PRELIMINARY DRAFT - DO NOT CITE

DROUGHTS OF DISMAY: RAINFALL AND ASSASSINATIONS IN ANCIENT ROME

CORNELIUS CHRISTIAN† AND LIAM ELBOURNE⋆

Abstract. We find that low rainfall in north-central Europe (Gaul/Germania) predicts assassinations of Roman emperors from 27 BC to 476 AD. Due to agricultural pressures on Germanic tribes, low precipitation caused more barbarian raids. These raids, in turn, weakened the Empire's overall political stability, and reduced the costs of assassinating an emperor. We buttress our empirical analysis with case study evidence.

†Brock University
⋆St. Francis Xavier University
E-mail addresses: cchristian2@brocku.ca.
Date: October 2017.
Michael Carter, Andrew Dickens, and Matthias Lalisse provided helpful comments. Any errors are our own.

Uneasy lies the head that wears the crown.

- William Shakespeare, Henry IV, Part 2

1. Introduction

Roman historian Kyle Harper (2016) claims that hardly any research has been conducted into how environmental change hastened the Fall of the Roman Empire. Harper himself has helped to remedy this lack of understanding (Harper, forthcoming). However, the question of how the environment, weather, and climate played into Roman political mechanisms, more generally, has been ill understood.

We fill this gap, partially, by examining assassinations of Roman emperors. The Roman Empire, which lasted from 27 BC to 476 AD had a total of 82 emperors.[1] It therefore provides a rich historical database from which to draw inferences. Morever, assassinations were not altogether rare: roughly 20% of emperors were killed, and about 5% of years involved an emperor's murder.

We find that lower rainfall in northern provinces, in Gaul and Germania, increases the likelihood of Roman emperor assassination. A standard deviation reduction in rainfall (mm) causes an 11% standard deviation rise in assassination probability. This is driven by the fact that when rainfall is low, Germanic tribes have less food, and engage in raiding across the frontier to feed themselves. These raids weaken political stability in the Roman Empire, antagonize the military class, and hence endanger the emperor's life.

To support this hypothesized mechanism, we show that low precipitation predicts more Germanic raids, and is correlated with proxies of political instability; namely, periods of inflation, and fewer building projects. A standard deviation drop in precipitation causes an 8.5% standard deviation increase in raids. Although raids happened across the Roman Empire, they were particularly problematic in Germania, since this province has historically weak state capacity.

[1]The Empire formally started with Augustus in 27 BC. While the entire Empire's end date is contestable, the Western Empire fell in 476 AD, when Emperor Romulus was deposed.

We buttress our analysis with case studies of two emperors: Severus Alexander, and Gallienus. The former was killed in Germania, after appeasing Germanic tribes that had conducted violent raids. The latter was assassinated after attempting to defeat a mutiny, supported by Gaul-based leaders.

We proceed as follows. In Section II, we situate our study within the broader literature. In Section III, we present historical background and case studies. Section IV discusses our data and empirical strategy. We show empirical results in Section V. Section VI concludes.

2. Related Literature

Our study follows a large literature that deals with economic shocks and violence (Hsiang et al., 2013; Collier and Hoeffler, 2004; Miguel et al., 2004). Bazzi and Blattman (2013), especially, suggest that case study evidence is necessary to uncover mechanisms between such shocks and violent outcomes. We offer such evidence, from Ancient Rome, to exposit an explicit mechanism linking a rainfall shock to assassination. Recent research has made substantial progress in uncovering such mechanisms (Anderson et al., forthcoming; Kung and Ma, 2014; Chaney, 2013; Dube and Vargas, 2013). In particular, Anderson et al. (forthcoming) find that bad weather shocks caused explusion of Jews from European cities, from 1100 to 1800, as Jews were effective political scapegoats. We provide evidence of another mechanism operating in Ancient Rome: tribal raids, due to food shortages, drove assassinations of Roman Emperors.

Furthermore, we add to our knowledge of regime change in autocracies (Derpanopoulos et al., 2016; Miller, 2014; Jones and Olken, 2009). Rome, being pre-industrial, did not experience the immense per capita growth we see today, although it arguably experienced some improvements in living standards (Temin, 2012). While the Roman Empire is different from our modern world, its long lifespan provides a rich sample of an autocratic government, allowing us to conclude that external forces compelled Romans to murder their emperor.

