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ECONOMIC SHOCKS AND UNREST IN FRENCH WEST AFRICA

CORNELIUS CHRISTIAN† AND JAMES FENSKE⋆

Abstract. We show that rainfall, temperature, and commodity price shocks predict unrest in colonial French West Africa between 1906 and 1956. We use a simple model of taxation and anti-tax resistance to explain these results. In the colonial period, the response of unrest to economic shocks was strongest in more remote areas and those lacking a history of pre-colonial states. In modern data spanning 1997 to 2011, the effect of economic shocks on unrest is weaker. Past patterns of heterogeneity are no longer present. The response of unrest to economic shocks, then, differs across institutional contexts within a single location.

1. Introduction

Unrest and the threat of unrest have historically been important sources of economic and institutional change (Acemoglu and Robinson, 2000; Ponticelli and Voth, 2011). The opportunity for citizens to contest power during transitory negative shocks can produce democratic transitions (Acemoglu and Robinson, 2001; Brückner and Ciccone, 2011). Unrest has also changed history within former colonies, where violent resistance shapes institutional legacies and current attitudes (Acemoglu et al., 2002; Wantchekon and García-Ponce, 2013). Unrest disrupts economic activity (Kilian, 2008). Where unrest turns to civil conflict, it may discourage investment (Abadie and Gardeazabal, 2003), disrupt life, labor, and human capital formation (Blattman and Miguel, 2010), interrupt trade (Rohner et al., 2013) and limit state capacity (Besley and Persson, 2010). It is important, then, to understand what causes unrest.

†University of Oxford
⋆University of Oxford
E-mail addresses: cornelius.christian@keble.ox.ac.uk, james.fenske@economics.ox.ac.uk.
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Centre for the Study of African Economies
Department of Economics · University of Oxford · Manor Road Building · Oxford OX1 3UQ
T: +44 (0)1865 271084 · F: +44 (0)1865 281447 · E: csae.enquiries@economics.ox.ac.uk · W: www.csae.ox.ac.uk

In this paper, we show that unrest in colonial French West Africa was more likely in years of adverse rainfall, higher temperatures, and, with exceptions, low export prices. We take data on anti-colonial incidents in French West Africa from Huillery (2011) in order to construct a district-level panel covering the years 1906-1956. We merge these data with temperature and rainfall series from Matsuura and Willmott (2009), a map of commodity production from Hopkins (1973), and multiple sources of commodity price data.

We find that higher levels of rainfall and lower temperatures predict less unrest, as do more favorable prices of cocoa, cotton, and bananas in the districts that produce these. By contrast, higher prices of groundnuts predict greater levels of unrest in regions where these are grown. We demonstrate the robustness of our results to the inclusion of district-specific time trends and to whether we use contemporaneous shocks or moving averages of prices, rainfall and temperature.

To account for our empirical findings, we construct a simple model with two players: a profit-maximizing state, and a group of farmers. The state sets a head tax on farmers, and can choose to invest in suppression (for example, building a military base). Farmers then observe the realization of their income, and can decide whether or not to resist taxation. We find that there are conditions under which such unrest is an equilibrium response to bad shocks. Colonial suppression of such unrest may or may not exist in equilibrium. Consistent with our model, we find that the response of unrest to adverse shocks is strongest where the lack of a pre-colonial kingdom made it more difficult for the state to collect payment from farmers who resisted taxation, in remote areas that lacked diverse income sources, and in areas where the reduced frequency of rainfall shocks encouraged levels of taxation that prompted unrest in bad years.

The former colonies of French West Africa provide an opportunity to evaluate the link between economic shocks and unrest in the same location, but under different institutional contexts. Merging our districts with geo-coded riots and protests since 1997 recorded in the Armed Conflict Location and Event Data Project's (ACLED) database, we show that the pattern of unrest has changed. We find that greater levels of rainfall continue to reduce unrest in the present, but that the link with temperature is no longer apparent. Similarly, we no longer find significant correlations between commodity prices and present-day riots and protests.

The pattern of response to these shocks has also changed. Riots and protests are more responsive to rainfall in districts where French military intervention lasted longest. The effect of rainfall on unrest is no longer mediated by the presence of pre-colonial states. There is no correlation between past and present levels of unrest, and districts of French West Africa in which unrest was more common under colonial rule are not more responsive to rainfall shocks in the present. We show, then, that the response of unrest to economic shocks depends crucially on institutions. In our example, the political economy of taxation directed the link between economic shocks and unrest.

1.1. **Related Literature.** Our contribution is to offer evidence on the effects of both environmental and commodity price shocks in a single location, under both colonial and post-colonial regimes. Our research is related to an established literature that demonstrates effects of economic shocks on conflict, unrest, and political transitions (Brückner and Ciccone, 2010; Burke and Leiga, 2010; Miguel et al., 2004). This is part of a broader literature linking economic conditions to unrest and conflict (Collier and Hoeffler, 2004; DiPasquale and Glaeser, 1998; Field et al., 2008). Existing literature on the role of these shocks in development has shown that their importance depends on both time and context (Bazzi and Blattman, 2014; Ciccone, 2011). By studying resistance to French colonialism within French West Africa, we reduce potential confounds and offer a specific mechanism through which shocks can precipitate political disturbance.

Our paper is closest to Dube and Vargas (2013), who find that in Colombia negative coffee price shocks cause violence due to an opportunity cost effect, while positive oil price shocks cause conflict due to a rapacity effect. In colonial French West Africa, adverse economic shocks did reduce the opportunity cost of resisting colonial taxation. While rapacity explains present-day responses of civil conflict to resource prices (e.g. Berman and Couttenier (2014); Sanchez de la Sierra (2014)), it has no analogue in the colonial period. Rather, we explain the positive link between civil unrest and the prices of palm produce and groundnuts by appealing to the local consumption of these goods, the coincidence of price increases with higher food prices, and political agitation by elites within the class of cultivators. Like Dube and Vargas (2013), we also focus on a single location, but investigate a greater number of shocks, and uncover variables that moderate the responsiveness of conflict both historically and in the present.

Our paper is, then, a contribution to the emerging literature on the heterogeneous effects of economic shocks. Recent work has demonstrated that the response of violence to economic shocks is mediated by several variables, including the cohesiveness of economic institutions (Besley and Persson, 2011), culture (Kung and Ma, 2014), production technologies (Jia, 2014), and the state of the labor market (Fetzer, 2014). Closely related to our work is that of Papaioannou (2014), who finds that extreme weather events in colonial Nigeria increased the incidence of homicide, imprisonment, and court cases. Our contribution is twofold. First, we use the heterogeneity of responses to colonial shocks in order to validate a model that explains the political economy of economic shocks and unrest in a specific context. Second, we demonstrate that the response of unrest to these shocks changes with the political environment within a single location.

Finally, we add to the literature on historical persistence (e.g. Dell (2010); Nunn (2008)), since we explore the reactions of both historical and modern unrest to shocks and the persistence of these reactions over time. Much of this literature has focused on the long-run effects of historical institutions on economic growth and living standards (Banerjee and Iyer, 2005; Bruhn and Gallego, 2012; Iyer, 2010). A portion of this literature has uncovered deep roots of violence in the present and recent past (Jha, 2013; Voigtländer and Voth, 2012), including conflict in Africa (Depetris-Chauvin, 2013; Heldring, 2014). Recently, Nunn (2014) has suggested that geography can shape long-run development by mattering at crucial periods in history. Although the environmental shocks that we study have this potential, we find no evidence of such long-run effects. Similarly, the trend in much of this literature is to demonstrate the presence of historical persistence. Our contribution, by contrast, is to show an example in which this persistence is absent. The political economy of unrest in French West Africa has changed since the colonial period.

We proceed as follows. In Section 2 we present both historical background on French West Africa and analyze a model of civil unrest. The model's predictions guide our empirical work. In Section 3 we describe the data and empirical strategy, before reporting estimates in Section 4. Section 5 concludes.

2. Model

2.1. **Historical Background.** France occupied trading posts along the West African coast such as Gorée throughout the period of the trans-Atlantic slave trade. From the 1850s to the 1880s, French military units attacked coastal regions along Senegal, Mauritania, Guinea, and Dahomey, but it was not until the 1880s that the French expanded inland, advancing as far as current Mali. In 1895, French West Africa (*Afrique Occidentale Francaise*) was officially created.

French rule in this region depended on taxable production of commodities such as coffee, cocoa, and cotton. In return for their taxes, Africans received little; military conquest and pacification accounted for 80% of the cost of French West Africa to France, and the salaries of French civil servants were a disproportionate share of local expenditure (Huillery, 2012). At the same time, France devoted few of its own resources to African development: from 1844 to 1957, only 0.29 percent of French public expenditures were spent in French West Africa. Head taxes unrelated to income accounted for 39% of total revenue over the 1907-1957 period (Huillery, 2012). The collection of these taxes was delegated to the canton and village chiefs (Suret-Canale, 1971, p. 346).

Although we focus on head taxes in our model, there were several forms of extraction that would have provoked African resistance during depressed periods. Economic rents were extracted through artificially low export prices, high import prices, compulsory cultivation of certain crops, and coercive labor institutions (Berg, 1960; Tadei, 2013a,b). Compulsory labor was used for the construction and maintenance of roads and other public works, in porterage, for public works, and in private concessionary companies (Conklin, 1998). Labor compulsion was greatest where the production of export crops was possible (Tadei, 2013c). The burdens of direct taxation and forced labor were more extensive in French West Africa than in Britain's West African colonies (Asiwaju, 1976, p. 583). A parallel system of law and courts known as the *indigénat* gave local administrators legal cover for this coercion. As Mann (2009, p. 334-335) puts it:

> In 1932, when an African auxiliary (*garde-cercle*) stuffed recalcitrant taxpayers into a small dwelling in which ten of them would suffocate, it was the *indigénat* that originally provided legal justification for his actions. And in the same year, when a man died of a cerebral hemorrhage after a week in detention, the only charge against him – the cause of his imprisonment – was a 'bad attitude towards paying his taxes', an offense punishable under the *indigénat*.

Importantly, colonial taxes did not adjust smoothly in response to conditions of production. Huillery (2011) does not report a complete series of tax rates, but her incomplete data do allow for some illustrative examples. Across 87 districts for which she reports head tax rates in both 1928 and 1936, 65 saw their tax rate increase over the course of the Great Depression. The average percentage change was an increase of 21%. The colonial state continued to recruit labor and collect taxes during a severe 1913-14 famine (Clark, 1995). Similarly, officials recognized that tax obligations were prompting migration from the frontier of the Ivory Coast to the neighboring Gold Coast (Ghana) in 1935, but did not act on proposals to reduce the tax burden (Asiwaju, 1976, p. 585). In Koudougou, French policies worsened a 1931 famine by hindering food-crop production in favor of cotton (Cordell and Gregory, 1982, p. 212). As commodity prices fell during the Great Depression, poll taxes remained unchanged (Suret-Canale, 1971, p. 280). It was under this often unsympathetic and authoritarian regime that resistance to colonial rule became common.

Resistance could take many forms, ranging from quiet out-migration to urban protests to armed insurrection (Asiwaju, 1976; Saul and Royer, 2001; Wantchekon and García-Ponce, 2013). Suppression could also take many forms. Dogon resistance to taxation in 1908 was met with a 'police tour' that destroyed local crops (Suret-Canale, 1971, p. 106). The colonial government countered the independence movement in the Ivory Coast by "falsifying election results, creating opposition parties, arresting [political] leaders, persecuting supporters, shutting down newspapers, and shooting demonstrators" (Wantchekon and García-Ponce, 2013). The economic literature on French West African violence is small. In an important contribution, Huillery (2011) instruments European settlement in French West Africa using cross-sectional variation in early colonial resistance. She finds that colonial settlement improves current economic outcomes, an argument in line with other studies of historical persistence (e.g. (Acemoglu et al., 2001)). What caused this resistance has not been shown empirically, and this is a question we turn to in this paper.

2.2. **A Simple Model of Unrest in French West Africa.**

2.2.1. *Setup.* We model civil unrest as a game between two risk-neutral players: a profit-maximizing colonial state, and a group of farmers. This is a stylized representation of the specific case we consider, since French West Africa's economy was largely agricultural. In our model, the state moves first, setting a head tax on farmers, and also deciding whether to invest in suppression. Practically, suppression could mean building a fort or stationing military equipment in a district. Farmers then realize their income, and can choose to resist. Resistance in this case includes actions such as riots or protests that signal farmers' refusal to pay taxes. The first purpose of this model is to show that it is possible for resistance to be an equilibrium response to adverse income shocks. The second purpose is to derive conditions that make such equilibria more likely.

The game's timing is as follows. In Period 1, the state sets a head tax, $\tau \geq 0$. The state also chooses whether or not to invest in suppression. This is a binary decision; investing in suppression costs s, while not investing costs nothing. The importance of suppression is that it allows the state to recover a portion of the farmers' income in the event of resistance. Investment in suppression, then, will discourage resistance. We assume for simplicity that a state that is indifferent between investing in suppression and not will choose no suppression. Similarly, a state that is indifferent between two tax rates will choose the lower rate.

In Period 2, Nature moves, and farmers' income is realized as either low, y_L, or high y_H. Clearly, $y_H > y_L$. Low income occurs with probability α and high income occurs with probability $1 - \alpha$.

In Period 3, farmers observe both whether the state has invested in suppression and the tax τ. We assume limited liability. If the tax exceeds income, so that $y < \tau$, then farmers pay all their income as tax in the event that they do not resist taxation. This captures farmers' credit constraints. We show later that when $y < \tau$, unrest always occurs.

Farmers choose to resist or not in this period. No resistance means that farmers simply pay the tax, and carry on as normal. This leads to a payoff of $y - \tau$. If the farmers choose resistance, then outcomes depend on whether or not the state chose suppression in Period 1. If the state chose suppression, then unrest succeeds with probability p. If the state chose no suppression, then unrest always succeeds. Unrest is destructive, damaging proportion $(1 - \mu)$ of income, where $\mu \in (0, 1)$. If resistance succeeds, farmers do not pay their tax, and so they receive a payoff of μy. If unrest is unsuccessful, then farmers must pay the state a proportion γ of their remaining income, where $\gamma \in (0, 1)$. They receive a payoff of $\mu(1-\gamma)y$. We assume for simplicity that a farmer indifferent between resisting taxation and not resisting will choose not to resist.

Finally, in Period 4, payoffs are realized for both the state and farmers. We solve this game using backward induction.

2.2.2. *Period 4.* Final payoffs are denoted $V^i(a_i|a_j)$, where $i \in \{f, s\}$ denotes either farmers or the state, and a_i denotes $i's$ action, given a tax rate τ. The actions available to the state are either S, suppression, or NS, no suppression. The farmers' actions are either R, resistance, or NR, no resistance. We use y_k to denote income, where $k \in \{L, H\}$.

