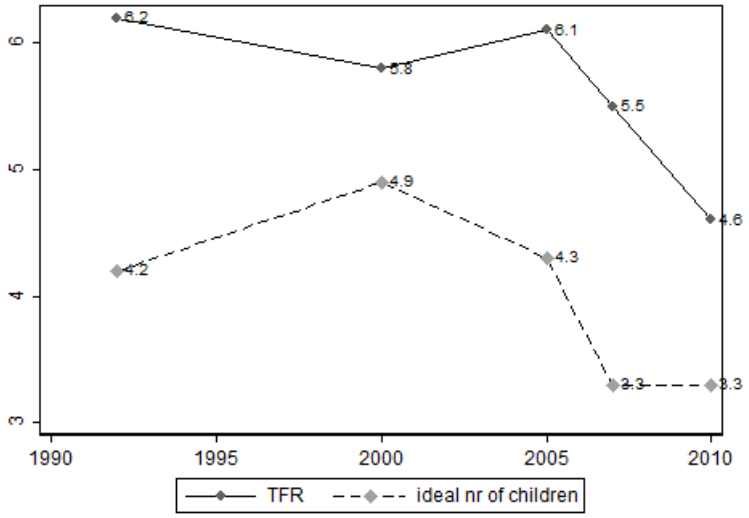
Figure 10: Health expenditures and overseas development assistance





Source: The figures on ODA are taken from www.oecd.org/dac/stats/ (accessed 3 June 2013); the figures on health expenditures are from World Bank (2013b).

Figure 11: TFR versus ideal number of children by year



Source: DHS data.

Table 1: Physical capital

DHS survey round (%)	1992	2000	2005	2007-08	2010
Housing characteristics					
Has electricity	2.3	6.2	4.8	6.0	9.7
Finished floor	11.0	13.1	13.0	14.6	16.9
Household durable goods					
Radio	32.3	35.2	45.8	58.2	62.6
Television	n.a.	2.4	2.3	3.4	5.3
Bicycle	6.4	7.6	11.0	12.2	15.2
Motorcycle	0.7	0.7	0.5	0.9	1.1
Pirvate car	0.5	0.9	0.7	0.8	0.8

Source: Author's calculations from DHS data.

Table 2: Fertility and reproductive health

DHS survey round (%)	1992	2000	2005	2007-08	2010
Total fertility rate[a]	6.2	5.8	6.1	5.5	4.6
Use of contraception[b]					
Any method	21.2	13.2	17.4	36.4	51.6
Any modern method	12.9	5.7	10.3	27.4	45.1
Unmet need for family planning	38.9	35.6	37.9	100.0	20.8
Delivery at health care facility[c]	26.3	25.7	29.7	53.7	78.3
Assistance of trained personnel	28.3	31.3	38.6	52.1	69.0
Maternal mortality rate[d]	n.a.	1071	750	n.a.	476

Notes: [a]For the three years preceding the survey and the percentage of women 15-49 currently pregnant; [b]Among married women; [c]Of live births in the last three years preceding the survey; [d]Per 100,000 live births, for the period of 0-4 years prior to the survey.

Source: Author's calculations from DHS data, except for the fertility and mortality rates which are taken from the DHS reports.

Table 3: Other health outcomes

DHS survey round	1992	2000	2005	2007-08	2010
Mortality rate					
Infant mortality	85	109	83	64	50
Under-5 mortality	151	196	152	103	76
Nutritional status					
Height-for-age (% below -2 SD)	56.8	48.3	51.1	n.a.	44.2
Weight-for-height (% below -2 SD)	5.0	8.3	4.7	n.a.	2.8
Weight-for-age (% below -2 SD)	24.3	19.5	17.5	n.a.	11.4
Health condition past two weeks (age 0-5)					
Diarrhoea (%)	22.0	17.2	14.4	13.9	13.3
Fever (%)	42.1	31.0	26.6	21.9	15.9
All vaccinations (% children 12-23 months)	86.3	76.0	75.2	80.4	90.1
Household owns mosquito net (any type, %)	n.a.	6.6	18.2	59.2	82.7
At least one household member has insurance (%)	n.a.	n.a.	n.a.	68	78

Source: Author's calculations from DHS data, except for the under-5 mortality rate, nutritional status and health insurance which are taken from the DHS reports.

Table 4: Educational outcomes

DHS survey round	1992	2000	2005	2007-08	2010
Educational level					
No education, men (%, >6 year)	29.4	24.9	19.4	n.a.	13.0
No education, women (%, >6 year)	40.4	32.6	27.7	n.a.	20.2
Mean years of education, men 15-65	3.9	4.1	4.1	n.a.	4.6
Mean years of education, women 15-65	3.0	3.3	3.4	n.a.	4.0
Net attendance ratio[a]					
Primary school, total	61.5	72.0	80.6	n.a.	87.5
Secondary school, total	5.7	4.9	4.0	n.a.	14.4
Gross attendance ratio[b]					
Primary school, total	84.6	104.5	134.2	n.a.	142.4
Secondary school, total	16.6	7.9	8.2	n.a.	26.1

Notes: [a]The NAR for primary school is the percentage of the primary school age (7-12 years) population that is attending primary school. The NAR for secondary school is the percentage of the secondary school age (13-18 years) population that is attending secondary school; [b]The GAR for primary (secondary) school is the total number of primary (secondary) school students, expressed as a percentage of the official primary (secondary) school age population. If there are significant numbers of overage and underage students at a given level of schooling, the GAR can exceed 100 per cent.

Source: Author's calculations from DHS data, except for the gross attendance ratio which is taken from the DHS reports for 2000, 2005 and 2010, and from the World Development Indicators for 1992.