Such politically-motivated violence can undoubtedly be costly; Frey and Torgler (2013) and Eisner (2011) observe that political violence encourages more disorder, and indeed such

violence limits economic growth and development (Rohner et al., 2013; Blattman and Miguel, 2010; Abadie and Gardeazabal, 2003). It is therefore important to understand what causes it.

Finally, our study contributes to our knowledge of Roman economics (Michaels, forthcoming; Harper, 2016; Temin, 2012; Scheidel, 2012). To our knowledge, this is the first study to systematically investigate the causes of Roman assassinations.

3. Historical Background

The Roman Empire began in 27 BC, after Augustus (born Gaius Octavius) defeated his rivals Mark Antony and Marcus Lepidus to form the Principate.[2] Augustus, widely regarded as a good ruler, laid the foundation for *pax romana*, 200 years of relative peace under the Empire. This, in turn, stimulated trade and stirred the market economy (Temin, 2012).

The peace did not last forever. The emperor Commodus's assassination, in 192, engendered political chaos, causing the Empire to attain de facto regional capitals in Trier, Milan, Constantinople, and Antioch, to the detriment of the city of Rome's status.[3] Two of these capitals, Trier and Milan, with their attendant bureaucrats and military elite, were well within striking distance of Germanic tribesmen.

After the so-called Chaos of the Third Century, Diocletian was crowned emperor in 284 AD, and restored the Empire's stability. Although this tepid peace held for a while, the Empire was crumbling militarily, especially after Rome permitted Gothic refugees within its borders in 376. Between 386 and 455, Gallic-Germanic tribes sacked Rome three times. In 476 AD, the Roman Empire fell, losing control of its Western provinces.

Roman provinces in Germania and Gaul are particularly pertinent to our study. Julius Caesar conquered Gaul in 50 BC, prior to the Empire's foundation. In the Second Century AD, the Emperor Trajan extended the empire to its maximum reaches along the Rhine-Danube frontier. Although Rome was capable of expanding further, the marginal benefit of doing so would have been miniscule. Contained within the Roman Gaul-Germanic frontier

[2]Augustus was Julius Caesar's nephew. Although Caesar had crowned himself emperor, he was swiftly assassinated by senators, plunging the Roman Republic into civil war.
[3]These four capitals were already major cities within the Empire.

were the Gallic La Tène people, who had an economy sophisticated enough to generate food surpluses. Just beyond that frontier resided the Germanic Jastorf culture, which was subsistence based (Heather, 2006). Fighting and occupying the Jastorf would have proven a waste. As Heather says, 'The Roman advance ground to a halt... around a major fault-line in European socio-economic organization' (pp. 57).

Although *pax romana* brought prosperity to both sides of the frontier, it arguably caused population pressures amidst limited agricultural land, especially as Jastorf resources were constrained. As King (1990) explains,

> One of the positive aspects of Roman conquest... was the establishment of the famous *pax romana*. This must be one of the reasons for an expansion of the population that is attested on both sides of the frontier. But such expansion also had its disadvantages... [I]ndeed, it can be argued that the land became exhausted as a result, bringing about a rapid decline in population in the political, economic and climatic instability that prevailed during the third century. (pp. 157)

The Empire's relative wealth, therefore, increased the returns to raiding across the frontier (Young, forthcoming). It is not a leap in logic to claim that low rainfall would, in turn, cause more raids.

These raids, in turn, induced political agitation among bureaucrats and military elite. As Heather makes clear,

> It was no longer the Senate of Rome, but the [military] commanders, concentrated on key frontiers, and the senior bureaucrats, gathered in the capitals from which these frontiers were administered, who settled the political fate of the Empire.

If these commanders and bureaucrats perceived a threat to their being, events may have been set in motion to murder the emperor.

With this link established, we have yet to concretely show that such raiding fuelled sufficient political chaos to shed an emperor's blood. We establish this using two case studies: those of Severus Alexander and Gallienus.