Farmers' final payoffs are, then:

$$V^f(R|S) = p\mu y_k + (1-p)(1-\gamma)\mu y_k$$
$$V^f(R|NS) = \mu y_k$$
$$V^f(NR|S) = V_f(NR|NS) = \max\{y_k - \tau, 0\}$$

Payoffs for the state are similarly given by:

$$V^s(S|R) = (1-p)\gamma\mu y_k - s$$
$$V^s(NS|R) = 0$$
$$V^s(NS|NR) = \min\{\tau, y_k\}$$
$$V^s(S|NR) = \min\{\tau - s, y_k - s\}$$

2.2.3. *Period 3.* Farmers observe whether the state invested in suppression in Period 1, and also observe the tax rate. The tax rate, τ, may be less than or greater than income, y_k. This gives us four cases to consider: suppression and $\tau \leq y_k$; suppression and $\tau > y_k$; no suppression and $\tau \leq y_k$; and, finally; no suppression and $\tau > y_k$. We consider these cases in turn.

In the first case, when the state chooses to suppress resistance and y_k exceeds τ, then farmers resist if and only if $V^f(R|S) > V^f(NR|S)$. That is, farmers resist taxation if resistance offers a better payoff than none. Comparing payoffs under the two scenarios suggests that farmers resist if taxes are too high. Under high income, they will resist if:

$\tau > \{1 - \mu[1 - \gamma(1-p)]\}y_H \equiv \tau_{SH}$.

Similarly, under low income, farmers will resist taxation if:

$\tau > \{1 - \mu[1 - \gamma(1-p)]\}y_L \equiv \tau_{SL}$.

Here, we have defined τ_{SH} and τ_{SL} as the tax rates above which further taxation will induce resistance when the state has invested in suppression under high and low incomes. Because the opportunity cost of resistance is increasing in income, this tax threshold is lower in the low income state. These cutoff rates are both increasing in γ, the proportion of output recovered by the state. Both are decreasing in p, the probability of a successful revolt. Both p and γ can be thought of as measures of state capacity. Conditional on the tax rate, a weaker state will be more likely to face resistance. This could explain, for example, why we find below that unrest manifests more in response to adverse shocks in stateless societies. In these districts, there is no state capacity that the colonial authority can build upon to easily suppress dissidents. In terms of the model, γ is low and p is high.

In the second case, when the state chooses suppression and $y_k < \tau$, taxes exceed income, and unrest always occurs. This is because it is always better to resist than to receive zero income. More precisely, when farmers' outside option is zero, then unrest offers higher expected payoffs.

In the third case, when the state does not invest in suppression and $\tau \leq y_k$, resistance occurs when $V^f(R|NS) > V^f(NR|NS)$. Again, comparing payoffs under the two scenarios suggests that farmers resist if taxes are too high. Under high income, they will resist under high income if:

$\tau > (1-\mu)y_H \equiv \tau_{NSH}$.

Under low income, this condition is

$\tau > (1-\mu)y_L \equiv \tau_{NSL}$.

Following similar notation as above, we have defined τ_{NSH} and τ_{NSL} as the tax rates above which further taxes will induce resistance when the state has not invested in suppression under high and low incomes. Intuitively, a low cost of rebelion $(1-\mu)$ implies a higher likelihood of unrest, conditional on the tax rate. It is also apparent from the above that $\tau_{SL} > \tau_{NSL}$ and $\tau_{SH} > \tau_{NSH}$; investment in suppression enables the state to collect more tax revenue without facing resistance.

Finally, if $\tau > y_k$, then the state simply taxes all the farmers' income. As under the case when the state has invested in suppression, resistance always occurs, because it is better to resist than to be left with nothing.

2.2.4. *Period 2.* Nature draws y_k from set $\{y_L, y_H\}$ with probabilities α and $1 - \alpha$, respectively.

2.2.5. *Period 1.* In period 1, the state decides on its preferred tax rate and whether or not to invest in suppression. In equilibrium, there are only four tax rates that are the state might choose: τ_{SL}, τ_{SH}, τ_{NSH}, and τ_{NSL}. These correspond to the maximum tax rates that prevent resistance in the high income state, or in both states, conditional on the decision of whether or not to invest in suppression. τ_{SL} ensures that there will be no resistance in the case that the state has chosen to invest in suppression. τ_{SH}, by contrast, guarantees that a state that has invested in suppression will face no resistance when income is high but will face resistance if income is low. A state that has invested in suppression will not choose any other tax rate. If $\tau < \tau_{SL}$, the state can increase taxes without facing any increased risk of resistance. Similarly, if $\tau_{SL} < \tau < \tau_{SH}$, the state can again increase taxes without changing farmers' decisions to resist taxation. We show in Appendix A.1 that the payoff to setting $\tau > \tau_{SH}$ is lower than choosing $\tau = \tau_{SH}$ after investing in suppression, because unrest is destructive. A similar logic rules out $\tau > \tau_{NSH}$ when the state does not choose suppression.

This implies that there are four possible outcomes:

(1) *Case SH*: The state invests in suppression and chooses $\tau = \tau_{SH}$. Farmers will resist taxation if incomes are low, and so unrest with suppression occurs with probability α.
(2) *Case SL*: The state invests in suppression and chooses $\tau = \tau_{SL}$. Farmers will not resist taxation in any state, and so unrest and suppression do not occur.
(3) *Case NSH*: The state invests in suppression and chooses $\tau = \tau_{NSH}$. Farmers will resist taxation if incomes are low, and so unrest without suppression occurs with probability α.
(4) *Case NSL*: The state invests in suppression and chooses $\tau = \tau_{NSL}$. Farmers will not resist taxation in any state, and so unrest and suppression do not occur.

It remains to consider the conditions under which each of these possible equilibria may exist. We show in Appendix A.2 that the expected payoff to the state in each of the four cases is given by:

$$
\begin{aligned}
EV^s_{SH} &= \alpha(1-p)\gamma\mu y_L + (1-\alpha)\{1-\mu[1-\gamma(1-p)]\}y_H - s \\
EV^s_{SL} &= \{1-\mu[1-\gamma(1-p)]\}y_L - s \\
EV^s_{NSH} &= (1-\alpha)(1-\mu)y_H \\
EV^s_{NSL} &= (1-\mu)y_L
\end{aligned}
$$

The state will chose taxes and suppression depending on the values of y_H, y_L, α, γ, μ, p and s. The outcome achieved in equilibrium will depend on which is greater: EV^s_{SL}, EV^s_{SH}, EV^s_{NSH}, or EV^s_{NSL}.

2.2.6. *Equilibrium.* Here, we describe the levels of suppression and taxation that exist in equilibrium, as well as the incidence of resistance. Begin by defining:

$$
\begin{aligned}
\Phi^{SH}_{SL}(y_L) &\equiv \frac{1-\mu[1-(1-\alpha)\gamma(1-p)]}{(1-\alpha)\{1-\mu[1-\gamma(1-p)]\}}y_L \\
&\equiv \theta^{SH}_{SL}y_L \\
\Phi^{SH}_{NSH}(y_L) &\equiv \frac{s}{(1-\alpha)\mu\gamma(1-p)} - \frac{\alpha}{1-\alpha}y_L \\
&\equiv \lambda^{SH}_{NSH} - \theta^{SH}_{NSH}y_L \\
\Phi^{SH}_{NSL}(y_L) &\equiv \frac{s}{(1-\alpha)\{1-\mu[1-\gamma(1-p)]\}} + \frac{1-\mu[1+\alpha\gamma(1-p)]}{(1-\alpha)\{1-\mu[1-\gamma(1-p)]\}}y_L \\
&\equiv \lambda^{SH}_{NSL} + \theta^{SH}_{NSL}y_L \\
\Phi^{SL}_{NSL} &\equiv \frac{s}{\mu\gamma(1-p)} \\
&\equiv \theta^{SL}_{NSL}
\end{aligned}
$$

$$\begin{aligned}\Phi_{SL}^{NSH}(y_L) &\equiv -\frac{s}{(1-\alpha)(1-\mu)} + \frac{1-\mu[1-\gamma(1-p)]}{(1-\alpha)(1-\mu)}y_L \\ &\equiv -\lambda_{SL}^{NSH} + \theta_{SL}^{NSH} y_L \\ \Phi_{NSL}^{NSH}(y_L) &\equiv \frac{1}{1-\alpha}y_L \\ &\equiv \theta_{NSL}^{NSH} y_L\end{aligned}$$

These functions of y_L allow the (y_H, y_L) space to be partitioned in order to describe the conditions under which the state prefers one outcome to another:

$$\begin{aligned}\mathcal{S}_{SH} &= \{(y_H, y_L) \in \mathbb{R}_+^2 : y_H \geq \Phi_{SL}^{SH}(y_L), y_H \geq \Phi_{NSL}^{SH}(y_L), y_H \geq \Phi_{NSH}^{SH}(y_L)\}, \\ \mathcal{S}_{SL} &= \{(y_H, y_L) \in \mathbb{R}_+^2 : y_H \leq \Phi_{SL}^{SH}(y_L), y_L \geq \Phi_{NSL}^{SL}\}, \\ \mathcal{S}_{NSH} &= \{(y_H, y_L) \in \mathbb{R}_+^2 : y_H \leq \Phi_{NSH}^{SH}(y_L), y_H \geq \Phi_{NSL}^{NSH}(y_L)\}, \\ \mathcal{S}_{NSL} &= \{(y_H, y_L) \in \mathbb{R}_+^2 : (y_H, y_L) \notin \mathcal{S}_{SH} \cup \mathcal{S}_{NSH} \cup \mathcal{S}_{NSL}\}.\end{aligned}$$

At this point, we can derive the main result of our model.

Proposition 1. *The payoffs to the state lead to the following equilibrium outcomes:*

(1) *The state (weakly) prefers suppression with $\tau = \tau_{SH}$ if $(y_H, y_L) \in \mathcal{S}_{SH}$.*
(2) *The state (weakly) prefers suppression with $\tau = \tau_{SL}$ if $(y_H, y_L) \in \mathcal{S}_{SL}$.*
(3) *The state (weakly) prefers no suppression with $\tau = \tau_{NSH}$ if $(y_H, y_L) \in \mathcal{S}_{NSH}$.*
(4) *The state (strongly) prefers no suppression with $\tau = \tau_{NSL}$ if $(y_H, y_L) \in \mathcal{S}_{NSH}$.*

If $(y_H, y_L) \in \mathcal{S}_{SH} \cup \mathcal{S}_{NSH}$, resistance occurs with probability α, i.e. when farmers face adverse income shocks.

Proof. See Appendix A.3. □

These regions are shown in Figure 1.

2.2.7. *Comparative statics.* As we show in appendix A.4, the regions $\mathcal{S}_{SH}$, $\mathcal{S}_{SL}$, $\mathcal{S}_{NSH}$, and $\mathcal{S}_{NSL}$ shown in Figure 1 are straightforward to depict once $\Phi_{SL}^{SH}(y_L)$, $\Phi_{NSL}^{SH}(y_L)$, $\Phi_{NSH}^{SH}(y_L)$, $\Phi_{SL}^{NSH}(y_L)$, $\Phi_{NSL}^{NSH}(y_L)$ and Φ_{NSL}^{SL} are defined.

Proposition 1 yields the intuitive empirical prediction that unrest, if it occurs, will happen during periods of low income. In our data, this will correspond to bad harvests or periods of depressed commodity prices. It is also clear from Figure 1 that this outcome will be most likely when y_H is large relative to y_L. This too is intuitive; the high tax rates that prompt resistance are only worth imposing if the expected gain to the state when incomes are high outweighs the loss when incomes are low.

It is also clear from Proposition 1 and Figure 1 that suppression will be observed during periods of low income if y_L is large relative to s (i.e. y_L is to the right of $\Phi_{NSH}^{SH}(y_L)$). This is again intuitive: the value of output that can be recovered in the low state must be large relative to the cost of recovery in order to justify investment in suppression.

There are five parameters apart from y_L and y_H that determine whether or not unrest will be an equilibrium response to low incomes: α, γ, μ, p and s. Here we discuss the effect of these parameters on the size of the region in which unrest is an equilibrium response to low incomes, i.e. the size of $\mathcal{S}_{SH} \cup \mathcal{S}_{NSH}$. This region is bounded by $\Phi_{SL}^{SH}(y_L)$, $\Phi_{NSL}^{SH}(y_L)$, and $\Phi_{NSL}^{NSH}(y_L)$. We derive comparative statics in Appendix A.5, and summarize these here.

In response to an increase in α, $\Phi_{SL}^{SH}(y_L)$ becomes steeper, $\Phi_{NSL}^{SH}(y_L)$ shifts upward, and $\Phi_{NSL}^{NSH}(y_L)$ becomes steeper. These changes work to shrink the region $\mathcal{S}_{SH} \cup \mathcal{S}_{NSH}$. An increase in α, then, works against the existence of unrest in equilibrium. This is intuitive. Unrest exists if the state has set high taxes that increase its payoff in the high income state at the expense of its payoff in the low income state. If the low income state is more likely, this becomes a less profitable strategy.

In response to an increase in γ, $\Phi_{SL}^{SH}(y_L)$ rotates downwards, $\Phi_{NSL}^{SH}(y_L)$ shifts downward, and $\Phi_{NSL}^{NSH}(y_L)$ does not move. These changes work to expand the region $\mathcal{S}_{SH} \cup \mathcal{S}_{NSH}$. Although farmers are less likely to resist a given tax burden if state capacity is greater, as measured by γ, a greater ability to recover payment from farmers in the case of unrest makes the state more willing to set taxes that will be resisted in the low income state.

In response to an increase in μ, $\Phi_{SL}^{SH}(y_L)$ may rotate in either direction, $\Phi_{NSL}^{SH}(y_L)$ shifts upward, and $\Phi_{NSL}^{NSH}(y_L)$ does not move. These changes have an ambiguous effect on the region $\mathcal{S}_{SH} \cup \mathcal{S}_{NSH}$.

In response to an increase in p, i.e. a reduction in $(1-p)$, $\Phi_{SL}^{SH}(y_L)$ rotates upwards, $\Phi_{NSL}^{SH}(y_L)$ shifts upwards, and $\Phi_{NSL}^{NSH}(y_L)$ does not move. These changes work to shrink the region $\mathcal{S}_{SH} \cup \mathcal{S}_{NSH}$. This is again intuitive; a greater probability of successful unrest reduces the state's incentive to set tax rates that will prompt resistance under low incomes.

In response to an increase in s, $\Phi_{SL}^{SH}(y_L)$ does not move, $\Phi_{NSL}^{SH}(y_L)$ shifts upward, and $\Phi_{NSL}^{NSH}(y_L)$ does not move. These changes work to shrink the region $\mathcal{S}_{SH} \cup \mathcal{S}_{NSH}$. Intuitively, if it is more costly for the state to recover revenue in a state of unrest, this will discourage the state from setting levels of taxation that prompt unrest.

The conditions under which the state will invest in suppression are not central to our results, but we present the relevant comparative statics in appendix A.6.