Table 5: The ratio of indicators between the richest 20% and the poorest 20% of the sample population

DHS survey round		1992	2000	2005	2007-08	2010
Use of contraception[a]						
Any method (%)		1.45	3.26	2.88	1.79	1.32
Any modern method (%)		1.53	6.19	3.72	1.78	1.29
Delivery at healthcare facility (%)[b]	Ratio of indicator between top and bottom wealth quintile	2.11	3.97	3.36	1.62	1.28
Assistance of trained personnel (%)		1.95	3.08	2.44	1.65	1.40
All vaccinations (% children 12-23 months)		1.05	1.08	1.00	1.02	1.10
Household owns mosquito net (any type, %)		n.a.	26.01	7.35	1.71	1.20
Net attendance ratio[c]						
Primary school, total		1.39	1.18	1.10	n.a.	1.19
Secondary school, total		4.86	12.88	24.24	n.a.	4.74

Notes: [a]Among married women; [b]Of live births in the last three years preceding the survey. [c]The NAR for primary school is the percentage of the primary school age (7-12 years) population that is attending primary school. The NAR for secondary school is the percentage of the secondary school age (13-18 years) population that is attending secondary school.

Source: Author's calculations from DHS data.

Table 6: The ratio of indicators between the urban and rural sample population

DHS survey round		1992	2000	2005	2007-08	2010
Use of contraception[a]						
Any method (%)		1.36	2.47	2.08	1.28	1.03
Any modern method (%)		1.57	4.16	2.47	1.39	1.05
Delivery at healthcare facility (%)[b]	Ratio of indicator between urban and rural samples	2.76	3.51	2.23	1.38	1.12
Assistance of trained personnel (%)		2.61	2.74	1.82	1.42	1.23
All vaccinations (% children 12-23 months)		1.08	1.02	0.94	1.00	1.04
Household owns mosquito net (any type, %)		n.a.	10.38	2.79	1.19	1.04
Net attendance ratio[c]						
Primary school, total		1.29	0.55	1.03	n.a.	1.06
Secondary school, total		3.18	6.24	4.04	n.a.	2.03

Notes: [a]Among married women; [b]Of live births in the last three years preceding the survey; [c]The NAR for primary school is the percentage of the primary school age (7-12 years) population that is attending primary school. The NAR for secondary school is the percentage of the secondary school age (13-18 years) population that is attending secondary school.

Source: Author's calculations from DHS data.

Table 7: Summary statistics, 2002–08

	2002–08 panel, *N*=241			
	2002		2008	
	Mean	St.error	Mean	St.error
Material welfare: Income				
Annual household net income (2011 prices, RWF)	217,757	368,995	283,264	332,847
Annual household net income/ae[a] (2011 prices, RWF)	54,614	135,973	60,725	69,412
Income composition				
Farm wage	7.0%	17.5%	6.2%	17.9%
Non-farm wage	7.2%	19.1%	7.6%	22.9%
Non-farm self	9.4%	22.8%	10.1%	24.9%
Farm self	60.0%	29.4%	56.7%	29.1%
Beer	7.2%	11.6%	6.6%	13.4%
Livestock	10.5%	14.6%	12.6%	19.2%
Material welfare: Assets				
Land size (ares)[b]	88.9	99.0	53.8	95.5
TLU[c]	1.0	1.5	1.1	1.2
Cattle	0.7	1.4	0.9	1.1
Goats	0.8	1.4	0.9	1.4
Sheep	0.2	0.7	0.1	0.5
Pigs	0.2	0.5	0.2	0.5
Household composition				
Household size	4.9	2.4	5.2	2.2
Adult equivalent[d]	4.5	2.3	4.8	2.1
Dependency ratio[e]	120.7	104.8	108.5	116.9
Female-headed (%)	49.6%	50.1%	46.5%	50.0%
Household member imprisoned (%)	7.4%	26.3%	6.6%	24.9%
Inequality				
Gini of net income	0.57	0.04	0.57	0.02
Gini of net income/ae	0.56	0.06	0.55	0.02
Gini of land size	0.51	0.02	0.62	0.03
Gini of TLU	0.52	0.02	0.39	0.02

Notes: [a]ae = adult equivalent; [b]are = equivalent to 100 m^2 or 0.01 ha; [c]One TLU is 175 kg of life mass. Cattle = 1 TLU, Pig = 0.25 TLU, Sheep and Goat = 0.15 TLU; [d]The adult equivalent is based on the calorie needs of household members, depending on their age and sex. The reference is an adult, aged 20-39 years, engaging in moderate activities. We took the same values as those used in the IHLSS; [e]The dependency ratio is calculated as the ratio of dependent over active household members (*100).

Source: Small panel dataset.

Table 8: Inter-temporal quintile transition matrices

Matrix A: Household income; *N*=241

Income quintiles in 2002	Income quintiles in 2008				
	1	2	3	4	5
1	14	12	13	6	4
	28.6	*24.5*	*26.5*	*12.2*	*8.2*
2	9	14	9	10	5
	19.2	***29.8***	*19.2*	*21.3*	*10.6*
3	13	8	8	13	7
	26.5	*16.3*	***16.3***	*26.5*	*14.3*
4	8	8	9	8	15
	16.7	*16.7*	*18.8*	***16.7***	*31.3*
5	5	6	9	11	17
	10.4	*12.5*	*18.8*	*22.9*	***35.4***

Matrix B: Household income/ae

Income quintiles in 2002	Income quintiles in 2008				
	1	2	3	4	5
1	14	10	16	5	4
	28.6	*20.4*	*32.7*	*10.2*	*8.2*
2	9	15	9	9	6
	18.8	***31.3***	*18.8*	*18.8*	*12.5*
3	8	12	5	11	12
	16.7	*25.0*	***10.4***	*22.9*	*25.0*
4	12	7	6	13	10
	25.0	*14.6*	*12.5*	***27.1***	*20.8*
5	6	4	12	10	16
	12.5	*8.3*	*25.0*	*20.8*	***33.3***