3.1. **Severus Alexander.** Severus Alexander ascended the throne after his cousin, Elagabalus, was assassinated in 222 AD. By most accounts, Alexander was a good emperor. According to Lampridius, in *Historia Augusta*, he never issued an imperial order without counsel from "twenty learned jurists and fifty men of wisdom," and he implemented a number of popular policies: interest-free loans for the poor, religious tolerance for Christians and Jews, and public works projects. Herodian says, of Alexander: "A stranger to savagery, murder, and illegality, he was noted for his benevolence and good deeds." While ancient historical texts suffer from issues of interpretation, there is a general consensus that Alexander was a wise ruler.[4]

Despite his sound administrative mind, he lacked discernment in military matters, and was keen to find diplomatic solutions, much to his troops' chagrin. When the Persian Sassanids invaded Rome's Eastern provinces, Alexander tried diplomacy first. A number of his troops mutinied, but Alexander crushed these rebellions, and declared victory against the Sassanid Empire.

However, he was not lucky in the northern empire. In 233, his governors reported that Germanic tribes had crossed the Rhine and Danube rivers, and were plundering Roman cities and villages in Germania.[5] Alexander rallied his troops and led an army north. His first instinct was to buy off the tribes, which angered his soldiers, who had had firsthand experience with these belligerent barbarians. In 235 AD, Roman troops beheaded Alexander while he was camped in Germania.

Severus Alexander's murder demonstrates two relevant points: (1) Germanic raids caused political dischord; (2) Chaos in Germania was unique in precipitating an emperor's demise. Point (1) is obvious from the preceding discussion. Point (2) is clear when one considers the

[4]Alexander ascended the throne at the age of 13, and allegedly relied on his mother for much policymaking guidance.
[5]We observe in our data that lagged precipitation in 233 was 1.2 standard deviations lower than its mean.

fact that, although Alexander's acquiescence towards the Sassanids was unpopular among his troops, he was nonetheless able to crush mutinies in Syria. When it came to Germania, however, he was not able to prevent his own death.

A broader point here may be made about state capacity, which is relevant in this instance since it allowed Alexander to smoothly destroy an attempted usurpation. Germania, compared to Syria, had weak state capacity. Putterman's (2012) state capacity index, which rates state capacity on an increasing scale from 0 to 50, states that between 1 AD to 500 AD, Germania's average score was 12.5, while Syria's was 25. In other words, Syria had twice the state capacity of Germania, making rebellions easier to crush in the former province.

3.2. **Gallienus.** Gallienus began his rule, in 253, by successfully defending the Rhine and Danube frontiers against Germanic raids. In 260, however, Sassanian King Shapur I captured Gallienus's father and co-emperor, Valerian, in the eastern part of the empire. The ensuing chaos caused several pretenders to the throne to arise,[6] and northern tribes seized the opportunity. The Alemanni, a Germanic tribe, invaded northern Italy, and the Franks campaigned as far south as Spain.

Amidst these tensions, the governor of Germania Superior and Inferior, Postumus, who was of Gallic extraction, gathered the Rhine forces and declared himself emperor, claiming the western provinces of Germania, Gaul, Hispania, and Britain, forming the so-called Gallic Empire. This new empire would outlast both Gallienus and Postumus, but would persist for less than 15 years.

The Gothic Invasion of 268 prevented Gallienus from reclaiming the western provinces, leaving Postumus in control of them. News of mutiny drew Gallienus away from the Gothic War, as cavalry commander Aurelius, stationed in Milan, defected to Postumus. Gallienus would defeat Aurelius, only to be murded by his own military officials, who were dissatisfied with the emperor's leadership.

[6]The *Historia Augusta* makes reference to these pretenders:

> "Now let us pass on to the twenty pretenders, who arose in the time of Gallienus because of contempt for the evil prince."

Although twenty is an exaggeration, several attempts were made to overthrow Gallienus after 260.

Gallienus is another example of conflict and political discord's unique effects along the northwestern frontier, further supporting the two points we made about Severus Alexander. Although Valerian's capture itself might have sowed disunity, it was the northern provinces, specifically, that proved irksome. Gallienus's assassination happened in northern Italy, but its roots were undoubtedly of Gallic and Germanic origin. Barbarian raids escalated into Postumus's separatist movement, which in turn persuaded Gallienus's commander, Aurelius, to defect. Gallienus defeated the traitor, but the emperor's troops ultimately killed Gallienus.

4. Data and Empirical Strategy

4.1. **Empirical Strategy.** To test for the effects of rainfall on Roman emperor assassinations in year t, we estimate the following specification:

$$Assassination_t = \beta_0 + \beta_1 Precipitation_{t-1} + \gamma' \mathbf{X} + \epsilon_t. \tag{1}$$

Here, $Assassination_t$ is either a dummy for whether or not an emperor was killed, or the total number of emperors killed in a given year.