3. Data and Empirical Strategy

3.1. **Empirical Strategy.** To test the effects of temperature, rainfall, and price shocks on unrest in both the colonial and modern periods, we estimate the following specification:

$$Unrest_{i,t} = \beta Shock_{i,t} + \delta_i + \eta_t + \epsilon_{i,t}. \tag{1}$$

Here, $Unrest_{i,t}$ is a dummy for whether unrest occurred in district i in year t. In practice, this is one of two variables. For the colonial period, we use $Incident_{i,t}$, an indicator for whether the annual report for district i in year t fails to report that nothing happened in the district. For the modern period, we use $Riots/Protests_{i,t}$. This is an indicator for whether a riot or protest occurred.

$Shock_{i,t}$ is a measure of the climate or price shock experienced by district i in year t. For environmental shocks, we use the three year moving average of either $\ln(Rain)_{i,t}$ or $\ln(Temperature)_{i,t}$. The definition of this shock is the same in both the colonial and modern periods. For colonial price shocks, we interact the three year moving average of international commodity prices with dummies that indicate whether a district produced a specific commodity: $Exporter_i^j \times \ln(Price^j)_{i,t}$. For example, we may interact the moving average of the log world cocoa price with an indicator for whether a district produces cocoa.

δ_i and η_t are district and year fixed effects, respectively. We use these to control for omitted heterogeneity at the level of districts and time periods. The equation is estimated using OLS. Standard errors are clustered by district. For our identification strategy, we exploit the fact that rainfall, temperature, and world commodity prices are exogenous from the perspective of a single district. A negative coefficient on β implies that the shock negatively predicts unrest, while a positive coefficient β means that the shock positively predicts unrest.

3.2. **Data.** We acquire colonial unrest data from Huillery (2011). She collected these from Annual Political Reports housed in the Archives Nationales in Paris. These reports were written to the federal governor of French West Africa by the local governors of each colony. Intended to inform both the federal governor and the French administration about political developments in each colony, these were compiled from quarterly district reports. Her sample covers years ending in 3, 6, and 9, between 1906 and 1956, inclusive. For additional documentation, see Huillery (2011).

Events described in the original reports cover a wide range of categories, including the disposition of the population, riots, opposition by local chiefs, problems in tax collection, and resistance to labor recruitment. The anti-colonial resistance expressed by these events includes the initial resistance to military conquest, refusal to obey, pay taxes, provide coerced labor, and enroll in the police, as well as nationalist activities (Huillery, 2011). Our main dependent variable is a summary indicator, taking a value of 0 if the report notes that nothing happened in the district in a given year, and 1 otherwise.

We collect data on modern riots and protests from the *ACLED* (Armed Conflict Location and Event Data) database. These cover the years 1997 to 2011. The data contain both dates and geographic coordinates for all reported instances of political violence in the countries that they cover. Geographic coordinates allow us to assign these events to the former colonial districts of French West Africa, so that our sample of districts remains unchanged across periods. Information on these events are compiled from multiple sources, including media and country reports, publications from humanitarian agencies, and published research. For the closest similarity between the colonial and modern data, we focus on riots and protests. Other events reported by the *ACLED* are not analogous to the events in the Huillery (2011) data. These include military battles and the establishment of bases. *ACLED* codes protests as non-violent meetings of three or more persons assembled for a for a political purpose, whether planned or spontaneous. Previously recognized groups, including political parties, may participate in protests. If these turn violent, they are then counted as "riots."

Rainfall and temperature data are from the standard Matsuura and Willmott (2009) series.[1] The raw data are reported on a $0.5° \times 0.5°$ grid. To compute the annual temperature for an individual district, we average over the monthly data for all the points within a district's boundaries. For districts too small to contain a single point in the Matsuura and Willmott (2009) data, we use temperatures at the nearest grid point.

We take commodity prices and price indices from several sources: Allen (2003); Allen and Unger (2003); Bazzi and Blattman (2014); Blattman et al. (2007); the *Historical Statistics of the United States*;[2] Lord and Boye (1991) and *Historical Statistics for Mineral and Material Commodities in the United States*.[3] The specific series used for each commodity are specified in Table A1 in the Appendix. Commodity prices for the modern period are all taken from Bazzi and Blattman (2014).

[1]See http://climate.geog.udel.edu/~climate/.
[2]See http://hsus.cambridge.org.
[3]See http://minerals.usgs.gov/minerals/pubs/historical-statistics/.

Commodity prices that were reported in pounds were converted to real values using the price index from Allen and Unger (2003), taking 1930 as a base year. Similarly, prices reported in US dollars were converted to real values using the price index from the *Historical Statistics of the United States*, taking 1930 as a base year for the historical period. Modern commodity prices were converted into real prices using the Bureau of Labor Statistics' Consumer Price Index with 2000 as the base year. Historical prices for cocoa, coffee and palm produce required merging the series from Blattman et al. (2007) and Bazzi and Blattman (2014). We normalize the Bazzi and Blattman (2014) series so that they are equal to the Blattman et al. (2007) series for the year 1950, which is the one point at which they overlap. The same procedure was used to join the cotton series from New York (1900-1941), ten markets (1941-1956) and the Bureau of Labor Statistics (1956-1960) reported in the *Historical Statistics for Mineral and Material Commodities in the United States*. We graph our commodity price series of interest in Figure 2.

To assign commodity price shocks to individual districts, we require information on which districts in French West Africa produce which products. These data are taken from the Hopkins (1973) map of export crop production in West Africa. We treat a district as a producer of a given commodity if the production zone mapped by Hopkins (1973) intersects with any part of this district. As an example, we provide a map of districts coded as cocoa-producing according to the Hopkins (1973) map in Figure 3. Classifications in Hopkins (1973) are consistent with the less detailed map that Austin (2009) gives for 1914, and the list of major exports by country in the late 1950s provided by Thompson and Aldoff (1975).

The commodities we consider are bananas, cocoa, coffee, cotton, groundnuts, and palm produce (kernels and oil). This exhausts the list of products that intersect French West Africa in the Hopkins (1973) map. Though this is not a complete list of the products exported by the colonies of French West Africa, it accounts for the bulk of export earnings. Indeed, groundnuts, coffee and cocoa together accounted for 70% of French West Africa's export earnings during the 1950s (Berg, 1960). Each of the products recorded in the Hopkins (1973) map was exported, though some had domestic markets as well.

The inclusion of district fixed effects in our baseline specification eliminates the need to control for district characteristics. We do, however, use additional variables from Huillery (2009, 2011) in order to test for heterogeneous responses to conflict. In particular, we use an indicator for access to the sea, an indicator for a navigable river, a dummy variable for a kingdom at the end of the nineteenth century, an indicator for a trading post before the colonial conquest, an indicator for an acephalous society before the colonial conquest, an indicator for above-median distance from the coast, an indicator for above-median distance from a port, an indicator for above-median area, an indicator for above-median years of resistance to French colonial conquest, an indicator for above-median date of the start of colonial conquest, and an indicator for above-median date of the final military intervention before a district submitted to French rule. We compute the coefficient of variation of rainfall using the Matsuura and Willmott (2009) data.

Summary statistics for our principal dependent variables, our shocks of interest, and district characteristics are shown in Table 1. We map the mean prevalence of colonial incidents and modern riots/protests in Figures 4 and 5, respectively.

4. Results

4.1. **Colonial period.**

4.1.1. *Main results.* Table 2 reports our main results for the 1906 to 1956 period. In addition to clustering by district, we report Conley (1999) standard errors adjusted for spatial dependence at distances of both 5 and 10 decimal degrees. These standard errors are smaller than when we cluster by district. Columns (1) and (2) show the results using rainfall and temperature shocks. Both effects are similar in magnitude. A standard deviation decrease in rainfall causes a 0.43 standard deviation increase in unrest, or 14.6 percentage points.[4] A standard deviation increase in temperature causes a 0.45 standard deviation increase in unrest, or 15.2 percentage points.[5] This is as we would expect; a decrease in rainfall or

[4] $-0.164 \times 0.89/0.34 \approx -0.430$, $-0.164 \times 0.89 \approx -0.146$
[5] $2.931 \times 0.052/0.34 \approx 0.448$, $2.931 \times 0.052 \approx 0.152$

an increase in temperature means less income for farmers, and so the opportunity cost of violence declines.

A similar logic holds for results in columns (3) to (6). A decrease in world commodity prices increases unrest. For example, a 50% decrease in the price of cocoa leads to a 6 percentage point increase in the probability of an incident, or 0.18 standard deviations.[6] These are all labor-intensive crops, so the results are, again, intuitive.

Columns (7) and (8) present a puzzle. Positive price shocks to groundnuts and palm increase unrest. There are several possible reasons for this. First, groundnut producers may also be groundnut consumers, so that a positive price shock increases living costs. Groundnuts have historically provided a high-protein substitute to meat for many poor people in colonial West Africa (Moradi et al., 2013).

Further, we can discuss the history of specific episodes of quiet and unrest in producing regions. Our groundnut result is driven largely by two episodes. First, many groundnut-producing districts were unusually quiet during the low prices of the 1930s: Kayes and Bafoulabe in 1933, Dedougou and Gaoua in 1936, and Tivaouane in 1939. Second, groundnut-producing districts were universally unquiet in 1943, despite the high prices paid for groundnuts during the Second World War.

Both of these episodes are explainable. During the 1930s, the colonial state used agricultural cooperatives to stock and distribute seeds, and to strengthen the power of the Muslim religious leaders that dominated groundnut production (Boone, 2006, p. 43). The French government temporarily provided producers with price support (Thompson and Adloff, 1958, p. 312). These efforts would have quelled unrest. By contrast, during the Second World War, imports were scarce due to rationing and coercion of African labor increased under the Free French (e.g. (Lawler, 1990)). This offset greater export prices, and led to protest.

In addition to these temporary pressures, several factors made groundnut production unusual in French West Africa, connecting its expansion with processes of upheaval and

[6] $-0.124 \times 0.5 \approx 0.062$, $-0.124 \times 0.5/0.34 \approx -0.182$. Because of zeroes for non-producing districts, a one standard deviation change in the shock measure is not meaningful. Figure 2 shows that a 0.5 unit change in the log price of any of the commodities of interest is well-within the sample variation.

social change. Even in the nineteenth century, groundnuts were an expansive crop cultivated largely by migrants (Brooks, 1975). Many of these early cultivators left behind a troubled past; they included ruined peasants, liberated slaves, and redundant laborers (Lachenmann, 1993). The spread of groundnut production was largely bound up with Islamic religious movements. Cultivators worked the land of these leaders, and migrated with them to expand production. French authorities upheld these men as local leaders through whom to exercise colonial rule. These leaders, in turn, were critical in the recruitment of forced laborers and soldiers for the colonial state (Robinson, 1991). Further, the expatriate Lebanese merchants who were active in the groundnut trade largely sided with Africans during the push for independence (Boumedouha, 1990).

Turning to the positive but insignificant correlation of palm prices with unrest in our baseline results, we show below that the significance of this correlation is sensitive to the inclusion of additional controls and district trends. Like groundnuts, palm oil was often grown by smallholders whose communities consumed the produce (Kiple et al., 2000). The oil palm was used as a source of cooking oil, fermented drinks, medicine, and kerosine substitutes (Thompson and Adloff, 1958, p. 315). Similarly, unrest concerning palm prices in Senegal in 1952 was met with minor government efforts to improve the situation of producers (Thompson and Adloff, 1958, p. 466).

Further, the positive correlation between palm oil prices and unrest in palm-producing districts is an artefact of the Second World War. It is entirely explained by the unusual quiet in coastal Conakry, Ouidah, Allada, and Porto-Novo in 1943: if this year is removed from the analysis, the correlation becomes negative and insignificant.

4.1.2. *Compliers.* Table 3 reports compliers for our colonial results. This exercise is similar to that in Dell (2012). We report heterogeneous compliance with rainfall and temperature shocks. In both cases, results are strongest in regions furthest from ports or from the coast. For both shocks, having had a pre-colonial state attenuates the effect of shocks, though the interaction is only significant for temperature. Areas where French conquest was resisted for longer respond more to temperature shocks. Both types of shock matter less where the coefficient of variation of rainfall is high, i.e. where shocks are more common. Neither type of shock is significantly attenuated by the mean frequency of colonial incidents or modern riots and protests.

Some of these responses can be accounted for by appealing to the comparative static results of the model. An increase in the coefficient of variation of rainfall is analogous to an increase in α, the probability of an adverse income shock. As in the model, this reduces the incentive of the state to set tax rates that will prompt resistance in the low-income state.

Similarly, the presence of an existing pre-colonial state gave colonial authorities greater tools with which to recover taxes despite resistance from farmers. This pattern was repeated across much of Africa (Acemoglu et al., 2014; Michalopoulos and Papaioannou, 2013). This reduced the returns to unrest. After falling commodity prices made it difficult for Daillonke producers in Sangalan to pay their taxes in 1931-32, French officials leaned on the Fulbe canton chiefs who were the successors of the former slave-owning class in order to find a way to extract payment (Klein and Roberts, 1987, p. 27). In regions without pre-colonial states, the French found it difficult to fill the difficult role of village chief; the true traditional leader often hid behind a former slave or another man of low rank (Suret-Canale, 1971, p. 82). In parts of Côte d'Ivoire, for example, locals resented the colonial chiefs for their role in tax collection and labor recruitment, as well as the inconsistency between how they were appointed and customary rules (Asiwaju, 1976). While the model predicts that greater state capacity would prompt higher tax rates that leave the incidence of unrest unchanged, French authorities may have been unable to fully exploit this advantage or may have been overconfident in the ability of appointed chiefs to collect payment from uncooperative farmers.

The greater responsiveness of incidents to shocks in more isolated districts is a reflection of the scarcity of alternative income opportunities from trade. In these regions, the gap between y_H and y_L is widened because of the lack of economic diversification. Districts that were more distant from a port or from the coast are less likely to have had a trading post before colonization or to be producers of cocoa, coffee, cotton, or palm produce in the Hopkins (1973) map, and they are no more likely to produce groundnuts. These areas were also poorer. They received less colonial investment as measured by teachers, public health staff or public work spending, rates of head taxes were lower, and less tax revenue was collected per capita.[7]

4.1.3. *Robustness.* We perform several robustness exercises that we report in the appendix. In Table A2, we show that the results are largely unchanged if district-specific trends are added. In Table A**??**, we show that replacing three-year moving averages of our shocks of interest with one-year lags of these same shocks gives nearly identical results, though the effect of rainfall is now marginally insignificant ($t = -1.58$).

In Table A4, we present marginal effects estimates of (1) using a logit estimator. These are largely similar to our baseline, except that the effect of cotton price shocks is now insignificant ($t = -1.38$). In Table A5, we include all shocks in the same specification. Again, the results resemble our baseline, except that the effect of banana price shocks is now insignificant ($t = -1.62$), while palm oil prices now enter positively and significantly. In Table A6, we control for the value of the dependent variable in the most recent year in the data. This is the closest our data permit to adding a true lagged dependent variable. The lag does not enter significantly in any specification. Results are largely similar to the baseline, except that palm prices now enter significantly and cotton is no longer significant ($t = -0.21$). Finally, we show that the results are very similar if we discard any districts that either reported no incidents in the colonial period, or an incident at every observation in the colonial period. These results are reported in Table A6.