Matrix C: Land ownership

Asset quintiles in 2002	Asset quintiles in 2008				
	1	2	3	4	5
1	16	12	11	6	4
	32.7	*24.5*	*22.5*	*12.2*	*8.2*
2	10	10	8	12	8
	20.8	***20.8***	*16.7*	*25.0*	*16.7*
3	10	12	10	9	8
	20.4	*24.5*	***20.4***	*18.4*	*16.3*
4	6	9	9	13	11
	12.5	*18.8*	*18.8*	***27.1***	*22.9*
5	7	6	10	8	17
	14.6	*12.5*	*20.8*	*16.7*	***35.4***

Matrix D: Livestock (TLU)

Asset quintiles in 2002	Asset quintiles in 2008				
	1	2	3	4	5
1	41	13	12	11	12
	46.1	*14.6*	*13.5*	*12.4*	*13.5*
2	8	2	8	3	2
	34.8	***8.7***	*34.8*	*13.0*	*8.7*
3	7	6	12	6	3
	20.6	*17.7*	***35.3***	*17.7*	*8.8*
4	12	4	18	15	6
	21.8	*7.3*	*32.7*	***27.3***	*10.9*
5	2	3	3	12	21
	4.9	*7.3*	*7.3*	*29.3*	***51.2***

Note: Figures in italics denote the row percentages, the other figures are the numbers of households.

Source: Small panel dataset.

Table 9: OLS regression to determine time dependence of material welfare

Dependent variable: end year material wealth	Log income 2008	Log income/ae 2008	Log land size 2008 (are)	Log livestock 2008 (TLU)
Base year material wealth				
Log income 2002	0.380***			
	(0.079)			
Log income/ae 2002		0.279***		
		(0.086)		
Log land size 2002 (are)			0.320***	
			(0.096)	
Log livestock 2002 (TLU)				0.428***
				(0.054)
Constant	7.488***	7.592***	1.939***	0.253**
	(0.925)	(0.914)	(0.498)	(0.127)
Commune dummies	Yes	Yes	Yes	Yes
Obs	241	241	241	241
R^2	0.149	0.114	0.200	0.282

Notes: ae = adult equivalent. are = 100m^2 or 0.01 ha.

Source: Small panel dataset.

Table 10: Explaining income and income mobility

Dependent variable Variables	Income 2002 (log)	Income 2008 (log)	
Land 2002 (log)	0.268***		
	(0.059)		
Labour 2002 (log)	0.838***		
	(0.116)		
Schooling 2002 (log)	0.056		
	(0.064)		
Female head 2002	-0.382***		
	(0.114)		
Land 2008 (log)		0.355***	
		(0.063)	
Labour 2008 (log)		0.628***	
		(0.145)	
Schooling 2008 (log)		0.131	
		(0.092)	
Female head 2008		-0.067	
		(0.198)	
Log income 2002			0.429***
			(0.080)
Land Δ (log)			0.197***
			(0.060)
Labour Δ (log)			0.647***
			(0.170)
Schooling Δ (log)			0.017
			(0.083)
Female head Δ			0.014
			(0.176)
Constant	9.468***	9.886***	7.063***
	(0.288)	(0.425)	(0.942)
Commune fixed effects	Yes	Yes	Yes
Observations	241	241	241
R^2	0.432	0.281	0.243

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: Small panel dataset.

Table 11: Social categories

Social category	Characteristics
Umutindi nyakujya (those in abject poverty)	Those who need to beg to survive. They have no land or livestock and lack shelter, adequate clothing and food. They fall sick often and have no access to medical care. Their children are malnourished and they cannot afford to send them to school.
Umutindi (the very poor)	The main difference between the *umutindi* and the *umutindi nyakujya* is that this group is physically capable of working on land owned by others, although they themselves have either no land or very small landholdings, and no livestock.
Umukene (the poor)	These households have some land and housing. They live on What they can eat, even if the food is not very nutritious. However,they do not have a surplus to sell in the market, their children do not always go to school and they often have no access to healthcare.
Umukene wifashije (the resourceful poor)	This group shares many of the characteristics of the *umukene* but, in addition, they have small ruminants and their children go to primary school.
Umukungu (the food-rich)	This group has larger landholdings with fertile soil and enough to eat. They have livestock, often have paid jobs, and can access healthcare.
Umukire (the money-rich)	This group has land and livestock, and often has salaried jobs. They have good housing, often own a vehicle, and have enough money to lend and to get credit from the bank. Many migrate to urban centres.

Source: GoR (2002).

Table 12: Distribution across self-reported social categories (2002 and 2008) and material welfare measures by social category (2008)

		2002			2008						
Categories		Nr	%	Cum %	Nr	%	Cum %	Income/ae 08	Land 08 (ares)	Livestock 08 (TLU)	Female head 08
Umutindi nyakujya	Those in abject poverty	7	2.9	2.9	7	2.9	2.9	28,200	17.4	0.2	0.71
Umutindi	The very poor	31	13.0	15.9	27	11.3	14.2	43,743	29.4	0.4	0.56
Umukene	The poor	102	42.7	58.6	88	36.8	51.1	45,511	42.9	0.8	0.51
Umukene wifashije	The resourceful poor	80	33.5	92.1	102	42.7	93.7	76,699	63.1	1.5	0.43
Umukungu	The food-rich	17	7.1	99.2	14	5.9	99.6	82,637	124.5	2.3	0.07
Umukire	The money-rich	2	0.8	100.0	1	0.4	100.0				

Notes: The distribution of 2002 is based on recall information asked in 2008. For the category *Umukire* no summary statistics are displayed because there only is one observation. ae = adult equivalent. are = $100m^2$ or 0.01 ha.