$Precipitation_{t-1}$ is a rainfall shock, lagged by one year. The reason we use a lagged shock is because Germanic tribes likely had limited grain storage capacities, and were able to temporarily smooth negative shocks (see below, in Data section). However, we also show that this is robust to a simultaneous shock.

We use Newey-West standard errors to account for serial correlation and heteroskedasticity (Newey and West, 1987). We assume that the error structure is autocorrelated up to 10 lags. We multiply the coefficient on β_1 by 100 for expositional ease.

Our identification strategy is based on the fact that rainfall in Gaul/Germania is exogenous. A negative coefficient on β_1 implies that the shock negatively predicts assassinations, while a positive coefficient on β_1 means that the shock positively predicts assassinations. In northern Europe, higher precipitation is good for agriculture - particularly grain, which was grown in Germania and Gaul.

4.2. **Data.** We acquire data on Roman assassinations from Scarre's (1995) *Chronicle of the Roman Emperors*, which offers a biography of each Roman emperor from Augutus to Romulus. Scarre clearly indicates when a Roman emperor had been murdered. He also indicates when an emperor engages in significant building projects; we create an index from 1 to 4 to capture the intensity of building, with 1 being little to no building, and 4 being large building projects. In particular, a '4' means that Scarre allocates two pages to discussing the emperor's building projects or describes the emperor as a great builder, a '3' involves a half-page to full page description of the emperor's buliding projects, a '2' implies a sentence or two, and a '1' means no mention of such projects.

Precipitation data for Gaul/Germania, for this period, are from Buengten et al. (2011). These authors collect data from 7,284 precipitation-sensitive oak tree rings from France, southeastern Germany, and northeastern Germany. They supplement this with 104 historical accounts to reconstruct AMJ (April-May-June) precipitation, for the region, from 398 BC to 2008 AD. Precipitation is measured in millimeters. We cannot exploit these rainfall data at a precise geographic level, since there can be variation in oak rings, even within a hectare, which is why Buengten and coauthors sample from over 7,000 such trees, in order to create a region-wide rainfall estimate.

There is substantial evidence that Roman Gaul and Germania grew grain, which requires good rainfall. Morever, this was a subsistence industry that did not permit good grain storage technology. As Craughwell (2008, p.70), says,

> "Most of the Germanic Tribes numbered about 100,000, of which only 10,000-15,000 were fighting men. Living conditions in the barbarous north did not permit overpopulation. Tribes such as the Vandals depended for survival on their harvests, supplemented by whatever they could get by hunting and foraging. In a good year there would be enough grain to get the tribe through the winter, but unlike the Romans, the Germanic tribes did not have huge granaries where they stored excess grain for emergency such as famine, drought, or the destruction of the crops in war."

When population pressures were particularly pronounced, these Germanic tribes supplemented their food supplies through raiding. As the empire progressed, Roman troops were withdrawn from policing the frontiers, and barricaded in forts, camps, and walled towns deep within provinces, making Germanic raids easier (Young, forthcoming; Craughwell, 2008, p. 71).

Raids data are from Venning (2011), who provides a chronology of events in the Roman Empire. We count the number of times Germanic raids occur in his chronology, according to the year in which they occur. We also include non-Germanic raids as a placebo check. Finally, we acquire inflation data from Temin (2009).

Summary statistics for our dependent variables and shocks of interest are shown in Table 1. Assassinations are by no means rare; about 20% of emperors were assassinated, and 5% of years involve an assassination. We also provide a time series graph of the total number of assassinations, against rainfall, over this period in Figure 2. The relationship between assassinations and rainfall is clearly negative.

5. Results

5.1. **Main Results.** In Table 2, we report our main results for Roman assassinations from 27 BC to 476 AD, using both lagged and current precipitation. Clearly, negative shocks to rainfall predict more assassinations. In Column (1), for example, a standard deviation decline in rainfall causes an 11.6% standard deviation increase in assassination probability. In Column (5), a standard deviation drop in rainfall causes a 13.4% standard deviation increase in total assassinations.

Our crucial identifying assumption is that rainfall is unrelated to unobservables that could bias our results. To test this, we perform a placebo test (not reported), regressing assassinations on future rainfall, one year forward. We find no significant effects from this exercise, and the coefficients are smaller than those for our main results. This supports our identification strategy.