We perform additional robustness checks and tests for additional compliers that we do not report. If we weight commodity price shocks by the share of a district that Hopkins (1973) depicts as producing that commodity, all coefficient signs remain the same as in our baseline. The effects of cotton and groundnuts become insignificant, however ($t = -1.21$ and $t = 1.13$, respectively). We interact the French colonial investments studied by Huillery

[7]For each of these variables except groundnuts, the district-level cross-sectional correlations with coast and port distance are negative and significant at the 5% level (not reported). The correlation with groundnuts is insignificant.

(2009) with rainfall and temperature shocks.[8] Although the signs on these interactions suggest a mitigating effect, they are not significant.

There are additional results we do not report. We find no evidence that the effects of rainfall or temperature are greater in the second half of the colonial period than during the first half. The effects of colonial rainfall and temperature shocks are greater in Islamic regions. Finally, we interact our rainfall and temperature shocks with the ecological regions mapped by White (1983).[9] In all regions where the effects of rainfall are significant, they are negative. These are the azonal, edaphic, semidesert, and woodland zones. Similarly, temperature enters significantly only in the desert and woodland zones, where its sign is positive. Our main results survive discarding areas that are majority desert, as well as restricting our sample to districts in which the Murdock (1967) *Ethnographic Atlas* reports that local ethnic groups derived most of their subsistence from agriculture.

We have not yet distinguished the types of incidents that responded to economic shocks. For 79% of "incidents" in the data, Huillery (2011) provides details on the reason for the disturbance, classifying these as land, taxes, recruitment, borders, or "other." We estimate (1), replacing the dependent variable with an indicator for an incident within each of these categories. We plot 95% confidence intervals for the response of these variables to the three year moving average of log rainfall in Figure 6. None of these are significant at the 5% level, and so the data do not allow us to distinguish which motives for unrest were the most responsive to economic shocks. Suggestively, the coefficients on all categories except "other" are negative, and the largest estimated effect is for incidents related to taxes.

4.2. **Modern period.**

4.2.1. *Main results.* Table 4 reports results for modern riots in the former colonies. Column (1) shows that rainfall predicts riots with some degree of accuracy; a standard deviation

[8]In particular, these are indicators for whether the number of teachers per capita averaged over the period 1910-1928 was above the median, whether the number of public health staff per capita averaged over the 1910-1928 period was above the median, and whether public works expenditure per capita over the period 1910-1928 was above the median.

[9]The land areas within French West Africa are classified by White (1983) as azonal, bushland, desert, edaphic, forest, forest transitions, semi-desert, and woodland.

decrease in rainfall leads to a 0.49 standard deviation increase in riots, or roughly a 13 percentage points.[10] Modern unrest, then, still reacts in a negative way to rainfall shocks. Temperature and commodity price shocks, by contrast, no longer follow their historical patterns. The effect of temperature is insignificant, and the point estimate has the opposite sign than what we would expect. All estimated effects of commodity prices are now insignificant, though their signs remain the same as in the colonial period.

4.2.2. *Compliers.* In Table 5, we show that heterogeneity in how districts respond to rainfall and temperature shocks has also changed between the colonial and modern periods. It remains the case that areas that are more remote respond more to rainfall shocks; this is significant in columns (2) and (3), and marginally insignificant in column (1) ($t = 1.61$). Precolonial kingdoms no longer attenuate rainfall shocks. Although the effect remains smaller in areas that are more prone to rainfall variability (column (6)), this difference is no longer significant. Now that the main effect of temperature has a different sign and is no longer statistically significant, it is no surprise that the pattern of compliers has completely changed.

4.2.3. *Robustness.* We use Tables A7 and A8 to show that the link between shocks and conflict in the present is less robust than it was in the past. In Table A7, we show that the correlation between rainfall and modern riots disappears after controlling for district-specific trends.[11] Similarly, the effect of rainfall does not survive the use of lagged values rather than moving averages.[12] Results remain similar if we use the count of riots and protests, rather

[10] $-0.165 \times 0.89/0.30 \approx 0.490$, $-0.165 \times 0.89 \approx 0.147$.

[11] Although our result differs from the more robust relationship between drought and civil war found by Miguel et al. (2004), this should not be surprising given the different outcome, later time period, and alternative econometric specification that we consider.

[12] We also find no response of riots and protests to commodity prices if we use the FAO Agro-MAPS used by Berman and Couttenier (2014) data to code districts as commodity producers (not reported). We treat a district as a "producer" if it intersects an administrative unit that produces the commodity in the FAO Agro-MAPS data. For each commodity, we use the Agro-MAP from the available year closest to 1997, the start of the ACLED data. In separate exercises, we use production data from first-level and second-level administrative units. There are two major shortcomings of the Agro-MAPS data that prevent us from using these data in our main analysis. First, there are substantial gaps in the data; many products are only available for a handful of African countries in any given year. Second, the administrative units in the Agro-MAPS are very different from the colonial districts that are our units of observation. This introduces substantial error into our coding of districts as "producers."

than an indicator; this is reported in Table A9. In Table A10, we show that our results are not sensitive to exclusion of capital cities from the data.

4.2.4. *Do modern riots and protests have deep roots?* In Tables 6 and 7 we show that, not only do colonial and modern unrest respond differently to economic shocks, their cross-sectional correlates differ. In Table 6, we regress the district-level prevalence of incidents on the geographic, political, and economic variables in our data. We use a tobit estimator to account for districts with no incidents or with no incident-free years. In Table 7 we do the same for modern riots and protests.

For the colonial period, we find that resistance was greater in areas of higher mean rainfall. We also find higher levels of unrest in groundnut-producing and cocoa-producing districts, though only in some specifications. All of these are regions in which higher incomes during good periods would have raised the return on taxation to the colonial state. Lastly, it is clear that areas with a pre-colonial kingdom and those that were acephalous experienced more unrest relative to the chiefdoms and city-states that form the excluded category. This latter result mirrors the findings from Huillery (2011) on anti-colonial hostility over the 1906-1920 period. None of these three patterns are evident in Table 6.

We report in Table 6 that there is almost no correlation between the incidence of colonial unrest and modern day riots and protests. This too mirrors results from Huillery (2011), who found that hostility over the 1906-1920 period was uncorrelated with hostility in the later colonial era once a dummy variable for the Casamance region was included. In her view, this was because anti-colonial hostility had a substantial "accidental" component. Indeed, it is striking how little variation is explained by our controls. Once country fixed effects are added, only the pre-colonial political variables and rainfall are significant in Table 6. In Table 7, there are no correlates of riots and protests that are robust across all specifications.

Huillery (2011) identifies two sources of random variation in hostility that explain this lack of persistence. The first is the individual personalities of specific administrators; some were more diplomatic, while others were more brutal. Second, the individual personalities of African leaders mattered. Some, like Samori Ture or Koulibaly of Kaarta, were "personally inclined to resistance towards colonial authority." Our baseline results provide a third reason: anti-colonial hostility was, in part, a response to transient economic shocks.

4.3. **Discussion.** It is clear from the results in section 4 that the model in section 2 helps explain the patterns of unrest we observe in colonial French West Africa, but not those experienced in the present. This is consistent with the existing secondary literature.

Much of the work on forms of resistance in colonial French West Africa describes it as a response to obligations such as taxation and forced labor. Asiwaju (1976) claims these impositions prompted migration into British territories, while Cordell and Gregory (1982, p. 220) make similar claims about internal migration. Parents in Koudougou protested against recruitment of their children as contract labor in 1932 (Cordell and Gregory, 1982, p. 217). Other forms of unrest that existed in response to economic shocks similarly have no parallel in the modern period. Clark (1994), for example, links the mass departures of slaves from their masters in the period from 1905 to 1911 to a series of droughts in the region.

This existing literature also recognizes that unrest was episodic. Resistance to conscription, for example, was less intense during peace time than it was during the First World War (Echenberg, 1975, p. 181). This recruitment followed on the famine of 1913-14. In the Upper Senegal Valley, this was the most severe famine in recent memory, and had devastated agriculture, pastoralism and commerce. The government had persisted in levying head and herd taxes at their usual rates (Clark, 1995). The literature similarly acknowledges that colonial suppression was often in response to failures to pay tax or meet forced labor obligations; half of all recorded punishments under the *indigénat* during the 1930s were for offences of this type (Mann, 2009, p. 342). Collective punishments for these infractions were also common under the *indigénat*; one official in 1921, for example, inflicted identical punishments on 15 individuals from a single village (Mann, 2009, p. 343).

The Volta-Bani revolt of 1915-16 is a useful example. Like other wartime episodes of resistance, it followed closely on the drought and famine of 1913-14. This had affected much of the Sahel, and was possibly the most severe famine in the region in the twentieth century (Van Beusekom, 1999). In our data, the three-year moving average of rainfall was visibly below its mean in 1913 and 1916 in Burkina Faso, Niger, Mali, and Senegal. The same drought had pushed Saharan groups such as the Tuareg south, leading to conflicts between migrants and locals (Suret-Canale, 1971, p. 82). Though recruitment into the army had at first appeared to be an honorable way to escape the effects of the famine, this illusion was destroyed once news of the conditions of war spread (Suret-Canale, 1971, p. 139). The Volta-Bani rising was a movement to resist taxation, forced recruitment and French rule. Organizers mobilized some 20,000 soldiers to fight against the French in an area stretching from Mali to Burkina Faso, and were only suppressed by a force of 5,000 French troops. This took place in a region of considerable ethnic diversity that lacked major pre-colonial states. The core of the rebelion was formed by alliances among villages and segmentary societies (Saul and Royer, 2001).

By contrast, modern riots and protests in the former colonies of French West Africa have frequently focused around issues such as prices, upward mobility, and service delivery. These events have had unions, students, youth, and members of political parties as participants (e.g. Mueller (2013); Wise (1998)). Only 3 of 982 events in the data are described as relating to taxes; all concern protests over a motor vehicle tax in Burkina Faso in 2010. Some of the events that have followed on periods of low rainfall and that are statistically influential in our modern results have included: a 2005 strike by the National Confederation of Guinean Workers the former Kindia district of Guinea, accompanied by a youth riot focused on high prices; events in 2004 and 2005 in the former Pita district of Guinea during which rioters protested electricity prices and students protested the poor conditions of their schools, and; Senegalese soldiers in the former Thies district protesting pay and benefits in 1999.

A series of marches and riots by students in the former colonial Bassam, Lahou, and Sassandra districts of Côte d'Ivoire in 1999 also followed a period of depressed rainfall. These were part of a larger set of student protests led by the Federation of Ivorian Students that had included meetings, sit-ins and demonstrations, concerning issues ranging from political suppression to medical care, examination requirements for higher education, student fees and loans, and university residences (Farmer, 1999). The politicization of education and student groups has a long history in Côte d'Ivoire. The Federation of Ivorian Students was established in 1990 to protest repression under the Houphouët-Boigny government, and student groups were mobilized for violence during the First Ivorian Civil War (Sany, 2010). The correlation between economic shocks and unrest in the present day, then, follows a different logic and often involves a different set of actors than during the colonial period.

5. Conclusion

In this paper, we collect data on both colonial unrest and modern riots in French West Africa. We show that from 1906 to 1956, unrest reacted positively to higher temperatures, negatively to greater rainfall, and, with some exceptions, negatively to greater commodity prices. These patterns are mitigated by institutions, geography, and history. Specifically, colonial unrest's reaction to shocks is strongest in remote areas with less history of states and less vulnerability to environmental shocks. These patterns can be understood as the equilibrium response of a tax-paying peasantry to an extractive colonial state.

To the best of our knowledge, our study is the first to provide evidence on unrest's response to both environmental and commodity price shocks within a single setting. We find differences in the responsiveness to shocks in the colonial and modern settings. The negative correlation between rainfall and unrest remains in the present, but it is smaller, less robust, and no longer mitigated by pre-colonial institutions or the general frequency of rainfall shocks. Temperature is no longer a significant predictor of unrest, nor are commodity price shocks.

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Figure 1. Equilibria in the model