Source: Small panel dataset.

Table 13: Mobility matrix of self-reported social categories

Categories in 2002	Categories in 2008: *Umutindi nyakujya*	*Umutindi*	*Umukene*	*Umukene wifashije*	*Umukungu*	*Umukire*
Umutindi nyakujya	6	0	1	0	0	0
	85.7	*0.0*	*14.3*	*0.0*	*0.0*	*0.0*
Umutindi	0	19	8	4	0	0
	0.0	***61.3***	*25.8*	*12.9*	*0.0*	*0.0*
Umukene	1	4	70	27	0	0
	1.0	*3.9*	***68.6***	*26.5*	*0.0*	*0.0*
Umukene wifashije	0	4	8	66	2	0
	0.0	*5.0*	*10.0*	***82.5***	*2.5*	*0.0*
Umukungu	0	0	1	5	11	0
	0.0	*0.0*	*5.9*	*29.4*	***64.7***	*0.0*
Umukire	0	0	0	0	1	1
	0.0	*0.0*	*0.0*	*0.0*	*50.0*	***50.0***

Notes: The different categories more or less correspond to the abject poor (*Umutindi nyakujya),* the very poor (*Umutindi*), the poor (*Umukene*), the resourceful poor (*Umukene wifashije*), the food-rich (*Umukungu*), and the money-rich (*Umukire*). Figures in italics denote the row percentages, the other figures are the numbers of households.

Source: Small panel dataset.

Table 14: Happiness, and mean income, assets and income change by happiness

Have you recently been feeling reasonably happy all things considered?	Nr	%	Cum %	Income/ae 08	Land 08 (ares)	Livestock 08 (TLU)	Female head 08	Income change 02-08	Self-reported mobility: "Better"
Strongly disagree	29	11.6	11.6	77897	33.33	0.93	0.59	15146	0.21
Disagree	52	20.8	32.4	47820	40.45	0.86	0.51	26078	0.24
Agree	143	57.2	89.6	61961	62.92	1.24	0.46	69011	0.31
Strongly agree	26	10.4	100	70134	81.47	1.39	0.19	183623	0.42

Notes: ae = adult equivalent. are = 100 m^2 or 0.01 ha.

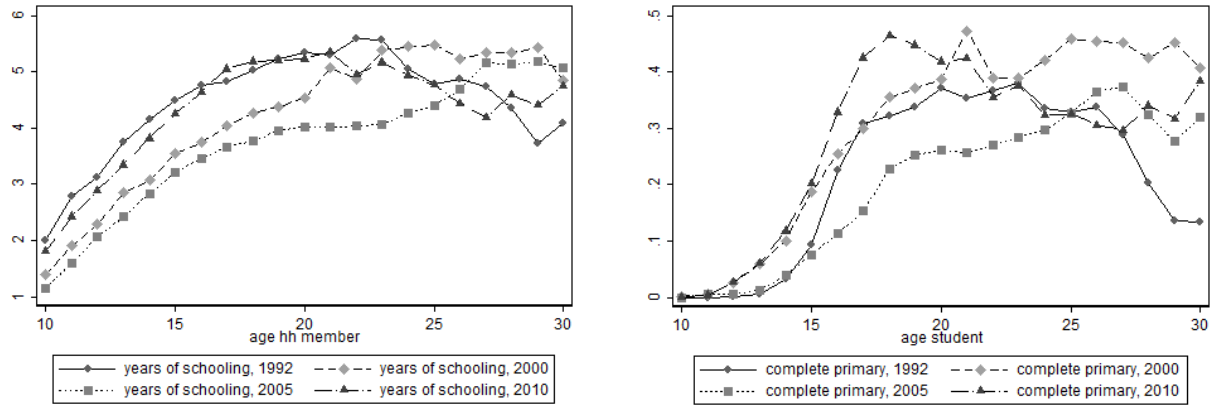
Source: Small panel dataset.

Appendix 1: The impact of conflict on schooling

Education is a stock variable. The impact of armed conflict on education may therefore cast a long shadow. For instance, although a large number of students were enrolled in primary school in the immediate post-war years (as can be seen from the NAR and GAR in Table 4), the average years of schooling remained far below pre-war levels in 2005, and only reached pre-war levels by 2010. This is shown in Appendix Figure A1, Panel (a).

The lower average years of schooling despite higher enrolment is symptomatic of the problem of slow grade progression. Panel (b) only considers the student population, depicting the share of the student population that completed primary school, showing that many students aged 15-25 in 2005 still had not completed primary school. These students, who were about 5-15 years old when the genocide started, are inflating the GAR for primary schooling.

Appendix Figure A1: (a) Years of schooling of the population and (b) primary completion of the student population



Notes: Author's calculations from DHS data.

