

POVERTY DYNAMICS, VIOLENT CONFLICT, AND CONVERGENCE IN RWANDA

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This paper analyzes the poverty impact of the violent events that affected Rwanda in the 1990s. The main objective of the paper is to identify systematically potential mechanisms linking violent conflict with changes in poverty across provinces and households in Rwanda before and after a decade of violence. In accordance with emerging literature on the long-term economic effects of violent conflict, we find empirical evidence for economic convergence between richer and poorer Rwandan provinces and households following the conflict shocks. Using a small but unique panel of households surveyed before and after the conflict period, we find that households whose house was destroyed or who lost land ran a higher risk of falling into poverty. We do not find much evidence for an economic effect of violent deaths at the household level due to substitution effects of labor within the household. Non-violent deaths however seem to increase income per adult equivalent for the survivors. Results are shown to be robust to sample selection and IV models.

JEL Codes: I32, O12, O55

Keywords: conflict, convergence, growth, poverty dynamics, Rwanda

1. INTRODUCTION

One and a half billion people in the world are affected by conflict and violence (World Bank, 2011). Violence kills, injures and displaces people, leads to economic insecurity, hunger and deprivation, and destroys infrastructure, social relations and institutions, leading to extreme forms of poverty and destitution. Regardless of these facts, there is remarkably little empirical evidence on the direct impact of violent conflict on poverty, or on the mechanisms governing the relationship between violence and poverty. The main objective of this paper is to systematically

Note: The authors would like to thank Michigan State University for making the DSA data available, the Department of Statistics in Kigali for making the EICV data available, and the Flemish Interuniversity Council (VLIR) for a grant that enabled field work in Rwanda. We thank Robert Bates, Arjun Bedi, Macartan Humphreys, Mansoob Murshed, Michael Spagat, participants in the first annual workshop of the Households in Conflict Network in Berlin, and in seminars in Edinburgh, The Hague, Brussels, IDS, Oxford, Columbia, and Yale, one anonymous referee, and the journal's editor for very useful comments and discussions. All errors remain the responsibility of the authors.

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Review of Income and Wealth © 2012 International Association for Research in Income and Wealth
Published by Blackwell Publishing, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main St,
Malden, MA, 02148, USA.

identify potential channels of transmission between violent conflict and dynamic poverty outcomes amongst population groups affected by the violence in Rwanda during the 1990s. The analysis starts by examining the economic impact of conflict at the provincial level. Subsequently, we link this impact to changes in poverty dynamics at the household level, making use of a small but unique household panel data, which followed the same Rwandan households before and after the 1994 genocide in two provinces, Gitarama and Gikongoro (situated in central and south Rwanda). This is one of the very few panels in the world that have traced households across violent events.

The major contributions of this paper are twofold. First, the paper contributes significantly to recent research on the relationship between poverty and conflict. Violent conflict has been identified as one of the main causes of poverty in many regions of the world. Although there is a large body of evidence on the destructive effects of war,¹ we are still far from understanding how these effects may or may not persist across time. A recent series of research papers have argued that the negative economic effects of war at the macro-level do not persist into the long term. The main intuition underlying this result lies in neoclassical growth theory: the temporary destruction of capital caused by violence can be overcome in the long term by higher investments in affected areas, effectively bringing the overall economy to its steady growth path.² In contrast, other studies have shown that education, labor, and health impacts of war at the individual and household levels can be observed decades after the conflict.³ Although economic effects may average out at the macro level, violent conflict may contribute to the emergence of poverty traps amongst certain population groups affected by killings, injury, looting, robbery, abductions, displacement, and overall social and physical destruction. However, no study has yet analyzed the direct impact of violence on long-term poverty outcomes, or on movements in and out of poverty of individuals and households that experienced a period of extreme violence.

We find evidence for economic convergence in Rwanda. Our results suggest that economic convergence in the post-conflict period in Rwanda was caused by a disproportional destruction in provinces that were economically better-off before 1990, and the targeting of households that had a house and were land-rich before the conflict events. We thus define convergence as regression toward mean income, whereby provinces and households who were initially better-off see their income decrease and those who were initially worse-off see their income increase over time. Our results are also consistent with the well-known result from income change regressions whereby regression toward the mean signals the presence of a strong transitory component in income.

The second contribution of the paper is to the empirical literature on poverty dynamics. The analysis of poverty dynamics has figured prominently in recent economics research (e.g., Bane and Ellwood, 1986; Appleton, 2002; Woolard and Klasen, 2005). The identification of the socio-economic characteristics of individuals and households that move in and out of poverty is critical to understanding

¹See reviews in Blattman and Miguel (2010) and Justino (2012).

²See discussion in Bellows and Miguel (2006) and Blattman and Miguel (2010).

³See Alderman *et al.* (2006), Akbulut-Yuksel (2009), Ichino and Winter-Ebmer (2004), and Shemyakina (2011).

how households adapt to shocks in order to design effective poverty-alleviating and economic security policies. Shocks such as price changes, sudden climatic changes, loss of work, or illness are the subject of an extensive literature in development economics.⁴ The poverty impact of political shocks, ranging from violent protests and riots to coups, revolutions, civil wars, genocide, and international wars, is less-well understood. There are several direct and indirect ways through which violent events will affect poverty dynamic outcomes amongst individuals and households affected by violence (Justino, 2009, 2012). Direct effects include changes in household composition due to killings, injuries, and recruitment of fighters, changes in the household economic status due to the destruction of assets and livelihoods, and effects caused by forced displacement and migration. Indirect effects can take place at the local (community) level or at the national level. Local indirect effects include changes in households' access to and relationship with local exchange, employment, credit and insurance markets, social relations and networks, and political institutions. National-level indirect channels are related to changes in economic growth and in distributional processes that impact on household welfare.

These effects are likely to push the worse-affected households into extreme forms of poverty and destitution, even if some of these households were not poor at the start of the conflict. The severity of these effects on poverty outcomes and on the persistence of poverty across time is dependent on two key factors: the initial economic position of the household and its level of exposure to violence (Justino 2009). Initial household characteristics—for instance, its economic position, composition, ethnicity, religion, and location—are important determinants of how households adapt to violent conflict. Keeping all other characteristics fixed, initial asset endowments will determine the capacity of households to draw on savings and accumulated assets, adapt to losses in productive assets, or access new forms of livelihood. Households in possession of land holdings, livestock, and savings may be able to use these to secure their access to food and credit and replace lost assets. Poorer, more vulnerable households may be less able to respond to the effects of violence.

But households that are poorer at the start of the conflict do not necessarily have to be the worst affected by the direct and indirect impacts of violence since wealthier households may have particular features that may attract violence. These features may have to do with identifiable forms of group membership (for instance, belonging to an ethnic or religious group), geographic location (such as living in areas desired by armed groups), or economic characteristics (for instance, property or other assets coveted by armed groups) (Justino, 2009). In those circumstances, wealthier households may lose their initial economic advantage when their property is looted or destroyed. Poorer households, in turn, may gain from economic, social, or political connections with armed groups. The net outcomes of violent conflict in terms of poverty dynamics are an empirical question that has largely remained unanswered in the literature.

⁴On the impact of trade shocks on household poverty dynamics, see McCulloch *et al.* (2001) and Justino *et al.* (2008). On the impact of weather shocks see, for instance, Paxson (1992). Gertler and Gruber (2002) provide empirical evidence on the impact of illness shocks on households' livelihoods.

The paper is structured as follows. Section 2 outlines briefly the violent events experienced in Rwanda during the 1990s. Section 3 discusses the impact of those events on economic performance and poverty outcomes in provinces and households across the whole of Rwanda using two cross-sectional datasets. Sections 4 and 5 analyze the impact of violent conflict on poverty dynamics using a panel dataset of households interviewed before and after the outbreak of violence in the 1990s. Section 4 discusses the dataset and key descriptive statistics, while Section 5 analyzes the results for both poverty transition functions and reduced-form income models. Section 6 summarizes the main results and concludes the paper.