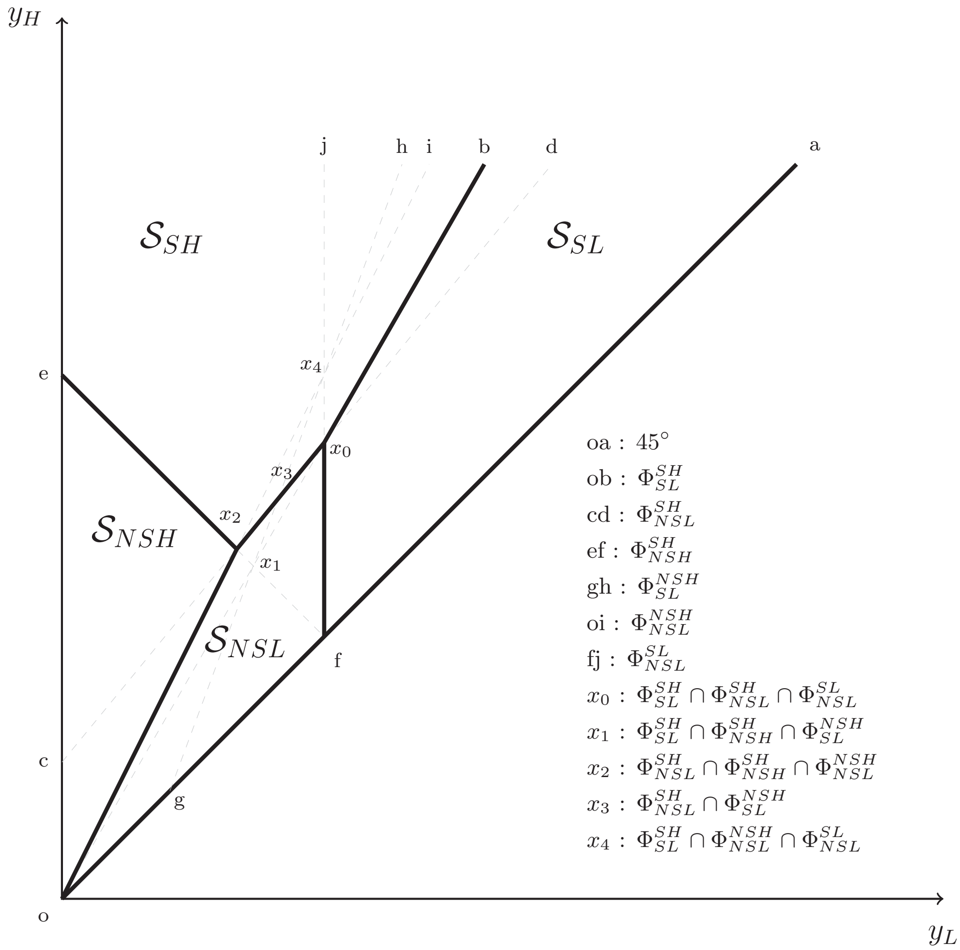

Figure 2. 3 Year Moving Average Log Prices in Survey Years, Relative to 1931

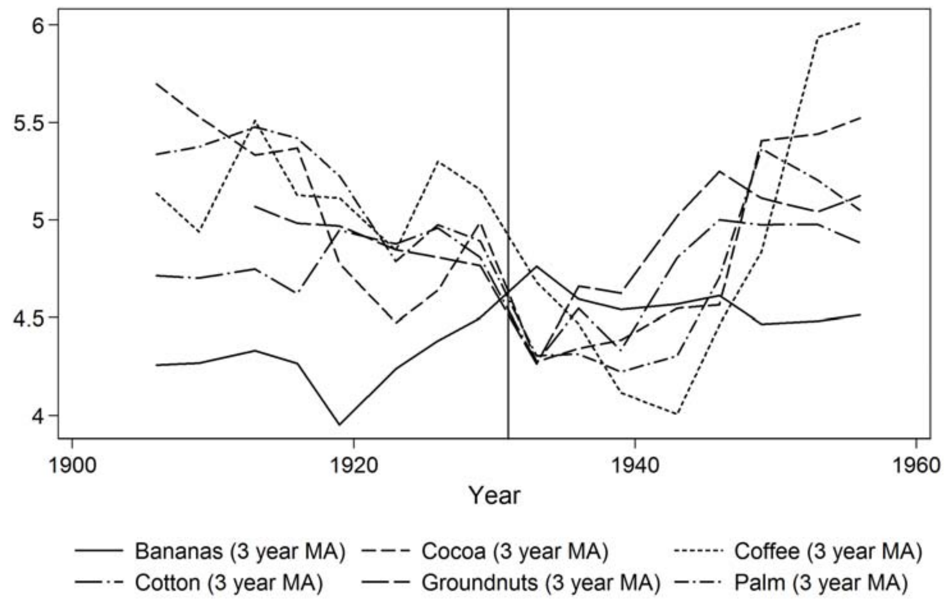

Figure 3. Cocoa production in Hopkins (1973)

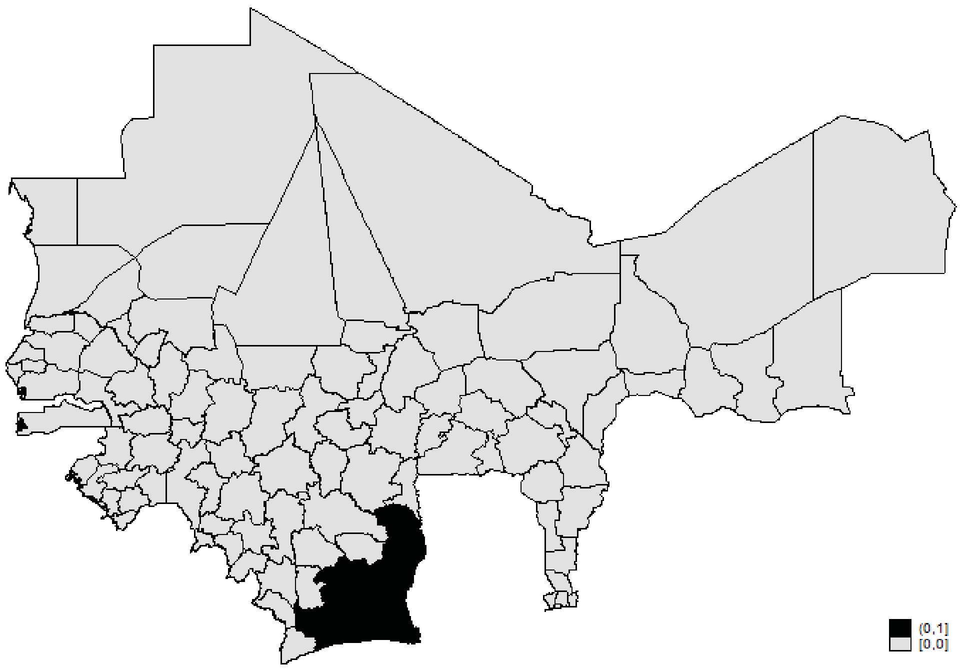

FIGURE 4. Colonial Incidents, 1906-1956

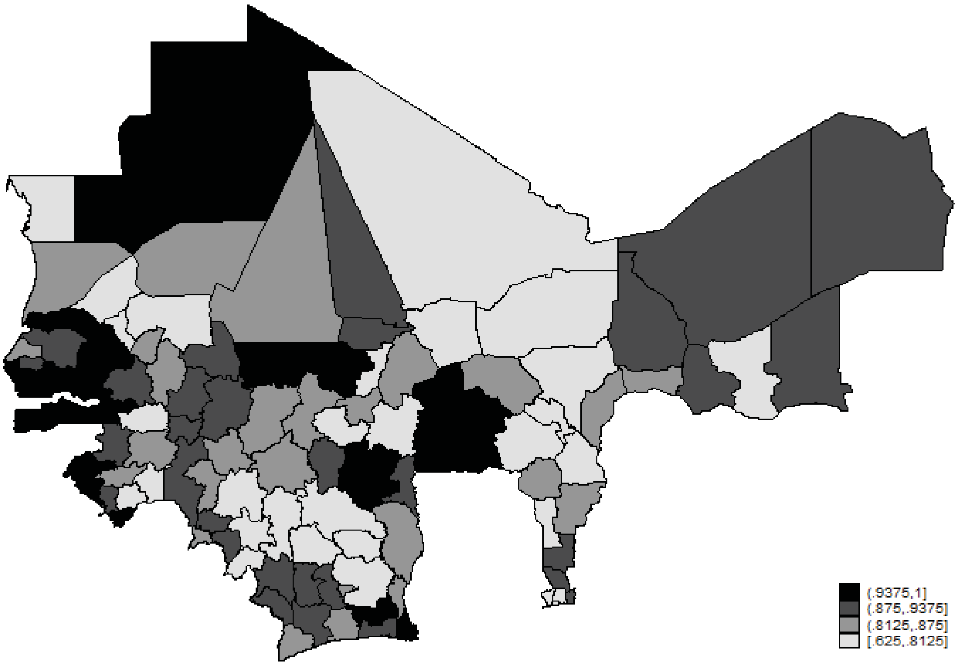

FIGURE 5. Riots and protests, 1997-2011

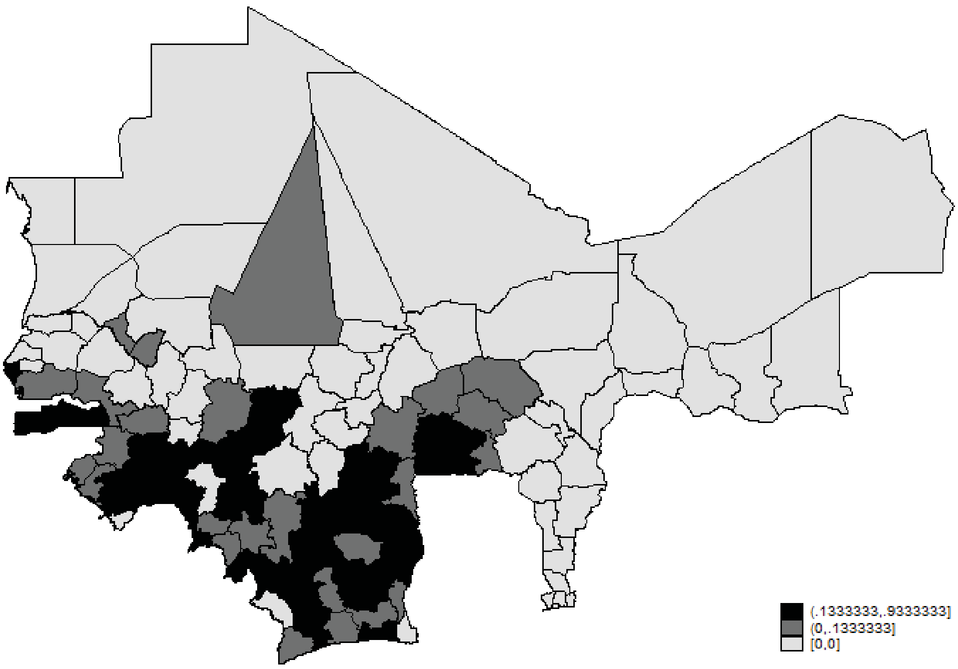

Figure 6. Types of incident: Coefficients and 95% Confidence Intervals

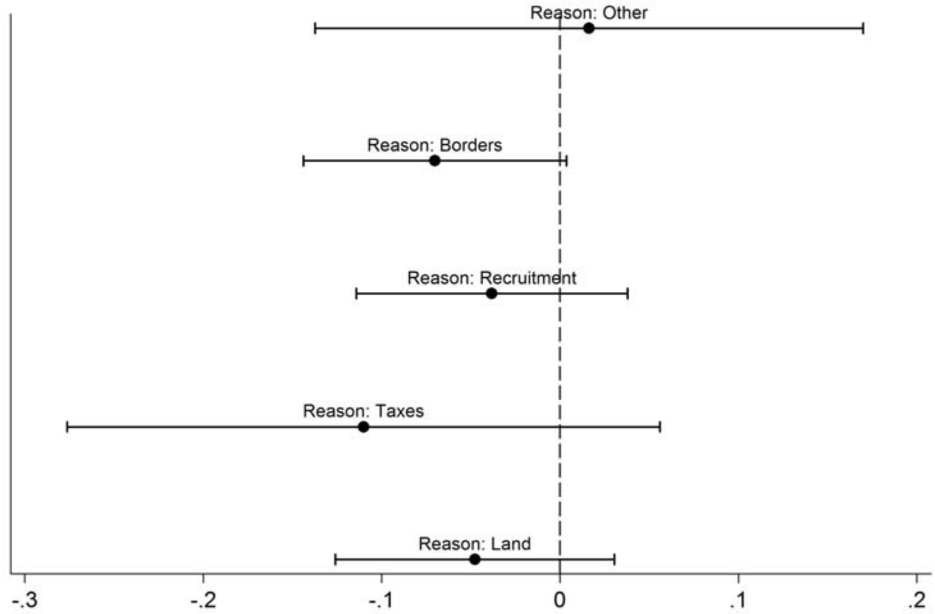

Table 1. Summary statistics

	(1) Mean	(2) s.d.	(3) Min	(4) Max	(5) N
Colonial data					
Incident	0.86	0.34	0	1	1,431
Log rainfall (3 year MA)	4.22	0.89	-0.059	5.79	1,760
Log temperature (3 year MA)	3.30	0.052	3.14	3.40	1,760
Exporter X Log Price: Bananas (3 year MA)	0.44	1.33	0	4.76	1,760
Exporter X Log Price: Cocoa (3 year MA)	0.50	1.49	0	5.70	1,760
Exporter X Log Price: Coffee (3 year MA)	0.81	1.86	0	6.01	1,760
Exporter X Log Price: Cotton (3 year MA)	0.26	1.08	0	5.00	1,760
Exporter X Log Price: Groundnuts (3 year MA)	0.89	1.89	0	5.25	1,540
Exporter X Log Price: Palm (3 year MA)	0.72	1.75	0	5.48	1,760
Modern Data					
Riots/Protests	0.10	0.30	0	1	1,680
Log rainfall (3 year MA)	4.09	0.88	0.17	5.59	1,554
Log temperature (3 year MA)	3.32	0.056	3.16	3.42	1,554
Exporter X Log Price: Banana (3 year MA)	0.72	1.99	0	6.46	1,456
Exporter X Log Price: Cocoa (3 year MA)	0.85	2.34	0	7.59	1,456
Exporter X Log Price: Coffee (3 year MA)	0.78	1.67	0	4.94	1,456
Exporter X Log Price: Cotton (3 year MA)	0.29	1.05	0	4.54	1,456
Exporter X Log Price: Groundnut (3 year MA)	1.32	2.66	0	6.90	1,456
Exporter X Log Price: Palm (3 year MA)	0.97	2.22	0	6.38	1,456
District Characteristics					
Indicator of access to the sea	0.21	0.41	0	1	112
Indicator of a kingdom at the end of the nineteenth century	0.48	0.50	0	1	112
Distance of the main city from the coast in km: Above median	0.49	0.50	0	1	112
Distance of the main city from the nearest port in km: Above median	0.49	0.50	0	1	112
Number of years of resistance to French colonial conquest: Above median	0.47	0.50	0	1	112
Mean of incidents: Above median	0.48	0.50	0	1	112
Mean of riots: Above median	0.48	0.50	0	1	112
Coefficient of variation of rain above median	0.50	0.50	0	1	112

Table 2. Main results: Colonial incidents

	(1)	(2)	(3)	(4)
	Dependent variable: Incident			
Shock	-0.164**	2.931***	-0.265**	-0.124**
s.e. Clustered by district	(0.066)	(1.094)	(0.114)	(0.063)
Conley s.e. (5 degree cutoff)	(0.065)	(0.906)	(0.112)	(0.050)
Conley s.e. (10 degree cutoff)	(0.063)	(0.810)	(0.097)	(0.039)
Observations	1,431	1,431	1,431	1,431
Shock	Rain	Temp.	Bananas	Cocoa
	Dependent variable: Incident			
	(5)	(6)	(7)	(8)
Shock	-0.104	-0.279**	0.230**	0.065
s.e. Clustered by district	(0.064)	(0.131)	(0.101)	(0.043)
Conley s.e. (5 degree cutoff)	(0.043)	(0.166)	(0.113)	(0.041)
Conley s.e. (10 degree cutoff)	(0.040)	(0.157)	(0.103)	(0.038)
Observations	1,431	1,431	1,212	1,431
Shock	Coffee	Cotton	Groundnuts	Palm

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by district in parentheses unless otherwise indicated. The estimator is OLS, with fixed effects for district and year. The dependent variable is an indicator for an incident.

Table 3. Compliance with colonial shocks.

