Preparing for Genocide: Community Work in Rwanda*

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Abstract

How do political elites prepare the civilian population for participation in violent conflict? We empirically investigate this question using village-level data from the Rwandan Genocide in 1994. Every Saturday before 1994, Rwandan villagers had to meet to work on community infrastructure, a practice called *Umuganda*. This practice was highly politicized and, in the years before the genocide, regularly used for spreading political propaganda. To establish causality, we exploit cross-sectional variation in meeting intensity induced by exogenous weather fluctuations. We find that an additional rainy Saturday resulted in a five percent lower civilian participation rate in genocide violence. These results pass a number of indirect tests of the exclusion restriction as well as other robustness checks and placebo tests.

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1 Introduction

In many civil wars and conflicts, ordinary civilians turn into killers. During the Rwandan Genocide in 1994, Hutu perpetrators killed about 800,000 people belonging to the Tutsi minority in only 100 days. About 430,000 civilian perpetrators joined the army and militiamen in the killings. In light of the high number of deaths and the large number of civilian perpetrators, it is crucial to understand the causes of civilian participation in the violence. Anecdotal evidence suggests that in the years prior to the Rwandan genocide, the weekly-held community meetings called *Umuganda* were used to sensitized and mobilized the civilian population, and are one of the reasons why the genocide could be carried out so quickly. *Umuganda* was originally designed as mandatory-work meetings to improve village infrastructure or build houses for the poor. However, earlier research suggests that by the early 1990s these meetings were abused by the political elites to spread anti-Tutsi sentiments and prepare the population for genocide. Understanding the possibly negative effect of these meetings is even more important given that there is a case for a beneficial effect of community meetings by increasing social capital (Knack and Keefer 1997; Putnam 2000; Grootaert and van Bastelaer, 2002; Guiso, Sapienza and Zingalez, 2008); they provide arenas for people to meet, exchange ideas, solve free-rider problems and create public goods.

This paper provides the first empirical analysis of how important local *Umuganda* meetings might have been in inducing the civilian population to participate in genocide. Identifying the causal effect of these meetings on participation in genocide is difficult for two reasons. First, we lack data on the number of people participating in *Umuganda* or the number of meetings taking place in a given locality. Second, even if data existed our estimates would likely suffer from omitted variable bias. On the one hand, village-specific unobservable characteristics that affect both genocide violence and *Umuganda* intensity, for instance local leader quality, could produce a spurious positive correlation between the two, biasing the estimate upwards. On the other hand, if *Umuganda* meetings were strategically used in areas where genocide participation would have been unobservably low, the estimate would be downward biased.

To overcome these data and endogeneity issues, we use exogenous rainfall variation to estimate the effect of *Umuganda* meetings on participation in civil conflict. The idea is simple: we expect the meetings to be less enjoyable when it rains and furthermore to be cancelled altogether in the case of heavy rain (Madestam et al., 2013; Madestam and Yanagizawa-Drott, 2011). The fact that the community-work took place on every Saturday makes it possible to isolate the effect of *Umuganda* from general rainfall effects (e.g. affecting income through agriculture) by only using variation in Saturday rainfall while controlling for average daily rainfall during our period of interest.

We use the number of Saturdays with heavy rainfall during the pre-genocide period as our variable of interest. After the outbreak of the civil war in October 1990, tensions between Hutus and Tutsis intensified and the approach of the Hutu-dominated government became more aggressive. Therefore, we will focus on the period between October 1990 up until the outbreak of the genocide in April 1994.

To control for local characteristics we also include 142 commune indicators. Furthermore, we can provide a strong placebo check by controlling for heavy rainfall on the other six weekdays. We thus ensure that identification only stems from local variation in rainfall on Saturdays, which is arguably exogenous and should only affect genocide participation through its effect on *Umuganda* meeting intensity.

There is, however, one major concern regarding the exclusion restriction. In particular, the effect we estimate might not be due to the political element of *Umuganda* per se, but merely a consequence of people getting together in general. We devote an ample amount of care to corroborate that this concern is unwarranted. In particular, we will show that neither rainfall on Sundays, a church day where people traditionally meet, nor rainfall on public holidays, affect participation. Moreover, the estimates are robust to excluding Kigali, the Rwandan capital.

We proxy for genocide violence by the number of people prosecuted in the Gacaca courts, normalized by village Hutu population in 1991. There were about 10,000 of these local courts set up all over the country to prosecute the crimes committed during the genocide. Using prosecution instead of actual participation rates might introduce some bias. However, as shown in Friedman (2013), the Gacaca data is strongly correlated with other measures of violence from other various sources. Moreover, we take into account that the Gacaca courts prosecuted not only genocide perpetrators, but also perpetrators who committed violence during the preceding civil war, by excluding communes where major violent events took place during that period. We also show that the results are robust to dropping areas where mass graves were discovered after the genocide (indicating high death rates).

Our reduced-form results indicate a negative relationship between *Umuganda* intensity and civilian participation in genocide: one additional rainy Saturday is associated with a 5 percent decrease in the civilian participation rate. The effect is similar although smaller and statistically weaker for armed-group participation. This is not surprising since militia and army men often came from outside the village where they committed crimes, and should thus not have been affected by pre-genocide rainfall in the village. The results are robust to controlling for rainfall on all other weekdays. Importantly, the coefficients for the other weekdays are small and insignificant.

Our results have important policy implications and are also relevant for other cases. In 2008, the Rwandan government reintroduced *Umuganda*. Our results show that these meetings can easily be abused and that caution is warranted, in particular since tension between the Tutsi and the Hutu is still present in Rwanda. Furthermore, similar practices have been installed in Burundi and are being discussed in the Democratic Republic of Congo (DRC). Both Burundi and the DRC have a long history of violent conflict along ethnic lines, which calls for caution when establishing an authoritarian institution such as mandatory community meetings.

Our paper contributes to the literature in several ways. First of all, it adds to the vast conflict literature. Blattman and Miguel (2010) give an excellent review of this literature, vehemently calling for well-identified studies on the roots of individual participation in violent conflict. This paper adds to the conflict literature by providing novel evidence on the strong effects that elite-level-controlled community meetings can have on preparing a population for genocide. Recent studies on the determinants of conflict and participation in violence consider institutions, government policy, income, foreign aid and propaganda (Besley and Persson, 2011; Dell, 2012; Dube and Vargas, 2013; Mitra and Ray, forthcoming; Nunn and Qian, forthcoming; Yanagizawa-Drott, 2013, respectively). Furthermore, our paper complements the literature on the Rwandan Genocide (Friedman, 2010; Straus, 2004; Verpoorten, 2012a-c; Verwimp, 2003, 2005, 2006; Yanagizawa-Drott, 2013) by providing novel evidence on its careful preparation. Thus, the study adds to results showing how Hutu unemployment and education (Friedman, 2013), propaganda through the RTLM hate radio (Yanagizawa-Drott, 2014), local state capacity (Heldring, 2014), and elite-supported armed groups (Rogall, 2014) affected civilian participation in the genocide.

On the methodology side, our findings speak to the recent discussion on the effects of rainfall on conflict other than through the income channel (Iyer and Topalova, 2014; Rogall, 2014; Sarsons, 2011). Prominent studies that use rainfall as an instrument for income in Africa include Brückner and Ciccone (2010), Chaney (2013) and Miguel, Satyanath and Sergenti (2004). Our results suggest that rainfall might have negative direct effects on conflict. Also, this paper's estimation strategy is similar to the ones used in Madestam et al. (2013) and Madestam and Yanagizawa-Drott (2011), who also use rainfall as a proxy or instrument for participation in outdoor events.

Our results are also in line with Satyanath, Voigtlaender and Voth (2013) which speak for a "dark side" of social capital, in contrast to several contributions highlighting its positive effects (Knack and Keefer, 1997; Grootaert and van Bastelaer, 2002; Guiso, Sapienza and Zingalez, 2008).

The remainder of the paper is organized as follows. Section 2 provides some background information on the Rwandan genocide. Section 3 presents the data used for the analysis and Section 4 lays out our empirical strategy. Section 5 presents the results and tests their robustness. Section 6 concludes with possible policy implications.

2 Background

2.1 A History of Conflict

A long chain of events lead up to the 1994 Rwandan genocide.[1] German and Belgian colonizers promoted the Tutsi minority and gave them supremacy over the Hutu majority.[2] This division created a strong tension between the two groups and culminated in the Rwandan revolution, or the Social revolution of 1959, where the Tutsi monarchy was dissolved in favor of a republic led by the Hutus. Many Tutsi civilians were killed; others fled Rwanda for neighboring countries such as Burundi, Tanzania and, in particular, Uganda. Thus, after gaining independence in 1962, Rwanda was ruled by a Hutu government. During the following decade the country faced several attacks from exiled Tutsi rebel groups with following Hutu retaliation.

