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Empty cups? Assessing the impact of civil war violence on coffee farming in Burundi

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Abstract

This paper exploits exogenous variation in Burundi's latest episode of civil war violence to estimate the causal impact of exposure to violence and the probability of growing coffee, some four years after the war ended. I constructed a unique panel dataset for a nationally representative sample of 242 households in 35 communities. Household fixed effects estimates show that exposure to individual violence decreases the probability of growing coffee in the post-war period by some 16%. This effect seems to be driven by a household member's experience of physical violence rather than theft of crops or assets. The results are consistent with the idea that physical violence may decrease household labour availability if such violence caused people to die or become physically or mentally disabled. On the other hand, I cannot rule out that changing risk and time preferences in response to violence may also play a role.

Key words: natural experiment; coffee; civil war; Burundi

1. Introduction

Burundi has experienced repeated waves of violence since its independence in 1962. The latest episode of raging warfare lasted more than a decade, resulting in some 300 000 deaths and over one million people displaced (Ngaruku & Nkukuziza 2000). While there is a large economic and political science literature on causes of civil war, our understanding of the (economic) legacies of such violence remains limited (Blattman & Miguel 2010). Neoclassical growth theory predicts that countries should recover quickly to equilibrium levels after violence ends, with some empirical evidence supporting this view (see Davis & Weinstein 2002; Brakman *et al*. 2004; Miguel & Roland 2011). However, recent micro-level research suggests certain negative impacts may persist for a long time (e.g. Barrera & Ibánez 2004; Kondylis 2008; Chamarbagwala & Morán 2011; Shemyakina 2011; Leon 2012; Valente 2014; Verwimp & Van Bavel 2014).

This article builds on this micro-economic literature and studies the impact of civil war violence on crop choice decisions. The topic is important, as civil war violence often disproportionately affects poor people in rural areas who rely primarily on farming as their main source of income and consumption. Specifically, I investigate the effect of conflict-induced exposure to violence on coffee-growing activities by agricultural households in Burundi. Burundi's main source of natural wealth is coffee. In addition to generating revenues for the state, coffee production provides farmers with a relatively large sum of cash income after harvest (Kimonyo & Ntiranyibagira 2007). Moreover, income from coffee is often the single source of cash income for a rural Burundian farmer, and is used to finance the construction of a house, send children to school and serve as collateral to obtain credit (Cochet & Ndarishikayne, 2000; Kimonyo & Ntiranyibagira 2007). Yet coffee requires considerable investments in terms of inputs like fertilisers, pesticides and intensive manual labour for pruning, mulching, composting and harvesting. Besides, it takes some three to four years for a coffee

tree to become productive (e.g. Cochet & Ndarishikayne 2000; Cochet 2004). The main goal of this paper was to understand how civil war violence affects incentives for this type of investment.

There now are a number of studies that have investigated the relationship between violence and investment. Macro-empirical studies link violence to lower investment – measured as the ratio of real (private and/or public investments in real GDP) – through weak property rights enforcement (Barro 1991; Alesina & Perotti 1996; Svensson 1998). The macro-economic literature has been complemented by micro-level research on the topic, where investments are usually related to household assets (e.g. livestock) or crop choice. These micro-studies broadly suggest that lower expected returns, increased relative risks and shortened time horizons may be important mediating factors explaining a negative correlation between violence and investment. Verpoorten (2009), for example, shows that livestock (cattle) were sold in response to violence in Rwanda to smooth consumption against adverse, war-related income shocks. Grun (2008) investigated the composition of households' assets across victims and non-victims of violence in Colombia, demonstrating that victims shift to investments in more mobile assets that are easier to take while on the run. Asset risks may also reduce a household's collateral and induce a shift to less risky portfolios. Rockmore (2012) found that Ugandan households shift their crop and livestock portfolios in response to conflict risk and suggested that changes in the composition of livestock affect changes in crop portfolio. Bundervoet (2010) reports that risky assets, proxied by livestock ownership in war-affected areas, motivated Burundian households to grow low-risk, low-return crops like cassava. Singh (2013) shows that the long-term investment decisions of Indian farmers dropped as a result of the Punjab insurgency (1981–1993). Lastly, Deiniger (2003) suggests exposure to community-level civil strife in Uganda shifted households towards subsistence, reduced investments in households' asset stocks and enterprise start-ups, and increased the probability of an enterprise closing down.

I contribute to this literature by building a unique panel data set for Burundian households and using a detailed account of exposure to civil war violence to look at the long-term impacts of violence on households' coffee-growing activities. In addition, if, as suggested by Collier (2003), there is evidence of a "conflict trap", where low levels of development are correlated with conflict resurgence, my results may be relevant in developing effective post-war reconstruction policies to avoid future warfare.

I exploited exogenous variation in exposure to violence at the village and household level to estimate the impact on households' propensity to grow coffee after the latest episode of violence ended in 2005. My identification strategy was based on the fact that exposure to the civil war violence was random, providing for a natural experiment (see Harrison and List (2004), for a definition of various types of field experiments, and Meyer (1995), for a discussion of the applicability of natural and quasi-experiments in economics).

I found that a household member's exposure to civil war violence reduces the probability of growing coffee in the post-war period by some 16 to 18%. The effect seems to be driven by exposure to any form of physical attacks, rather than theft of assets or crops. Although speculative, this is consistent with the idea that a decrease in labour availability as a result of physical violence may be a mediating factor in explaining the negative relationship between violence and coffee-growing activities. I also found that owning cattle had a robust, positive impact on growing coffee. This corroborates evidence from Rockmore (2012) and Bundervoet (2010), who report shifts in crop portfolio to lower-risk crops in response to violence, and suggest a link between such shifts and livestock ownership.

The paper is organised as follows. Section 2 provides background information on the (historical) importance of coffee in Burundi and the most recent episode of civil war violence. In section 3 I describe the sampling frame and the data collection process and present descriptive statistics for the

main variables. Section 4 outlines my empirical strategy and presents the regression results. Section 5 concludes.