	(1)	(2)	(3)	(4)
	Dependent variable: Incident			
Panel A. Rainfall Shocks				
Shock	-0.166**	0.014	-0.021	-0.223**
	(0.075)	(0.090)	(0.101)	(0.085)
Interaction	0.010	-0.281**	-0.210*	0.134
	(0.117)	(0.124)	(0.124)	(0.111)
Panel B. Temperature Shocks				
Shock	3.890***	0.512	0.270	5.314***
	(1.170)	(1.778)	(1.804)	(1.626)
Interaction	-4.823*	3.997*	4.412**	-4.313**
	(2.847)	(2.146)	(2.182)	(2.055)
Interacted Variable	*Access to the sea*	*Distance of the main city from the coast in km: Above median*	*Distance of main city from nearest port: Above median*	*Kingdom at the end of the nineteenth century*
Observations	1,431	1,431	1,431	1,431

	(5)	(6)	(7)	(8)
	Dependent variable: Incident			
Panel A. Rainfall Shocks				
Shock	-0.203**	-0.552***	-0.212*	-0.163**
	(0.091)	(0.191)	(0.117)	(0.065)
Interaction	0.094	0.438**	0.081	-0.009
	(0.114)	(0.190)	(0.120)	(0.165)
Panel B. Temperature Shocks				
Shock	1.346	6.050***	3.073*	3.055**
	(1.156)	(2.010)	(1.800)	(1.250)
Interaction	4.539**	-4.505*	-0.268	-0.447
	(2.171)	(2.406)	(2.032)	(2.532)
Interacted Variable	*Years of resistance to conquest: Above median*	*CV of rainfall: Above median*	*Mean of incidents: Above median*	*Mean of riots/protests: Above median*
Observations	1,431	1,431	1,431	1431

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by district in parentheses. The estimator is OLS, with fixed effects for district and year. The dependent variable is an indicator for an incident.

Table 4. Modern riots and protests

	(1)	(2)	(3)	(4)
	Dependent variable: Riots/protests			
Shock	-0.138*	0.054	-0.246	-0.049
	(0.075)	(1.135)	(0.170)	(0.126)
Observations	1,554	1,554	1,456	1,456
Shock	Rain	Temp.	Bananas	Cocoa
	Dependent variable: Riots/protests			
	(5)	(6)	(7)	(8)
Shock	-0.009	-0.130	0.194	0.039
	(0.053)	(0.165)	(0.144)	(0.059)
Observations	1,456	1,456	1,456	1,456
Shock	Coffee	Cotton	Groundnuts	Palm

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by district in parentheses. The estimator is OLS, with fixed effects for district and year. The dependent variable is an indicator for riots/protests.

Table 5. Compliance with modern shocks.

	(1)	(2)	(3)	(4)
	Dependent variable: Riots/protests			
Panel A. Rainfall Shocks				
Shock	-0.165*	-0.098	-0.088	-0.060
	(0.090)	(0.106)	(0.113)	(0.082)
Interaction	0.094	-0.106	-0.119	-0.165
	(0.137)	(0.113)	(0.120)	(0.133)
Panel B. Temperature Shocks				
Shock	-0.067	3.558**	2.449	0.542
	(1.131)	(1.649)	(1.663)	(1.469)
Interaction	1.211	-5.699***	-4.057**	-0.925
	(3.114)	(1.691)	(1.655)	(1.524)
Interacted Variable	*Access to the sea*	*Distance of the main city from the coast in km: Above median*	*Distance of main city from nearest port: Above median*	*Kingdom at the end of the nineteenth century*
Observations	1,554	1,554	1,554	1,554

	(5)	(6)	(7)	(8)
	Dependent variable: Riots/protests			
Panel A. Rainfall Shocks				
Shock	-0.031	-0.284*	-0.244*	-0.183***
	(0.089)	(0.145)	(0.128)	(0.045)
Interaction	-0.222*	0.225	0.192	0.120
	(0.132)	(0.152)	(0.133)	(0.172)
Panel B. Temperature Shocks				
Shock	0.503	0.502	-0.666	-0.824
	(1.299)	(1.715)	(1.362)	(1.021)
Interaction	-1.111	-0.805	1.395	2.753
	(1.727)	(1.552)	(1.513)	(1.971)
Interacted Variable	*Years of resistance to conquest: Above median*	*CV of rainfall: Above median*	*Mean of incidents: Above median*	*Mean of riots/protests: Above median*
Observations	1,554	1,554	1,554	1,554

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by district in parentheses. The estimator is OLS, with fixed effects for district and year. The dependent variable is an indicator for riots/protests.

Table 6. Deep roots of colonial unrest?

	(1)	(2)	(3)	(4)	(5)	(6)
	ρ	*Dependent variable: Mean incident X 100*				
Mean of riots	0.04					
Mean Rainfall	0.04	0.070**			0.113***	0.111**
		(0.032)			(0.033)	(0.043)
Mean Temperature	0.13	1.054			1.883	1.651
		(1.684)			(1.398)	(1.326)
Coefficient of variation of rain	0.01	-11.392			4.218	7.415
		(13.451)			(12.818)	(12.092)
Altitude of district's main city in meters	-0.19	-0.005*			-0.004	-0.001
		(0.003)			(0.003)	(0.003)
Latitude of district's main city	0.08	0.582			0.671	0.673
		(0.688)			(0.685)	(0.904)
Longitude of district's main city	-0.11	-0.075			0.065	-0.814
		(0.232)			(0.267)	(0.589)
Indicator of access to the sea	0.09	1.044			0.369	-2.065
		(3.526)			(3.841)	(3.909)
Indicator of a navigable river	-0.01	-0.451			0.066	-0.029
		(2.148)			(1.758)	(1.772)
Distance of the main city from the coast in km	0.01	-0.010			0.017	-0.001
		(0.012)			(0.012)	(0.013)
Distance of the main city from the nearest port in km	0.03	0.016			-0.011	0.008
		(0.011)			(0.012)	(0.014)
Area in km2	0.06	0.000			0.000	0.000
		(0.000)			(0.000)	(0.000)
Indicator of a kingdom at the end of the nineteenth century	0.16		5.184**		7.421***	5.733***
			(2.123)		(1.909)	(1.845)
Indicator of an acephalous society before the colonial conquest	0.13		8.651***		14.834***	11.914***
			(2.605)		(3.476)	(3.549)
Number of years of resistance to French colonial conquest	-0.05		-0.144		-0.162**	-0.127**
			(0.089)		(0.073)	(0.062)
Year of the last military intervention before final submission	-0.17		-0.213***		-0.184	-0.229
			(0.081)		(0.151)	(0.153)
Bananas	0.17			4.592	-1.104	0.071
				(3.880)	(3.711)	(3.997)
Cocoa	0.08			4.153	6.365**	12.028***
				(3.206)	(3.142)	(4.345)
Coffee	0			-3.479	-0.512	0.036
				(3.428)	(3.120)	(3.537)
Cotton	-0.21			-7.379*	-2.284	-0.074
				(3.854)	(4.449)	(4.873)
Groundnuts	0.29			8.707***	8.825***	2.555
				(2.550)	(2.283)	(2.355)
Palm	0.12			3.815	3.056	3.443
				(3.844)	(3.560)	(4.077)
Indicator of a trading post before the colonial conquest	0.04			-0.360	-3.000	-0.295
				(4.110)	(4.458)	(4.477)
Country Fixed Effects		No	No	No	No	Yes
Observations		110	110	110	110	110

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Robust standard errors in parentheses. The estimator is tobit. The dependent variable the fraction of years during which an incident occurred. Column (1) contains correlation coefficients with mean incidents.

Table 7. Deep roots of modern riots and protests?

	(1)	(2)	(3)	(4)	(5)	(6)
	ρ	*Dependent variable: Mean incident X 100*				
Mean Rainfall	0.36	-0.153			0.001	-0.150
		(0.125)			(0.119)	(0.150)
Mean Temperature	-0.3	-1.164			1.310	3.055
		(3.460)			(3.353)	(3.867)
Coefficient of variation of rain	-0.24	-211.961*			-278.834**	-312.621***
		(106.850)			(110.503)	(102.890)
Altitude of district's main city in meters	0.04	0.007			0.009	0.003
		(0.007)			(0.007)	(0.007)
Latitude of district's main city	-0.3	-5.796**			-0.779	-2.957
		(2.234)			(2.261)	(4.707)
Longitude of district's main city	-0.17	-3.756***			-2.773***	-1.919
		(0.933)			(0.935)	(2.566)
Indicator of access to the sea	0.13	19.753*			6.765	15.645
		(10.903)			(11.336)	(12.867)
Indicator of a navigable river	0.25	16.765**			14.514**	6.673
		(6.681)			(6.594)	(6.456)
Distance of the main city from the coast in km	-0.23	0.085*			0.000	0.067
		(0.044)			(0.040)	(0.062)
Distance of the main city from the nearest port in km	-0.23	-0.073*			0.005	-0.056
		(0.039)			(0.037)	(0.048)
Area in km2	-0.13	0.000*			0.000*	0.000***
		(0.000)			(0.000)	(0.000)
Indicator of a kingdom at the end of the nineteenth century	-0.04		-0.864		5.545	5.799
			(7.333)		(6.186)	(7.462)
Indicator of an acephalous society before the colonial conquest	0.09		18.126**		-13.376	-5.044
			(8.342)		(13.296)	(13.601)
Number of years of resistance to French colonial conquest	-0.07		-0.382		0.139	0.218
			(0.253)		(0.314)	(0.285)
Year of the beginning of the colonial conquest	0.06		0.045		0.472	0.495
			(0.281)		(0.491)	(0.509)
Bananas	0.29			23.012*	19.867*	16.957
				(13.402)	(10.567)	(10.376)
Cocoa	0.29			7.264	16.940*	4.734
				(11.286)	(9.084)	(12.314)
Coffee	0.26			16.064**	5.085	8.631
				(7.853)	(11.220)	(11.115)
Cotton	0.22			16.595	27.474**	34.343**
				(12.478)	(11.727)	(13.544)
Groundnuts	0.12			12.598	18.026*	29.250**
				(9.023)	(9.446)	(12.769)
Palm	0.16			-10.157	-0.811	0.623
				(9.728)	(9.317)	(11.949)
Indicator of a trading post before the colonial conquest	0.15			-1.022	17.279	19.791
				(18.219)	(17.109)	(19.387)
Country Fixed Effects	No	No	No	No	No	Yes
Observations		111	112	112	111	111

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Robust standard errors in parentheses. The estimator is tobit. The dependent variable the fraction of years during which a riot or protest occurred. Column (1) contains correlation coefficients with mean riots and protests.

Appendix A. Derivations and proofs

A.1. **Demonstration that $\tau > y_H$ will not be chosen.** If the state invests in suppression and chooses $\tau > y_H$, unrest always occurs and is always suppressed. The state's payoff if income is low will be $(1-p)\gamma\mu y_L - s$, while it will be $(1-p)\gamma\mu y_H - s$ if high income is realized. The expected value of the state's payoff, then, will be:

$EV^s_{S,\tau>y_H} = \alpha(1-p)\gamma\mu y_L + (1-\alpha)(1-p)\gamma\mu y_H - s.$

Contrast this with the case where the state chooses $\tau = \tau_{SH} = \{1-\mu[1-\gamma(1-p)]\}y_H$. If income is high, no unrest occurs, and the state receives $\tau_{SH} - s$, or $\{1-\mu[1-\gamma(1-p)]\}y_H - s$. If income is low, then resistance occurs, and the state receives $(1-p)\gamma\mu y_L - s$.

The expected value of the state's payoff, then, will be:

$EV^s_{SH} = \alpha(1-p)\gamma\mu y_L + (1-\alpha)\{1-\mu[1-\gamma(1-p)]\}y_H - s.$

If it were the case that $EV^s_{S,\tau>y_H}$ were preferred to EV^s_{SH}, it would have to be the case that:

$$\alpha(1-p)\gamma\mu y_L + (1-\alpha)(1-p)\gamma\mu y_H - s >$$
$$\alpha(1-p)\gamma\mu y_L + (1-\alpha)\{1-\mu[1-\gamma(1-p)]\}y_H - s$$

This simplifies to $\mu > 1$, which is false by assumption. Similar logic shows that EV^s_{NSH} is always preferred to $EV^s_{NS,\tau>y_H}$.

A.2. **Derivation of expected payoffs for the state.** There are four cases to consider: 1) suppression with $\tau = \tau_{SH}$, 2) suppression with $\tau = \tau_{SL}$, 3) no suppression with $\tau = \tau_{NSH}$, and 4) no suppression with $\tau = \tau_{NSH}$.

First, consider suppression with $\tau = \tau_{SH}$. If high income is realized, there will be no resistance, and the state receives $\tau_{SH} - s$, or $\{1-\mu[1-\gamma(1-p)]\}y_H - s$. If low income is realized, there is resistance, and the state receives $(1-p)\gamma\mu y_L - s$. The expected payoff of this is:

$$EV^s_{SH} = \alpha(1-p)\gamma\mu y_L + (1-\alpha)\{1-\mu[1-\gamma(1-p)]\}y_H - s.$$

Second, consider suppression with $\tau = \tau_{SL}$. Regardless of the realization of income, the state will receive $\tau_{SL} - s$. The state's expected payoff, then, is:

$$EV^s_{SL} = \{1-\mu[1-\gamma(1-p)]\}y_L - s.$$

Third, consider no suppression with $\tau = \tau_{NSH}$. If high income is realized, there will be no resistance, and the state receives τ_{NSH}, or $(1-\mu)y_H$. If low income is realized, there is resistance, and the state receives nothing. The expected payoff of this is:

$$EV^s_{NSH} = (1-\alpha)(1-\mu)y_H.$$

Finally, consider no suppression with $\tau = \tau_{NSL}$. Regardless of the realization of income, the state will receive τ_{NSL}.

The expected payoff of this is:

$$EV^s_{NSH} = (1-\mu)y_L.$$

A.3. **Proof of proposition 1.** The state (weakly) prefers suppression with $\tau = \tau_{SH}$ if $EV^s_{SH} \geq EV^s_{SL}$, $EV^s_{SH} \geq EV^s_{NSH}$, and $EV^s_{SH} \geq EV^s_{NSL}$.

$EV^s_{SH} \geq EV^s_{SL}$ if:

$$\alpha(1-p)\gamma\mu y_L + (1-\alpha)\{1-\mu[1-\gamma(1-p)]\}y_H - s \geq \{1-\mu[1-\gamma(1-p)]\}y_L - s.$$

This simplifies to:

$$y_H \geq \frac{1-\mu[1-(1-\alpha)\gamma(1-p)]}{(1-\alpha)\{1-\mu[1-\gamma(1-p)]\}} y_L \equiv \Phi^{SH}_{SL}(y_L).$$

$EV^s_{SH} \geq EV^s_{NSH}$ if:

$$\alpha(1-p)\gamma\mu y_L + (1-\alpha)\{1-\mu[1-\gamma(1-p)]\}y_H - s \geq (1-\alpha)(1-\mu)y_H.$$

This simplifies to:

$$y_H \geq \frac{s}{(1-\alpha)\mu\gamma(1-p)} - \frac{\alpha}{1-\alpha} y_L \equiv \Phi^{SH}_{NSH}(y_L).$$

$EV^s_{SH} \geq EV^s_{NSL}$ if:

$$\alpha(1-p)\gamma\mu y_L + (1-\alpha)\{1-\mu[1-\gamma(1-p)]\}y_H - s \geq \frac{1}{1-\alpha} y_L.$$

This simplifies to:

$$y_H \geq \frac{s}{(1-\alpha)\{1-\mu[1-\gamma(1-p)]\}} + \frac{1-\mu[1+\alpha\gamma(1-p)]}{(1-\alpha)\{1-\mu[1-\gamma(1-p)]\}} y_L \equiv \Phi^{SH}_{NSL}(y_L).$$

Together, these three conditions define the region $\mathcal{S}_{SH}$:

$$\mathcal{S}_{SH} = \{(y_H, y_L) \in \mathbb{R}^2_+ : y_H \geq \Phi^{SH}_{SL}(y_L), y_H \geq \Phi^{SH}_{NSL}(y_L), y_H \geq \Phi^{SH}_{NSH}(y_L)\}.$$

The state (weakly) prefers suppression with $\tau = \tau_{SL}$ if $EV^s_{SL} \geq EV^s_{SH}$, $EV^s_{SL} \geq EV^s_{NSH}$, and $EV^s_{SL} \geq EV^s_{NSL}$.

