The Dual Legacy of Colonial Cash Crop Production: State Capacity, Resource Dependence, and the Risk of Conflict

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Abstract

Agricultural shocks from climate variability and downturns in global commodity prices are a significant cause of subnational armed conflict in sub-Saharan Africa. Existing studies attribute the association between agricultural shocks and subnational violence to opportunity cost effects. In this paper, we investigate how legacies of colonial cash crop production moderate this effect. Leveraging unique historical data on cash crop production and infrastructural power at the end of colonialism, we show that enclaves of colonial export production had higher levels of state presence and infrastructural investment. One might therefore expect post-colonial states to be better able to contain potential unrest in these areas of relatively high state capacity. On the other hand, the economic specialization in a handful of profitable export crops may make cash crop areas particularly vulnerable to price and weather shocks. We find that shocks have strong conflict-inducing effects in cash crop areas. While colonial road investments significantly attenuate these effects, it takes unusually high levels of local state capacity to fully offset them. Future iterations of this paper will aim to isolate the mechanisms by which road density reduces conflict risk induced by economic shocks.

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Introduction

There is an emerging scholarly consensus that agricultural shocks are a significant source of conflict in sub-Saharan Africa. Whether driven by climate variability (especially rising temperature) (Burke et al., 2009; Hsiang, Burke and Miguel, 2013; Hsiang and Burke, 2014; Couttenier and Soubeyran, 2014; O'Loughlin, Linke and Witmer, 2014; Hodler and Raschky, 2014; Witmer et al., 2017) or a downturn in global commodity prices (Berman and Couttenier, 2015; Fjelde, 2015; McGuirk and Burke, 2017), negative production shocks are linked to increased localized violence . This represents an important turn in the study of conflict in Africa. Despite the importance of agriculture to African economies, the link between it and conflict in the region has generally been a black box.[1]

The predominant explanation for the association between agricultural shocks and subnational violence is the opportunity cost theory of conflict (Miguel, Satyanath and Sergenti, 2004; Hsiang, Burke and Miguel, 2013; Dube and Vargas, 2013)[2]. The central tenet is that negative shocks lead to a decline in the profitability of agriculture, which lower real wages, and increase the relative value of joining an armed movement. In contrast, extant studies tend to discount that agricultural shocks work via a weakening of state capacity (Berman and Couttenier, 2015; Fjelde, 2015; McGuirk and Burke, 2017), which reduces the government's capabilities to effectively administer, control and police its territory—another prominent theory of civil war (Fearon and Laitin, 2003).

We revisit this debate. We replicate studies analyzing the effect of agricultural shocks triggered by climate variability and price shocks on armed conflict(Witmer et al., 2017; Berman and Couttenier, 2015).Our original empirical contribution is rather than using contemporary agricultural production, which may be endogenous to conflict, we use unique historical data on cash crop production at the end of colonialism (Roessler et al., 2017). Across Africa, the cash crop revolution and the economic organization of the colonial state had profound effects on state building and long-run development. As we

[1] This was largely driven by the fact that cross-national studies of natural resources and conflict tended to find stronger effects of minerals and oil than agriculture. See for example the review piece by Ross (2004).

[2] There is a long tradition of civil war research adopting this framework. See for example Lichbach 1995; Humphreys and Weinstein 2008

show below and in our previous research, areas of colonial economic extraction tend to be wealthier and have much better infrastructure today than other parts of the state (Roessler et al., 2017). Given this legacy of infrastructural power and state consolidation, we would expect the state to have greater capacity and be better able to weather agricultural shocks compared to other areas that depend on agricultural income.

However, this is not what we find. If anything, colonial cash crop areas see more violence in response to economic shocks. The opportunity cost effect seems to hit particularly hard where large parts of the population depend on the cash crop economy. Inherited legacies of better infrastructure and higher levels of local state capacity for the most part fail to offset the conflict-inducing effects of temperature and price shocks in cash crop areas.

This is a puzzling finding. Why is the state not able to marshal its greater capacity to effectively contain potential unrest in historical cash crop enclaves? Equally puzzling, however, is, given the state's greater presence in these areas and better access to information, what prevents governments, in the face of agricultural shocks, to bargain away conflicts (Fearon, 2011)? Extant studies have been largely silent on the bargaining failures underpinning conflicts induced by economic shocks. In the next iteration of this paper we will address these two puzzles.

The rest of the paper is as follows. We first review the literature on agricultural shocks on conflict. We then explain the historical legacy of cash crop production on state building in Africa and use our unique data to analyze how, if at all, state consolidation moderates the effect of agricultural shocks on conflict. We then lay out next steps of the paper.

Literature Review

There is a large and growing literature on the effects of external shocks on violent conflict.