In 1974 - paramount to the introduction of a modern version of *Umuganda* - Juvénal Habyarimana took power in Rwanda through a coup d'état. His subsequent rule was based on a pro-Hutu ideology ("Hutu power"), further discussed in the next section. During the same period, a rebel group called the Rwandan Patriotic Front (RPF) had emerged in exile, mostly comprised of Tutsi refugees. In October 1990, the RPF invaded Rwanda from Uganda, starting the Rwandan civil war. Fighting between the Hutu-led government and the Tutsi rebels continued until the Arusha Accords were signed in August 1993.[3] While a multi-party system had been installed in the early phase of the peace talks, this had little (or no) effect on reducing societal tension and conflict. In April 1994, President Habyarimana's plane was shot down over Kigali. This event is widely seen as the starting point of the Rwandan genocide, which was carried out during approximately 100 days, with the result of around 800,000 Tutsis and moderate Hutus being killed.

A vast number of civilian Hutus took part in the killings, directed by the interim government (Dallaire, 2005). In our sample, there are approximately 430,000 civilian perpetrators.

[1] For insightful accounts of this period, see for example Prunier (1995), Gouveritch (1998), Des Forges (1999), Dallaire (2003), Hatzfeld (2005, 2006) and Straus (2006).

[2] In the 1991 census data used in this paper, the average reported share of Hutus per commune is 87%

[3] The essence of this treaty was a power-sharing government, including representatives from both sides of the conflict.

2.2 Umuganda

The practice of *Umuganda* dates back to pre-colonial times. During a day of community-service, villagers would get together to build houses for those not able to, or help each other out on the fields in times of economic hardship such as sickness or death within families (Mukarubuga, 2006). Rather than being mandatory, *Umuganda* was initially considered a social obligation (Melvern, 2000). This changed during the the colonial period, when the Belgian colonizers used *Umuganda* for organizing compulsory work. Consistently, the local term for *Umuganda* was now *uburetwa*, or *forced labor* (IRDP 2003). All men had to provide communal work 60 days per year. Most of the manual labor was hereby carried out by members of the ethnic majority (Hutu) under the supervision of Tutsi chiefs (Pottier 2006): a first sign of *Umuganda's* potential to create a division between the two ethnic groups.

During the post-colonial era from 1974 onwards, the meaning of *Umuganda* changed again when the newly elected Hutu president Habyarimana turned it into a political doctrine (Mamdani, 2001). Verwimp (2000, pp. 344) cites Habyarimana:

> *The doctrine of our movement [Movement for Development, MRND] is that Rwanda will only be developed by the sum of the efforts of its people. That is why it has judged the collective work for development a necessary obligation for all inhabitants of the country.*

The program combined a practical motivation - achieving development objectives with weak state finances - with a strong ideological element. Participation was again compulsory through government coercion, and failure to participate usually involved paying a fine.[4] The local leaders of the neighborhood, the *nyumbakumi*, who preceded over a group of ten households, were responsible for the weekly *Umugandas* and had the power to decide who were to participate and to demand fines from those failing to participate (Verwimp, 2000). The state chose the projects on which at least one adult male per family had to work on *every* Saturday morning (Uvin, 1998). According to a report from 1986: 56% of the work performed during *Umuganda* was concerned with various types of anti-erosion measures, such as terracing and digging ditches; 15% was construction of communal buildings; 21% consisted in maintenance work of communal roads; 3% was related to construction of water supply systems, and another 3% was related to agriculture. In this period, *Umuganda* substantially contributed to Rwanda's GDP (Guichaoua 1991).

Habyarimana's ideology stressed the importance of the cultivator as the true Rwandan (Straus, 2006). This view clearly embraced the Hutu population with their history as cultivators, as opposed to the Tutsi who were said to be pastoralists. In fact, during the period leading up to the genocide, *Umuganda* was used to strengthen

[4] In today's Rwanda, the fine for not participating in *Umuganda* is slightly less than $10.

group cohesion within the "indigenous" ba-Hutu and marginalize the "non-indigenous" ba-Tutsi (Lawrence & Uwimbabazi 2013). The patriotic focus of *Umuganda* became particularly salient in the early 1990's when *"government propaganda gave no choice to Rwandans other than to attend* Umuganda *for political mobilization"* (Lawrence & Uwimbabazi 2013, pp. 253). Furthermore, "..*those who could not attend were regarded as enemies of the country who ran the risk of being brutalised and killed"* (ibid.).

Although little is known about the link between participation in *Umuganda* before the genocide and participation in violence during the genocide - a link which we hope to shed new light on in this paper - anecdotal evidence speaks to the importance of *Umuganda* as an instrument for local party and state officials to mobilize the peasant population. Verwimp (2013, pp. 40) notes:

> *Umuganda gave the local party and state officials knowledge and experience in the mobilization and control of the labor of the peasant population. A skill that [would] prove deadly during the genocide.*

Mobilization was relatively easy because all Rwandans of working age, be it farmers or intellectuals, were required to participate in *Umuganda* (Guichaoua ,1991). Although a correlation, Straus (2006) shows that 88 percent of the perpetrators he interviewed had taken part in *Umuganda* on a regular basis before the genocide broke out. The practice of *Umuganda* was also used during the genocide itself between April and mid-July 1994 when it was replaced by *gukorn akazi*, or "do the work", which meant the killing of Tutsis (Verwimp, 2013). Other slogans related to *Umuganda* used before the genocide such as "clearing bushes and removing bad weeds" now had a completely altered connotation (Lawrence & Uwimbabazi, 2013).

In 2008, the Tutsi-led government re-introduced *Umuganda* in Rwanda with the general aim to promote development and reduce poverty in the aftermath of the genocide (Uwimbabazi, 2012). Participation is again mandatory for all able-bodied individuals between 18 and 65 years of age, and typical tasks include cleaning streets, cutting grass and trimming bushes along roads, repairing public facilities or building houses for vulnerable persons on the last Saturday of every month.

3 Data

We combine several datasets from different sources to construct our final dataset, which comprises 1433 Rwandan sectors.[5]

[5]The focus of our analysis is the sector, which is the second smallest administrative level, and the level for which the outcome data on perpetrators is available. See Section 3.3 for a further discussion on matching the data.

3.1 Participation Rates

Our two key measures are participation in civilian violence and organized violence. Since no direct measure of participation rates is available, we use prosecution rates for crimes committed during the genocide as a proxy (Yanagizawa-Drott, 2014; Friedman, 2013; Heldring, 2014; Rogall, 2014). These data are taken from a nation-wide sector-level dataset, provided by the government agency ”National Service of Gacaca Jurisdiction”, which records the outcome of the almost 10.000 Gacaca courts set up all over the country. Depending on the role played by the accused and on the severity of the crime, two different categories of perpetrators are identified.

The first category which we refer to as ”organized participants” concerns: (i) planners, organizers, instigators, supervisors of the genocide; (ii) leaders at the national, provincial or district level, within political parties, army, religious denominations or militia; (iii) the well-known murderer who distinguished himself because of the zeal which characterized him in the killings or the excessive wickedness with which killings were carried out; (iv) people who committed rape or acts of sexual torture. These perpetrators mostly belonged to army and militia or were local leaders. There were approximately 77.000 people prosecuted in this category.

The second category which we refer to as ”civilian participants” concerns: (i) authors, co-authors, accomplices of deliberate homicides, or of serious attacks that caused someone’s death; (ii) the person who - with intention of killing - caused injuries or committed other serious violence, but without actually causing death; (iii) the person who committed criminal acts or became accomplice of serious attacks, without the intention of causing death. People accused in this category are not members of any of the organized groups listed for the first category and are thus considered to be civilians in this paper. Approximately 430.000 people were prosecuted in this category. As mentioned, the second category is our main outcome variable since civilian participation in the killings is more likely to have been affected by *Umuganda* than organized perpetrators.

The reliability of the prosecution data is a key issue for the analysis. One concern when using prosecution data instead of actual participation is the presence of survival bias: in those sectors with high participation rates, the violence might have been so widespread that no witnesses were left, or the few remaining too scared to identify and accuse the perpetrators, resulting in low prosecution rates. This concern is, however, unlikely to be warranted: Friedman (2013) shows that the Gacaca data is positively correlated with several other measures of violence from three different sources.[6] Furthermore, Friedman (2013, pp. 19-20) notes that *”the Gacaca courts have been very thorough in investigating, and reports of those afraid to speak are rare, so this data is likely to*

[6]These sources are a 1996 report from the Ministry of Higher Education, Scientific Research, and Culture (Kapiteni, 2006); the PRIO/Uppsala data on violent conflicts (Gleditsch et al, 2002); and a database of timing and lethality of conflict from Davenport and Stam (2007).

be a good proxy for the number of participants in each area". Nevertheless, to be cautious, in the following analysis we will show that our results are robust to dropping those sectors with mass graves (an indication of high death rates).