Appendix 2: Inter-provincial differences, rural sample

Appendix Table 1

(a) Reproductive health

	1992	2000	2005	2007	2010	1992	2000	2005	2007	2010
	Use of any method					Use of modern method				
Butare	-0.072**	-0.051**	-0.010	-0.047	-0.021	-0.060**	-0.039***	-0.032	-0.059	-0.023
	(0.031)	(0.023)	(0.026)	(0.042)	(0.027)	(0.025)	(0.014)	(0.020)	(0.038)	(0.027)
Byumba	0.044	-0.025	0.015	0.115***	0.065**	0.053**	-0.013	0.006	0.098***	0.067**
	(0.032)	(0.022)	(0.025)	(0.041)	(0.031)	(0.026)	(0.014)	(0.019)	(0.038)	(0.031)
Cyangugu	-0.057*	-0.037	0.038	0.041	-0.190***	-0.039	0.003	0.049**	0.068*	-0.205***
	(0.033)	(0.022)	(0.025)	(0.040)	(0.032)	(0.027)	(0.014)	(0.019)	(0.037)	(0.032)
Gikongoro	0.039	-0.040*	-0.032	-0.158***	-0.070*	0.034	-0.020	-0.047**	-0.113***	-0.088**
	(0.032)	(0.023)	(0.025)	(0.041)	(0.040)	(0.026)	(0.014)	(0.019)	(0.037)	(0.040)
Gisenyi	-0.008	-0.072***	0.016	-0.066	-0.065**	-0.001	-0.038**	0.012	-0.056	-0.079***
	(0.028)	(0.024)	(0.025)	(0.041)	(0.028)	(0.023)	(0.015)	(0.019)	(0.037)	(0.028)
Gitarama	0.010	-0.010	0.049*	0.028	0.149***	-0.021	-0.013	0.036*	-0.027	0.124***
	(0.028)	(0.023)	(0.026)	(0.041)	(0.029)	(0.023)	(0.014)	(0.021)	(0.038)	(0.029)
Kibungo	-0.068**	-0.000	0.136***	-0.084**	0.019	-0.024	-0.005	0.012	-0.061*	0.006
	(0.030)	(0.023)	(0.025)	(0.040)	(0.027)	(0.024)	(0.014)	(0.020)	(0.037)	(0.027)
Kibuye	-0.022	-0.068***	-0.045*	-0.081**	-0.026	-0.013	-0.037***	-0.010	-0.088**	-0.051
	(0.033)	(0.022)	(0.025)	(0.041)	(0.031)	(0.027)	(0.014)	(0.020)	(0.038)	(0.031)
Ruhengeri	0.066**	-0.090***	-0.011	-0.048	0.021	0.053**	-0.046***	-0.011	-0.027	0.037
	(0.029)	(0.022)	(0.025)	(0.039)	(0.028)	(0.024)	(0.014)	(0.020)	(0.036)	(0.028)
Umutara		-0.066***	0.015	-0.020	-0.028		-0.022	-0.003	-0.011	-0.033
		(0.025)	(0.024)	(0.039)	(0.036)		(0.016)	(0.019)	(0.036)	(0.036)
Constant	0.213***	0.149***	0.135***	0.375***	0.522***	0.128***	0.060***	0.084***	0.283***	0.466***
	(0.019)	(0.016)	(0.018)	(0.028)	(0.020)	(0.016)	(0.010)	(0.014)	(0.026)	(0.020)
Obs	3,150	3,831	4,432	2,888	5,788	3,150	3,831	4,432	2,888	5,788
R^2	0.012	0.009	0.016	0.021	0.023	0.011	0.007	0.009	0.018	0.024

	Delivery at health facility					Birth assistance by trained personnel				
Butare	-0.062*	0.028	0.028	-0.008	0.008	0.014	0.089***	0.148***	0.063*	-0.014
	(0.033)	(0.030)	(0.032)	(0.046)	(0.026)	(0.027)	(0.025)	(0.028)	(0.036)	(0.022)
Byumba	-0.110***	-0.012	-0.003	0.079*	0.033	-0.012	-0.008	0.008	0.014	0.011
	(0.035)	(0.028)	(0.029)	(0.047)	(0.030)	(0.028)	(0.024)	(0.026)	(0.035)	(0.025)
Cyangugu	-0.159***	-0.139***	-0.109***	-0.269***	-0.197***	-0.118***	-0.167***	-0.229***	-0.228***	-0.235***
	(0.035)	(0.028)	(0.030)	(0.047)	(0.029)	(0.028)	(0.024)	(0.026)	(0.035)	(0.025)
Gikongoro	-0.124***	-0.059**	-0.124***	-0.131***	-0.113***	-0.104***	-0.068***	-0.111***	-0.179***	-0.175***
	(0.036)	(0.030)	(0.030)	(0.045)	(0.038)	(0.028)	(0.025)	(0.026)	(0.035)	(0.033)
Gisenyi	-0.166***	-0.029	-0.075**	0.029	-0.062**	-0.096***	-0.030	-0.027	-0.053	-0.034
	(0.031)	(0.030)	(0.029)	(0.045)	(0.026)	(0.025)	(0.026)	(0.026)	(0.035)	(0.023)
Gitarama	0.024	0.086***	0.132***	0.061	0.097***	0.085***	0.085***	0.187***	0.024	0.112***
	(0.031)	(0.029)	(0.033)	(0.046)	(0.029)	(0.025)	(0.025)	(0.029)	(0.036)	(0.025)
Kibungo	-0.209***	-0.006	-0.090***	-0.026	0.045*	-0.121***	-0.063**	-0.171***	0.029	0.046**
	(0.032)	(0.029)	(0.030)	(0.045)	(0.025)	(0.026)	(0.024)	(0.027)	(0.035)	(0.022)
Kibuye	-0.165***	-0.015	-0.013	0.044	-0.003	-0.096***	-0.071***	-0.019	-0.036	0.012
	(0.036)	(0.028)	(0.031)	(0.045)	(0.030)	(0.028)	(0.024)	(0.027)	(0.035)	(0.026)
Ruhengeri	-0.160***	-0.017	0.029	-0.006	-0.018	-0.105***	-0.041*	0.022	-0.093***	-0.025
	(0.032)	(0.028)	(0.030)	(0.045)	(0.028)	(0.025)	(0.024)	(0.026)	(0.034)	(0.023)
Umutara		0.076**	0.043	0.041	0.032		0.117***	0.119***	0.018	0.031
		(0.032)	(0.029)	(0.044)	(0.036)		(0.027)	(0.026)	(0.033)	(0.030)
Constant	0.347***	0.172***	0.253***	0.478***	0.746***	0.312***	0.230***	0.283***	0.489***	0.647***
	(0.021)	(0.020)	(0.022)	(0.031)	(0.020)	(0.017)	(0.017)	(0.019)	(0.024)	(0.017)
Obs	2,870	3,687	4,518	2,504	4,526	4,809	6,183	6,948	4,222	7,777
R^2	0.034	0.021	0.028	0.032	0.027	0.026	0.031	0.047	0.037	0.029

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Rural Kigali is base category.