2. A BRIEF HISTORY OF CONFLICT IN RWANDA

In 1994, Rwanda was the stage for one of the most deplorable events in modern history. Between April and July 1994, at least 500,000 Tutsi, or about 75 percent of the Tutsi population, together with many Hutu who were known to be opponents of the Habyarimana regime, were killed by the Rwandan military (FAR), local police, the national guard, and the *Interahamwe* militia (Des Forges, 1999).⁵ This episode of extreme violence shocked the world. However, several events in Rwanda's history contributed to its outbreak.

The ethnic composition of Rwanda's population has been a major issue in the country's politics since colonial times. The Belgian colonizer favored the Tutsi ruling class because they were considered racially superior to the peasant Hutu. In the 1950s, following the spread of anti-colonial and independence movements, the ruling Tutsi began to claim the independence of Rwanda. At that time, a Hutu counter-elite was given the chance to study at catholic seminars. Making use of Belgian military and political aid, this new elite of Hutu leaders succeeded in overturning the ruling Tutsi regime and replace it by the leadership of the *Parme-hutu*, the party for the emancipation of the Hutu. G. Kayibanda, a seminarian, became the first president. The ethnic divide remained and was strengthened. The new rulers, at the national as well as at the local level, established their power by removing all Tutsi from positions of power. Ordinary Tutsi who were not associated with political power became targets of reprisal and murder.⁶

In 1973, a group of army officers close to Juvénal Habyarimana took power via a coup d'état. They were frustrated by the monopolization of power by the group led by Kayibanda, whose power base was the central prefecture of Gitarama. Habyarimana's support group, originated from northern Rwanda, saw all benefits of power go to the people from Gitarama. After the coup d'état, Habyarimana became the new president. He established the MRND (Mouvement Révolutionnaire National pour le Développement), the single party to which every Rwandan was supposed to belong to by birth. Aided by the high coffee prices in the late 1970s, the country's main export crop, and generous donor support, Habyarimana was liked, or at least not contested, by a large part of the popula-

⁵Other scholars, such as Prunier (1995), put the death toll between 500,000 and 800,000.

⁶For detailed treatment of the history of Rwanda, we refer to Prunier (1995), Newbury (1988), and De Lame (1996), among others.

tion. Ethnicity was made a central political issue, and several instruments were put in place to control the population (Verwimp, 2003).

A key characteristic of the Habyarimana regime was its doctrine on the relation between population and land. The president had never been an advocate of family planning policies, fully supported by the Catholic Church. The fertility rate of Rwandan women was among the highest in the world and the average size of cultivated land per family shrank rapidly from 1.2 ha in 1984 to 0.9 ha in 1990 (National Agricultural Surveys, 1984 and 1989–91). Many families had not enough land to earn a living and feed their families. In 1986, when discussing the fate of the 1959–62 refugees, the Central Committee of the MRND said that their return was not possible because the country was overpopulated. Tutsi refugees in the Diaspora, and especially in Uganda, started to mobilize militarily against Habyarimana. In October 1990, a group of rebels consisting of Tutsi refugees who had left Rwanda during the 1959–62 revolution and their offspring, attacked Rwanda from Uganda. These attacks were followed by a civil war between the Rwandan armed forces (Forces Armées Rwandaises, FAR) and the rebel army (Rwandan Patriotic Front, RPF). On April 6, 1994, Habyarimana's plane was shot down. After that, genocide took place. This was followed by a period of mass migration into neighboring Zaire (now the Democratic Republic of Congo), Tanzania, and Burundi. In November 1996, the Rwandan patriotic army (RPA, successor of the RPF) organized a reprisal to the 1994 events by attacking Zairian camps, killing thousands of armed ex-FAR and unarmed civilians. During the 1997–2000 period, most remaining refugees either died or were repatriated. These conflicts had considerable impact on a population already living well below international living standards.

3. POVERTY AND CONFLICT IN RWANDA, 1990–2000

The war and genocide had an unequal impact on Rwanda's provinces, which can be attributed to four major events that occurred during this period: the civil war in 1990–94, the genocide in 1994, the mass migration of 1994–98, and the (counter) insurgency in 1997–99. The war and subsequent events affected considerably the economic position of Rwanda's provinces and households.

Table 1 provides estimates for the economic performance of Rwanda provinces between 1990 and 2000. We make use of two cross-sectional datasets. The first is the 1989–91 DSA (Département de Statistiques Agricole) survey, implemented by the Ministry of Agriculture. The DSA data were collected from 1,248 rural households in all prefectures (later called provinces). Since data collection was disrupted by the war in northern Rwanda, the most complete data are for the 1990 crop year. The second dataset is a nationwide household survey, the EICV (Enquête Intégrale des Conditions de Vie), conducted by the Department of Statistics of the Ministry of Finance in the period July 2000–July 2001 in rural Rwanda, and October 1999–July 2000 in urban Rwanda. The EICV is a nationwide, multiple purpose household survey of 6,240 rural and urban households.

Before 1990, the southern provinces were much poorer compared to the northern and eastern provinces. The average income per adult equivalent in Kibungo, the richest province, was three times that in Gikongoro, the poorest

TABLE 1
CHANGES IN INCOME IN RWANDA'S PROVINCES, 1990–2000

Province	Income 1990	Rank	Income 2000	Rank	Real Income	Growth Rate	Rank
	RwF per ae (1)	1990 (2)	RwF per ae (3)	2000 (4)	2000 (5)	of Real Income* (6)	
Kibungo	22,494	1	56,822	1	17,430	-0.26	10
Rural Kigali	15,151	2	38,930	8	11,942	-0.24	9
Ruhengeri	14,160	3	54,260	3	16,648	0.16	7
Byumba	12,949	4	52,536	4	16,115	0.22	6
Gisenyi	12,937	5	56,603	2	17,363	0.29	4
Gitarama	11,954	6	50,875	5	15,606	0.27	5
Butare	9,624	7	35,743	10	10,964	0.13	8
Cyangugu	9,217	8	41,803	6	12,823	0.33	3
Kibuye	8,857	9	41,691	7	12,788	0.37	2
Gikongoro	7,804	10	38,931	8	11,942	0.43	1
All Rural	12,600		48,000		14,724	0.16	

Notes: *The consumption price index in 2000 is 326 compared to 100 in 1990.

Source: Agricultural Household Survey (DSA, 1989–90), EICV (1999–2001).

province. In 2000, Kibungo was still the richest province, but the average household was only 1.5 times richer than a household in Butare, now the poorest province. Interestingly, Rwanda's high performing provinces prior to the genocide (Kibungo in the east and Ruhengeri in the north) have experienced low economic growth during the conflict decade. Provinces that were poor, prior to the war and genocide, are still poorer than the Rwandan average, but they have experienced much stronger economic growth than the other provinces.⁷ The provinces that performed better before the genocide (Kibungo, Rural Kigali, Ruhengeri, Buymba) had lower rates of economic performance in the post-conflict period. These provinces were the scene of major battles between enemy armies, resulting in serious damage to the capital stock, including land, housing, and cattle. Rural Kigali and Kibungo were also the scene of mass resettlement of former refugees and Ugandan-based exiles, putting strain on land resources. Both provinces experienced horrific massacres and killings during the genocide given their sizeable Tutsi population (though lower than the southern provinces). Many Hutu civilians were also killed in Kibungo and Rural Kigali.