Another concern is that some of those prosecuted in the Gacaca courts committed their crimes not during the genocide, but rather during the period of civil war preceding the genocide (October 1990 until August 1993). Although the bulk of the crimes treated in the Gacaca courts concerns acts committed during the genocide, we cannot rule out that (a) some perpetrators may in fact have been accused for participation in massacres and other violence during the civil war (and not during the genocide), and (b) that individuals who had previously participated in violent acts during the civil war were more likely to have been recognized and trialled for genocide crimes than individuals who participated "only" in the genocide. In order to mitigate this concern, we also present results where we exclude communes where major violent events occurred during Oct 1990-Mar 1994 (Viret, 2010). We use only the acts of violence directed toward Tutsis since violent crimes by Tutsis directed toward Hutus were not trialled in the Gacaca courts (Human Rights Watch, 2011; Longman, 2009).

3.2 Rainfall Data

We use the recently released National Oceanic and Atmospheric Administration (NOAA) database of daily rainfall estimates, which stretches back to 1983, as a source of exogenous weather variation. The NOAA data relies on a combination of actual weather station gauge measures and satellite information on the density of cloud cover to derive rainfall estimates at 0.1-degree ($\sim$ 11 kilometers at the equator) latitude-longitude intervals. Considering the small size of Rwanda this high spatial resolution data, to our knowledge the only one available, is crucial to obtaining reasonable rainfall variation. Furthermore, the high temporal resolution, i.e. daily estimates, allows us to confine variation in rainfall to the exact days of *Umuganda*. Since Rwanda is a very hilly country there is considerable local variation in rainfall. Also, these sectors criss cross the various rainfall grids and each sector polygon is thus likely to overlap with more than one rainfall grid. The overall rainfall in each sector is thus obtained through a weighted average of the grids, where the weights are given by the relative areas covered by each grid.

To construct our main independent variable, we count the number of Saturdays a sector received more than 10 millimeter of rainfall during the period from October 1990 through March 1994. As a robustness check, we also use other thresholds, i.e. 5 mm, 7.5 mm, 8.9 mm, and 12.5 mm.[7] The same measures are created for all other weekdays during the same time period. Figure 2 in the Appendix shows the average number of Saturdays

[7] The threshold 8.9 mm corresponds to 0.35 inches, and is the same as the higher threshold used in Madestam et al. (2013). In the Appendix, Table 11, we also show that our results are robust to estimating a linear specification using average daily rainfall for Saturdays and all other weekdays as our main explanatory variables.

with rainfall above each of these different thresholds for each province.

3.3 Matching of data and summary statistics

The different data sets are matched by sector names within communes. Unfortunately, the matching is imperfect, as some sectors either have different names in different data sources, or use alternate spelling. It is not uncommon for two or more sectors within a commune to have identical names, which prevents successful matching. However, overall only about 5 percent of the sectors cannot be correctly matched across all sources. Furthermore, as these issues are idiosyncratic, the main implication for our analysis is lower precision in the estimates than otherwise would have been the case. Table 6 in the Appendix reports the summary statistics for our variables.

4 Empirical Strategy

To identify the effect of *Umuganda* meetings on participation in genocide violence, we use local variation in rainfall as a proxy. Since we lack data on the number of people participating in *Umuganda*, we will focus on the reduced form effect.

4.1 Identifying assumptions

Our identification strategy rests on two assumptions. First, sectors with heavier rainfall on Saturdays experienced fewer or less intensive *Umuganda* meetings (first stage). Second, conditional on our control variables, rainfall on Saturdays does not have a direct effect on genocide violence other than through the *Umuganda* meetings (exclusion restriction).

4.1.1 First Stage

Ideally, we would like to directly test a first stage relationship using data on the number of people participating in *Umuganda* before the genocide. Since such data does not exist, we will instead provide indirect evidence for expecting a strong first stage.

Several other studies have documented and exploited negative relationships between rainfall and participation in open-air events. The estimation strategy used in this paper is similar to the ones used in Madestam et al. (2013), and Madestam and Yanagizawa-Drott (2011). The first of these two studies evaluates the effect of the Tea Party movement's protests during Tax Day in the US on several policy outcomes, and instruments for lower participation using rainfall on that particular day. The second study uses rainfall during 4^{th} of July in the

US as a proxy for lower participation in the celebrations and estimates the effect of participation on political values and voting behavior later in life. In a similar vein Collins and Margo (2007) use rainfall in April 1968 as an instrument for participation in the riots that erupted in the US after Martin Luther King was murdered. Moreover, there are many studies which use rainfall and other weather phenomena for exogenous variation in voter turnout on election days (Gomez et al., 2007; Horiuchi and Saito, 2009; Hansford and Gomez, 2010; Fraga and Hersh, 2011; Eisinga et al., 2012). However, rain has an effect both on the direct cost of voting and on the opportunity cost of voting. Lind (2014) for example finds that voter turnout in Norway increases due to rain on the election day, explained by the lower opportunity cost of going to the polling station when weather is bad. The presence of such a mechanism is however highly unlikely when it comes to *Umuganda* due to its mandatory nature. Rather, rainfall would make the meetings and the work less productive or even lead to cancellations. Furthermore, the typical tasks carried out during *Umuganda* would have been hard to perform during heavy rainfall. The meetings, as well as the work, took place outside, and as mentioned above, the bulk of the tasks were related to landscaping, road maintenance, construction, and agriculture (Guichaoua, 1991).

Since we cannot know whether rainfall affected the extensive or the intensive margin of *Umuganda* meetings, we account for these possible nonlinearities by counting the number of Saturdays for which total rainfall was above a certain threshold. Varying these thresholds will give us an indication of whether rainfall lead to cancellations or rather made the meetings less enjoyable. On the one hand, if we see effects at low thresholds, it speaks to less enjoyable meetings. If, on the other hand, the effects set in only at higher levels, cancellations are more likely to be driving the results. Average daily rainfall in Rwanda is however low (see Table 6 in Appendix), which means that for very high thresholds, the variation will be too small to detect any effects.

4.1.2 Exclusion Restriction

Our empirical strategy relies on the counterfactual assumption that, absent the *Umuganda* meetings, rainfall on Saturdays had no effect on genocide violence. This is unlikely to be true without further precautions. Since rainfall affects agricultural output and this in turn has an important impact on socio-economic outcomes in a context like Rwanda where most of the population are subsistence farmers, our proxy is likely to be correlated with household income. Indeed, Friedman (2013) shows that socio-economic status is likely to affect genocide participation. In addition to affecting agricultural outcomes, heavy rainfall might destroy infrastructure such as roads or housing, which is also likely to affect households' economic well-being. Income, in return, potentially affects genocide participation as reasons for participating were often driven by material incentives and genocide perpetrators were given an opportunity to loot the property of the victims, or through enabling people to bribe themselves out of participating (Hatzfeld, 2005).

To address this problem, and to solely isolate the Saturday rainfall effect, we control for average daily rainfall during January 1984 through September 1990, and our period of interest: October 1990 - March 1994. Furthermore, we also control for rainfall on the other six weekdays. The absence of systematic, significant effects for other days than Saturdays would be a strong placebo test. To account for local characteristics we also add 142 commune indicators. Thus, the results shown only use local variation.

At this point, we still need to argue that no other events potentially happening parallel to *Umuganda* on Saturdays could be driving our results. In particular, one might worry that people meeting and interacting in general, e.g. during sports or music events, might affect participation in genocide violence. In the results section below, we will provide several tests alleviating this concern. First, we will show that neither rainfall on Sundays, the weekday when people traditionally meet in church, nor rainfall on public holidays, have an effect on genocide violence. Second, we will show that our results are robust to excluding villages in Kigali City, the capital. This is the most densely populated area of Rwanda and the economic and political center of the country, and therefore likely to have seen more public events.

4.2 Specifications

We run the following reduced-form regression to estimate the effect of *Umuganda* meetings on participation in genocide violence

$$\frac{P_{ic}}{H_{ic}} = \alpha + \beta \ \#Saturdays(rain > t \ mm) + \mathbf{X}_{ic}\pi + \gamma_c + \varepsilon_{ic} \tag{1}$$

where P_{ic}/H_{ic} is the share of Hutu prosecuted in either category 1 or category 2, i.e. our proxy for genocide violence in sector i in commune c. $\#Saturdays(rain > t \ mm)$ is our explanatory variable of interest: the number of Saturdays in October 1990-March 1994 with total rainfall above t mm. $\mathbf{X}_{ic}$ is a vector of sector-specific controls, including average daily rainfall January 1984-September 1990, average daily rainfall October 1990-March 1994, and the number of all other weekdays with rainfall above t mm during October 1990-March 1994. Finally, γ_c are commune indicators, and ε_{ic} is the error term. We allow the error terms to be correlated across sectors within the same commune by clustering the standard errors on commune level, and also use specifications where we allow for correlation across sectors within a 25, 50 and 75 km radius, following Conley (1999). Moreover, since the prosecution rates are heavily skewed to the right, we weight our observations based on total sector population size before the genocide, but our results do not rely on this weighting scheme.

Running a weighted least squares (WLS) regression, with the share of prosecuted Hutus as the dependent variable and population size as weights, the coefficient β will capture the percentage point change in genocide participation following an additional Saturday with rainfall above t mm. Our main specification uses 10 mm as a measure of heavy rainfall, but our results are robust to using other rainfall thresholds.