2. Background

2.1 Coffee

Economic activity in Burundi revolves around agriculture: more than 85% of the country's population is engaged in agricultural production, primarily at subsistence level. The main food crops grown are beans, sorghum, cassava, bananas and maize (Cochet 2004). Coffee is Burundi's most important export product, accounting for more than 80% of its annual export earnings (Food and Agriculture Organization [FAO] 2005). Yet coffee production also is a typical smallholder activity and Burundi ranks among small producers with a world market share of less than 1% (Oketch & Polzer 2002). The production process for coffee can be partitioned into four stages. The first stage entails raising and cultivating trees using inputs like seedlings, fertiliser, insecticides, land and labour. The processing stage includes curing coffee cherries through wet or dry processing and 'milling' to remove the fruit from the bean. The product is green coffee, of which 80% is traded internationally. In the next stages, coffee beans are roasted and marketed to the end users. These third and fourth stage remain underdeveloped in Burundi, with the bulk of the roasting, grinding and packaging done in the US or European end markets (World Bank 2014).

The importance of coffee dates back to the period of Belgian rule, when the colonial administration replaced an agricultural economy that was based largely on growing cereals (millet, sorghum and maize) and legumes (peas and beans) with one oriented towards serving the needs of the overseas rulers (Cochet & Ndarishikanye 2000). Subsistence crops and livestock across the country were replaced by coffee and, to a lesser extent, tea (Ngaruko & Nkurinziza 2000; Oketch & Polzer 2002). The government forced peasants to set up coffee plantations (containing at least 51 trees) in order to have cash money to pay taxes imposed by the coloniser and enforced through local chiefs (Cochet & Ndarishikanye 2000). The law forbade farmers to uproot coffee trees so as to ensure sufficient foreign exchange for the state. Indeed, the state treated coffee production as a public good, creaming off rents by setting producer prices much lower than world market prices (and often even lower than production costs). In the 1950s, quality improvement policies were imposed and producer prices were raised, allowing farmers to pay taxes and consume manufactured goods, motivating many households to take up coffee farming. After independence and up to 1976, the coffee sector was largely privatised, but political instability caused a decline in quality and production. In 1976, private coffee factories were nationalised and managed by the governmental *Office des Cultures Industrielles du Burundi* (OCIBU). With the start of the civil war in 1993, famers destroyed coffee trees, replacing them with food crops, in response to increasing issues of food security and as a means to decrease government revenues.

In 1996, in response to a military coup by Pierre Buyoya, six African countries imposed economic sanctions on Burundi, prohibiting the acquisition of the necessary inputs for cultivating coffee, and coffee exports. As a result, coffee exports fell dramatically – from some 29 000 tons in 1995 to less than 14 000 tons in 1996 (FAO 1997), severely reducing the government's foreign exchange earnings and famers' income and inviting illegal exports to neighbouring countries (Hoskins & Nutt 1997). Fluctuating world market prices for coffee (global coffee prices collapsed in 1989 and 2001) also contributed to a decline and increased the volatility of production during the period of conflict. Attempts to reform the coffee sector through privatisation and deregulation have been ongoing since the mid-1980s. Although they hardly advanced during the war, reforms resumed after 2001, limiting the role of OCIBU and creating small associations formed at the level of one or more hillsides (*sous-collines*). These associations are responsible, amongst others, for collecting coffee beans, paying

supplying farmers and granting members (small) loans (to buy fertiliser or consumer goods) from the association's own or externally acquired capital (World Bank 2005). Further commercialisation of coffee production is warranted to increase productivity, facilitate investments in infrastructure to transport high-quality coffee to international markets, and provide labour opportunities in the wider economy (Bamber *et al.* 2014). New reforms are currently being developed that increasingly focus on producing high-quality specialty coffee, a growing market particularly in Western markets. This may provide opportunities to (further) raise farmers' income (World Bank 2014).

2.2 Violence

Burundi has, since its independence in 1962, been involved in multiple cycles of gruesome violence. The latest episode of ravaging war started in 1993 and ended in 2005, when a peace agreement was brokered between the national authorities and all but one of the rebel movements, resulting in peace and relative political stability. Although the Burundian conflict is often framed as an ethnic war, the reality presents an intractable conflict in which structural violence took place against all Burundians who did not belong to the small urban ruling elites (Oketch & Polzer 2002; Daley 2006). Colonial rule was first enforced by Germany, and later Belgium, following the outcome of the First World War. The colonial government installed a system of 'indirect rule'. This consisted of the "incorporation of native authorities into a state-enforced customary order" (Mahmood Mamdami 1996, cited in Uvin 1999), cementing the position of the aristocratic Tutsi, and reserving education and jobs almost exclusively for them. After independence in 1962, both the Tutsi and emerging Hutu elites engaged in a competition for state control. Following a coup d'état in 1966, the Tutsi monopolised power for almost three decades. To perpetuate its control of the state, the post-colonial, largely Tutsi, government was characterised by extreme repression. Uvin (1999) describes how a Tutsi army response (killing some 100 000 mostly educated Hutu) to a Hutu rebellion in 1972 resulted in something that became a pattern during the civil war two decades later: "in response to rumors and fears Hutu peasants would attack and kill local Tutsi, local power holders and even ordinary people. The army was then sent in to restore order and indiscriminately killed vastly more people".