The opposite story can be told for the poor provinces in the south and in the west, which recovered quickly in economic terms. These provinces had the largest percentage of Tutsi in Rwanda, resulting in unprecedented loss of population,⁸ but were not the scene of intense battles between the RPF and the FAR in 1994. Thus, the capital stock was not damaged to the degree it was damaged in the north and the east. There was also no mass resettlement of former refugees from Uganda in these provinces. As a result the labor/land and labor/capital ratios remained more or less unaffected after the conflict. The levels of convergence observed across provinces in Rwanda are therefore due to the higher level of destruction experi-

⁷For a detailed description of our analysis of the impact of the four violent events on the economy, we refer to a previous working paper (Justino and Verwimp, 2006).

⁸Population loss in these provinces in 1994 is estimated at around 10–15 percent of the population (or 75 percent of the Tutsi population).

enced by provinces that had higher incomes and higher economic growth rates before 1990, rather than due to recovery in capital investment in affected areas. This effect is likely to have affected profoundly poverty patterns and economic structures of Rwandan households.

Table 2 shows household-level information on poverty headcounts calculated from the 1989–90 DSA survey and compares those with levels of poverty almost ten years later using similar information collected in the EICV survey.⁹ The results show that the overall rural sample poverty increased by 2.3 percent between the two periods.¹⁰ The small increase of the headcount over time is not a country-wide phenomenon and is marked by large differences across provinces. Poverty decreased substantially in Gikongoro, Cyangugu, and Kibuye. It increased substantially in Rural Kigali, Kibungo and Byumba. The headcount index remained the same for households with a male head, but increased for female-headed households and households with older household heads. Household poverty increased across the education spectrum, with the most educated having the highest headcount indices. This is due to the fact that the genocide in 1994 had a very large disproportional impact on the educated population (de Walque and Verwimp, 2010). The indices for extreme poverty show a similar trend.

In the next section, we make use of a panel dataset to better understand these patterns of mobility in Rwanda and their causes by analyzing income mobility for the same sample of households before and after the violent events of the 1990s. The advantage of panel datasets is that panel data allows us to control for unobservable characteristics at the household-level which cross-sectional surveys fail to account for.

4. EVIDENCE FROM A HOUSEHOLD PANEL DATASET, 1990–2002

In the first months of 2002, one of the authors collected household demographic, economic and agricultural data from a subset of households in two provinces in Rwanda interviewed in the 1989–91 DSA survey. This unique household dataset—the Post-Conflict Survey on the Rural Household Economy—spans the period of the war and genocide.¹¹ A total of 258 households were interviewed in 16 clusters in Gikongoro and Gitarama in 2002, covering all the clusters in these two provinces that were included in the 1989–91 DSA survey.

Gikongoro is a poor province in the south of Rwanda, heavily affected by the genocide due to its high numbers of Tutsi population before 1990. Gitarama is located in central Rwanda. These provinces are very interesting to analyze due to their exposure to the war and genocide during the 1990s. Gikongoro was very affected by the genocide in 1994, losing most of its Tutsi population. However, Gikongoro was occupied by the French army under Operation Turquoise from

⁹Since the 1990 survey did not collect data on non-food consumption, we have restricted our comparison to income poverty and extreme income poverty. In order to compare the two cross-sections, we have constructed comparable welfare variables in the two years. For details of this calculation, see Justino and Verwimp (2006).

¹⁰Only the EICV has data on urban poverty, making a comparison of urban poverty over time not possible. Only 10 percent of the population lived in urban areas in Rwanda in 1990.

¹¹For details on data collection and fieldwork, see Berlage *et al.* (2003).

TABLE 2
HOUSEHOLD POVERTY IN RURAL RWANDA, 1990–2000

	Real Mean Income 1990 (1)	Real Mean Income 2002 (2)	% Δ 90–02 (3)	Headcount Index 1990 (4)	Headcount Index 2002 (5)	% Δ 90–02 (6)	Headcount Index 1990 (food poverty) (7)	Headcount Index 2002 (food poverty) (8)	% Δ 90–02 (9)
All rural	12,600	14,724	16.9	69.7	72.0	3.3	52.4	55.0	5.0
Province									
Butare	9624	10,964	13.9	80.5	80.1	-0.5	65.2	65.8	0.9
Buyamba	12,949	16,115	24.4	64.3	70.1	9.0	49.7	53.3	7.2
Cyangugu	9217	12,823	39.1	88.2	75.3	-14.6	77.1	61.2	-20.6
Gikongoro	7804	11,942	53.0	85.5	77.5	-9.4	73.9	61.5	-16.8
Gisenyi	12,937	17,363	34.2	67.9	71.8	5.7	50.0	52.0	4.0
Gitarama	11,954	15,606	30.6	66.2	64.9	-2.0	47.0	48.7	3.6
Kibungo	22,494	17,430	-22.5	35.4	59.3	67.5	15.1	40.0	164.9
Kibuye	8857	12,788	44.4	93.4	74.6	-20.1	74.8	59.1	-21.0
Rural Kigali	15,151	11,942	-21.2	55.8	77.5	38.9	34.4	62.1	80.5
Ruhengeri	14,160	16,648	17.6	69.8	74.0	6.0	50.6	53.1	4.9
Umutara	—	—	—	—	62.7	—	—	45.0	—
Gender									
Male	12,746	16,390	28.6	69.0	69.1	0.1	50.9	51.9	2.0
Female	10,934	11,260	3.0	73.2	77.8	6.3	58.7	61.0	3.9
Age of the head									
20–40	12,700	17,188	35.3	69.1	68.4	1.0	50.1	50.5	0.8
+40	12,510	12,784	0.02	70.5	74.7	5.9	54.6	58.4	6.9
Education									
None	10,516	11,532	9.7	75.0	78.0	4.0	59.2	61.8	4.4
Primary	13,320	16,116	21.0	66.3	70.1	5.7	46.6	52.1	11.8
>Primary	41,640	26,397	-36.6	17.1	42.3	147.4	8.0	27.7	246.3
Occupation									
Farming	11,654	13,170	13.0	71.5	74.1	3.6	53.3	56.3	5.6
Non-farming	21,440	25,995	21.2	52.0	53.8	3.4	43.9	40.7	-7.2

Notes: The poverty line is defined at 49,575 RwF per adult equivalent per year in 2000 and 13,300 RwF per adult equivalent in 1990. The extreme or food poverty line is defined as 35,000 RwF per adult equivalent in 2000 and 9,400 RwF in 1990. The samples are population weighted: N (1990) is 1248, N (2000) is 5218.
Source: Agricultural Household Survey (DSA, 1990), EICV (1999–2001).

mid-June to September 1994, which protected the province against further army and rebel attacks. Gitarama was the central prefecture during the Kayibanda regime and was heavily attacked during the war in the 1990s (see Section 2). The unfolding of the genocide in Gitarama was different from other provinces. More Tutsi were saved in Gitarama compared to other provinces. For historical reasons, intermarriage was more common in Gitarama than in other provinces. In addition, resistance of Tutsi and Hutu was also strong in several locations in the province (Des Forges, 1999).

The data for both provinces do not cover the new immigrants after 1994, only households that were already residing in Rwanda in 1990. We defined a household to be part of the panel if the head of the household in 2002 was a member of the household in the household sample interviewed in 1990. This was the case for 186 of the 258 households interviewed in 2002.¹² In eight cases, data on income sources or other important variables were missing in either 2002 or 1990. This gave us a final panel of 178 households, or 73 percent of the original 1990 sample. Although this is a smaller dataset compared to other panel surveys, it is the only dataset that spans the period before and after the war and genocide in Rwanda, thus constituting a unique panel. The panel data sample is not representative for the whole of Rwanda, but contains invaluable information on Rwandan households during a key episode in its history.