5 Results

5.1 Main Effects

The reduced-form relationship between the number of civilian perpetrators per Hutu and the number of Saturdays with rainfall above 10 mm in each sector is strongly negative and statistically significant at the one percent significance level (Column 1 in Table 1). This relationship holds when adding the number of other weekdays with rainfall above 10 mm as controls (Column 2 in Table 1). Regarding magnitude, one more Saturday with rainfall above 10 mm corresponds to a 0.43 percentage points reduction in the civilian participation rate. If we assume a one-to-one relationship between the number of rainy Saturdays and the number of canceled *Umuganda* meetings, then an additional canceled meeting reduces the average civilian participation rate by 5.6 percent (interpreted at the mean number of civilian perpetrators per Hutu, which is 7.7 percent). Reassuringly, none of the other weekdays is systematically and significantly related to violence.

The results for organized perpetrators are weaker. This is not surprising. Since this category (organized perpetrators) to a large extent consists of members of the militia, it is not clear that the sector where they committed their genocide crimes and were subsequently prosecuted is the same sector as the one where they lived before the genocide (October 1990-March 1994). This would potentially mean that they will not have been exposed to the same number of *Umugandas* as the inhabitants of that sector. If this is the case, it will have the same effect on our analysis as if our rainfall variables were measured with error and our estimate would suffer from attenuation bias.[8]

[8]Since our main focus in this paper is to examine if *Umuganda* can explain local variation in civilian violence, we will focus on this category in our following sensitivity analysis. The corresponding results for organized perpetrators can be found in the Appendix.

Table 1: Main Specification

Dependent variable:	Cat 2 per Hutu		Cat 1 per Hutu	
	(1)	(2)	(3)	(4)
Number Sat>10	-0.00426***	-0.00410***	-0.00067**	-0.00059**
	(0.00126)	(0.00128)	(0.00033)	(0.00030)
Number Sun>10		0.00037		-0.00040
		(0.00104)		(0.00031)
Number Mon>10		0.00079		0.00096***
		(0.00110)		(0.00031)
Number Tue>10		0.00019		-0.00049*
		(0.00085)		(0.00029)
Number Wed>10		0.00030		0.00003
		(0.00114)		(0.00028)
Number Thu>10		-0.00011		-0.00065
		(0.00134)		(0.00041)
Number Fri>10		-0.00056		0.00003
		(0.00096)		(0.00026)
Standard controls	yes	yes	yes	yes
Commune FE	yes	yes	yes	yes
R^2	0.52	0.52	0.36	0.37
N	1433	1433	1433	1433

* p<0.10, ** p<0.05, *** p<0.01.
Notes: Results from weighted least squares (WLS) estimation use population size as weights, and the number of perpetrators per Hutu as the dependent variable. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and 142 commune indicators. Robust standard errors in parentheses are adjusted for clustering at the commune level.

5.1.1 Sensitivity Check of Rainfall Threshold

To understand whether rainfall lead to cancellations, or rather made the *Umuganda* meetings less enjoyable, we vary the threshold in increments of 2.5 mm; from 5 mm to 12.5 mm. Following Madestam et al. (2013), we also use 0.35 inches (which corresponds to 8.9 mm) as a threshold. Table 2 reports the results for civilian participation. Rainfall on Saturdays is negatively related to civilian participation and significant at least at the 5 percent significance level for all thresholds above 5 mm, suggesting that it was rather cancellation that lead to a decrease in violence. Again, we find no other significant effects for other weekdays.

Table 2: Robustness - Different Rain Thresholds - Category 2

Dependent variable:	Cat 2 per Hutu				
Number rainy days above:	5mm	7.5mm	8.9mm	10mm	12.5mm
	(1)	(2)	(3)	(4)	(5)
Saturday	0.00025	-0.00297**	-0.00294**	-0.00410***	-0.00310**
	(0.00105)	(0.00126)	(0.00147)	(0.00128)	(0.00141)
Sunday	0.00029	0.00120	0.00150	0.00037	0.00039
	(0.00092)	(0.00105)	(0.00123)	(0.00104)	(0.00148)
Monday	0.00103	-0.00065	0.00082	0.00079	-0.00060
	(0.00120)	(0.00098)	(0.00106)	(0.00110)	(0.00133)
Tuesday	0.00079	-0.00118	0.00046	0.00019	0.00134
	(0.00120)	(0.00157)	(0.00097)	(0.00085)	(0.00130)
Wednesday	0.00002	-0.00070	0.00004	0.00030	-0.00147
	(0.00080)	(0.00105)	(0.00118)	(0.00114)	(0.00097)
Thursday	0.00094	-0.00061	0.00166	-0.00011	-0.00138
	(0.00113)	(0.00110)	(0.00131)	(0.00134)	(0.00113)
Friday	-0.00008	0.00088	-0.00059	-0.00056	-0.00260**
	(0.00081)	(0.00100)	(0.00101)	(0.00096)	(0.00102)
Standard controls	yes	yes	yes	yes	yes
Commune FE	yes	yes	yes	yes	yes
R^2	0.51	0.51	0.51	0.52	0.52
N	1433	1433	1433	1433	1433

* p<0.10, ** p<0.05, *** p<0.01.

Notes: Results from weighted least squares (WLS) estimation use population size as weights, and the number of category 2 perpetrators per Hutu as the dependent variable. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and commune indicators. Main explanatory variables are number of weekdays in Oct 1990-Mar 1994 with rainfall above 5, 8.9, 10, and 12.5 mm, respectively. Robust standard errors in parentheses are adjusted for clustering at the commune level.

5.2 Exclusion Restriction

Throughout our period of interest (1990-94), violent acts targeted at Tutsis and moderate Hutus were already taking place. If these pre-genocide perpetrators are included in the Gacaca data, and there is a relationship between rainfall before the genocide and targeted violence during this period, our estimates might be biased. To rule out that the estimates are not picking up the effects of rainfall in 1990-94 on events during the same time period, we exclude communes where targeted violence took place before the genocide, identified from Viret (2010). Reassuringly, our results for civilian participation are robust to excluding these pre-violence communes (Column 1 in Table 3).

In addition to this, there is a concern that our estimate is picking up other events that potentially also take place on Saturdays. While we cannot perfectly test that this is not the case, we perform several robustness checks aiming to exclude this possibility. First, as seen in Table 1, we find no significant effect for Sunday rainfall. Since people traditionally attend church on Sundays, this rules out that our effect is solely the result of people meeting and thus driven by events other than *Umuganda*. Second, in similar vein, when we rerun our main specification, but also control for the number of public holidays (excluding Saturdays since these might still be subject to *Umuganda*) with rainfall above 10 mm, the coefficient on Saturday rainfall remain significant and none of the coefficients on public holiday rainfall are statistically significant. This is true both when adding the total number of public holidays (column 2 in Table 3) and public holidays separated into religious and non-religious holidays (column 3 in Table 3). The estimated coefficients might appear large at first, however when expressed in term of standard-deviations the numbers are small. While a one-standard deviation increase in the number of rainy Saturdays reduces civilian violence by 1.7 percentage points, a one standard-deviation increase in the number of rainy public holidays reduces civilian violence only by 0.1 percentage points.

Table 3: Exclusion Restriction

Dependent variable:	Cat 2 per Hutu		
Sample:	Excl. Pre-Violence	Full Sample	
	(1)	(2)	(3)
Number Sat>10	-0.00483***	-0.00408***	-0.00391***
	(0.00148)	(0.00124)	(0.00121)
Number Sun>10	0.00051	0.00040	0.00045
	(0.00123)	(0.00105)	(0.00107)
Number Mon>10	0.00117	0.00081	0.00076
	(0.00127)	(0.00107)	(0.00107)
Number Tue>10	0.00002	0.00026	0.00036
	(0.00098)	(0.00097)	(0.00095)
Number Wed>10	-0.00023	0.00029	0.00030
	(0.00122)	(0.00115)	(0.00113)
Number Thu>10	0.00121	-0.00010	-0.00004
	(0.00153)	(0.00134)	(0.00134)
Number Fri>10	-0.00013	-0.00049	0.00007
	(0.00113)	(0.00115)	(0.00132)
Num Public Holidays >10		-0.00541	
		(0.02395)	
Num Non-Religious Public Holidays >10			-0.01340
			(0.01768)
Num Religious Public Holidays >10			-0.05314
			(0.03878)
Standard controls	yes	yes	yes
Commune FE	yes	yes	yes
R^2	0.49	0.52	0.52
N	1213	1433	1433

* p<0.10, ** p<0.05, *** p<0.01.

Notes: Results from weighted least squares (WLS) estimation use population size as weights, and the number of perpetrators per Hutu as dependent variable. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and commune indicators. Column 1 and 3 control for number of public holidays with rainfall above 10 mm, excluding public holidays that fell on a Saturday. Column 1 exclude communes where violent acts have been reported for the period Oct 1990-Mar 1994. Column 2 includes number of public holidays with rainfall above 10 mm during the same period, excluding those on a Saturday. Column 3 separately controls for the number of religious and non-religious public holidays with rainfall above 10 mm, excluding those on a Saturday. Robust standard errors in parentheses are adjusted for clustering at the commune level.