The reverse also applied. While Hutu feared a repetition of the 1972 event, the Tutsi were similarly afraid that they would be killed by Hutu-led violence if they did not use force to maintain power (reinforced by the 1994 genocide in neighbouring Rwanda), leading to pre-emptive attacks from both sides (Uvin 1999; Oketch & Polzer 2002). In some cases, people were killed by knives or bayonets, but rebels also bombed areas, for example in Ruyigi, Gitega and Cankuzo, using shell grenades, sometimes even from helicopter gunships (Human Rights Watch 2003). In addition to (mass) killings, torture, rape, kidnapping and destruction, soldiers and rebels looted goods from civilian houses and their lands, although looting was not a central objective of the perpetrators of violence. Uvin (1999) concludes: "Thus both Burundi and Rwanda have a long-standing history of widespread, indiscriminate killing." Very often innocents were slaughtered: women, children, poor farmers, low-level civil servants, all "ordinary people who were just in the wrong place at the wrong time". Although the war ended in 2005, the violence had already subsided by 2002. The intensity of violence varied substantially across (and within) communities. It is this variation that I focus on in my study. The validity of using exposure to violence as a source of exogenous variation here depends critically on the assumption that the victims of violence were not selected on the basis of (pre-war) characteristics that predict 'coffee growing' in 2007. The qualitative evidence above supports this notion.[1,2] In section 4 I present further support for my key assumption, demonstrating that

[1] I wish to refrain here from a discussion about ethnic identity and economic activities for ethical reasons. Moreover, the household fixed effects in my models will control for such unobserved heterogeneity.

[2] Historical accounts of the war show that violence started in the north-eastern provinces. Yet, in less than two months, the violence spread across the entire country (see Chrétien and Mukuri (2000) for a detailed description of the spatial and temporal spread of the violence).

characteristics like having (had) a powerful position within the village prior to the war, or belonging to a particular ethnic group, are unable to explain selection into violence.

3. Data and description of the sample

3.1 Sampling procedure

I used a sample of 242 households from 35 rural communities in rural Burundi. The sample was based on an original, nationally representative sample of 6 668 households, using a two-stage clustered and stratified random sampling approach. Stratification was based on the four agro-ecological zones that are present in Burundi (Republic of Burundi 1998). The sample originates from 1998, when the World Bank and the Burundi Institute of Statistics and Economic Studies (ISTEEBU) conducted a household and community survey to analyse living standards (henceforth the Burundi Priority Survey (BPS) 1998). Almost half (3908) of the households interviewed in 1998 lived in 391 communities in rural areas. The primary sampling unit comprised the *sous-colline* (hillside): the lowest administrative unit (community) in Burundi. Communities were randomly chosen with a probability proportional to their population from a list that featured all communities in Burundi. The secondary sampling unit comprised 10 randomly selected households from a list of all households residing in the community (Republic of Burundi 1998). Respondents in two provinces, Makamba and a large part of Bujumbura Rurale, could not be interviewed at the time as a result of ongoing battles between rebels and government forces.

In 2007, a team of researchers from Wageningen University, the Free University in Brussels and ISTEEBU designed a follow-up questionnaire for the rural areas: the Burundi Household Priority Survey (BPHS) and Burundi Community Survey (BCS) 2007, which together comprised BPS 2007. Budget constraints did not allow us to track and re-survey all 391 rural communities and the 3 908 surveyed households within them. We therefore drew a random sample of 100 out of the 391 communities (3 908 households) with the aim to trace and re-interview 1 000 households within these sites that were part of the 1998 sample. We managed to locate and re-interview 874 out the 1 000 households selected, and conducted an extended version of the original survey that was used in 1998. The household survey contained detailed questions about demographic and socio-economic indicators, including education, employment, health, production, consumption, assets, income, civil war victimisation, land tenure security, trust, social capital and subjective welfare.

For the community questionnaire we relied on a group of key experts, often the village-level leader, accompanied by elders. They would collectively discuss and answer our questions. The community questionnaire entailed questions about infrastructure, violence, clashes between the warring factions and rebel recruitment. Questionnaires were designed in French, and interviews were conducted in the local language, Kirundi. We trained 65 interviewers during a one-week course, during which we improved the questionnaire. The questionnaire was piloted in an out-of-sample village, followed by final corrections to the survey. Fifty interviewers were selected in a competitive exam that included a case study on household composition, consumption and production, as well as a range of questions on research ethics. A team leader supervised each team of five interviewers. Two out of five team members were women.

In 2009, the research team from Wageningen returned to Burundi. Our budget was even smaller than in 2007, which meant that we were unable to track and revisit the entire 2007 sample. We therefore drew a stratified random subsample from the sample of villages that had taken part in the BPS 1998 and 2007. Stratification was now based on the incidence of village-level war-related violence. We

started with a sample of 36 villages, of which 25 had been exposed to violence and 11 had not.[3] The aim of the 2009 project was to gauge and compare social, risk and time preferences among violence-affected and non-affected respondents (see Voors *et al*. (2012) for the results of this analysis). We conducted a set of economic experiments and a short-exit survey that included questions about demographic variables (including the respondent's ethnic origin, something we had not been able to ask before) and a number of recall questions regarding the respondent's livelihoods prior to the start of the war. Data from this survey is henceforth referred to as Burundi Experiments Exit Survey (BEES). I used recall questions from the BEES to construct the two-year panel and observe changes over time within household.[4] My sample thus comprised all households of the 2009 subsample for which I have complete information.

3.2 Data

I sought to explain variation in coffee farming before and after the Burundi civil war. Table 1 summarises the key variables used in the analysis.