These effects can be favourably compared to Hsiang et al's (2013) meta-analysis of the literature on climate and conflict, which finds that a standard deviation increase in temperature causes a 4% median increase in interpersonal violence, and a 14% increase in intergroup violence, across studies. If assassinations are, appropriately, classified as interpersonal violence, then our reported magnitudes are large. However, we are cautious in interpreting this too strongly, since assassinations are very different from regular murders.

5.2. **Mechanisms.** In Table 3, columns (1) and (2), we regress Germanic and Gallic raids on precipitation. Column (1)'s dependent variable is the number of raids, while column (2)'s is a dummy for whether or not a raid occurred. Clearly, more precipitation causes fewer raids. In column (1), for example, a standard deviation decrease in rainfall causes a 4% standard deviation increase in reported raids.

In columns (3) and (4), we use raids that did *not* happen in Gaul/Germania as a placebo test. Clearly, the magnitude of these raids is smaller, and insignificant. This supports the fact that low rainfall in Gaul/Germania instigated raids in the region.

In Table 4, we show that rainfall predicts proxies of political instability; namely, imperial building, and inflation. When rainfall is low, building projects are fewer, and inflation is higher. For example, in column (1), a standard deviation increase in rainfall causes a 25.6% increase in the building index. This supports our assertion that when Gallic/Germanic rainfall is good, political stability is more likely across the Empire, permitting uninterrupted building projects. Indeed, this makes historical sense: construction workers cannot work well while facing the threat of violent barbarian raiders.

Finally, Table 5 uses lagged rainfall to instrument for raids, which are then used to predict assassinations. The size of the effect is substantial. For example, in column (3), a standard deviation increase in the raid dummy causes a 29.3% increase in the probability of assassination. However, this result should be interpreted with caution, and as a robustness check, since the exclusion restriction may not be satisfied.

6. Conclusion

In this paper, we uncover a startling mechanism that encouraged a Roman emperor's murder. Namely, Germanic frontier raiders, incited by starvation, weakened the empire's political stability, which reduced the costs of assassinating an emperor. We show that rainfall in the northern empire predicts assassinations, and that rainfall also predicts Germanic raids. Moreover, through case studies of emperors Alexander Severus and Gallienus, we demonstrate a link between such raids, and the political intrigue which hastened the emperor's demise. This political link is further supported when we examine inflation, and periods of building.

Broader points may be cautiously made about external events at the time. Peter Heather (2017) argues that the later Roman Empire's overextension and weakness made it ripe for pillage, as Vandals, Goths, and Huns, among others, raided across the Rhine-Danube frontier, ultimately culminating in the Fall of Rome. Although our paper does not tackle Heather's point directly, the link is clear: external events, happening perhaps hundreds of miles away, can have deletrious impacts within an empire's borders.

References

Abadie, Alberto, and Javier Gardeazabal. "The Economic Costs of Conflict." *American Economic Review*, March 2003, *93*(1), pp. 113-132.

Anderson, Robert Warren, Noel D. Johnson, and Mark Koyama. "Jewish Persecutions and Weather Shocks: 1100-1800." *Economic Journal*, forthcoming.

Bazzi, Samuel, and Christopher Blattman. "Economic Shocks and Conflict: Evidence from Commodity Prices." *American Economic Journal: Macroeconomics*, October 2014, *6*(4), pp. 1-38.

Besley, Timothy, and Torsten Persson. "State Capacity, Conflict, and Development." *Econometrica*, January 2010, *78*(1), pp. 1-34.

Besley, Timothy, and Torsten Persson. "The Logic of Political Violence." *Quarterly Journal of Economics*, August 2011, *126*(3), pp. 1411-1445.

Blattman, Christopher, and Edward Miguel. "Civil War." *Journal of Economic Literature*, March 2010, *48*(1), pp. 3-57.

Buengten, Ulf, Willy Tegel, Kurt Nicolussi, Michael McCormick, David Frank, Valerie Trouet, Jed O'Kaplan, Franz Herzig, Karl-Uwe Heusser, Heinz Wanner, Jurg Luterbacher, and Jan Esper. "2500 years of European climate variability and human susceptibility." *Science*, February 2011, *331*(6017), pp. 578-582.

Collier, Paul and Anke Hoeffler. "Greed and grievance in civil war." *Oxford Economic Papers*, August 2004, *54*(4), pp. 563-595.