5.3 Robustness Checks

Next, we perform a number of robustness checks, all reported in Table 4. To make sure that our results are not driven by potential survival bias in the prosecution data, we exclude villages where mass graves have been found (since this is an indication of high death rates). We also exclude sectors in Kigali Ville. This is the province where the capital city of Rwanda, Kigali, is located. The coefficients on Saturday rainfall are virtually identical to our baseline results and similarly significant at 99 percent confidence (Columns 2-3 in Table 4).

Table 4: Robustness - Excl. Massgraves and Kigali Ville

Dependent variable:	Cat 2 per Hutu		
Sample:	Full Sample	Excl. Massgraves	Excl. Kigali Ville
	(1)	(2)	(3)
Number Sat>10	-0.00410***	-0.00403***	-0.00419***
	(0.00128)	(0.00130)	(0.00128)
Number Sun>10	0.00037	0.00051	0.00031
	(0.00104)	(0.00105)	(0.00104)
Number Mon>10	0.00079	0.00056	0.00078
	(0.00110)	(0.00106)	(0.00111)
Number Tue>10	0.00019	0.00072	0.00021
	(0.00085)	(0.00086)	(0.00086)
Number Wed>10	0.00030	0.00028	0.00019
	(0.00114)	(0.00109)	(0.00120)
Number Thu>10	-0.00011	-0.00013	0.00011
	(0.00134)	(0.00128)	(0.00128)
Number Fri>10	-0.00056	-0.00013	-0.00037
	(0.00096)	(0.00094)	(0.00099)
Standard controls	yes	yes	yes
Commune FE	yes	yes	yes
R^2	0.52	0.51	0.52
N	1433	1367	1422

* p<0.10, ** p<0.05, *** p<0.01.

Notes: Results from weighted least squares (WLS) estimation use population size as weights, and the number of perpetrators per Hutu as the dependent variable. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and commune indicators. Column 1 is our main specification for category 2 per Hutu. Column 2 exclude 66 sectors where at least one massgrave has been found. Column 3 exclude the 11 sectors in Kigali Ville, the province where the capital of Rwanda is located. Robust standard errors in parentheses are adjusted for clustering at the commune level.

Finally, as a placebo check, we re-estimate the reduced-form regressions by replacing pre-genocide rainfall with rainfall in the period of October 1994-March 1998 (from here on denoted post-genocide period), and by adding the post-genocide rainfall to our main specification. To account for possible seasonality in the rainfall data, we have chosen the exact same calendar period as our period of interest (i.e. October 1, 1990 until March 31, 1994). Table 5 reports the results. Reassuringly, we see that the coefficients on Saturdays are small and insignificant throughout.

Table 5: Placebo Rainfall Oct 1994-Mar 1998

Dependent variable:	Cat 2 per Hutu		
	(1)	(2)	(3)
Number Sat>10	-0.00410***		-0.00449***
	(0.00128)		(0.00126)
Number Sun>10	0.00037		0.00050
	(0.00104)		(0.00112)
Number Mon>10	0.00079		0.00111
	(0.00110)		(0.00101)
Number Tue>10	0.00019		0.00062
	(0.00085)		(0.00087)
Number Wed>10	0.00030		0.00058
	(0.00114)		(0.00136)
Number Thu>10	-0.00011		0.00054
	(0.00134)		(0.00144)
Number Fri>10	-0.00056		-0.00031
	(0.00096)		(0.00102)
Number Sat> 10 1994-1998		-0.00017	0.00002
		(0.00105)	(0.00109)
Number Sun> 10 1994-1998		0.00122	0.00101
		(0.00111)	(0.00109)
Number Mon> 10 1994-1998		-0.00275**	-0.00317**
		(0.00119)	(0.00140)
Number Tue> 10 1994-1998		-0.00155	-0.00101
		(0.00110)	(0.00106)
Number Wed> 10 1994-1998		-0.00173	-0.00237
		(0.00153)	(0.00156)
Number Thu> 10 1994-1998		-0.00125	-0.00115
		(0.00125)	(0.00129)
Number Fri> 10 1994-1998		0.00121	0.00197*
		(0.00110)	(0.00102)
Standard controls	yes	yes	yes
Commune FE	yes	yes	yes
R^2	0.52	0.51	0.52
N	1433	1433	1433

* p<0.10, ** p<0.05, *** p<0.01.
Notes: Results from weighted least squares (WLS) estimation use population size as weights, and the number of perpetrators per Hutu as the dependent variable. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and commune indicators. Column 1 is our main specification for category 2. Column 2 instead uses number of weekdays with rainfall above 10 mm during *Oct 1994-Mar 1998* as the main explanatory variables. Column 3 adds the number of weekdays with rainfall above 10 mm during Oct 1994-Mar 1998 as additional control to our main specification. Robust standard errors in parentheses are adjusted for clustering at the commune level.

6 Discussion and Conclusion

Using rainfall on the day of the mandatory community-work meeting *Umuganda* as a proxy for lower intensity in the meetings at the sector level, we find that less intensity in community work decreased the share of civilian perpetrators in the Rwandan genocide by around five per cent. Our results suggest that the political elites in Rwanda used local-level community meetings to make civilians participate in extraordinary violence. This finding is important for several reasons.

First, a large number of civilians took part in the killings during the Rwandan genocide. It is a common understanding that the genocide was centrally planned and organized. The link between the planning and the wide acceptance of the genocide among the civilian population has however not been much explored, and our paper sheds new light on an important channel.

Second, people getting together to create public goods would foster a sense of belonging and create social capital, generally viewed as positive for development and community building (see for example Knack and Keefer, 1997; Grootaert and van Bastelaer, 2002; Guiso, Sapienza and Zingalez, 2008). As emphasized by Putnam (2000), social capital can bridge the divides in a society. However, similar to Satyanath, Voigtlaender and Voth (2013) who find that a higher density of civic associations in interwar German cities lead to a faster entry by the Nazi Party, we also show evidence of a ”dark side” of social capital. Thus, although the institution of *Umuganda* may have the potential to act as a community building force, our results show that when placed in the wrong hands its effects could become disastrous.

The more optimistic view of this institution might explain why the current Rwandan government reinstalled *Umuganda* in 2008. Indeed, the official statements about *Umuganda* emphasize values such as ”solidarity” and ”reconciliation”, and the practice is said to contribute to fostering a sense of community. These mandatory work days are now held monthly, on the last Saturday of every month. A similar practice is also present in Burundi and is being discussed in DR Congo. Our analysis clearly shows that caution is warranted, perhaps especially in countries with a long history of ethnic tension.

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7 Appendix

7.1 Summary Statistics

Table 6: Summary Statistics

	Mean	Std. Dev	Min	Max
Perpetrators				
Number of Category 2	290	286	0	2807
Number of Category 1	52	71	0	1145
No Perpetrators (=1)	0.05	0.223	0	1
No Category 2 Perpetrators (=1)	0.06	0.231	0	1
No Category 1 Perpetrators (=1)	0.11	0.318	0	1
Population				
Population in Sector 1991	4880	2481	555	32686
Hutu share in Commune (pct) 1991	0.87	0.087	0.49	0.98
Violence				
Pre-Genocide violence (=1)	0.15	0.361	0	1
Massgrave in Sector (=1)	0.05	0.210	0	1
Rainfall				
Avg Daily Rain Jan 1984-Sep 1990 (mm)	2.55	0.480	1.72	4.07
Avg Daily Rain Oct 1990-Mar 1994 (mm)	2.44	0.546	1.48	4.05
Number Sat Rain $>$10 mm	18.25	4.244	11	32
Number Sun Rain $>$10 mm	15.14	5.192	5	33
Number Mon Rain $>$10 mm	15.13	4.216	6	29
Number Tue Rain $>$10 mm	18.10	3.523	9	31
Number Wed Rain $>$10 mm	20.51	4.760	12	35
Number Thu Rain $>$10 mm	21.53	3.972	15	37
Number Fri Rain $>$10 mm	17.02	4.755	5	32
Num Public Holidays Rain $>$10 mm	0.85	0.197	0.556	1.369
Num Non-Religious Public Holidays Rain $>$10 mm	1.56	0.208	1.2	2.2
Num Religious Public Holidays Rain $>$10 mm	0.10	0.115	0.8	1.4
Administration				
Num of Sectors in Commune	11	3.7	6	27
Observations				
Sectors	1433			
Communes	142			
Provinces	11			