Table 1: Descriptives

Variable	Mean	SD	Min	Max	Observations community level	Observa-tions HH level
Panel A violence variables						
Attack 1993-2003[a]	0.71	0.46	0	1	35	242
Relative # of dead in attacks 1993-2003	2.38	4.47	0	15.63	35	242
Individual victimisation index 1993-2003	0	1	-0.91	5.14	35	242
Theft	0.46	0.50	0	1	35	242
Physical violence	0.31	0.46	0	1	35	242
Panel B household and village characteristics						
Coffee farmer[a,b]	0.43	0.50	0	1	35	484
Cattle owned[b]	0.27	0.92	0	1	35	484
Migration during the war[a]	0.12	0.33	0	1	35	242
Aid recipient between 1998 and 2007[a]	0.29	0.46	0	1	35	242
Credit[a,b]	0.47	0.50	0	1	35	484
Other cash crops[a,b]	0.04	0.20	0	1	35	484
Household size[a,b]	3.41	1.36	0.4	8.2	35	484
Ethnic minority[a]	0.26	0.44	0	1	35	233
Powerful position in the village in 1993[a]	0.29	0.20	0	0.8	35	242
Ethnic homogeneity 1993	82.87	16.89	30	99	31	
Votes for Ndadaye 1993	64.51	17.68	9.94	93.51	34	
Population density (log) 1990	5.43	0.51	4.20	6.11	35	
Distance to Bujumbura (km, log)	4.49	0.39	3.68	5.12	35	
Altitude (m, log)	7.41	0.10	7.14	7.70	35	

Notes: [a] denotes a binary variable. [b] refers to household variables for which I have pre-war (1993) and post-war (2007) data and presents the mean value of the two time periods.
Sources: BPS (1998); BPS (2007); BEES (2009). All surveys are available on request

[3] In one of the villages we were unable to complete the games and the questionnaire: there had been a miscommunication between the research team and the village chief, whom we would always ask beforehand for permission to execute the experiments and the survey. The village chief was under the impression we had not officially asked for permission and requested us to leave the village. We were hence left with 35 communities in total.
[4] Deaton (1997:19) suggests "in some cases panel data may be collected in a single interview by asking people to recall previous events. This works best for major events in people's lives like migration or the birth of a child". Coffee would plausibly classify as a major event, and people would be well able to recall whether they grew coffee before the war (another major event) or not.

3.2.1 Panel A: Violence

I used four measures of violence obtained from Voors *et al*. (2012): (i) *community violence*, which simply measures the number of deaths on the sous-colline as a consequence of (a) confrontations between rebels and the army or (b) one-sided violence between 1993 and 2003. This number is divided by the size of the population as stated by local administrators.[5] On average, about 2.4% of a community population was killed as a result of (any of) these attacks; (ii) *individual violence*, which is an additive index of physical (death of household member, forced labour, torture, ambush) and non-physical (theft of assets, crops and money) exposure of any household member. Since the absolute scale of this variable is arbitrary, it was normalised to have a mean of zero and a standard variation of one; (iii) *physical violence* and (iv) *theft* refer to the individual violence measure as described in (ii), separated into two variables, one for 'physical attacks' and the other for 'theft'.

3.2.2 Panel B: household and village characteristics

The dependent variable took a value of 1 if the household grew coffee in a particular year. On average, about 43% of the sample grew coffee. The data for year 0 were recall data based on the 2009 exit survey, whereas data for year 1 were based on the information in the BPS 2007. The recall questions requested respondents to only answer "yes" or "no" to the question whether they grew coffee before the war. This clearly reduced the cognitive burden to recall information from more than 13 years ago, reducing measurement error. On the other hand, the binary information is less informative; I do not know the number of coffee trees a household owns, nor their production.[6]

I used six time-varying controls for which recall data were available and which potentially could be a confounding factor in estimating a causal relationship between violence and coffee farming. Livestock may proxy for wealth (see, for example, Bundervoet 2010), and could account for selection into violence. I measured this variable as the number of cattle a household owns, which is 0.3 on average. Migration during the war could be correlated with violence and be a reason why farmers no longer grow coffee (e.g. issues over land as a result of migration could play a role here). On average, 12% of households migrated (and returned) during the war. Aid programmes may have targeted households most affected by the war. If such programmes advised households to grow (or, conversely, not to grow) coffee, a possible relationship between violence and coffee may be spurious.[7] I therefore included a binary variable that was 1 if the household reported to have been an aid recipient between 1998 and 2007. Almost 30% of the households reported having received aid during this period. Coffee requires investments in terms of money and (hired) labour that may not be available to all farmers. I used a binary indicator that measures whether people have taken up loans that may explain a choice to grow or not grow coffee. Some 47% of the sample took out credit. Cash crops other than coffee (tea, tobacco or cotton) arguably may substitute for coffee. Only 4.3% of households grew other cash crops. Larger households may have been more (less) able to defend themselves against rebels or government forces *and* have more manpower to grow coffee, suggesting a positive (negative) link between growing coffee and violence. Households in my sample had about 3.2 members, measured in adult equivalents following Fuchs (1986). Related, household labour may be a mediating factor: if the war disrupted household labour supply through, for example, physical or mental health problems,

[5] Several examples from the psychological literature testify that merely witnessing violent events, without the act or pain being inflicted on oneself, may be sufficient to result in severe trauma that potentially could induce behavioural changes (see, for example, Blanchard *et al*. 1982; Macksoud & Aber 1996; Yehuda 2002; Neugebauer *et al*. 2009).

[6] I do have production figures for 2007. While I cannot use this information in the panel analysis, I can use the production data to check whether farmers who are classified as coffee farmers are also actively engaged in growing coffee (as opposed to just having coffee trees and leaving them unattended). There is a 100% match: all farmers classified as coffee farmers in 2007 indeed produced coffee in 2007.

[7] Aid programmes promoting the rehabilitation of a particular cash crop after the war are not uncommon: see, for example, Dinerman (2006) for the case of cotton in Mozambique.

this could explain a change in coffee-growing activities. However, I do not have data available for 1993 that allow me to test this idea.[8,9]

4. Empirical strategy

4.1 Selection into violence

I exploited the geographical variation in violence to estimate the impact on growing coffee using a difference-in-difference analysis. Key to my identification strategy was that violence is not related to characteristics that predict growing coffee. If coffee farmers were targeted more than non-coffee farmers, or unobserved variables influenced both the chance to get attacked and the propensity to grow coffee, my estimates would be inappropriate.