In order to analyze how poverty dynamics changed in Gikongoro and Gitarama between 1990 and 2002, we have calculated per adult equivalent incomes for all households in the sample. This variable is comparable between the two rounds of the survey. In both rounds, household income is defined as the sum of production for own consumption, crop sales, sales of home manufactured beverages (banana and sorghum beer), wages from off-farm work, and sales of livestock products.¹³

Table 3 provides some descriptive statistics on the evolution of poverty headcounts in the two provinces in 1990 and 2002. The table shows that the number of households below the poverty line in the two provinces included in the sample increased by 2.2 percent, from 73.1 percent in 1990 to 75.3 percent in 2002. This is in line with the results reported in Table 2.¹⁴ We show in Justino and Verwimp (2006) that the increase in poverty in the two provinces between these two years is robust to the choice of poverty line. These estimates hide considerable variations across the sample. Increases in the number of poor (and extremely poor) house-

¹²In addition to the panel of 186 traced households, we included a limited number of new households in order to obtain a sample of 16 households per cluster. We interviewed two more households than expected. The newly added households are not included in this analysis.

¹³There are differences between the income variable used in the cross-sections and in the panel data analysis. In particular, the second round of the panel dataset only collected data for one season—October 2001 to March 2002—and does not have data on transfers received from others. In this paper, we compare data for the same season in both years, thus removing seasonality biases from the data.

¹⁴Changes in income and poverty outcomes in Gikongoro obtained in the panel dataset are similar, if somehow stronger, to those obtained in Table 2. We obtained higher results for poverty headcounts in Gitarama in the panel dataset. This is because the panel dataset includes only households that lived in the same location before the genocide.

TABLE 3
POVERTY WITHIN POPULATION SUBGROUPS IN PANEL DATASET (N = 178)

	Income 1990 (1)	Income 2002 (2)	% Δ 90-02 (3)	Poverty 1990 (4)	Poverty 2002 (5)	% Δ 90-02 (6)	Extreme Poverty 1990 (7)	Extreme Poverty 2002 (8)	% Δ 90-02 (9)
Entire sample									
Gikongoro	3,223	8,709	170.2	73.1	75.3	3.0	57.9	66.9	15.5
Gitarama	6,010	5,435	-9.6	62.4	80.3	28.7	83.3	56.7	-31.9
Sex of head									
Male	5,308	7,431	40.0	70.5	74.5	5.7	55.7	66.4	19.2
Female	3,866	4,987	29.0	86.2	79.3	-8.0	69.0	69.0	0.0
Ethnicity									
Hutu	5,156	6,475	25.6	73.1	77.5	6.0	56.2	68.7	22.2
Tutsi	4,929	7,059	43.2	66.7	60.0	-10.0	66.7	53.3	-20.1
Age of head									
20-30	6,760	7,007	3.7	47.4	89.5	88.8	42.1	73.7	75.1
30-40	5,532	7,830	41.5	71.9	82.5	14.7	54.4	75.4	38.6
40-50	3,616	4,428	22.5	83.3	83.3	0.0	73.3	70.0	-4.5
50-60	4,569	6,399	40.1	79.4	70.6	-11.1	58.8	64.7	10.0
60+	5,142	8,023	56.0	73.7	55.3	-25.0	57.9	50.0	-13.6
No. of adult eq.									
0-3	7,320	9,916	35.5	48.5	69.7	43.7	30.3	57.6	90.1
3-6	5,024	5,666	12.8	73.1	75.3	3.0	60.2	67.8	12.6
+6	3,734	5,501	47.3	88.5	78.9	-10.8	71.2	71.2	0.0
Education of head									
No schooling	4,095	5,290	29.2	80.8	75.8	-6.2	66.7	65.7	-1.5
Primary	5,952	6,946	16.7	65.2	76.4	17.1	47.2	69.4	47.0
>Primary	9,859	15,754	59.8	42.9	57.1	33.1	42.9	57.1	33.1
Head occupation									
Farming	5,570	3,438	-38.3	72.7	75.8	4.3	56.5	67.1	18.8
Non-farming	5,020	5,170	3.0	76.5	70.6	-7.7	70.6	64.7	-8.4
Land size (in hect.)									
0-0.33	3,845	6,028	56.8	88.2	94.1	6.7	76.5	88.2	15.3
0.33-0.66	4,513	5,584	23.7	73.5	75.5	2.7	61.2	59.2	-3.3
0.66-1	5,646	4,345	-23.0	67.5	62.5	-7.4	42.5	57.5	35.3
+1	5,914	9,298	57.2	67.3	72.3	7.4	54.6	67.3	23.3

Source: Rwanda panel household survey 1990-2002.

holds in 2002 were particularly noticeable amongst smaller Hutu households, households headed by younger males, more educated households, and households with larger plots of land.

In Tables 4 and 5, we make use of the panel dimension of the dataset and present descriptive statistics on household movements in and out of poverty between the two rounds of the survey. Table 4 illustrates changes in household poverty dynamics across several household characteristics, while Table 5 shows estimates for changes in poverty dynamics across different conflict-related variables observable at the household level: (i) ethnic characteristics of the household; (ii) number of male and female adults that died in the 1990–96 period and in the 1997–2002 period; (iii) whether or not a household had its house destroyed in those two periods; (iv) the amount of land lost in the two periods;¹⁵ and (v) whether or not the household had any member in prison during the survey period.

Table 4 shows that 55.1 percent of all households in the panel remained poor in both years, while 18 percent moved out of poverty and 20.2 percent became poor in 2002. Only 6.7 percent of all households remained non-poor in both 1990 and 2002. Falls into poverty and extreme poverty were most notably among households headed by a young more educated male with incomplete primary school, employed in farming activities, and owing a larger plot of land. The results indicate once more the disproportionate effect of the violence on educated and land-rich households, as observed before.

The conflict-related variables have also affected different households in very different ways (Table 5). Movements both into and out of poverty were more frequent for Tutsi heads of households, and households that had lost an adult male in the 1990–96 period. This is possibly due to the close correlation between male deaths and Tutsi identity in that period. The results further show that more households that experienced the deaths of adult males and females in the 1997–2002 period move out of poverty (and less move into poverty) than other households. These effects may be explained by the fact that these are deaths of old, economically unproductive household members. We will discuss this effect later in light of the econometric results in the next section. The descriptive results in Table 5 suggest further that house destruction and land losses may have had significant impacts on household poverty dynamics across the two years. A larger percentage of households exposed to house destruction in both periods moved into poverty in 2002, and less moved out of poverty in 2002, in relation to households that did not experience the destruction of their house. Loss of land in the 1990–96 period has unexpected results: more households that experienced land losses in that period moved out of poverty (but not of extreme poverty) than households that did not experience the loss of land. The loss of land in the 1997–2002 period is more in line with expected results. In the next section, we analyze in further detail the determinants of these changes in poverty status amongst Rwandan households between 1990 and 2002, using appropriate controls and correction for possible selectivity and endogeneity biases in our sample.

¹⁵We estimate the effect of these events in two separate periods—1990–96 and 1997–2002—in order to account for potential differences in short- and long-term effects.