Figure 1: Distribution of Perpetrators per Hutu

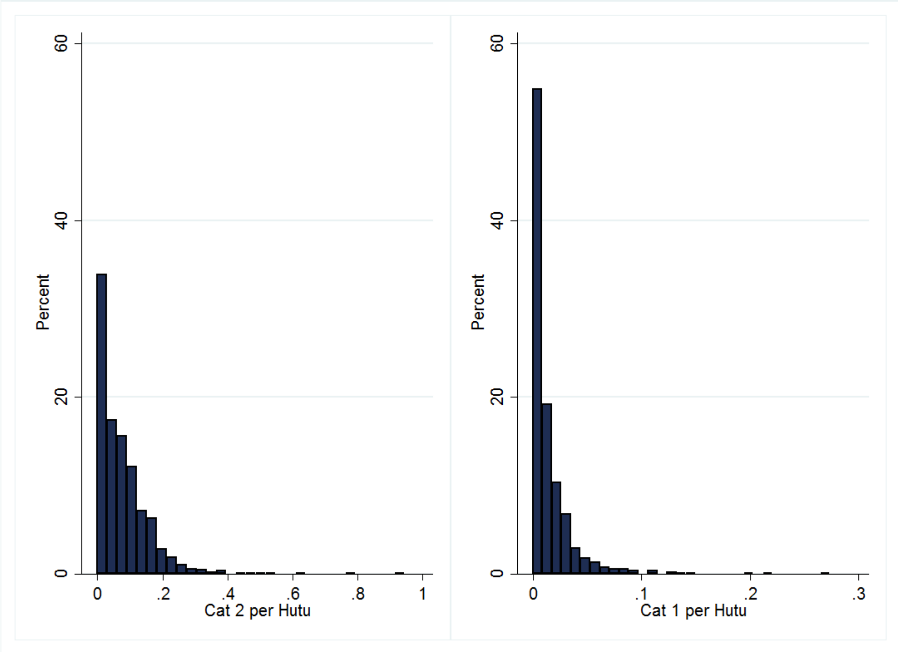
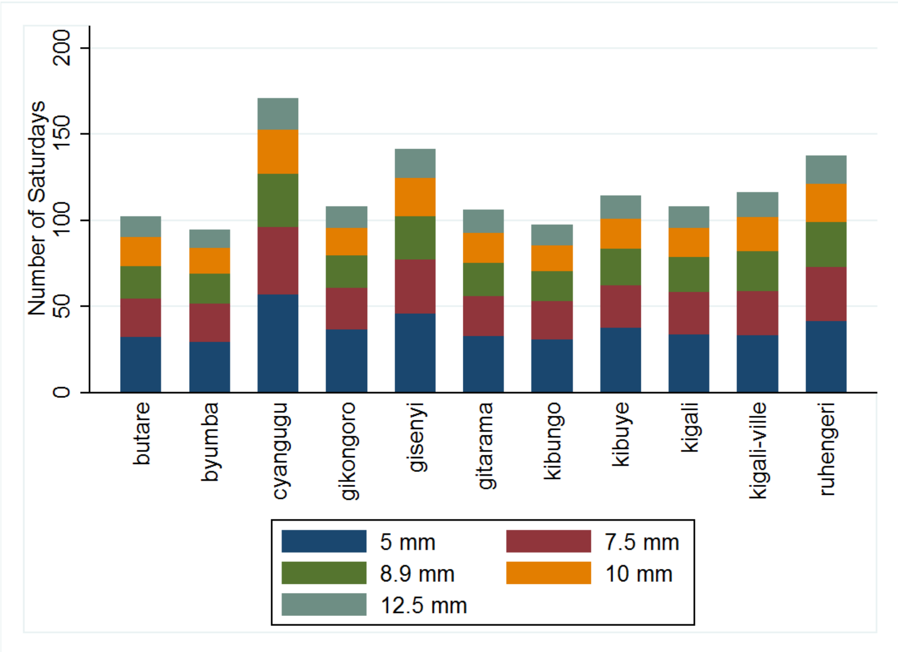


Figure 2: Number of Saturdays above *t* mm of Rain, Province Averages



7.2 Sensitivity Analysis for Category 1

Tables 7-10 report our sensitivity analyses for organized participation (category 1). As mentioned earlier, we expect this estimation to be less precise since the variation in this category is much lower than for civilian participation (category 2). Also, it is not clear that a large part of the prosecuted in category 1 actually lived in the sector where they where prosecuted, and hence would then not have been exposed to the same number of *Umuganda* meetings as the inhabitants of that sector. This is equivalent to having measurement error in the Saturday rainfall variable, and we therefore expect the estimation for organized participation to suffer from attenuation bias. Across specifications, the coefficients on Saturday rainfall is negative, but as expected, the magnitude is small and the significance level varies.

7.2.1 Sensitivity Check of Rainfall Threshold

Table 7: Robustness - Different Rain Thresholds - Category 1

Dependent variable:	Cat 1 per Hutu				
Number rainy days above:	5mm	7.5mm	8.9mm	10mm	12.5mm
	(1)	(2)	(3)	(4)	(5)
Saturday	0.00005	-0.00031	-0.00040	-0.00059**	-0.00067*
	(0.00028)	(0.00028)	(0.00030)	(0.00030)	(0.00035)
Sunday	0.00003	0.00007	-0.00010	-0.00040	-0.00019
	(0.00025)	(0.00035)	(0.00033)	(0.00031)	(0.00039)
Monday	0.00035	0.00039	0.00058**	0.00096***	0.00032
	(0.00027)	(0.00028)	(0.00026)	(0.00031)	(0.00030)
Tuesday	0.00025	0.00030	0.00009	-0.00049*	0.00029
	(0.00028)	(0.00026)	(0.00028)	(0.00029)	(0.00041)
Wednesday	0.00002	0.00007	-0.00023	0.00003	-0.00018
	(0.00027)	(0.00024)	(0.00040)	(0.00028)	(0.00039)
Thursday	0.00018	-0.00005	-0.00025	-0.00065	-0.00031
	(0.00022)	(0.00037)	(0.00038)	(0.00041)	(0.00045)
Friday	0.00012	0.00037	-0.00008	0.00003	-0.00028
	(0.00022)	(0.00031)	(0.00030)	(0.00026)	(0.00034)
Standard controls	yes	yes	yes	yes	yes
Commune FE	yes	yes	yes	yes	yes
R^2	0.36	0.36	0.36	0.37	0.36
N	1433	1433	1433	1433	1433

* p<0.10, ** p<0.05, *** p<0.01.

Notes: Results from weighted least squares (WLS) estimation use population size as weights, and the number of category 1 perpetrators per Hutu as the dependent variable. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and commune indicators. Main explanatory variables are number of weekdays in Oct 1990-Mar 1994 with rainfall above 5, 8.9, 10, and 12.5 mm, respectively. Robust standard errors in parentheses are adjusted for clustering at the commune level.

7.2.2 Exclusion Restriction

Table 8: Exclusion Restriction

Dependent variable:	Cat 1 per Hutu		
Sample:	Excl. Pre-Violence	Full Sample	
	(1)	(2)	(3)
Number Sat>10	-0.00051	-0.00054*	-0.00055*
	(0.00032)	(0.00028)	(0.00029)
Number Sun>10	-0.00023	-0.00033	-0.00036
	(0.00038)	(0.00031)	(0.00030)
Number Mon>10	0.00103***	0.00101***	0.00101***
	(0.00032)	(0.00031)	(0.00031)
Number Tue>10	-0.00061*	-0.00035	-0.00035
	(0.00031)	(0.00029)	(0.00031)
Number Wed>10	0.00002	0.00001	0.00002
	(0.00029)	(0.00029)	(0.00029)
Number Thu>10	-0.00032	-0.00063	-0.00062
	(0.00040)	(0.00043)	(0.00041)
Number Fri>10	0.00031	0.00016	0.00025
	(0.00026)	(0.00028)	(0.00030)
Num Public Holidays >10		-0.01045*	
		(0.00556)	
Num Non-Religious Public Holidays >10			-0.00773**
			(0.00357)
Num Religious Public Holidays >10			-0.00829
			(0.00872)
Standard controls	yes	yes	yes
Commune FE	yes	yes	yes
R^2	0.36	0.37	0.37
N	1213	1433	1433

* p<0.10, ** p<0.05, *** p<0.01.

Notes: Results from weighted least squares (WLS) estimation use population size as weights, and the number of perpetrators per Hutu as dependent variable. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and commune indicators. Column 1 and 3 control for number of public holidays with rainfall above 10 mm, excluding public holidays that fell on a Saturday. Column 1 exclude communes where violent acts have been reported for the period Oct 1990-Mar 1994. Column 2 includes number of public holidays with rainfall above 10 mm during the same period, excluding those on a Saturday. Column 3 separately controls for the number of religious and non-religious public holidays with rainfall above 10 mm, excluding those on a Saturday. Robust standard errors in parentheses are adjusted for clustering at the commune level.