I addressed the concern of possible selection by estimating regression models, where I explain exposure to violence between 1993 and 2003 from a relevant set of available pre-war variables and (where possible) community fixed effects. In addition to the variables explained in section 3.2, I have included variables reflecting whether a household member held any powerful position within the community before the war; an indicator for belonging to the minor ethnic group in Burundi; and a number of household variables for which I have data from the 1998 BPS, including age, gender and literacy of the household head. Relevant community-level variables include the log of population density in 1990; the log of altitude; the percentage of votes for (Hutu) president Ndadaye in 1993; and the log of distance to the nation's capital Bujumbura. The results are presented in Table 2. Column (1) shows there is no robust predictor of communal level violence except for population density, which is borderline significant at $p = 0.10$. Less populated areas were more likely to get attacked, consistent with the idea that more populated areas may have been more able to resist the violence and organise counter-attacks. Yet this variable loses its significance when included in column (2), which uses a continuous measure of communal violence. The models in columns (1) and (2) are likely underpowered, however, due to the small number of communities in the sample. I therefore proceeded with predictors of individual exposure to violence in columns 3 to 5, using the full set of household observations (242). Columns (3), (4) and (5) present results using various measures of individual violence exposure as dependent variable. There is a robust, positive, albeit weakly significant effect of growing other cash crops (tea, cotton or tobacco) across all three specifications. Also, smaller households and households with older heads were more likely to become a victim of theft. I return to these issues in my main analysis below.

[8] I only have data on family labour from BPHS 2007. When correlating household size with family labour for the 2007 observations, I find that these two correlate reasonably well, at 0.45 ($p = 0.000$). Although clearly imperfect, it provides some confidence that my household size variable picks up some of the variation that would otherwise be explained by family labour.

[9] Loss of land potentially also could account for a decrease in coffee-growing activities, although some of this effect may have been captured by including the variable on migration. The data do not provide much support for the notion that loss of land is an important mediating variable. Only 1% indicated having lost (some) of their land due to the war, and including this as a dummy variable into the regression had no effect (results not shown but available on request).

Table 2: Selection into violence

Dependent variable	Attacks 1993-2003 (community)	Relative number dead 1993-2003 (community)	Attacks 1993-2003 (HH)	Theft (HH)	Physical attack (HH)
Pop. density 1990 (log)	-2.35	-0.53			
	(1.22)*	(2.68)			
Distance to Bujumbura (km, log)	-1.17	-6.89			
	(1.22)	(3.02)			
Altitude (m, log)	-2.26	-17.35			
	(5.99)	(10.39)			
Percentage of votes for Ndadaye	0.04	0.05			
	(0.03)	(0.06)			
Ethnic homogeneity in 1993	0.04	0.02			
	(0.03)	(0.06)			
Coffee farmer in 1993[a]	0.09	3.40	0.17	0.10	0.17
	(1.59)	(3.56)	(0.16)	(0.15)	(0.16)
Powerful position in village in 1993[a]	0.13	0.94	0.07	-0.04	0.14
	(2.20)	(5.63)	(0.15)	(0.15)	(0.16)
Credit taken out in 1993[a]	1.22	5.53	-0.16	-0.24	-0.01
	(1.88)	(4.72)	(0.17)	(0.17)	(0.18)
Cattle in 1993	-1.35	1.34	0.004	0.04	-0.03
	(0.93)	(2.06)	(0.06)	(0.06)	(0.07)
Household size (in 1993)			-0.004	-0.11	0.10
			(0.06)	(0.06)*	(0.06)
Other cash crops (in 1993)[a]	8.38	-3.17	1.01	0.78	0.79
	(6.74)	(9.07)	(0.41)*	(0.40)*	(0.42)*
Ethnic minority[a]			-0.08	-0.16	0.13
			(0.21)	(0.21)	(0.22)
Age HH head (in 1998)			0.004	0.01	-0.004
			(0.005)	(0.005)**	(0.005)
Gender HH head (in 1998)			-0.05	-0.19	0.10
			(0.17)	(0.17)	(0.18)
Literacy HH head (in 1998)			-0.06	-0.08	-0.006
			(0.15)	(0.15)	(0.15)
Observations	30	30	233	233	233
Community FE	No	No	Yes	Yes	Yes
Pseudo/Adjusted R^2	0.29	0.11	0.16	0.12	0.12

Notes: The dependent variable in column (1) is a binary variable that is 1 if the community experienced any violent attack between 1993 and 2003, and 0 otherwise. Column (2) is a dependent measure of the number of deaths by attacks in a community, relative to its population. Column (3) is a continuous measure of household-level attacks. Column (4) is a continuous variable measuring theft. Column (5) is a continuous variable measuring physical violence. Column (1) presents results from a probit regression; the results in columns 2 to 5 are estimated using ordinary least squares. [a] refers to binary variables. Standard errors in parentheses. * significant at $p < 0.10$; ** significant at $p < 0.05$; *** significant at $p < 0.01$

Sources: BPS (1998); BPS (2007); BEES (2009)

4.2 Regression analysis

I was primarily interested in the impact of violence on farmers' propensity to grow coffee. I started my analysis by using a parsimonious OLS specification, estimating equation (1):[10]

[10] I used a linear probability model (LPM) instead of a logit or probit model, which is commonly used with a binary dependent. However, unobserved time-invariant heterogeneity (fixed effects) in these non-linear specifications cannot be eliminated by a simple transformation, as in an LPM (Hsiao 1986, chapter 7; Besley 1995). A potential problem with a LPM is that the predicted $\hat{Y}$ falls outside the (-1, 1) interval. However, all of my estimates of $\hat{Y}$ fall neatly within the (-1, 1) range.

$$Coffee_{ijt} = \alpha_{ij} + \beta\left(violence_j * T_t\right) + X_{ijt} + \gamma_t + \varepsilon_{ijt} \quad (1)$$

where the probability of growing coffee, $Coffee_{ijt}$, by household i in community j, in year t, is explained by the interaction between communal violence experienced, $violence_j$, and a time dummy T_t, a vector of household controls X_{ijt}, and household and year fixed effects α_{ij} and γ_t respectively. I clustered standard errors at the community level to control for intra-cluster correlation. The inclusion of household fixed effects takes care of all time-invariant heterogeneity at the household level (e.g. road access, education, initial wealth, ethnic origin),[11] mitigating concerns about selection issues. By the same token, year fixed effects (e.g. national policies, changes in world market prices) allow me to control for unobserved changes over time. The coefficient of interest is β that measures the effect of civil war violence on the probability to grow coffee, four years after the war has ended. Recall that growing other cash crops, household size and the age of the head of household predicted selection into violence. I therefore include other cash crops, household size and other time-varying variables described above as additional household controls. I cannot control for the age of the household head as I only have information for this variable in 1998 and 2007. The impact of violence may be thus be overestimated if older people are more likely to stop growing coffee than younger farmers. On the other hand, the age variable is only significant in the theft equation.