TABLE 4
POVERTY DYNAMICS FOR HOUSEHOLD PANEL (HOUSEHOLD CHARACTERISTICS) (N = 178)

	% Sample in 1990	% Sample in 2002	P → P		P → NP		NP → P		NP → NP	
			Poverty	Food Poverty	Poverty	Food Poverty	Poverty	Food Poverty	Poverty	Food Poverty
Entire sample			55.1	40.5	18.0	17.4	20.2	26.4	6.7	15.7
Province										
Gikongoro	33.7	33.7	58.3	48.3	33.3	35.0	8.3	8.3	0.0	8.3
Gitarama	66.3	66.3	53.0	36.4	9.4	8.5	27.4	35.6	10.3	19.5
Age of head										
20–30	10.7	4.50	36.8	26.3	10.5	15.8	52.6	47.4	0.0	10.5
30–40	32.0	12.4	61.4	43.9	10.5	10.5	21.1	31.6	7.0	14.0
40–50	16.9	29.8	70.0	56.7	13.3	16.7	13.3	13.3	3.3	13.3
50–60	19.1	23.0	58.8	41.2	20.6	17.7	11.8	23.6	8.8	17.7
60+	21.4	30.3	39.5	29.0	34.2	29.0	15.8	21.1	10.5	21.1
Sex of head										
Male	83.7	63.5	52.4	38.9	18.1	16.8	22.2	27.5	7.4	16.8
Female	16.3	36.5	69.0	48.3	17.2	20.7	10.3	20.7	3.5	10.3
No of adult eq.										
0–3	18.5	21.9	33.3	18.2	15.2	12.1	36.4	39.4	15.2	30.3
3–6	52.3	42.7	54.8	40.9	18.3	19.4	20.4	26.9	6.5	12.9
+6	29.2	35.4	69.2	53.9	19.2	17.3	9.6	17.3	1.9	11.5
Education of head										
No schooling	55.6	45.5	61.6	46.5	19.2	20.2	14.1	19.2	5.1	14.1
Primary	40.45	50.56	48.6	33.3	16.6	13.9	27.7	36.1	6.9	16.6
>Primary	3.9	3.9	28.6	28.6	14.3	14.3	28.6	28.6	28.6	28.6
Head occupation										
Farming	90.4	94.4	54.0	39.1	18.6	17.4	21.7	28.0	5.6	15.5
Non-farming	9.6	5.6	64.7	52.9	11.8	17.7	5.9	11.8	17.7	17.7
Land size (in hect.)										
0–0.33	19.1	29.9	85.3	67.7	2.9	8.8	8.8	20.6	2.9	2.9
0.33–0.66	27.5	27.7	55.1	36.7	18.4	24.5	20.4	22.5	6.1	16.3
0.66–1	22.5	14.7	40.0	25.0	27.5	17.5	22.5	32.5	10.0	25.0
+1	30.9	27.7	47.3	38.2	20.0	16.4	25.5	29.1	7.3	16.4

Notes: P = poor; NP = non-poor.

Source: Rwanda panel household survey 1990–2002.

TABLE 5
POVERTY DYNAMICS FOR HOUSEHOLD PANEL (CONFLICT SHOCKS) (N = 178)

	% Sample in 1990	% Sample in 2002	P → P		P → NP		NP → P		NP → NP	
			Poverty	Food Poverty	Poverty	Food Poverty	Poverty	Food Poverty	Poverty	Food Poverty
Ethnicity of the head										
Hutu	90.0	90.0	57.5	41.3	15.6	15.0	20.0	27.5	6.9	16.3
Tutsi	8.4	8.4	33.3	33.3	33.3	33.3	26.7	20.0	6.7	13.3
Adult men died 90–96										
No	80.9	80.9	57.6	42.4	16.0	16.0	19.4	25.0	6.9	16.7
Yes	19.1	19.1	44.1	32.4	26.5	23.5	23.5	32.4	5.9	11.8
Adult women died 90–96										
No	92.1	92.1	52.4	38.4	18.9	17.7	22.0	27.4	6.7	16.5
Yes	7.9	7.9	85.7	64.3	7.1	14.3	0.0	14.3	7.1	7.1
Adult men died 97–02										
No	92.7	92.7	56.4	42.4	17.0	15.8	20.6	26.7	6.1	15.2
Yes	7.3	7.3	38.5	15.4	30.8	38.5	15.4	23.1	15.4	23.1
Adult women died 97–02										
No	91.0	91.0	55.6	40.7	16.7	16.7	20.4	26.5	7.4	16.1
Yes	9.0	9.0	50.0	37.5	31.3	25.0	18.8	25.0	0.0	12.5
House destroyed 90–96										
No	90.4	90.4	55.3	39.8	18.6	18.0	19.9	26.7	6.2	15.5
Yes	9.6	9.6	52.9	47.1	11.8	11.8	23.5	23.5	11.8	17.7
House destroyed 97–02										
No	91.0	91.0	55.6	40.7	18.5	17.9	19.1	24.7	6.8	16.7
Yes	9.0	9.0	50.0	37.5	12.5	12.5	31.3	43.8	6.3	6.3
Lost land 90–96										
No	86.0	86.0	54.3	39.9	17.7	19.0	20.9	25.5	7.2	15.7
Yes	14.0	14.0	60.0	44.0	20.0	8.0	16.0	32.0	4.0	16.0
Lost land 97–02										
No	79.2	79.2	53.2	38.3	19.9	20.6	19.2	24.1	7.8	17.0
Yes	21.8	21.8	62.2	48.7	10.8	5.4	24.2	35.1	2.7	10.8
In prison										
No	92.1	92.1	54.3	39.6	18.3	18.9	20.7	26.2	6.7	15.2
Yes	7.9	7.9	64.3	50.0	14.3	0.0	14.3	28.6	7.1	21.4

Notes: P = poor; NP = non-poor.

Source: Rwanda panel household survey 1990–2002.

5. DETERMINANTS OF POVERTY DYNAMICS IN RWANDA

5.1. Empirical Approach

Several models have been proposed in the literature to analyze the impact of economic shocks on changes in household consumption expenditure, income, or earnings (Townsend, 1994; Dercon, 2004). There is, however, a scarcity of models that estimate directly the effects of conflict-related changes on poverty or on poverty dynamics. The objective of this section is to estimate the direct impact of shocks directly related to the violent events experienced in Rwanda in the 1990s on household poverty dynamics between 1990 and 2002. We make use of multinomial logit models and reduced-form models of changes in income per adult equivalent that explore the panel dimension of the dataset. We also use Heckman models to correct for sample selectivity and IV models to instrument for income in 1990.

Multinomial logit regressions are commonly used to model processes that involve a single outcome among several alternatives that cannot be ordered (for example, choices between modes of travelling, occupational choices, etc.). Poverty dynamics between two periods can be divided into four mutually exclusive outcomes: (i) being poor in both periods; (ii) being non-poor in the first period and poor in the second period; (iii) being poor in the first period and non-poor in the second period; and (iv) being non-poor in both periods. Independence between the four outcomes is tested using a Hausman chi-squared statistic (Greene, 2000).¹⁶

The multinomial logit model determines the probability that household i experiences one of the j outcomes above. This probability is given by:

$$(1) \quad P(Y_i = j) = \frac{e^{\beta_j x_i}}{1 + \sum_{k=1}^J e^{\beta_k x_i}}, \text{ for } j = 1, 2, \dots, J \quad \text{and} \quad P(Y_i = 0) = \frac{1}{1 + \sum_{k=1}^J e^{\beta_k x_i}}.$$

In the equations above, Y_i is the outcome experienced by household i , β_k are the set of coefficients to be estimated, and x_i includes aspects specific to the individual household, as well as to its choices. β_0 has been set to zero (i.e., β_0 has been defined as the base category) in order to identify the model (Greene, 2000). All other β_k are estimated in relation to this benchmark.

From the model above, we have computed the J log-odds ratios $\ln[P_{ij}/P_{i0}] = \beta'_j x_i$. The log-odds ratios (also called relative risk ratios) can be normalized on any other probability, which will yield $\ln[P_{ij}/P_{i0}] = x'_i(\beta_j - \beta_k)$. For convenience, we have calculated in Table 6 $\ln[P(Y_{i1} = 2)/P(Y_{i0} = 0)]$ and $\ln[P(Y_{i1} = 1)/P(Y_{i0} = 3)]$. These models represent, respectively, the risks of a household escaping and falling into poverty.¹⁷ Explanatory variables are those outlined in the previous section: household characteristics plus changes in poverty transitions attributed directly to specific conflict shocks observable at the household level.

¹⁶The hypothesis of no independence is rejected for all models reported in Table 6.