7.2.3 Robustness check

Table 9: Robustness - Excl. Massgraves and Kigali Ville

Dependent variable:	Cat 1 per Hutu		
Sample:	Full Sample	Excl. Massgraves	Excl. Kigali Ville
	(1)	(2)	(3)
Number Sat>10	-0.00059**	-0.00048*	-0.00061**
	(0.00030)	(0.00028)	(0.00030)
Number Sun>10	-0.00040	-0.00030	-0.00041
	(0.00031)	(0.00031)	(0.00032)
Number Mon>10	0.00096***	0.00084***	0.00096***
	(0.00031)	(0.00028)	(0.00031)
Number Tue>10	-0.00049*	-0.00039	-0.00049
	(0.00029)	(0.00030)	(0.00030)
Number Wed>10	0.00003	0.00007	0.00002
	(0.00028)	(0.00028)	(0.00030)
Number Thu>10	-0.00065	-0.00063	-0.00062
	(0.00041)	(0.00041)	(0.00040)
Number Fri>10	0.00003	0.00012	0.00006
	(0.00026)	(0.00025)	(0.00027)
Standard controls	yes	yes	yes
Commune FE	yes	yes	yes
R^2	0.37	0.37	0.37
N	1433	1367	1422

* $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Notes: Results from weighted least squares (WLS) estimation use population size as weights, and the number of perpetrators per Hutu as the dependent variable. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and commune indicators. Column 1 is our main specification for category 1 per Hutu. Column 2 excludes 66 sectors where at least one mass-grave has been found. Column 3 excludes the 11 sectors in Kigali Ville, the province where the capital of Rwanda is located. Robust standard errors in parentheses are adjusted for clustering at the commune level.

7.2.4 Placebo check

Table 10: Placebo Rainfall Oct 1994-Mar 1998

Dependent variable:	Cat 1 per Hutu		
	(1)	(2)	(3)
Number Sat>10	-0.00059**		-0.00070**
	(0.00030)		(0.00030)
Number Sun>10	-0.00040		-0.00035
	(0.00031)		(0.00030)
Number Mon>10	0.00096***		0.00102***
	(0.00031)		(0.00032)
Number Tue>10	-0.00049*		-0.00040
	(0.00029)		(0.00030)
Number Wed>10	0.00003		0.00008
	(0.00028)		(0.00027)
Number Thu>10	-0.00065		-0.00054
	(0.00041)		(0.00040)
Number Fri>10	0.00003		0.00016
	(0.00026)		(0.00026)
Number Sat> 10 1994-1998		0.00000	0.00013
		(0.00027)	(0.00028)
Number Sun> 10 1994-1998		0.00076**	0.00073**
		(0.00033)	(0.00031)
Number Mon> 10 1994-1998		-0.00062*	-0.00060**
		(0.00033)	(0.00030)
Number Tue> 10 1994-1998		0.00038	0.00042
		(0.00040)	(0.00036)
Number Wed> 10 1994-1998		-0.00024	-0.00034
		(0.00037)	(0.00034)
Number Thu> 10 1994-1998		-0.00023	-0.00027
		(0.00034)	(0.00034)
Number Fri> 10 1994-1998		0.00037	0.00048*
		(0.00027)	(0.00025)
Standard controls	yes	yes	yes
Commune FE	yes	yes	yes
R^2	0.37	0.36	0.38
N	1433	1433	1433

* p<0.10, ** p<0.05, *** p<0.01.

Notes: Results from weighted least squares (WLS) estimation use population size as weights, and the number of perpetrators per Hutu as the dependent variable. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and commune indicators. Column 1 is our main specification for category 1 per Hutu. Column 2 uses number of weekdays with rainfall above 10 mm during Oct 1994-Mar 1998 as main explanatory variables. Column 3 adds the number of weekdays with rainfall above 10 mm during Oct 1994-Mar 1998 as additional controls to our main specification. Robust standard errors in parentheses are adjusted for clustering at the commune level.

7.3 Additional Sensitivity Analysis for Category 1 and 2

Table 11 shows the result of a linear specification using average daily rainfall on Saturdays October 1990-March 1994 as the main explanatory variable, controlling for average daily rainfall on all other weekdays during the same period, average daily rainfall in January 1984-September 1990, and 142 commune indicators. The point estimate on Saturday rainfall for civilian violence suggests that the participation rate, on average, decreased by 4.1 percentage points for each additional mm of rainfall. This effect appears large, but comes from the fact that the mean and variance of average daily rainfall on Saturdays are low (2.4 mm with a standard deviation of 0.6 mm). A one standard deviation increase in average rainfall on Saturdays, is estimated to reduce the average civilian participation rate by 2.5 percentage points.

Table 12 reports the results from unweighted OLS regressions with clustered standard errors on commune level (column 1-2), and with standard errors allowing for spatial correlation within a certain radius of the sector following Conley (1999) (column 3-8). Results are presented using a radius of 25km, 50km, and 75km, respectively. The statistical significance of the coefficient on Saturday rainfall is stronger for civilian participation for all three radii compared to using robust standard errors adjusted for clustering on commune level. For organized participation, the statistical significance of the point estimate of Saturday rainfall is more sensitive to choice of radius.

Table 13 reports the results of estimating our main specifications for civilian and organized participation using unweighted OLS, with and without clustered standard errors. The results are basically unchanged.

As a final robustness check, Table 14-16 report the results of separately excluding areas with pre-genocide violence (column 2), including public holidays (column 3), excluding areas with massgraves (column 4), and excluding sectors in Kigali Ville (column 5), using the number of weekdays with rainfall above 7.5 mm, 8.9 mm, and 12.5 mm, respectively, as the main explanatory variables. The point estimates for the number of Saturdays with rainfall above these different thresholds are basically the same across all thresholds and robustness checks.

Table 11: Linear Specification

Dependent variable:	Cat 2 per Hutu	Cat 1 per Hutu
	(1)	(2)
Avg rain Sat	-0.04088**	-0.00562
	(0.01604)	(0.00353)
Avg rain Sun	0.00522	-0.00181
	(0.01863)	(0.00475)
Avg rain Mon	0.00296	0.00500
	(0.01534)	(0.00434)
Avg rain Tue	0.01357	0.00277
	(0.01321)	(0.00427)
Avg rain Wed	0.01707	-0.00100
	(0.01437)	(0.00300)
Avg rain Thu	-0.00091	-0.00056
	(0.01071)	(0.00279)
Avg rain Fri	0.00250	-0.00007
	(0.01010)	(0.00233)
Standard controls	yes	yes
Commune FE	yes	yes
R^2	0.51	0.36
N	1433	1433

* p<0.10, ** p<0.05, *** p<0.01.

Notes: Results from weighted least squares (WLS) estimation use population size as weights, and the number of perpetrators per Hutu as the dependent variable. All models include average daily rainfall Jan 1984-Sep 1990, and 142 commune indicators. Robust standard errors in parentheses are adjusted for clustering at the commune level.

Table 12: Robustness check - Conley Standard Errors

Model:	OLS with Clustered SE		OLS with Conley SE					
Dependent variable:	Cat 2 per Hutu	Cat 1 per Hutu	Cat 2 per Hutu			Cat1 per Hutu		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Number Sat>10	-0.00382**	-0.00055	-0.00382***	-0.00382***	-0.00382***	-0.00055	-0.00055*	-0.00055**
	(0.00153)	(0.00038)	(0.00129)	(0.00135)	(0.00135)	(0.00035)	(0.00030)	(0.00027)
Number Sun>10	0.00052	-0.00035	0.00052	0.00052	0.00052	-0.00035	-0.00035	-0.00035
	(0.00124)	(0.00036)	(0.00099)	(0.00090)	(0.00082)	(0.00032)	(0.00033)	(0.00031)
Number Mon>10	0.00139	0.00117***	0.00139	0.00139	0.00139	0.00117***	0.00117***	0.00117***
	(0.00117)	(0.00036)	(0.00097)	(0.00109)	(0.00110)	(0.00034)	(0.00038)	(0.00041)
Number Tue>10	0.00063	-0.00053	0.00063	0.00063	0.00063	-0.00053*	-0.00053*	-0.00053**
	(0.00092)	(0.00033)	(0.00105)	(0.00119)	(0.00114)	(0.00029)	(0.00028)	(0.00026)
Number Wed>10	0.00078	0.00005	0.00078	0.00078	0.00078	0.00005	0.00005	0.00005
	(0.00128)	(0.00037)	(0.00108)	(0.00093)	(0.00088)	(0.00029)	(0.00024)	(0.00021)
Number Thu>10	0.00018	-0.00048	0.00018	0.00018	0.00018	-0.00048	-0.00048	-0.00048
	(0.00152)	(0.00049)	(0.00126)	(0.00136)	(0.00150)	(0.00036)	(0.00036)	(0.00034)
Number Fri>10	-0.00047	0.00000	-0.00047	-0.00047	-0.00047	0.00000	0.00000	0.00000
	(0.00118)	(0.00032)	(0.00112)	(0.00105)	(0.00091)	(0.00027)	(0.00029)	(0.00029)
Standard controls	yes	yes	yes	yes	yes	yes	yes	yes
Commune FE	yes	yes	yes	yes	yes	yes	yes	yes
Radius			25 km	50 km	75 km	25 km	50 km	75 km
N	1433	1433	1433	1433	1433	1433	1433	1433

*significant at 10 percent, **significant at 5 percent, ***significant at 1 percent.