Table 3: Conflict and coffee farming

	OLS (1)	OLS (2)	OLS (3)	OLS (4)	OLS (5)	OLS (6)
Percentage death in attacks	-0.03 (0.006)***	-0.007 (0.08)				
Individual violence			-0.07 (0.04)*	-0.07 (0.04)*		
Theft					-0.02 (0.04)	
Physical violence						-0.08 (0.04)**
Cattle owned		0.08 (0.03)***		0.08 (0.03)***	0.08 (0.03)***	0.08 (0.03)***
Aid		-0.09 (0.08)		-0.08 (0.09)	-0.08 (0.09)	-0.08 (0.09)
HH size		0.02 (0.03)		0.03 (0.03)	0.03 (0.03)	0.03 (0.03)
Credit		0.10 (0.09)		0.08 (0.07)	0.08 (0.08)	0.08 (0.07)
Migration		0.001 (0.09)		0.03 (0.09)	0.01 (0.09)	0.03 (0.09)
Other cash crops		0.09 (0.15)		0.03 (0.15)	0.05 (0.16)	0.06 (0.15)
Constant	0.46 (0.01)***	0.28 (0.10)**	0.55 (0.18)***	0.35 (0.11)***	0.35 (0.11)***	0.35 (0.11)***
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	No	No	No
Community-specific Year FE	No	No	Yes	Yes	Yes	Yes
Adjusted R^2	0.001	0.05	0.01	0.08	0.08	0.08
Observations	484	484	484	484	484	484

Notes: Standard errors in parentheses (SE are clustered at the community level in columns (1) and (2) to correct for intra-cluster correlation.
* significant at p < 0.10; ** significant at p < 0.05; *** significant at p < 0.01
Sources: BPS (1998); BPS (2007); BEES (2009)

Columns (1) and (2) of Table 3 report the effect of communal violence on the probability of growing coffee at the household level. Column (1) presents results for the parsimonious model and column (2) shows estimates conditional on a set of controls. The measured effect of violence is negative and

[11] See Nuru and Seebens (2008) for the importance of such characteristics in predicting the production of high-value cash crops.

strongly significant, but becomes much smaller and insignificant once the relevant controls and year dummies are added in column 2. Communal attacks thus do not seem to have had an impact on a farmer's decision to grow coffee, or the effect is simply not strong enough to be identified.

Next, I looked at individual-level violence, estimating equation (2):

$$Coffee_{ijt} = \alpha_{ij} + \beta(violence_{ij} * T_t) + X_{ijt} + \delta_{jt} + \varepsilon_{ijt} \quad (2)$$

This is similar to estimating (1), except I now replaced year fixed effects with community-specific year fixed effects, δ_{jt}. Note that including community-specific year fixed effects in (1) would have perfectly predicted the community-level violence variable. Community-specific year fixed effects capture (unobserved) community-level events that happened between 1993 and 2007. These may include, for example, regional weather shocks, targeted aid programmes, and changes in local institutions or market access. Including community-specific year fixed effects should further purge concerns about endogeneity.

The results are reported in Columns (3) to (6) of Table 3. The impact of individual violence on the decision to grow coffee is large, negative and significant. A one-unit increase in the violence index reduces the probability to grow coffee in the post-war period by seven percentage points, or 16% (column 3). Including household controls does not have an effect on the point estimates (column 4). This corroborates the idea that households were not selected into violence based on the basis of observable characteristics (also refer to Altonji *et al*. (2005) and Oster (2014)).

The individual-level violence variable can be broken down into 'physical' and 'non-physical violence'.[12] The additive index implicitly assumes that all types of violence would have a similar impact. Yet, being a victim of a crop raid could arguably have a different effect from, say, being kidnapped or tortured (also see Deiniger 2003). I therefore investigated whether physical attacks invited a different behavioural response than exposure to theft. Column (5) shows no systematic relationship between theft of money, agricultural produce or assets and growing coffee during the post-war period. What happens when looking at physical violence? Column (6) reports a large negative and significant impact of physical violence on the farmers' decision to grow coffee; a one-unit increase in the physical violence index reduces the probability to grow coffee by eight percentage points, or 18% of the mean value. The aggregate effect thus seems driven by exposure to physical attacks rather than theft.

In sum, my estimates show no robust impact of community-level violence on coffee farming, but a strong negative significant impact when looking at individual exposure. What explains the null effect of the community-level violence data? Perhaps communal variation in violence is not large enough to be identified in a model with household and year fixed effects (note the sign of the coefficient is always negative but only significant when no controls or time dummies are added). By contrast, the models for individual-level violence show a robust negative impact of violence on coffee-growing activities in the post-war period. Moreover, when decomposing the individual violence variable into physical attacks and theft, the results seem to be driven by exposure to physical violence. One interpretation may be related to the political context of the coffee industry in Burundi, as described in section 2. Coffee rents were creamed off by the government and arguably used to buy weapons for the government's army to finance their warfare. If, as anecdotal evidence suggests, households left the coffee sector to cut off government revenues, households most affected by the war may have been more inclined to do so than less-affected households, explaining the negative result. Although such an effect arguably wears off (to some extent) after the ending of the war, people's perception of a

[12] Note that these two variables are not very strongly correlated. The correlation coefficient is only 0.19.

predatory government as the sole beneficiary of coffee revenues may not have changed much since then.