¹⁷ $e^{\beta_j x_i}$ is the relative risk ratio for a unit change in the variable x : a relative risk ratio (rrr) of less than one means that the variables decrease the probability of the household being in the base category, whereas an rrr of more than one increases the probability of the household being in the alternative state.

Discrete poverty functions like logits and multinomial logits models are often criticized on the grounds that they introduce measurement errors by using arbitrarily defined poverty lines (see Deaton, 1997, for a discussion). This is a particularly serious problem in analyses that use developing countries datasets, since large numbers of households may be concentrated around the poverty line. On the other hand, more conventional income or earnings functions impose constant parameters across the entire consumption distribution. This feature may, in turn, limit their application to the analysis of the impact of shocks on household poverty transitions if the determinants of household welfare yield different returns to the poor and the non-poor (Appleton, 2002). In fact, it is possible to have situations in which some households may experience decreases in consumption expenditure without becoming poor, and vice versa. Due to the advantages and disadvantages entailed by discrete and continuous variable models, we compare and contrast both in what follows.

The continuous variable model is an adaptation of the models used by Dercon (2004) and Justino *et al.* (2008) to analyze the impact of economic reforms on household poverty using, similarly to us, micro-level panel data. The base model used is the following:

$$(2) \quad \ln y_{it} - \ln y_{it-1} = \alpha + \gamma \ln k_{it-1} + \eta \ln h_{ct-1} + \theta (\ln S_{it} - \ln S_{it-1}) + \delta X_{it} + \varepsilon_{it},$$

where y_{it} is the level of income per adult equivalent in year t , α is a common source of income growth across all households, k_i represents the household level of capital per capita, h_c is a vector of commune or region level of capital (infrastructure, institutions, and so forth), and S_{it} is a multiplicative risk resulting from specific shocks that affect the technology coefficient (Dercon, 2004). X_{it} are household variables that vary across time and ε_{it} is a stochastic error term with zero mean. Results are given in Table 7. We present the estimation results of model (2) using change in the logarithmic function of household income per adult equivalent (in real terms) in column 1.

5.2. Attrition in the Household Panel

The possibility that estimates may be biased as a consequence of selective sample attrition is a major concern in the panel data literature (Fitzgerald *et al.*, 1998; Alderman *et al.*, 2000, 2006). The main concern is that observable or non-observable characteristics of households that were dropped from our sample are significantly different from the panel households. There can be several reasons for selective sample attrition in our data. First, households who were dropped from the analysis may be poorer in 1990, resulting in a panel whose average income in 1990 is biased upward. This would cause a significant bias in our analysis as we are particularly interested in poverty dynamics. Second, households who were dropped from the analysis may have had an older head in 1990, making it more likely that he/she will die and that the household will be less likely to be traced again. As households with older heads are in general wealthier, such selective sample selection may result in a panel whose average income in 1990 is biased downward. Third, households may have been dropped from the analysis because they were targeted in the genocide. The main reason

for this would be that they had a Tutsi head of the household. There may also be other observed and unobserved household characteristics responsible for selective sample attrition.

In Tables A1 and A2 in the online Appendix, we calculate the extent of a potential attrition problem in our panel dataset. We address the potential attrition bias on observables using a Heckman sample selection model to correct for attrition in income regressions in column 2 in Table 7. The first stage of this procedure is exactly the same as the probit model presented in column 3 of Table A2. Selection instruments are those variables that came out significantly different between attrited and non-attrited households. The Heckman procedure then constructs an estimate of the inverse Mills ratio and produces an OLS regression on the income variable with estimates corrected for sample attrition.¹⁸ Vytlacil (2002) shows that the identifying assumptions for the selection model are equivalent to those invoked by Imbens and Angrist (1994) in the linear instrumental variables context, to which we now turn.

5.3. *Endogeneity and Instrumental Variable Models*

The initial income variable in the regression in Table 7 is a lagged endogenous variable which, given plausible assumptions about the correlation of errors (e.g., positive correlation of errors over time in the reporting of incomes) will lead to biased estimates of the coefficients. We expect to find a negative correlation between income in 1990 and income change as households are reverting to their more permanent income. Following Fields *et al.* (2002) and Woolard and Klasen (2005), we disregard the transitory part of income since we are not interested in short-term fluctuations but more in medium-term effects. To address these issues, we resort to the use of instrumental variable techniques to predict initial incomes. The instruments we use are land size per adult equivalent and the number of cattle owned by the household, both measured in 1990. These capital stock variables predict permanent income. In order to demonstrate the validity of the instruments, we proceed in two steps. In the first step, we demonstrate that both instruments are correlated with household income in 1990 (columns 3 and 5 in Table 7). In the second step, we test the joint null hypothesis that the instruments are valid instruments, i.e., uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. To this purpose we test for overidentification using the Sargan test-statistic. Under the null hypothesis, the test statistic is distributed as chi-squared in the number of overidentifying restrictions, which is one in our case. Table 7 shows that the null hypothesis is not rejected, implying that our instruments are valid and correctly excluded from the estimation. In order to obtain robust standard errors, we replace the Sargan statistic with the Hansen-J statistic. We obtain a similar result: that the instruments are valid and correctly excluded from the estimation (see Table 7). Anderson's canonical correlation test shows that our model is identified

¹⁸For a formal presentation of the sample selectivity correction model, we refer to Heckman (1979) and Vella (1998). Examples of applied work are reported in Heckman (1980) and Sahn and Alderman (1988).

(the null hypothesis of underidentification is rejected), meaning that our excluded instruments are relevant—that is, uncorrelated with the endogenous regressors. We get the same result using robust standard errors as well as with the cluster option, in which case STATA reports the Kleibergen–Paaprk LM statistic instead of the Anderson test.

We have further tested for potential weak identification of the instruments. Weak identification arises when the excluded instruments are only weakly correlated with the endogenous regressors. Estimators can perform poorly when instruments are weak. Table 7 shows the result of the test for weak identification. When errors are assumed to be independently and identically distributed (i.i.d.) (as in column 4), the test for weak identification reported is an F version of the Cragg–Donald Wald statistic. Stock and Yogo (2005) have constructed critical values for this test, which are also used, given the absence of other critical values, when the i.i.d. assumption is dropped (as in column 6). Our results show that weak identification is rejected at the 15–20 percent level. This is an acceptable result given that underidentification is rejected and that we use a small but unique panel of post-genocide data. When we use only one instrument instead of two, weak identification is rejected at the 10 percent level. We, however, use two instruments in our preferred specification since redundancy tests reject the redundancy of either of our two instruments. We arrive at similar test-statistics and similar results when we use household income (instead of household income per adult equivalent) and area cultivated instead of area cultivated per adult equivalent as instrument.

5.4. Results

This section discusses the results obtained in the regressions in Tables 6 and 7. We examine the impact of violent conflict on household poverty dynamics in Rwanda through the following mechanisms: initial income conditions, household composition characteristics, household geographical location, land losses, death of household members, property destruction, and imprisonment.

The Effect of Initial Household Income

In Table 7, where initial household income is instrumented for, the coefficient is negative and statistically significant. This is the regression toward the mean. The higher income was in 1990, the more likely the household was to experience a drop in welfare over the conflict period. This is consistent with the targeting of better-off households during the genocide and the civil war, as discussed above. It also suggests that there are large transitory components in the income of most households, which is consistent with the picture of high mobility presented above. The result is also consistent with typical findings about measurement error which also tend to produce regression toward the mean (Bound *et al.*, 2001).