Source: Author's calculations from DHS data.

(b) Preventive healthcare

	1992	2000	2005	2007	2010	2000	2005	2007	2010
	Received all vaccinations					Household owns bed net			
Butare	-0.034	0.157***	0.083	0.076	-0.060*	-0.079***	0.093***	-0.046	-0.021
	(0.054)	(0.057)	(0.059)	(0.062)	(0.033)	(0.008)	(0.019)	(0.031)	(0.015)
Byumba	-0.022	0.068	0.015	0.131**	-0.031	-0.079***	0.058***	-0.141***	-0.051***
	(0.052)	(0.057)	(0.054)	(0.062)	(0.039)	(0.009)	(0.018)	(0.030)	(0.018)
Cyangugu	-0.035	0.110*	-0.038	0.089	-0.201***	-0.060***	0.144***	-0.069**	0.093***
	(0.052)	(0.059)	(0.055)	(0.062)	(0.037)	(0.009)	(0.018)	(0.030)	(0.018)
Gikongoro	0.047	0.197***	0.124**	0.041	-0.009	-0.093***	-0.047***	-0.129***	-0.161***
	(0.057)	(0.063)	(0.054)	(0.060)	(0.048)	(0.009)	(0.018)	(0.030)	(0.022)
Gisenyi	-0.075	0.131**	-0.112**	0.157***	-0.187***	-0.096***	-0.019	-0.241***	-0.104***
	(0.048)	(0.064)	(0.054)	(0.057)	(0.035)	(0.009)	(0.018)	(0.030)	(0.016)
Gitarama	-0.017	0.215***	0.082	-0.012	-0.020	-0.078***	0.099***	-0.002	0.056***
	(0.047)	(0.060)	(0.062)	(0.059)	(0.037)	(0.008)	(0.018)	(0.031)	(0.016)
Kibungo	-0.117**	0.048	-0.103*	0.070	-0.071**	-0.054***	0.024	0.045	0.080***
	(0.049)	(0.058)	(0.057)	(0.061)	(0.033)	(0.008)	(0.018)	(0.031)	(0.015)
Kibuye	-0.091*	0.112*	0.159***	0.115*	-0.081**	-0.098***	0.054***	-0.090***	-0.112***
	(0.049)	(0.060)	(0.056)	(0.060)	(0.037)	(0.009)	(0.018)	(0.031)	(0.018)
Ruhengeri	-0.025	0.082	0.104*	0.049	-0.042	-0.095***	-0.050***	-0.107***	-0.145***
	(0.051)	(0.063)	(0.054)	(0.061)	(0.035)	(0.008)	(0.018)	(0.030)	(0.016)
Umutara		0.018	-0.029	0.028	-0.019	-0.054***	0.082***	-0.035	0.066***
		(0.064)	(0.054)	(0.057)	(0.045)	(0.009)	(0.017)	(0.030)	(0.022)
Constant	0.900***	0.658***	0.738***	0.730***	0.971***	0.099***	0.107***	0.648***	0.843***
	(0.033)	(0.039)	(0.040)	(0.040)	(0.025)	(0.006)	(0.013)	(0.021)	(0.011)
Obs	843	988	1,316	916	1,389	7,622	8,165	5,549	10,530
R^2	0.016	0.024	0.043	0.017	0.045	0.029	0.029	0.024	0.049

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Rural Kigali is base category.

Source: Author's calculations from DHS data.

(c) Education

	1992	2000	2005	2010	1992	2000	2005	2010
	NAR primary				NAR secondary			
Butare	-0.004	-0.062**	-0.063**	-0.012	0.017	0.003	0.000	-0.011
	(0.027)	(0.026)	(0.025)	(0.016)	(0.014)	(0.009)	(0.011)	(0.017)
Byumba	0.056*	-0.030	0.027	0.013	-0.021	-0.011	-0.014	-0.013
	(0.031)	(0.026)	(0.023)	(0.018)	(0.016)	(0.009)	(0.011)	(0.019)
Cyangugu	-0.016	0.082***	-0.060***	0.021	0.012	0.008	-0.022**	-0.011
	(0.030)	(0.025)	(0.023)	(0.018)	(0.016)	(0.009)	(0.010)	(0.020)
Gikongoro	0.072**	-0.028	-0.004	-0.013	0.017	0.011	-0.022**	-0.008
	(0.031)	(0.025)	(0.022)	(0.023)	(0.016)	(0.009)	(0.010)	(0.024)
Gisenyi	-0.026	0.057**	0.014	-0.021	-0.012	-0.031***	-0.023**	0.037**
	(0.027)	(0.026)	(0.022)	(0.016)	(0.015)	(0.011)	(0.010)	(0.018)
Gitarama	0.014	0.116***	0.056**	0.029*	0.004	-0.015	-0.005	0.022
	(0.026)	(0.024)	(0.024)	(0.017)	(0.014)	(0.009)	(0.010)	(0.019)
Kibungo	-0.066**	-0.097***	-0.043*	0.001	0.004	0.008	-0.015	-0.003
	(0.028)	(0.025)	(0.024)	(0.016)	(0.016)	(0.009)	(0.010)	(0.017)
Kibuye	-0.052*	0.051**	-0.063***	-0.038**	-0.028*	-0.032***	-0.018*	-0.037*
	(0.030)	(0.024)	(0.023)	(0.018)	(0.016)	(0.010)	(0.010)	(0.020)
Ruhengeri	0.029	0.066***	0.024	0.051***	-0.008	-0.027***	0.010	0.012
	(0.027)	(0.023)	(0.023)	(0.017)	(0.014)	(0.009)	(0.010)	(0.018)
Umutara		0.087***	-0.377***	0.013		-0.025**	-0.004	-0.026
		(0.027)	(0.023)	(0.021)		(0.010)	(0.010)	(0.024)
Constant	0.608***	0.677***	0.834***	0.865***	0.052***	0.036***	0.036***	0.128***
	(0.017)	(0.017)	(0.017)	(0.012)	(0.009)	(0.006)	(0.007)	(0.013)
Obs	4,993	6,857	6,612	8,383	3,643	5,697	5,545	6,681
R^2	0.006	0.020	0.080	0.005	0.004	0.009	0.005	0.004