The condition that $EV^s_{SL} \geq EV^s_{SH}$ is simply the reverse of the above condition that $EV^s_{SH} \geq EV^s_{SL}$, and so simplifies to $y_H \leq \Phi^{SH}_{SL}(y_L)$.

$EV^s_{SL} \geq EV^s_{NSH}$ if:

$$\{1-\mu[1-\gamma(1-p)]\}y_L - s \geq (1-\alpha)(1-\mu)y_H.$$

This simplifies to:

$$y_H \leq -\frac{s}{(1-\alpha)(1-\mu)} + \frac{1-\mu[1-\gamma(1-p)]}{(1-\alpha)(1-\mu)}y_L \equiv \Phi_{SL}^{NSH}(y_L)$$

$EV_{SL}^s \geq EV_{NSL}^s$ if:

$$\{1-\mu[1-\gamma(1-p)]\}y_L - s \geq (1-\mu)y_L.$$

This simplifies to:

$$y_L \geq \frac{s}{\mu\gamma(1-p)} \equiv \Phi_{NSL}^{SL}.$$

Note that Φ_{SL}^{NSH} is redundant. For Φ_{SL}^{NSH} to matter in the definition of $\mathcal{S}_{SL}$, it would need to intersect Φ_{SL}^{SH} to the right of the intersection between Φ_{SL}^{SH} and Φ_{NSL}^{SL}. However, because Φ_{SL}^{NSH} and Φ_{SL}^{SH} intersect when $y_L = \frac{s(1-\mu+\mu\gamma(1-p))}{\mu\gamma(1-p)[(1-\mu+\mu\gamma(1-p))+\alpha(1-\mu)]}$, while Φ_{SL}^{SH} and Φ_{NSL}^{SL} intersect when $y_L = \frac{s}{\mu\gamma(1-p)}$, this cannot occur.

Together, the two remaining conditions define the region $\mathcal{S}_{SL}$:

$$\mathcal{S}_{SL} = \{(y_H, y_L) \in \mathbb{R}_+^2 : y_H \leq \Phi_{SL}^{SH}(y_L), y_L \geq \Phi_{NSL}^{SL}\}.$$

The state (weakly) prefers no suppression with $\tau = \tau_{NSH}$ if $EV_{NSH}^s \geq EV_{SH}^s$, $EV_{NSH}^s \geq EV_{SL}^s$, and $EV_{NSH}^s \geq EV_{NSL}^s$.

The condition that $EV_{NSH}^s \geq EV_{SH}^s$ simply reverses the earlier condition that $EV_{SH}^s \geq EV_{NSH}^s$, and so simplifies to $y_H \leq \Phi_{NSH}^{SH}(y_L)$. The condition that $EV_{NSH}^s \geq EV_{SL}^s$, likewise, reverses the condition that $EV_{SL}^s \geq EV_{NSH}^s$. It simplifies to $y_H \geq \Phi_{SL}^{NSH}(y_L)$. Note that Φ_{SL}^{NSH} is again redundant. For Φ_{SL}^{NSH} to matter in the definition of $\mathcal{S}_{NSH}$, it would need to intersect

Φ_{NSL}^{NSH} to the left of the intersection between Φ_{NSL}^{NSH} and Φ_{NSH}^{SH}. However, because Φ_{SL}^{NSH} intersects Φ_{NSL}^{NSH} when $y_L = \frac{s}{\mu\gamma(1-p)}$, while Φ_{NSL}^{NSH} intersects Φ_{NSH}^{SH} where $y_L = \frac{s}{\mu\gamma(1+\alpha)(1-p)}$, this cannot occur.

$EV_{NSH}^s \geq EV_{NSL}^s$ if:

$$(1-\alpha)(1-\mu)y_H \geq (1-\mu)y_L.$$

This simplifies to:

$$y_H \geq \frac{1}{1-\alpha}y_L \equiv \Phi_{NSL}^{NSH}.$$

Together, the two binding conditions define the region $\mathcal{S}_{NSH}$:

$$\mathcal{S}_{NSH} = \{(y_H, y_L) \in \mathbb{R}_+^2 : y_H \leq \Phi_{NSH}^{SH}(y_L), y_H \geq \Phi_{NSL}^{NSH}(y_L)\}.$$

Finally, the state (strongly) prefers no suppression with $\tau = \tau_{NSL}$ if $EV_{NSL}^s > EV_{SH}^s$, $EV_{NSL}^s > EV_{SL}^s$, and $EV_{NSL}^s > EV_{NSH}^s$. Each of these simply reverse conditions stated above, and so reduce to $y_H < \Phi_{NSL}^{SH}(y_L)$, and $y_L < \Phi_S^{NSL}L$, and $y_H < \Phi_{NSL}^{NSH}(y_L)$ respectively. Together, these define the region $\mathcal{S}_{NSL}$:

$$\mathcal{S}_{NSL} = \{(y_H, y_L) \in \mathbb{R}_+^2 : (y_H, y_L) \notin \mathcal{S}_{SH} \cup \mathcal{S}_{NSH} \cup \mathcal{S}_{NSL}\}.$$

A.4. **Notes on Figure 1.** Figure 1 is drawn to be consistent with several characteristics of $\mathcal{S}_{SH}$, $\mathcal{S}_{NSH}$, $\mathcal{S}_{SL}$, and $\mathcal{S}_{NSL}$. Note that λ_{NSL}^{SH}, λ_{NSH}^{SH}, θ_{SL}^{SH}, λ_{SL}^{NSH}, θ_{NSL}^{SH}, θ_{SL}^{NSH}, θ_{NSL}^{NSH}, and θ_{NSL}^{SL} are all positive scalars, while θ_{NSL}^{SH} is ambiguous in sign. The equations $\Phi_{SL}^{SH}(y_L)$, $\Phi_{NSL}^{SH}(y_L)$, $\Phi_{SL}^{NSH}(y_L)$ and $\Phi_{NSL}^{NSH}(y_L)$ are all upward-sloping in y_L. Because $\theta_{SL}^{SH} > \theta_{NSL}^{SH}$, $\Phi_{SL}^{SH}(y_L)$ is steeper than $\Phi_{NSL}^{SH}(y_L)$. Since $\theta_{SL}^{SH} < \theta_{SL}^{NSH}$, $\Phi_{SL}^{SH}(y_L)$ is flatter than $\Phi_{SL}^{NSH}(y_L)$. Because $\theta_{SL}^{SH} > \theta_{NSL}^{NSH}$, $\Phi_{SL}^{SH}(y_L)$ is steeper than $\Phi_{NSL}^{NSH}(y_L)$.

Because $\theta^{SH}_{NSL} < \theta^{NSH}_{SL}$, $\Phi^{SH}_{NSL}(y_L)$ is flatter than $\Phi^{NSH}_{SL}(y_L)$. Similarly, $\theta^{SH}_{NSL} < \theta^{NSH}_{NSL}$, and so $\Phi^{SH}_{NSL}(y_L)$ is flatter than $\Phi^{NSH}_{NSL}(y_L)$. Finally, because $\theta^{NSH}_{SL} > \theta^{NSH}_{NSL}(y_L)$, $\Phi^{NSH}_{SL}(y_L)$ is steeper than $\Phi^{NSH}_{NSL}(y_L)$.

Also note that $\Phi^{SH}_{NSL}(y_L)$ and $\Phi^{SH}_{NSH}(y_L)$ have strictly positive intercepts. Because $\lambda^{SH}_{NSL} < \lambda^{SH}_{NSH}$, $\Phi^{SH}_{NSL}(y_L)$ has a lower intercept than $\Phi^{SH}_{NSH}(y_L)$.

Define $\beta \equiv 1 - \mu + \mu\gamma(1-p)$. The points at which $\Phi^{SH}_{SL}(y_L)$, $\Phi^{SH}_{NSL}(y_L)$, $\Phi^{SH}_{NSH}(y_L)$, $\Phi^{NSH}_{SL}(y_L)$, $\Phi^{NSH}_{NSL}(y_L)$ and Φ^{SL}_{NSL} intersect are given by:

$$\begin{aligned}
\Phi^{SH}_{SL} \cap \Phi^{SH}_{NSL} \text{ at } & \left\{\frac{s}{\mu\gamma(1-p)}, \theta^{SH}_{SL}\frac{s}{\mu\gamma(1-p)}\right\} && \equiv x_0 \\
\cap \Phi^{SH}_{NSH} \text{ at } & \left\{\frac{s\beta}{\mu\gamma(1-p)[\beta+\alpha(1-\mu)]}, \theta^{SH}_{SL}\frac{s\beta}{\mu\gamma(1-p)[\beta+\alpha(1-\mu)]}\right\} && \equiv x_1 \\
\cap \Phi^{NSH}_{SL} \text{ at } & \left\{\frac{s\beta}{\mu\gamma(1-p)[\beta+\alpha(1-\mu)]}, \theta^{SH}_{SL}\frac{s\beta}{\mu\gamma(1-p)[\beta+\alpha(1-\mu)]}\right\} && \equiv x_1 \\
\cap \Phi^{NSH}_{NSL} \text{ at } & \{0, 0\} && \equiv o \\
\cap \Phi^{SL}_{NSL} \text{ at } & \left\{\frac{s}{\mu\gamma(1-p)}, \theta^{SH}_{SL}\frac{s}{\mu\gamma(1-p)}\right\} && \equiv x_0
\end{aligned}$$

$$\begin{aligned}
\Phi^{SH}_{NSL} \cap \Phi^{SH}_{NSH} \text{ at } & \left\{\frac{s}{\mu\gamma(1+\alpha)(1-p)}, \frac{s}{(1-\alpha)\mu\gamma(1+\alpha)(1-p)}\right\} && \equiv x_2 \\
\cap \Phi^{NSH}_{SL} \text{ at } & \{y_L(x_3), y_H(x_3)\} && \equiv x_3 \\
\cap \Phi^{NSH}_{NSL} \text{ at } & \left\{\frac{s}{\mu\gamma(1+\alpha)(1-p)}, \frac{s}{(1-\alpha)\mu\gamma(1+\alpha)(1-p)}\right\} && \equiv x_2 \\
\cap \Phi^{SL}_{NSL} \text{ at } & \left\{\frac{s}{\mu\gamma(1-p)}, \theta^{SH}_{SL}\frac{s}{\mu\gamma(1-p)}\right\} && \equiv x_0
\end{aligned}$$

Here,

$$\begin{aligned}
y_L(x_3) &= \frac{(\beta+1-\mu)s}{\beta^2 - (1-\mu)[\beta - (1+\alpha)\mu\gamma(1-p)]}, \\
y_H(x_3) &= -\frac{s}{(1-\alpha)(1-\mu)} + \frac{\beta}{(1-\alpha)(1-\mu)} \times \frac{(\beta+1-\mu)s}{\beta^2 - (1-\mu)[\beta - (1+\alpha)\mu\gamma(1-p)]}
\end{aligned}$$

$$\begin{aligned}
\Phi^{SH}_{NSH} \cap \Phi^{NSH}_{SL} \text{ at } &\left\{ \frac{s\beta}{\mu\gamma(1-p)[\beta+\alpha(1-\mu)]}, \theta^{SH}_{SL} \frac{s\beta}{\mu\gamma(1-p)[\beta+\alpha(1-\mu)]} \right\} && \equiv x_1 \\
\cap \Phi^{NSH}_{NSL} \text{ at } &\left\{ \frac{s}{\mu\gamma(1+\alpha)(1-p)}, \frac{s}{(1-\alpha)\mu\gamma(1+\alpha)(1-p)} \right\} && \equiv x_2 \\
\cap \Phi^{SL}_{NSL} \text{ at } &\left\{ \frac{s}{\mu\gamma(1-p)}, \frac{s}{\mu\gamma(1-p)} \right\} && \equiv f
\end{aligned}$$

$$\begin{aligned}
\Phi^{SH}_{SL} \cap \Phi^{NSH}_{NSL} \text{ at } &\left\{ \frac{s}{\mu\gamma(1-p)}, \frac{s}{(1-\alpha)\mu\gamma(1-p)} \right\} && \equiv x_4 \\
\cap \Phi^{SL}_{NSL} \text{ at } &\left\{ \frac{s}{\mu\gamma(1-p)}, \frac{s}{(1-\alpha)\mu\gamma(1-p)} \right\} && \equiv x_4
\end{aligned}$$

$$\Phi^{NSH}_{NSL} \cap \Phi^{SL}_{NSL} \text{ at } \left\{ \frac{s}{\mu\gamma(1-p)}, \frac{s}{(1-\alpha)\mu\gamma(1-p)} \right\} \qquad \equiv x_4$$

A.5. **Comparative statics: Unrest.** First, consider a change in α, the probability of low income. It is the case that:

$$\begin{aligned}
\frac{\partial \theta^{SH}_{SL}}{\partial \alpha} &= \frac{\gamma\mu(1-p)(N(\theta^{SH}_{SL})) - D(\theta^{SH}_{SL})) + (1-\mu)N(\theta^{SH}_{SL})}{D(\theta^{SH}_{SL})^2} > 0 \\
\frac{\partial \lambda^{SH}_{NSL}}{\partial \alpha} &= \frac{\lambda^{SH}_{NSL}}{(1-\alpha)} > 0 \\
\frac{\partial \theta^{SH}_{NSL}}{\partial \alpha} &= \frac{\gamma\mu(1-p)(N(\theta^{SH}_{NSL})) - D(\theta^{SH}_{NSL})) + (1-\mu)N(\theta^{SH}_{NSL})}{D(\theta^{SH}_{NSL})^2} \lesseqgtr 0 \\
\frac{\partial \theta^{NSH}_{NSL}}{\partial \alpha} &= \frac{\alpha}{(1-\alpha)^2} > 0
\end{aligned}$$

We use $N(X)$ and $D(X)$ to denote the numerator and denominator of X, respectively. These results rely on the observations that $N(\theta^{SH}_{SL}) > D(\theta^{SH}_{SL})$, and $N(\theta^{SH}_{NSL}) \lesseqgtr D(\theta^{SH}_{NSL})$.