The Effect of Household Composition Characteristics

The results in Table 6 (columns 1, 2, 5, and 6; model 1) illustrate interesting effects of household and commune characteristics on the dynamics of poverty

TABLE 6
MOVEMENT INTO AND OUT OF POVERTY AND EXTREME POVERTY 2002–1990 (MULTINOMIAL LOGIT MODEL, ESTIMATES ARE RRR) (N = 178)

	Movement Out of Poverty/Extreme Poverty (Model 1)		Movement Out of Poverty/Extreme Poverty (Model 2)		Movement Into Poverty/Extreme Poverty (Model 1)		Movement Into Poverty/Extreme Poverty (Model 2)	
	P to NP (1)	VP to NVP (2)	P to NP (3)	VP to NVP (4)	NP to P (5)	NVP to VP (6)	NP to P (7)	NVP to VP (8)
Household characteristics								
Household size 1990	0.94	1.11	0.94	1.06	1.02	0.85	1.09	0.84
Size of cultivated land	1.00	1.00	1.00	1.00	1.01***	1.01*	1.01**	1.00*
Characteristics of the head								
Sex (female = 1)	0.23*	0.40	0.19***	0.35	1.47	2.65	1.99	2.03
Age	1.04	0.88	1.00	0.91	0.93	0.86	0.82	0.84
Age squared	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Education (educated = 1)	2.21	1.90	3.48	2.57*	0.11***	0.90	0.28*	1.04
Occupation (non-farmer = 1)	0.75	2.59	0.65	2.46	0.001***	0.19	0.004***	0.23
Ethnicity (1 = Tutsi)	17.86***	23.21**	14.23**	19.42**	1.33	0.46	2.15	0.48
Commune variables								
Altitude	1.00***	1.01***	1.00**	1.00***	1.00	1.00**	1.00	0.99*
Distance to market	1.01	1.11	0.91	0.96	0.81	1.64*	0.78	1.63*
Shocks								
Rainfall	1.00	1.00	1.00	1.00	1.15***	1.00	1.15***	1.00
Loss land 90–96	0.57	0.28***	0.95	0.37**	1.52	1.45	2.38	1.43
Loss land 97–02	0.40	0.11**	0.43	0.15**	171.5***	4.54**	55.85**	4.07*
Viol death adult male 94–96			2.72*	5.37*			3.19	3.05
Non-viol death male 90–96			22.70***	10.91**			1.20e+10	3.81
Non-viol death male 97–02			8.57***	39.33***			0.70	0.66
Total death male 90–96	8.41***	10.84***			14.84	2.36		
Total death male 97–02	3.41	10.46**			0.02**	0.31**		
Viol death adult female 94–96								
Non-viol death female 90–96			8.59e-16***	6.27e-19***				
Non-viol death female 97–02			2.80e-15***	3.80				
Total death female 90–96	0.07***	0.47	4.07*	5.73*				
Total death female 97–02	4.37*	6.34*			2.76e-21	1.82		
House destroyed 90–96	0.09**	0.025**	0.11**	0.054**	1.65	1.52	0.68	1.35
House destroyed 97–02	0.48	0.58	0.43	0.72	3.32	6.60**	1.36	6.20**
Adult in prison	3.17	5.87e-15***	2.72	2.31e-18***	3.21	1.07	1.57	1.09
Pseudo R ²	0.381	0.346	0.366	0.356	0.381	0.346	0.366	0.356
Hausman statistic	336.2***	34.2***	16.1***	2.4***	336.2***	34.2***	16.1***	2.4***

Notes: *, **, *** statistically significant at 10%, 5%, and 1%. P/NP = poor/non-poor; VP/VNP = very poor (food poverty line).

Source: Rwanda panel household survey 1990–2002.

TABLE 7
CHANGE OF LOG INCOME PER ADULT EQUIVALENT 2002–1990, OLS, HECKMAN SAMPLE SELECTION
AND IV MODELS

	Change in Log Income per Adult Equivalent		Change in Log Income per Adult Eq., with i.i.d Assumption, IV Model		Change in Log Income per Adult Eq., i.i.d Assumption Dropped (robust S.E.), IV Model	
	OLS (1)	Heckman (2)	First Stage (3)	2SLS (4)	First Stage (5)	2SLS (6)
Log income 1990				-0.59**		-0.59***
Land size per adult equivalent			0.007**		0.007***	
Number of cattle			0.10**		0.10***	
Household size 1990	0.13***	0.20***	-0.12***	0.047	-0.12***	0.047
Characteristics of the head						
Sex (female = 1)	-0.03	-0.03	-0.22	-0.153	-0.22	-0.135
Age	-0.006	-0.001	0.008	0.004	-0.009	-0.004
Age squared	0.00	0.00	0.00	0.00	0.00	-0.00
Education (educated = 1)	-0.209	-0.15	0.30***	0.084	0.30**	0.084
Occupation (non-farmer = 1)	-0.024	-0.08	0.14	0.008	0.14	0.008
Ethnicity (1 = Tutsi)	0.32	0.30	0.17	0.42	0.17	0.42
Commune variables						
Altitude	0.002***	0.002***	-0.009***	0.002***	-0.009***	0.002***
Distance to market	-0.24**	-0.23***	0.138***	-0.148**	0.138***	-0.147**
Shocks						
Rainfall	0.001	0.007	-0.003***	-0.008	-0.003**	-0.0008
Loss of land 90–96	-0.03	0.01	-0.009	-0.016	-0.009	-0.016
Loss of land 97–02	-0.32*	-0.36*	0.049	-0.303*	0.049	-0.303**
Violent death adult male 1994–96	0.19	0.17	-0.09	0.101	-0.09	0.101
Non-violent male death 90–96	0.09	0.09	-0.035	0.11	-0.035	0.11
Non-violent male death 97–02	0.42*	0.45	-0.068	0.45*	-0.068	0.45*
Violent death adult female 94–96	-0.38	-2.00	0.10	-0.43	0.10	-0.43
Non-violent female death 90–96	0.19	-0.39	-0.42	0.044	-0.42	-0.044
Non-violent female death 97–02	0.35	0.38	-0.015	0.45*	-0.015	0.45
House destroyed 90–96	-0.54	-0.57**	0.042	-0.57**	0.042	-0.57*
House destroyed 97–02	-0.29	-0.29	0.084	-0.22	0.084	-0.22
Adult in prison	-0.37	-0.31	0.064	-0.25	0.064	-0.25
Constant	-4.31***	-5.21***	9.68***	1.55	9.68***	1.55
Centered R-squared	0.44		0.54	0.55	0.54	0.55
Mills lambda		1.45				
Wald chi ²		95.83***				
F-stat			7.85***	7.25***	9.61***	9.33***
Overidentification test				0.013		0.013
Underidentification test				22.26***		15.9***
Weak identification test				11.0		11.9

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%. The selection equation in the Heckman model (not shown) includes all statistically significant variables from the probit model (3) in Table A2 in the Appendix.

Source: Rwanda panel household survey 1990–2002.

amongst Rwandan households in the 1990–2002 period. Household size in 1990 did not determine significantly the chances of Rwandan households escaping or falling into poverty, but is associated with increases in the probability of any given household having a higher income in 2002 (Table 7). This effect disappears when instrumental variables are introduced (columns 4 and 6 in Table 7).

Land size in 1990 affected the probability of any given household falling into poverty: households with larger land holdings had increase probability (1 percent) of falling below both general and food poverty lines. This is likely due to the effects of violence on targeted land-rich households as discussed before.

Female headed households are less likely to move out of poverty than male headed households (columns 1, 2, 3, and 4 in Table 6). They are also more likely to fall into poverty (columns 5, 6, 7, and 8 in Table 6) and have lower incomes (Table 7). This result is in line with other findings in the development economics literature, but is only statistically significant in columns 1 and 3 in Table 6. The coefficients are not statistically significant in the models in Table 7.

Higher levels of education decrease the probability of poor households in 1990 moving into poverty in 2002 (Table 6). The effect of education on log income per adult equivalent is not statistically significant in Table 7. These regression results indicate that the negative effect of higher education on poverty outcomes found in the previous section disappears when we control for household characteristics related to conflict exposure, which are closely related to education (see also de Walque and Verwimp, 2010).