A second interpretation of the results may relate to the destructive impact of the war on the country's infrastructure, obstructing access to in- and output markets (in as far as access is determined at the household or individual level).

Third, exposure to violence may have led to a decrease in household labour availability; members may have died, or become physically or mentally disabled to work. With coffee being a labour-intensive crop and virtually no functioning labour markets in place, available household labour may simply have become insufficient (see Young (2005) for evidence of such a mechanism within the domain of HIV/AIDS). Although my data unfortunately do not allow me to test this, the explanation is consistent with the final set of outcomes obtained from splitting the violence variable into 'physical violence' and 'theft'. The results here show that farmers refrain from growing coffee if they, or one of their household members, have personally experienced a physical attack that may include torture, ambush, kidnapping, forced labour supply or death as an immediate result of an attack, but are not significantly affected if something has been stolen from them. In addition to the argument that physical violence may result in a decrease in household labour, while theft does not, theft simply also may be experienced differently. Theft is present at all times and may be considered part of everyday life, having little impact on farmers' decisions whether to grow coffee or not.[13]

Finally, risk and time preferences may play a role in explaining the decline in coffee farming for violence-affected households. Voors *et al*. (2012) find evidence of changing risk and time preferences in response to violence, although the coefficient for individual-level violence is only significant in the time preference model, showing that exposure to violence increases discount rates. My outcomes corroborate this result: growing coffee requires farmers to be patient, since it takes some three to four years for coffee trees to produce. The decrease in coffee farming in response to violence is thus consistent with higher discount rates, or being less patient.

5. Conclusion

Using unique constructed panel data from Burundi, this study contributes to the growing literature on the effects of civil war violence on economic decision making. I used exogenous variation in the geographical spread of violence and household fixed effects models to causally relate the impact of violence to growing coffee in the post-war period. I found that exposure to individual-level violence decreases the probability of growing coffee four years after the end of the war by some 16 to 18%. This effect is economically important. Coffee comprises a significant and (often unique) source of cash income for rural Burundian households and is used for investments in, for example, education, health, land and housing. Moreover, the growth potential of the Burundian coffee sector is high, particularly with increased world demand for high-quality specialty coffee (Basdevant 2009). The national government and NGOs thus may wish to give farmers incentives to grow coffee (again) to reduce poverty and decrease the chance of new violence. Concrete policy recommendations will depend on the underlying mechanisms explaining the link from exposure to civil war violence to a decline in coffee farming. If farmers (still) perceive coffee as a source of taxable income that primarily benefits urban elites, reforms should focus on raising producer prices and ensuring coffee profits flow back to coffee-producing communities through investment in infrastructure such as private washing

[13] The sample naturally only consists of surviving and returning households that could be traced. Perhaps households that would have grown coffee in the post-war period were also the ones most likely to have fled during the war (and not returned). On the other hand, Voors *et al*. (2012), using an extended version of my sample (considering newly formed households between 1998 and 2007 as well), find little evidence of a particular type of household staying behind.

stations and roasting factories to move Burundian coffee production up the global value chain. If, on the other hand, a decrease in household labour availability accounts for the negative result, a focus on creating flexible labour markets to hire seasonal labour would be warranted. Lastly, if risk and time preferences play a role, policymakers may need to think of instruments (e.g. provision of credit markets) that enable farmers to better manage their risk portfolio and adopt longer planning horizons. I view the assessment of the impact of one or a combination of such interventions on producing coffee among rural smallholders as an interesting avenue for future research.

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References

Alesina A & Perotti R, 1996. Income distribution, political instability, and investment. European Economic Review 40(6): 1203–28.

Altonji JG, Todd EE & Taber CR, 2005. Selection on observed and unobserved variables: assessing the effectiveness of catholic schools. Journal of Political Economy 113: 151–84.

Bamber P, Guinn A & Gereffi G, 2014. Burundi in the coffee global value chain: Skills for private sector development. Durham, North Carolina: Duke University, Center on Globalization Governance and Competitiveness.

Barrera F & Ibánez AM, 2004. Does violence reduce investment in education? A theoretical and empirical approach. Working paper, CEDE-Universidad de Los Andes, Colombia.

Barro R, 1991. Economic growth in a cross-section of countries. Quarterly Journal of Economics 106: 407–43.

Basdevant O, 2009. How can Burundi raise its growth rate? The impact of civil conflicts and state intervention on Burundi's growth performance. IMF Working Paper NO. 09/11, International Monetary Fund, Washington DC.

Besley T, 1995. Property rights and investment incentives: Theory and evidence from Ghana. Journal of Political Economy 103(5): 903–37.

Blanchard E, Kolb L, Pallmeyer T & Gerardi RJ, 1982. A psychophysiological study of posttraumatic stress disorder in Vietnam veterans. Psychiatric Quarterly 54: 220–9.

Blattman C & Miguel E, 2010. Civil war. Journal of Economic Literature 48(1): 3–57.

Brakman S, Garretsen H & Schramm M, 2004. The strategic bombing of German cities during World War II and its impact on city growth. Journal of Economic Geography 4(2): 201–18.

Bundervoet T, 2010. Assets, activity choices, and civil war: Evidence from Burundi. World Development 38(7): 955–65.

Chamarbagwala R & Morán HE, 2011. The human capital consequences of civil war: Evidence from Guatemala. Journal of Development Economics 94(1): 41–61.

Chrétien J-P & Mukuri M, 2000. Burundi, la Fracture Identitaire. Logiques de Violence et Certitudes Ethniques (1993–1996). Paris: Karthala.

Cochet H, 2004. Agrarian dynamics, population growth and resource management: The case of Burundi. GeoJournal 60(2): 111–22.