Craughwell, Thomas J. *How the Barbarian Invasions Shaped the Modern World*. Fair Winds Press, 2008.

Dube, Oeindrilla and Juan F. Vargas. "Commodity Price Shocks and Civil Conflict: Evidence from Colombia." *Review of Economic Studies*, October 2013, *80*(4), pp.1384-1421.

Harper, Kyle. *The Fate of Rome: Climate, Disease, and the End of an Empire.* Princeton University Press, Princeton, NJ, forthcoming.

Harper, Kyle. "The Environmental Fall of the Roman Empire." *Daedalus*, Spring 2016, *145*(2), pp. 101-111.

Heather, Peter. *The Fall of the Roman Empire: A New History of Rome and the Barbarians*. Oxford University Press, UK, 2007.

Hsiang, Solomon M., Marshall Burke, and Edward Miguel. "Quantifying the Influence of Climate on Human Conflict." *Science*, September 2013, *312*(6151).

Johnson, Noel D., and Mark Koyoma. "Taxes, Lawyers, and the Decline of Witch Trials in France." *Journal of Law and Economics*, February 2014, *57*(1), pp. 77-112.

Jha, Saumitra. "Trade, Institutions, and Ethnic Tolerance: Evidence from South Asia." *American Political Science Review*, November 2013, *107*(4), pp. 806-832.

Kiernan, Ben. *The Pol Pot Regime: Race, Power, and Genocide in Cambodia under the Khmer Rouge, 1975-79*. Yale University Press, 2008.

Miguel, Edward, Shanker Satyanath, and Ernest Sergenti. "Economic Shocks and Civil Conflict: An Instrumental Variables Approach." *Journal of Political Economy.*, August 2004, *112*(4), pp.725-753.

Nevins, Joseph. *A Not-So-Distant Horror: Mass Violence in East Timor.* Cornell University Press, 2005.

Rorke, Martin. "The Scottish Herring Trade, 1470-1600." *The Scottish Historical Review*, October 2005, *84*(2), pp.149-165.

Rowlands, Alison. "Witchcraft and Gender in Early Modern Europe." *Brian Levack (ed.) The Oxford Handbook of Witchcraft in Early Modern Europe and Colonial America*. Oxford University Press, 2013, pp. 449-467.

Smout, T.C. *A History of the Scottish People, 1560-1830.* The Chaucer Press Ltd., UK, 1973.

Torell, D.T., W.C. Weir, G.E. Bradford, and G.M. Spurlock. "Effects of time of shearing on wool and lamb production." *California Agriculture*, November 1969, *23*(11), pp. 16-18.

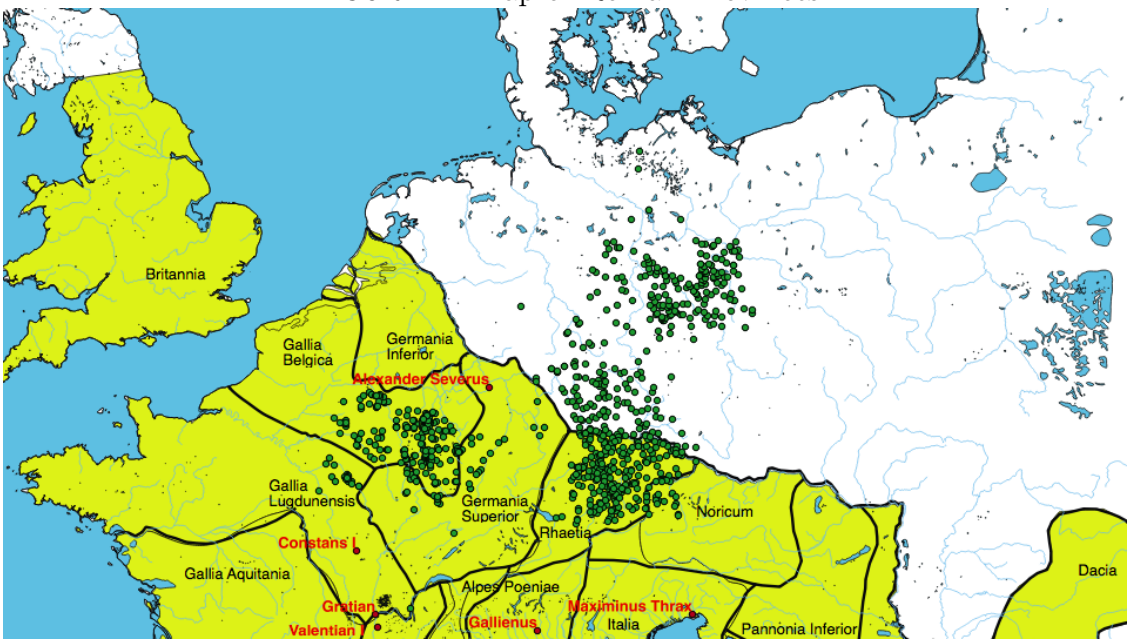
Voigtlander, Nico and Hans-Joachim Voth. "Persecution Perpetuated: The Medieval Origins of Anti-Semitic Violence in Nazi Germany." *Quarterly Journal of Economics*, May 2012, *128*(2), pp. 469-530.