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Rural Kigali is base category.

Source: Author's calculations from DHS data.

Appendix 3: Going further back in time

The panel dataset includes three rounds of data from surveys implemented in 1990, 2002 and 2008 in two Rwandan provinces, Gikongoro and Gitarama.

The first round of the dataset was collected in 1990 by the Division of Agricultural Statistics of Rwanda's Ministry of Agriculture and Livestock, in collaboration with Michigan State University. It was designed as a national farm survey, covering a nationwide random sample of 1,248 farm households, and collecting information on subsistence production, crop sales, livestock production, non-farm income, beer brewing, transfers, land area, household composition and schooling.

The second round was collected in 2002 as part of a study for DGOS (Belgian Development Cooperation). Because of financial constraints, this round was limited to the 256 households initially surveyed in the provinces of Gitarama and Gikongoro. The questions asked were comparable to those of the 1990 survey. Additionally, recall information was collected about war-related shocks, other adverse income shocks, and household consumption shortfalls, among others.

Owing to attrition and missing variables for some households, the 2002 survey round includes complete information for only 188 households among the 256 households that were originally surveyed in 1990. Attrition is a common caveat of panel data, but in this case, the dropout of households was especially high because of the killings and population displacement. As attrition was high, and especially so among Tutsi-headed households, it was decided to add Tutsi-headed households by oversampling them in the second round (2002), lifting their share from less than 10 per cent to 22.5 per cent (59/258) (Verpoorten and Berlage 2007).

The third round was collected in 2008 on a grant from the Rwandan government. It relied on a survey design similar to that used in the previous two rounds and set out to interview the 258 households who were interviewed in 2002 (of which 188 were also interviewed in 1990). As the country was largely stable between the second and third rounds, attrition was much lower this time. Four of the 258 households interviewed in 2002 could not be found, while 13 households could not be considered as the same because all former household members had been replaced by distant family or by neighbours.

In our panel data analysis of the period 2002–08, we consider the 241 remaining households. Among these households, 176 were also interviewed in 1990. Using a pre-war wave of the panel data allows us to assess to what extent growth is catch-up.

Appendix Table A2 gives the summary statistics for the 176 households that were included in all three rounds. The numbers show that the average net income per adult equivalent was very similar in 1990 and 2002, at approximately RWF 48,000, but then rose by about 25 per cent to 60,985 RWF in 2008, corresponding to an average annual growth of 4.0 per cent between 2002 and 2008. Both land ownership and livestock ownership decreased between 1990 and 2002. Livestock ownership recovered a bit by 2008, but the decline in landownership continued and even accelerated; from 97.0 areas in 1990 to 86.6 areas in 2002 and further down to 51.6 areas in 2008.

In terms of income composition, the contribution of non-farm employment to income increased over time from 2.0 per cent in 1990 to 6.8 per cent in 2008 for non-farm wage employment and from 6.9 per cent to 10.4 per cent for non-farm self-employment. Most of this increase took place during the first sub-period (1990–2002). The contribution of income from livestock increased from 7.2 per cent in 1990 to 12.1 per cent in 2008, while the contribution from agricultural

production declined from 69.9 per cent to 55.0 per cent. The latter trend is on par with the decline in land owned.

The proportion of female-headed households stood at 17 per cent in 1990 but increased to over 40 per cent in 2002 and remained high in 2008.

In 1990, income and land inequality were relatively low at 0.39 and 0.44 respectively, compared to 0.50 and 0.52 in 2002, and 0.55 and 0.61 in 2008. The fast increasing inequality in land is part of a trend that started in the pre-war years. It corresponds to the results of Clay and Kampayana (1997) and André and Plateau (1998), which indicate that inequality in Rwanda had been on the rise since the mid-1980s and increased rapidly in the period leading up to the genocide.

In sum, while income levels in 2002 were very similar to 1990—which is an achievement considering the wartime shocks—income levels in 2008 stood much higher than their pre-war levels. Growth in 2002–08 was therefore not mainly catch-up in this sample. Compared to 1990, income inequality however increased considerably.