Cochet H & Ndarishikanye B, 2000. The production of coffee in Burundi: Agronomy, popularization and social returns. Canadian Journal of African Studies 34(2): 218–48.

Collier P, 2003. Breaking the conflict trap: Civil war and development policy. Washington DC: World Bank.

Daley P, 2006. Ethnicity and political violence in Africa: The challenge to the Burundi state. Political Geography 25(6): 657–79.
Davis DR & Weinstein DE, 2002. Bones, bombs and breakpoints: The geography of economic activity. American Economic Review 92: 1269–89.
Deaton A, 1997. The analysis of household surveys: A microeconometric approach to development policy. Baltimore and London: World Bank Publications.
Deiniger K, 2003. Causes and consequences of civil strife: Micro-level evidence from Uganda. Oxford Economic Papers 55: 579–606.
Dinerman A, 2006. Revolution, counter-revolution and revisionism in post-colonial Africa: The case of Mozambique 1975-1994. London: Routledge.
Food and Agriculture Organization, 2005. Food and agriculture indicators. Country: Burundi. Food and Agricultural Organization of the United Nations, Rome.
Food and Agriculture Organization, 1997. Special Report, FAO/WFP Crop 43 and Food Supply Assessment Mission to Burundi, March 4, Section 5.
Fuchs VR, 1986. Sex differences in economic well-being. Science 232(4749): 459–64.
Grun RE, 2008. Household investment under violence: The Colombian case. World Bank Policy Research Paper No. 4713, World Bank, Washington DC.
Harrison GW & List JA, 2004. Field experiments. Journal of Economic Literature 42(4): 1009–55.
Hoskins E & Nutt S, 1997. The humanitarian impact of economic sanctions on Burundi. Occasional Paper # 29, The Thomas J. Watson Jr. Institute for International Studies, Brown University, Providence, Rhode Island.
Human Rights Watch, 2003. Everyday victims. New York: Human Rights Watch.
Hsiao C, 1986. Analysis of panel data. Cambridge: Cambridge University Press.
Kimonyo JP & Ntiranyibagira D, 2007. Reform of the coffee sector in Burundi. Prospects for participation, peace and prosperity. London: International Alert and USAID.
Kondylis F, 2008. Agricultural outputs and conflict displacement: Evidence from a policy intervention in Rwanda. Economic Development and Cultural Change 57(1): 31–66.
Leon G, 2012. Civil conflict and human capital accumulation the long-term effects of political violence in Perú. Journal of Human Resources 47(4): 991–1022.
Macksoud MS & Lawrence Aber J, 1996. The war experiences and psychosocial development of children. Child Development 67(1): 70–88.
Meyer BD, 1995. Natural and quasi-experiments in economics. Journal of Business & Economic Statistics 13(2): 151–61.
Miguel E & Roland G, 2011. The long-run impact of bombing Vietnam. Journal of Development Economics 96(1): 1–15.
Neugebauer R, Fisher PW, Blake Turner J, Yamabe S, Sarsfield JA & Stehling-Ariza T, 2009. Post-traumatic stress reactions among Rwandan children and adolescents in the early aftermath of genocide. International Journal of Epidemiology 38(4): 1033–45.
Ngaruko F & Nkurunziza JD, 2000. An economic interpretation of conflict in Burundi. Journal of African Economies 9(3): 370–409.
Nuru S & Seebens H, 2008. The impact of location on crop choice and rural livelihood: Evidence from villages in Northern Ethiopia (No. 123). ZEF discussion papers on development policy.
Oketch JS & Polzer T, 2002. Conflict and coffee in Burundi. In Lind J & Sturman K (eds.), Scarcity and surfeit. The ecology of Africa's conflicts. Pretoria: Institute for Security Studies.
Oster E, 2013. Unobservable selection and coefficient stability: Theory and validation. NBER Working Paper No. 19054, National Bureau of Economic Research, Cambridge MA.
Republic of Burundi, 1998. Enquete Prioritaire: Etude Nationale sur les Conditions de Vie des Populations. Burundi Institute of Statistics and Economic Studies (BISES), Burundi.
Rockmore M, 2012. Living within conflicts: Risk of violence and livelihood portfolios. Households in Conflict Network (HiCN) Working Paper No. 121, Institute of Development Studies, University of Sussex, Falmer, Brighton.

Shemyakina O, 2011. The effect of armed conflict on accumulation of schooling: Results from Tajikistan. Journal of Development Economics 95(2): 186–200.
Singh P, 2013. Impact of terrorism on investment decisions of farmers: Evidence from the Punjab insurgency. Journal of Conflict Resolution 57(1): 143–68.
Svensson J, 1998. Investment, property rights and political instability: Theory and evidence. European Economic Review 42(7): 1317–41.
Uvin P, 1999. Ethnicity and power in Burundi and Rwanda: Different paths to mass violence. Comparative Politics 31(3): 253–71.
Valente C, 2014. Education and civil conflict in Nepal. World Bank Economic Review 28(2): 354–83.
Verpoorten M, 2009. Household coping in war and peacetime: Cattle sales in Rwanda, 1991-2001. Journal of Development Economics 88(1): 67–86.
Verwimp P & Van Bavel J, 2014. Schooling, violent conflict, and gender in Burundi. The World Bank Economic Review 28(2): 384–411.
Voors MJ, Nillesen EEM, Verwimp P, Bulte EH, Lensink R & Van Soest DP, 2012. Violent conflict and behavior: A field experiment in Burundi. American Economic Review 102(2): 941–64.
World Bank, 2005. Burundi diagnosis of poverty. Draft December 2005, 61–2.
World Bank, 2014. Skills development for growth. Building skills for coffee and other priority sectors. Report no. ACS8675, The World Bank, Washington DC.
Yehuda R, 2002. Post-traumatic stress disorder. New England Journal of Medicine 346: 108–14.
Young A, 2005. The gift of the dying: The tragedy of Aids and the welfare of future African generations. The Quarterly Journal of Economics 120(2): 423–66.