Yanagizawa-Drott, David. "Propaganda and Conflict: Evidence from the Rwandan Genocide." *Quarterly Journal of Economics*, August 2014, *129*(4), pp. 1947-1994.

TABLE 1. Summary Statistics

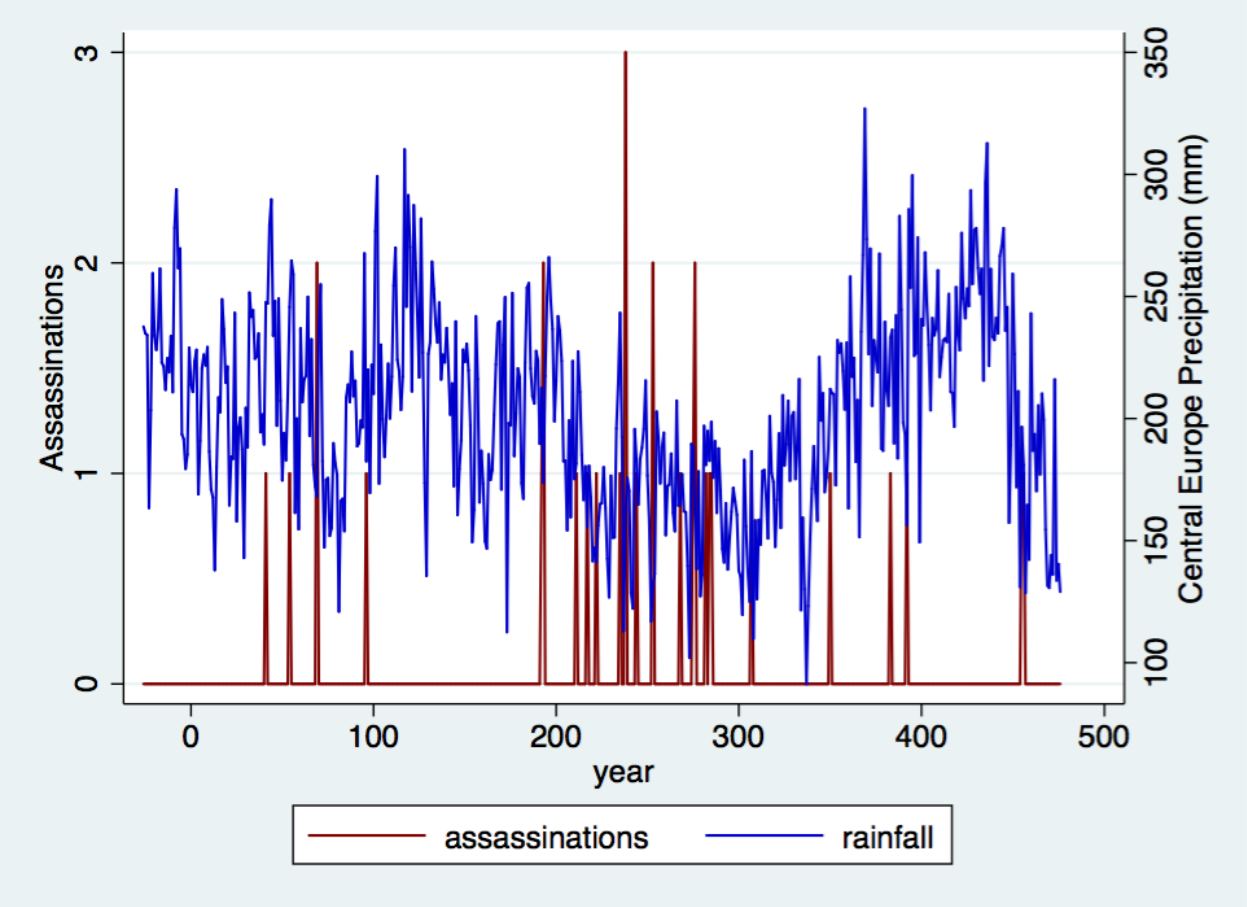
Variable	N	Mean	Std. Dev.	Min	Max
Assassinations	503	.062	.293	0	3
Assassination Dummy	503	.050	.218	0	1
Precipitation	503	202.1	41.3	91.3	326.9
Lagged Precipitation	503	202.2	41.2	91.3	326.9
Raids	503	.046	.236	0	2
Raid Dummy	503	.040	.196	0	1
Inflation	350	.642	.480	0	1
Building	364	2.75	1.21	1	4