Appendix Table A2: Summary statistics

	1990/2002/2008 panel, N=176					
	1990		2002		2008	
	Mean	St.Dev.	Mean	St.error	Mean	St.error
Material welfare: Income						
Annual household net income (2011 prices, RWF)	196,825	143,757	208,535	307,556	289,340	344,851
Annual household net income/ae[a] (2011 prices, RWF)	47,268	37,289	48,223	55,539	60,985	69,855
Income composition						
Farm wage	7.7%	14.4%	8.7%	19.6%	7.2%	19.4%
Non-farm wage	2.0%	7.8%	8.1%	19.8%	6.8%	20.7%
Non-farm self	6.9%	16.6%	7.9%	20.0%	10.2%	25.1%
Farm self	69.9%	21.5%	59.3%	28.9%	55.0%	28.8%
Beer	6.3%	8.6%	8.1%	12.5%	6.9%	13.4%
Livestock	7.2%	9.7%	9.3%	12.9%	12.1%	18.6%
Material welfare: Assets						
Land size (ares)[b]	97.0	87.5	86.6	99.9	51.6	88.2
TLU[c]	1.0	1.4	0.9	1.5	1.1	1.2
Cattle	0.8	1.3	0.7	1.4	0.9	1.0
Goats	0.8	1.4	0.8	1.4	0.9	1.3
Sheep	0.3	1.0	0.2	0.6	0.1	0.5
Pigs	0.3	1.1	0.3	0.5	0.2	0.6
Household composition						
Household size	5.4	2.3	5.1	2.4	5.3	2.2
Adult equivalent[d]	4.8	2.1	4.7	2.3	4.9	2.1
Dependency ratio[e]	108.1	88.4	121.1	101.5	114.2	119.0
Female-headed (%)	17.0%	37.7%	41.5%	49.4%	40.3%	49.2%
Household member imprisoned (%)			7.4%	0.262	6.3%	0.243
Inequality						

Gini of net income	0.36	0.02	0.52	0.04	0.58	0.02
Gini of net income/ae	0.39	0.02	0.50	0.03	0.55	0.02
Gini of land size	0.44	0.02	0.52	0.03	0.61	0.03
Gini of TLU	0.48	0.03	0.53	0.03	0.39	0.02

Notes: [a]ae = adult equivalent; [b]are = 100 m^2 or 0.01 ha; [c]One TLU is 175 kg of life mass. Cattle = 1 TLU, Pig = 0.25 TLU, Sheep and Goat = 0.15 TLU; [d]The adult equivalent is based on the calorie needs of household members, depending on their age and sex. The reference is an adult, aged 20-39 years, engaging in moderate activities; [e]The dependency ratio is calculated as the ratio of dependent over active household members (*100).

Source: Author's compilation.

Appendix 4: Calculating income, land ownership and livestock ownership

Expenditures are the preferred measure of material welfare but, because of lack of data, we use income as a measure of household welfare. The use of income rather than expenditures may overstate the extent of economic mobility, especially in a predominantly agricultural setting, in which income varies greatly from year to year and households try to smooth consumption across years. In addition, measuring income is prone to errors, for example because of the difficulty of accounting correctly for the value of subsistence production. Given these drawbacks, we also look at asset ownership. In general, physical assets are measured with less error and are indicators of the long-run economic status of households.

To measure income, we use information on five income sources: subsistence agriculture, crop sales, beer brewing, livestock production and off-farm earnings.[29] We calculated gross income by taking the sum over the monetary values of these different income sources.[30] To obtain net income, we subtracted the cost of hiring in casual labour and of the inputs needed for beer brewing. We did not have satisfactory data on other agricultural inputs. However, the net income measure is likely to be a good approximation since farming in Rwanda is still overwhelmingly traditional, relying almost exclusively on manure for fertilizing the soil and on small hand implements (hoes and machetes) for most tasks.

To calculate monetary values of subsistence agriculture and livestock production, we used prices at the provincial level, except for beer and crop sales, for which we could use the prices reported by the household. The general price level rose by a factor of 3 between 1990 and 2002 (GoR

[29] Ideally, we should also include income from transfers. However, this information is only available for the 1990 survey. Leaving out transfers may result in a biased income measure. Such a bias is likely to be small since transfers are the least important income source. In the 1990 survey, transfers made up only 3 per cent of total income.

[30] It is not clear how best to include livestock production in income. The return on livestock may be in the form of manure, meat, milk, eggs and offspring. Besides, households may sell livestock. In Rwanda, livestock is kept largely for its manure. The use of manure increases land productivity, and consequently this livestock return is captured by the income from subsistence agriculture and crop sales. Livestock is hardly ever kept for meat consumption, because most rural Rwandans are too poor to consume sizeable amounts of meat (Kangasniemi 1998). However, selling eggs or milk contributes to cash income. Therefore, we included the revenue from eggs and milk sales in livestock income. Including the receipts from livestock sales in revenue is problematic because livestock sales are rare and irregular. The estimated income would be highly dependent on whether households happened to sell livestock during a period. An alternative approach is to assume that the income from livestock is proportional to the value of livestock holdings (Kangesniemi 1998). We applied this method. The proportionality factor we use is the calculated average probability of selling cattle.

2005),[31] and by a factor of 1.8 between 2002 and 2008 (IMF World Economic Outlook).[32] Therefore, to obtain income in prices of 2008, we multiplied the incomes of 1990 and 2002 by 5.4 and 1.8, respectively.

The two most important assets for Rwandan rural households are livestock (cattle, goats, sheep and pigs) and land. We consider both the total land area cultivated and owned. The information on the different types of livestock is pooled into an index, based on weights equal to the TLU.[33]

[31] McKay and Loveridge (2005) report price levels of 106.7 in 1990 and 348.4 in 2000 compared to the base year 1989 (price index in 1989 = 100). Information on the consumer price index for the period 1999–2005, published by the Government of Rwanda on their website, indicates that, after a slight increase in 2001, the price level in 2002 was again at its 2000 level. Inflation for the period 1990–2002 would therefore be more or less 328 per cent. Since a considerable part of this increase is due to increased prices for housing, water, electricity, gas and other mostly urban consumption goods, this price index is likely to overestimate inflation in rural areas. Therefore, although somewhat arbitrary, we adjust it downwards to 300 per cent for our sample.

[32] See, http://knoema.com/IMFWEO2013Apr (accessed 4 June 2013).

[33] One TLU is 175 kg of life mass. Cattle = 1 TLU, Pig = 0.25 TLU, Sheep and Goat = 0.15 TLU.