Second, consider a change in γ.

$$\frac{\partial\theta_{SL}^{SH}}{\partial\gamma} = -\frac{(N(\theta_{SL}^{SH}) - D(\theta_{SL}^{SH}))\mu(1-\alpha)\gamma(1-p)}{D(\theta_{SL}^{SH})^2} < 0$$

$$\frac{\partial\lambda_{NSL}^{SH}}{\partial\gamma} = -\frac{s(1-\alpha)\mu(1-p)}{D(\lambda_{NSL}^{SH})^2} < 0$$

$$\frac{\partial\theta_{NSL}^{SH}}{\partial\gamma} = \frac{(D(\theta_{NSL}^{SH}) - N(\theta_{NSL}^{SH})(1-\alpha)\mu(1-p) - D(\theta_{NSL}^{SH})\mu(1-p)}{D(\theta_{NSL}^{SH})^2} \lesseqgtr 0$$

$$\frac{\partial\theta_{NSL}^{NSH}}{\partial\gamma} = 0$$

We again rely on the fact that $N(\theta_{SL}^{SH}) > D(\theta_{SL}^{SH})$.

Third, consider a change in μ.

$$\frac{\partial\theta_{SL}^{SH}}{\partial\mu} = \frac{(N(\theta_{SL}^{SH}) - D(\theta_{SL}^{SH}))(1-(1-\alpha)\gamma(1-p)) - \alpha N(\theta_{SL}^{SH})}{D(\theta_{SL}^{SH})^2} \lesseqgtr 0$$

$$\frac{\partial\lambda_{NSL}^{SH}}{\partial\mu} = \frac{s(1-\alpha)[1-\gamma(1-p)]}{D(\lambda_{NSL}^{SH})^2} > 0$$

$$\frac{\partial\theta_{NSL}^{SH}}{\partial\mu} = \frac{(N(\theta_{NSL}^{SH}) - D(\theta_{NSL}^{SH}))\alpha\gamma(1-p) + N(1-\alpha-\gamma(1-p)}{D(\theta_{NSL}^{SH})^2} \lesseqgtr 0$$

$$\frac{\partial\theta_{NSL}^{NSH}}{\partial\mu} = 0$$

Fourth, consider a change in p.

$$\frac{\partial\theta_{SL}^{SH}}{\partial(1-p)} = -\frac{(N(\theta_{SL}^{SH}) - D(\theta_{SL}^{SH}))(1-\alpha)\gamma\mu}{D(\theta_{SL}^{SH})^2} < 0$$

$$\frac{\partial\lambda_{NSL}^{SH}}{\partial(1-p)} = -\frac{s(1-\alpha)}{D(\lambda_{NSL}^{SH})^2}$$

$$\frac{\partial\theta_{NSL}^{SH}}{\partial(1-p)} = \frac{(N(\theta_{NSL}^{SH})) - D(\theta_{NSL}^{SH}))\alpha\gamma\mu - \mu\gamma N(\theta_{NSL}^{SH})}{D(\theta_{NSL}^{SH})^2}$$

$$\frac{\partial\theta_{NSL}^{NSH}}{\partial(1-p)} = 0$$

We again use the fact that $N(\theta_{SL}^{SH}) > D(\theta_{SL}^{SH}$.

Finally, consider a change in s.

$$\frac{\partial \theta_{SL}^{SH}}{\partial s} = 0$$
$$\frac{\partial \lambda_{NSL}^{SH}}{\partial s} = \frac{1}{D(\lambda_{NSL}^{SH})} > 0$$
$$\frac{\partial \theta_{NSL}^{SH}}{\partial s} = 0$$
$$\frac{\partial \theta_{NSL}^{NSH}}{\partial s} = 0$$

A.6. **Comparative statics: Suppression.** Here, we discuss the effect of α, γ, μ, p and s on the size of the region in which the state invests in suppression, i.e. the size of $\mathcal{S}_{SH} \cup \mathcal{S}_{SL}$. This region is bounded by $\Phi_{NSH}^{SH}(y_L)$, $\Phi_{NSL}^{SH}(y_L)$, and $\Phi_{NSL}^{SL}(y_L)$.

First, consider an increase in α. $\Phi_{NSH}^{SH}(y_L)$ shifts upwards and becomes steeper. $\Phi_{NSL}^{SH}(y_L)$ shifts upwards and rotates ambiguously. $\Phi_{NSL}^{SL}(y_L)$ does not move. Together, these shrink the region $\mathcal{S}_{SH} \cup \mathcal{S}_{SL}$, making suppression less likely.

Second, consider an increase in γ. $\Phi_{NSH}^{SH}(y_L)$ shifts downwards. $\Phi_{NSL}^{SH}(y_L)$ shifts downwards and rotates ambiguously. $\Phi_{NSL}^{SL}(y_L)$ shifts left. Together, these enlarge the region $\mathcal{S}_{SH} \cup \mathcal{S}_{SL}$, making suppression more likely.

Third, consider an increase in μ. $\Phi_{NSH}^{SH}(y_L)$ shifts downwards. $\Phi_{NSL}^{SH}(y_L)$ shifts downwards and rotates ambiguously. $\Phi_{NSL}^{SL}(y_L)$ shifts left. Together, these enlarge the region $\mathcal{S}_{SH} \cup \mathcal{S}_{SL}$, making suppression more likely.

Fourth, consider an increase in p. $\Phi_{NSH}^{SH}(y_L)$ shifts upwards. $\Phi_{NSL}^{SH}(y_L)$ shifts upwards and rotates ambiguously. $\Phi_{NSL}^{SL}(y_L)$ shifts right. Together, these shrink the region $\mathcal{S}_{SH} \cup \mathcal{S}_{SL}$, making suppression less likely.

Finally, consider an increase in s. $\Phi_{NSH}^{SH}(y_L)$ shifts upwards. $\Phi_{NSL}^{SH}(y_L)$ shifts upwards. $\Phi_{NSL}^{SL}(y_L)$ shifts right. Together, these shrink the region $\mathcal{S}_{SH} \cup \mathcal{S}_{SL}$, making suppression less likely.

Table A1. Sources of Price Data

Product	Source	Currency	Years
Bananas	Lord and Boye (1991)	USD	1900-1988
Cocoa	Blattman, Hwang, and Williamson (2007), Bazzi and Blattman	GBP (BHW), USD (BB)	1840-1950 (BHW), 1950-1956 (BB)
Coffee	Blattman, Hwang, and Williamson (2007), Bazzi and Blattman	GBP (BHW), USD (BB)	1846-1950 (BHW), 1950-2009 (BB)
Cotton	Historical Statistics of the United States	USD	1784-1998
Groundnuts	Historical Statistics of the United States	USD	1909-1999
Palm-kernels/Palm Oil	Blattman, Hwang, and Williamson (2007), Bazzi and Blattman	GBP (BHW), USD (BB)	1846-1950 (BHW), 1950-2009 (BB)
US Wholesale Price Index	Historical Statistics of the United States	N/A	1890-1951
UK Wholesale Price Index	Allen (2003)	N/A	1750-2002

Table A2. Main results with district trends

	(1)	(2)	(3)	(4)
	Dependent variable: Incident			
Shock	-0.165**	2.554**	-0.228**	-0.190*
	(0.075)	(1.144)	(0.103)	(0.112)
Observations	1,431	1,431	1,431	1,431
Shock	Rain	Temp.	Bananas	Cocoa
	Dependent variable: Incident			
	(5)	(6)	(7)	(8)
Shock	-0.077	-0.237*	0.196*	0.090*
	(0.067)	(0.123)	(0.113)	(0.047)
Observations	1,431	1,431	1,212	1,431
Shock	Coffee	Cotton	Groundnuts	Palm

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by district in parentheses. The estimator is OLS, with fixed effects for district and year and with district-specific trends. The dependent variable is an indicator for an incident.

Table A3. Main results with one-year lags as shocks

	(1)	(2)	(3)	(4)
	Dependent variable: Incident			
Shock	-0.081	1.723*	-0.250**	-0.142**
	(0.051)	(0.913)	(0.118)	(0.063)
Observations	1,431	1,431	1,431	1,431
Shock	Rain	Temp.	Bananas	Cocoa
	Dependent variable: Incident			
	(5)	(6)	(7)	(8)
Shock	-0.104*	-0.185**	0.175**	0.075
	(0.053)	(0.090)	(0.084)	(0.046)
Observations	1,431	1,431	1,212	1,431
Shock	Coffee	Cotton	Groundnuts	Palm

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by district in parentheses. The estimator is OLS, with fixed effects for district and year. The dependent variable is an indicator for an incident.

Table A4. Main results estimated using logit

	(1)	(2)	(3)	(4)
	Dependent variable: Incident			
Shock	-0.160**	3.773***	-0.340**	-0.160**
	(0.070)	(1.221)	(0.146)	(0.066)
Observations	1,145	1,145	1,145	1,145
Shock	Rain	Temp.	Bananas	Cocoa
	Dependent variable: Incident			
	(5)	(6)	(7)	(8)
Shock	-0.138	-0.119	0.411**	0.089
	(0.089)	(0.086)	(0.191)	(0.059)
Observations	1,145	1,145	968	1,145
Shock	Coffee	Cotton	Groundnuts	Palm

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Marginal effects reported. Standard errors clustered by district in parentheses. The estimator is logit, with fixed effects for district and year. The dependent variable is an indicator for an incident.

Table A5. All shocks at once

	(1)
	Dependent variable: Incident
Log rainfall (3 year MA)	-0.247***
	(0.087)
Log temperature (3 year MA)	3.728***
	(1.238)
Exporter X Log Price: Bananas (3 year MA)	-0.217
	(0.134)
Exporter X Log Price: Cocoa (3 year MA)	-0.258*
	(0.140)
Exporter X Log Price: Coffee (3 year MA)	-0.050
	(0.078)
Exporter X Log Price: Cotton (3 year MA)	-0.258**
	(0.110)
Exporter X Log Price: Groundnuts (3 year MA)	0.202**
	(0.098)
Exporter X Log Price: Palm (3 year MA)	0.152**
	(0.059)
Observations	1,212

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by district in parentheses. The estimator is OLS, with fixed effects for district and year. The dependent variable is an indicator for an incident.

Table A6. Further robustness

	(1)	(2)	(3)	(4)
Panel A: Main results with lag incident				
	Dependent variable: Incident			
Shock	-0.219***	3.566**	-0.421**	-0.250**
	(0.075)	(1.364)	(0.162)	(0.113)
Lag Incident	-0.050	-0.050	-0.055	-0.053
	(0.034)	(0.034)	(0.033)	(0.034)
Observations	1,183	1,183	1,183	1,183
Shock	Rain	Temp.	Bananas	Cocoa
	Dependent variable: Incident			
	(5)	(6)	(7)	(8)
Shock	-0.158	-0.034	0.264**	0.117**
	(0.124)	(0.159)	(0.133)	(0.049)
Lag Incident	-0.058*	-0.054	-0.046	-0.052
	(0.033)	(0.034)	(0.038)	(0.034)
Observations	1,183	1,183	1,074	1,183
Shock	Coffee	Cotton	Groundnuts	Palm
Panel B: Main results discarding districts with no variation in the outcome				
	(1)	(2)	(3)	(4)
	Dependent variable: Incident			
Shock	-0.199**	3.742***	-0.335**	-0.151**
	(0.076)	(1.274)	(0.147)	(0.073)
Observations	1,166	1,166	1,166	1,166
Shock	Rain	Temp.	Bananas	Cocoa
	Dependent variable: Incident			
	(5)	(6)	(7)	(8)
Shock	-0.119*	-0.234*	0.282*	0.085
	(0.069)	(0.131)	(0.158)	(0.057)
Observations	1,166	1,166	989	1,166
Shock	Coffee	Cotton	Groundnuts	Palm

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by district in parentheses. The estimator is OLS, with fixed effects for district and year. The dependent variable is an indicator for an incident.

Table A7. Modern results with district trends

	(1)	(2)	(3)	(4)
	Dependent variable: Riots/protests			
Shock	-0.073	-0.251	-0.188	-0.003
	(0.081)	(1.480)	(0.159)	(0.143)
Observations	1,554	1,554	1,456	1,456
Shock	Rain	Temp.	Bananas	Cocoa
	Dependent variable: Riots/protests			
	(5)	(6)	(7)	(8)
Shock	-0.027	-0.778**	0.209	0.032
	(0.060)	(0.392)	(0.147)	(0.062)
Observations	1,456	1,456	1,456	1,456
Shock	Coffee	Cotton	Groundnuts	Palm

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by district in parentheses. The estimator is OLS, with fixed effects for district and year and with district-specific trends. The dependent variable is an indicator for riots/protests.

Table A8. Modern results with one-year lags as shocks

	(1)	(2)	(3)	(4)
	Dependent variable: Riots/protests			
Shock	-0.051	0.053	-0.188	0.057
	(0.039)	(0.752)	(0.116)	(0.094)
Observations	1,665	1,665	1,456	1,456
Shock	Rain	Temp.	Bananas	Cocoa
	Dependent variable: Riots/protests			
	(5)	(6)	(7)	(8)
Shock	0.002	-0.266	0.101	0.049
	(0.047)	(0.181)	(0.097)	(0.055)
Observations	1,456	1,456	1,456	1,456
Shock	Coffee	Cotton	Groundnuts	Palm

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by district in parentheses. The estimator is OLS, with fixed effects for district and year. The dependent variable is an indicator for riots/protests.

Table A9. Modern results with incident counts as the dependent variable.

	(1)	(2)	(3)	(4)
	Dependent variable: Riots/protests			
Shock	-1.034	19.353	-4.148	-1.239
	(0.815)	(12.805)	(5.468)	(1.256)
Observations	1,554	1,554	1,456	1,456
Shock	Rain	Temp.	Bananas	Cocoa
	Dependent variable: Riots/protests			
	(5)	(6)	(7)	(8)
Shock	-0.117	-0.283	1.156**	0.128
	(0.156)	(0.532)	(0.579)	(0.198)
Observations	1,456	1,456	1,456	1,456
Shock	Coffee	Cotton	Groundnuts	Palm

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by district in parentheses. The estimator is OLS, with fixed effects for district and year. The dependent variable is the number of riots/protests in a year.

Table A10. Modern results discarding capital cities.

	(1)	(2)	(3)	(4)
	Dependent variable: Riots/protests			
Shock	-0.134*	0.175	-0.240	-0.058
	(0.074)	(1.182)	(0.195)	(0.128)
Observations	1,442	1,442	1,352	1,352
Shock	Rain	Temp.	Bananas	Cocoa
	Dependent variable: Riots/protests			
	(5)	(6)	(7)	(8)
Shock	0.003	-0.135	0.282**	0.042
	(0.057)	(0.188)	(0.126)	(0.063)
Observations	1,352	1,352	1,352	1,352
Shock	Coffee	Cotton	Groundnuts	Palm

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by district in parentheses. The estimator is OLS, with fixed effects for district and year. The dependent variable is an indicator for riots/protests.