FIGURE 1. Map of Roman Provinces



The above figure shows Roman provinces in Gaul and Germania. The green dots are the locations of oak tree rings, while the red dots show the locations of certain emperors' assassinations.

FIGURE 2. Assassinations and Precipitation, 27 BC - 476 AD



The above figure shows the number of assassinations of Roman Emperors (blue), against reconstructed April-May June (AMJ) precipitation (red), over time.

TABLE 2. Effect of Rainfall on Assassinations

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	Dummy	Dummy	Dummy	Dummy	Count	Count
$\text{Precipitation}_{t-1}$	-.061***	-.013***			-.095***	
	(.019)	(.005)			(.036)	
Precipitation_{t}			-044**	-.010**		-.074***
			(.020)	(.004)		(.027)
Estimation	OLS	Logit	OLS	Logit	OLS	OLS
AR(10)	.012		.012		.065	.012
No. of observations	503	503	503	503	503	503

Columns (1)-(4) report results using an assassinations dummy, while columns (5) and (6) report results using the total number of assassinations. Newey-West standard errors are reported in parentheses in columns (1), (3), (5), and (6). Robust standard errors are reported in columns (2) and (4). All columns, except for (2) and (4), report the coefficient multiplied by 100. The AR(10) row reports the p-value from the Breusch-Godfrey test, with null hypothesis of no autocorrelation up to 10 lags. Significance levels are ***< .01, **< .05, and *< .1.

TABLE 3. Mechanism: Raids

	(1)	(2)	(3)	(4)
Dependent variable:	Raids	Dummy	Outside raids	Outside Dummy
$\text{Precipitation}_{t-1}$	-.053**	-.040**	-.025	-.024
	(.026)	(.019)	(.040)	(.038)
AR(10)	.0001	.0007	.0141	.0105
No. of observations	503	503	503	503

Column (1) reports total raids in Gaul/Germania, while column (2) is a dummy for raids in Gaul/Germania. Column (3) is total raids *outside* of Gaul/Germania, while column (4) is a dummy for total raids outside of the region. Newey-West standard errors are reported in parentheses. The AR(10) row reports the p-value from the Breusch-Godfrey test, with null hypothesis of no autocorrelation up to 10 lags.
Significance levels are ***< .01, **< .05, and *< .1.

TABLE 4. Mechanism: Indicators of Instability

	(1)	(2)
Dependent variable:	Building	Inflation
$\text{Precipitation}_{t-1}$	.007***	-.006***
	(.003)	(.0009)
AR(10)	.000	.000
No. of observations	364	350

Newey-West standard errors are reported in parentheses. The AR(10) row reports the p-value from the Breusch-Godfrey test, with null hypothesis of no autocorrelation up to 10 lags. Significance levels are ***< .01, **< .05, and *< .1.

TABLE 5. Instrumental Variables

	(1)	(2)	(3)	(4)
Dependent variable:	Dummy	Count	Dummy	Count
Raids_t	1.14*	1.80*		
	(.581)	(.929)		
RaidDummy_t			1.50*	2.26*
			(.784)	(.1.27)
No. of observations	503	503	503	503

This table reports a regression of assassinations on raids, where raids are instrumented by lagged precipitation. Newey-West standard errors are reported in parentheses. Significance levels are ***< .01, **< .05, and *< .1.