Notes: Column 2-3 report the results from ordinary least squares (OLS) estimation without population weights, using the number of perpetrators per Hutu as dependent variable, and robust standard errors in parentheses are adjusted for clustering at the commune level. Column 4-6 report the results from OLS estimation with Conley standard errors allowing for spatial correlation within a radius of 25, 50 and 75 km respectively, using Cat 2 per Hutu as the dependent variable. Column 7-9 report the results from OLS estimation with Conley standard errors for the same three radii, using Cat 1 per Hutu as the dependent variable. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and 142 commune indicators.

Table 13: Robustness check - Unweighted OLS with and without Clustered SE

Model:	Unweighted OLS		Unweighted OLS no clustering	
Dependent variable:	Cat 2 per Hutu	Cat 1 per Hutu	Cat 2 per Hutu	Cat 1 per Hutu
	(1)	(2)	(3)	(4)
Number Sat>10	-0.00382**	-0.00055	-0.00382***	-0.00055
	(0.00153)	(0.00038)	(0.00126)	(0.00035)
Number Sun>10	0.00052	-0.00035	0.00052	-0.00035
	(0.00124)	(0.00036)	(0.00111)	(0.00031)
Number Mon>10	0.00139	0.00117***	0.00139	0.00117***
	(0.00117)	(0.00036)	(0.00100)	(0.00034)
Number Tue>10	0.00063	-0.00053	0.00063	-0.00053*
	(0.00092)	(0.00033)	(0.00090)	(0.00031)
Number Wed>10	0.00078	0.00005	0.00078	0.00005
	(0.00128)	(0.00037)	(0.00107)	(0.00033)
Number Thu>10	0.00018	-0.00048	0.00018	-0.00048
	(0.00152)	(0.00049)	(0.00104)	(0.00034)
Number Fri>10	-0.00047	0.00000	-0.00047	0.00000
	(0.00118)	(0.00032)	(0.00103)	(0.00027)
Standard controls	yes	yes	yes	yes
Commune FE	yes	yes	yes	yes
R^2	0.48	0.37	0.48	0.37
N	1433	1433	1433	1433

* p<0.10, ** p<0.05, *** p<0.01.

Notes: Column 2-3 report the results from ordinary least squares (OLS) estimation without population weights, using the number of perpetrators per Hutu as the dependent variable. Robust standard errors are adjusted for clustering at commune level. Column 3-4 report the same results as in Column 1-2 with the only difference that the robust standard errors in parentheses are not adjusted for clustering at the commune level. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and 142 commune indicators.

Table 14: Robustness checks for threshold 7.5 mm

Dependent variable:	Cat 2 per Hutu				
	Full Sample	Excl. pre-vio	Incl. pub. hol.	Excl. mass grave	Excl. Kigali Ville
	(1)	(2)	(3)	(4)	(5)
Number Sat>7.5	-0.00297**	-0.00300*	-0.00294**	-0.00291**	-0.00295**
	(0.00126)	(0.00161)	(0.00122)	(0.00133)	(0.00124)
Number Sun>7.5	0.00120	0.00061	0.00120	0.00129	0.00089
	(0.00105)	(0.00126)	(0.00105)	(0.00109)	(0.00100)
Number Mon>7.5	-0.00065	-0.00038	-0.00063	-0.00101	-0.00053
	(0.00098)	(0.00113)	(0.00098)	(0.00101)	(0.00099)
Number Tue>7.5	-0.00118	-0.00117	-0.00116	-0.00048	-0.00129
	(0.00157)	(0.00174)	(0.00157)	(0.00154)	(0.00154)
Number Wed>7.5	-0.00070	-0.00044	-0.00076	-0.00033	-0.00070
	(0.00105)	(0.00119)	(0.00110)	(0.00102)	(0.00104)
Number Thu>7.5	-0.00061	0.00037	-0.00067	-0.00077	-0.00068
	(0.00110)	(0.00129)	(0.00115)	(0.00108)	(0.00109)
Number Fri>7.5	0.00088	0.00123	0.00089	0.00098	0.00083
	(0.00100)	(0.00117)	(0.00101)	(0.00108)	(0.00099)
Num Public Holidays >10			-0.00783		
			(0.02266)		
R^2	0.51	0.49	0.51	0.51	0.51
N	1433	1213	1433	1367	1422

* p<0.10, ** p<0.05, *** p<0.01.

Notes: Results from weighted least squares (WLS) estimation use population size as weights, and the number of category 2 perpetrators per Hutu as the dependent variable. The rainfall measures are the number of weekdays with daily rainfall above 7.5 mm in the period Oct 1990-Mar 1994. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and 142 commune indicators. Robust standard errors in parentheses are adjusted for clustering at the commune level.

Table 15: Robustness checks for threshold 8.9 mm

Dependent variable:	Cat 2 per Hutu				
	Full Sample	Excl. pre-vio	Incl. pub. hol.	Excl. mass grave	Excl. Kigali Ville
	(1)	(2)	(3)	(4)	(5)
Number Sat>8.89	-0.00294**	-0.00281	-0.00290**	-0.00291**	-0.00297**
	(0.00147)	(0.00182)	(0.00141)	(0.00144)	(0.00150)
Number Sun>8.89	0.00150	0.00067	0.00155	0.00171	0.00143
	(0.00123)	(0.00142)	(0.00131)	(0.00126)	(0.00122)
Number Mon>8.89	0.00082	0.00128	0.00084	0.00053	0.00090
	(0.00106)	(0.00124)	(0.00104)	(0.00108)	(0.00108)
Number Tue>8.89	0.00046	0.00067	0.00053	0.00098	0.00039
	(0.00097)	(0.00118)	(0.00102)	(0.00101)	(0.00093)
Number Wed>8.89	0.00004	-0.00023	0.00000	-0.00009	0.00001
	(0.00118)	(0.00141)	(0.00121)	(0.00111)	(0.00116)
Number Thu>8.89	0.00166	0.00310*	0.00163	0.00158	0.00144
	(0.00131)	(0.00159)	(0.00131)	(0.00127)	(0.00129)
Number Fri>8.89	-0.00059	-0.00032	-0.00054	-0.00029	-0.00051
	(0.00101)	(0.00122)	(0.00111)	(0.00102)	(0.00101)
Num Public Holidays >10			-0.00779		
			(0.02295)		
R^2	0.51	0.49	0.51	0.51	0.51
N	1433	1213	1433	1367	1422

* p<0.10, ** p<0.05, *** p<0.01.
Notes: Results from weighted least squares (WLS) estimation use population size as weights, and the number of category 2 perpetrators per Hutu as the dependent variable. The rainfall measures are the number of weekdays with daily rainfall above 8.9 mm in the period Oct 1990-Mar 1994. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and 142 commune indicators. Robust standard errors in parentheses are adjusted for clustering at the commune level.

Table 16: Robustness checks for threshold 12.5 mm

Dependent variable:	Cat 2 per Hutu				
	Full Sample	Excl. pre-vio	Incl. pub. hol.	Excl. mass grave	Excl. Kigali Ville
	(1)	(2)	(3)	(4)	(5)
Number Sat>12.5	-0.00310**	-0.00354**	-0.00320**	-0.00308**	-0.00321**
	(0.00141)	(0.00170)	(0.00136)	(0.00141)	(0.00142)
Number Sun>12.5	0.00039	0.00046	0.00035	0.00031	-0.00010
	(0.00148)	(0.00173)	(0.00149)	(0.00150)	(0.00159)
Number Mon>12.5	-0.00060	-0.00040	-0.00068	-0.00042	-0.00051
	(0.00133)	(0.00154)	(0.00132)	(0.00121)	(0.00144)
Number Tue>12.5	0.00134	0.00083	0.00134	0.00165	0.00144
	(0.00130)	(0.00144)	(0.00130)	(0.00135)	(0.00130)
Number Wed>12.5	-0.00147	-0.00157	-0.00151	-0.00140	-0.00173
	(0.00097)	(0.00111)	(0.00095)	(0.00094)	(0.00112)
Number Thu>12.5	-0.00138	-0.00107	-0.00147	-0.00162	-0.00145
	(0.00113)	(0.00128)	(0.00113)	(0.00120)	(0.00120)
Number Fri>12.5	-0.00260**	-0.00309**	-0.00272**	-0.00228**	-0.00256**
	(0.00102)	(0.00136)	(0.00111)	(0.00102)	(0.00107)
Num Public Holidays >10			0.00916		
			(0.02239)		
R^2	0.52	0.49	0.52	0.51	0.51
N	1433	1213	1433	1367	1422

* p<0.10, ** p<0.05, *** p<0.01.

Notes: Results from weighted least squares (WLS) estimation use population size as weights, and the number of category 2 perpetrators per Hutu as the dependent variable. The rainfall measures are the number of weekdays with daily rainfall above 12.5 mm in the period Oct 1990-Mar 1994. All models include average daily rainfall Jan 1984-Sep 1990, average daily rainfall Oct 1990-Mar 1994, and 142 commune indicators. Robust standard errors in parentheses are adjusted for clustering at the commune level.