The occupation variable yields expected results. Households that were employed outside farming activities have a lower probability of falling below the poverty line (Table 6). The result becomes statistically insignificant in Table 7 once selection effects or endogeneity of the income variable are corrected for.

The most significant result in terms of household composition characteristics relates to household ethnicity: Tutsi households had a high probability of escaping poverty (Table 6). Ethnicity did not affect household movements into poverty. In Tables 4 and 5 we already noticed that more Tutsi than Hutu moved into poverty and escaped poverty. However, when we correct for selectivity bias in the income regression and for endogeneity (Table 7), this effect disappears.

The Effect of Household Geographical Characteristics

Geographical variables have some—but not large—effect on poverty dynamics of Rwandan households. Distance to market—measured by the number of hours that each household takes to reach the nearest market—seems only to affect the probability of households falling into poverty: the larger the distance of any given household to local markets, the higher the probability of that household having fallen below the food poverty line between 1990 and 2002 (Table 6). This result is also reflected in Table 7: households that are far from markets are more likely to have lower incomes. This is a common result in other studies of poor households in developing countries, where distance to markets has been often shown to be significantly related to the ability to trade crops and cattle (see, for instance, Bardhan and Udry 1999).

Households living in higher altitudes had a 1 percent increase in the probability of escaping poverty and extreme poverty (Table 6). Higher levels of altitude also impact positively on income changes between 1990 and 2002 (Table 7). This result is likely to reflect unobserved commune level effects. In particular, high altitude may have served as a protection for some of the worst effects of the conflict, not accounted for by our household or individual level covariates.

The Effect of Land Loss

A large number of Rwandan households were affected by land losses between the two survey years. In the 1990–96 period, 14 percent of the households included in our sample lost land, whereas 21.8 percent of households lost some percentage of their land holdings between 1997 and 2002 (see Table 4). The main reasons for the loss of land are the transfer of land to a son and the sale of land out of need for cash (Verwimp, 2005). Given the importance of land amongst assets of Rwandan households, it is not surprising that this variable has affected the levels of poverty amongst our sample households (see model 1, Table 6, columns 1, 2, 5, and 6). Land losses between 1990 and 1996 or between 1997 and 2002 resulted in large decreases in the probability of a given household moving out of extreme poverty (columns 2 and 4 in Table 6). In addition, the loss of any land between 1997 and 2002 increased very substantially the probability of a household falling into poverty by over 170 percent (50 percent in model 2) (columns 5 and 7 in Table 6), and to fall below the food poverty line by around 4 percent (columns 6 and 8 in Table 6). It also contributes toward the decrease in income per adult equivalent (Table 7). The impact of recent losses appears to be more severe than the impact of older losses, reflecting the persistence of land distributional issues in Rwanda, even after the height of the conflict.

The Effect of Death of Household Members

The death of an adult male in the 1997–2002 period decreased the probability of a household being below the food poverty line in 2002. All types of male deaths increase movements out of poverty (Table 6). This result disappears once we correct for selectivity bias in Table 7. This is because excess mortality in the 2002 sample is one of the main reasons why the sample in 2002 differs from sample in 1990. In 2002 we only observe the survivors. Once this sample selectivity bias is corrected for, the result becomes statistically insignificant. The result for non-violent male death reappears statistically significant in the IV models in columns 5 and 6 of Table 7. All female deaths decrease the probability of poor households in 1990 of moving out of poverty by 2002 (Table 6). The exception is non-violent death of females in the 1997–2002 period, which increases the probability of households moving out of poverty. As for the male non-violent deaths, the effect disappears in the Heckman selection model but reappears statistically significantly in the IV models. Through further investigation, we observed that male and female non-violent deaths in the 1997–2002 period refer to a small number of deaths amongst ill, old, and economically unproductive household members. The likely explanation for the result is that although household members who are ill do not contribute to household income generation, they do need to consume from the generated income. As a result, in terms of income per adult equivalent income, surviving household members will benefit from higher incomes per adult equivalent once the ill household member dies.¹⁹

¹⁹Grimm (2010) finds similar results in Indonesia.

Overall we observe no significant impact of violent conflict on household poverty through the violent death mechanism. This is most likely due to two factors. The first is the fact that death may have been an easy identifier of those affected by the violence, and therefore aid transfers may have benefited those households more. The second factor is the substitution effect in labor supply among household members, whereby male labor may have been substituted by female or child labor. Donovan *et al.* (2003) researched the effect of adult death on Rwandan households using data on coping strategies reported by 1,500 rural households. They found that the effect on farm labor supply was dominant: 6 out of 10 households reported a reduction in farm labor due to a male adult death. However, other household members are likely to have substituted male workers. For instance, Beegle (2005), researching the effect of adult mortality on the labor supply of Tanzanian households, shows that households experiencing decreased income or farm output after an adult death do not necessarily experience a reduction of income, production, or consumption per capita due to intra-household labor substitution effects.

The Effect of Property Destruction and Imprisonment

As discussed in Section 2, the conflict in Rwanda during the 1990s led to the destruction of assets, houses in particular, and the imprisonment of a large number of individuals. These events have affected the poverty status of households in our sample. The destruction of a house in the 1990–96 period—in 90 percent of the cases because of violence (own calculations from survey)—led to a decreased probability of escaping poverty (Table 6) and a significant decrease (around 60 percent across all model specifications) in average incomes (Table 7). The destruction of houses in the 1997–2002 period—in 90 percent of the cases due to excessive rain (own calculations from survey)—led to a significant increase in the probability of a households falling below the food poverty line (Table 6). The effect of house destruction is robust in the Heckman and IV models. The imprisonment of a household member did not have a very significant impact on household poverty dynamics or in changes in income status, except for a decrease in the probability of households escaping from extreme levels of poverty.

6. CONCLUSIONS

We have presented an analysis of the dynamics of poverty in rural Rwanda spanning a period of violent conflict in the 1990s. We aimed to contribute to the understanding of the effect of violence on household welfare. The analysis of the poverty impact of violent conflict at the household level revealed that previously land-rich, income non-poor households have fared badly over the decade spanning the conflict. These were the households most affected by the genocide and the civil war. This result mirrored similar patterns of convergence at the province level, where we observed more positive economic changes in the post-conflict period among provinces less affected by fighting and the genocide. Provinces that were better-off before the 1990s events in Rwanda suffered disproportionately from severe destruction of their productive factors and recovered more slowly than

other provinces once the conflict was over. At the household level, we observe that the destruction of the house and the loss of land have had a negative impact on household welfare levels in 2002. We also find that previously land-poor, income-poor households were able to move out of poverty when an adult member, who suffered from disease, died. Surviving members have more income per adult equivalents after a non-violent death of an adult. We emphasize that this result is drawn in the context of a rural economy struck by extreme land scarcity, absence of technological innovation in agriculture and lack of capital.

The results discussed in the paper suggest that violent conflict affects the welfare of households in very different ways from other shocks. Households with more assets, larger land holdings, higher incomes, and more education are typically found to be more able to adapt to economic shocks that affect their economic productivity. However, assets and wealth that protect households against economic shocks may also be those that increase the exposure of the same households to violence or political shocks as in the case of Rwanda. This has important policy implications, suggesting that policies during and after violent conflict must focus on increasing economic resilience by reducing levels of vulnerability, not only to poverty but also to being targeted by violence. Policies that focus only on targeting income-poor households may miss out on large numbers of vulnerable people that may become targets of violence and see their levels of physical and economic security threatened.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Table A1: Testing for Selection Attrition, Comparing Means for Households in the 1990 Sample

Table A2: Probit Models Testing for Selective Attrition, Using FGM Method