One stream focuses on global volatility in primary commodity prices and violence. A number of subnational studies find a robust link between price shocks in primary commodities and an increase in violence (Dube and Vargas, 2013; Berman and Couttenier, 2015; Fjelde, 2015; Berman, Couttenier and Rohner, 2017).[3] Consistent with the path-breaking study by Dube and Vargas (2013) that posits price shocks differentially affect labor-intensive sectors, such as agriculture, from capital-intensive ones, like mining, rising agricultural prices are found to reduce violence (Berman and Couttenier, 2015; Fjelde, 2015), whereas rising mining prices increase armed conflict (Berman, Couttenier and Rohner, 2017).

A second prominent stream focuses on climate variability and its effect on violence. One of the most robust findings in this growing literature is that increases in temperature and droughts have significant effects on armed conflict(Burke et al., 2009; Hsiang, Burke and Miguel, 2013; Hsiang and Burke, 2014; Couttenier and Soubeyran, 2014; O'Loughlin, Linke and Witmer, 2014; Hodler and Raschky, 2014; Witmer et al., 2017).[4] In contrast, rainfall variability has much more inconsistent effects (Miguel, Satyanath and Sergenti, 2004; Ciccone, 2011; Miguel and Satyanath, 2011; O'Loughlin, Linke and Witmer, 2014; Witmer et al., 2017). The general consensus is that increasing temperature and droughts affect conflict via a reduction in agricultural productivity.

The predominant explanation for the association between agricultural shocks and sub-national violence is the opportunity cost theory of conflict(**??**)[5]. The central tenet is that negative shocks lead to a decline in the profitability of agriculture, which lower real wages, and increase the relative value of joining an armed movement. In contrast, extant studies tend to discount that agricultural shocks work via a weakening of state capacity(Berman and Couttenier, 2015; Fjelde, 2015; McGuirk and Burke, 2017), which reduces the governments capabilities to effectively administer, control and police its territory—another prominent theory of civil war (**?**).

Yet as we explain in the next section, colonial cash crop production in Africa shaped

[3]At the macro-level the link between commodity shocks and conflict is less robust. See Bazzi and Blattman (2014); Berman and Couttenier (2015), though also Brückner and Ciccone (2010). As citet-berman2015externa@759l note, this difference in macro-level and micro-level findings suggests the price shock-conflict nexus works "mainly through the escalation and spatial evolution of ongoing conflicts rather than through the outbreak of new ones."

[4]See, however, Buhaug et al. (2014) for a critical view on the effect of climate variability on conflict.

[5]There is a long tradition of civil war research adopting this framework. See for example Lichbach 1995; Humphreys and Weinstein 2008

state building and long-run economic development. One could therefore expect cash crop enclaves to be among the most consolidated parts of the state and best able to manage economic shocks.

Cash Crop Production and State Building

The political and economic geography of the African state was shaped by the cash crop revolution that took off in Africa in the 19th century following the end of the slave trade. An important driver of the imperial conquest of Africa in its own right,(McPhee, 1926; Hogendorn, 1969; Hopkins, 1973; Lynn, 1997; Austin, 2009, 2010; Frankema, Williamson and Woltjer, 2015), under colonialism the cash crop revolution intensified and spread. Responding to demand back home for agricultural products for industrial and luxury use, colonial governments saw the cultivation of cash crops along with mineral extraction as the path to fiscal self-sufficiency. Across Africa, colonial authorities harnessed the economic, coercive and administrative power of their new states to increase production and bring these primary commodities to market. Toward this end, colonial governments provided extension services to increase yields, constructed processing centers, built roads and railways as well as power generation plants, administrative offices, hospitals and schools to service production areas.

Economic growth, thus, took off in those areas where cash crops were grown or minerals mined —- many of which were previously undeveloped due to a lack of infrastructure and a disproportionately high disease burden. Increasing returns from the initial investments in roads, railways, and electricity generation produced strong path dependent effects, setting these zones on track for higher levels of development throughout the post-independence period. However, faced with severe resource constraints (van de Walle, 2009; Gardner, 2012) and declining terms of trade(Frankema, Williamson and Woltjer, 2015), colonial governments tended to narrowly specialize in the primary commodities they supported and their geographic location. Beyond the cash crop and mineral enclaves, areas were either neglected – with the scarcest of public services provided(van de

Walle, 2009) – or, worse, relegated as a labor reserve and intentionally underdeveloped to create a cheap supply of labor to work in the cash crop and mining enclaves(Berg, 1965; Cordell and Gregory, 1982; Plange, 1979; Cordell, Gregory and Piché, 1996). The consequence was, on the whole, a legacy of stark inequality – beyond the capital city, "an empty panorama" punctuated only by the few economic enclaves on which the fiscal health of the colony depended.

In our previous paper we show empirically that colonial cash crop and mining enclaves have higher levels of infrastructure investment and population densities and how the economic inequalities thereby created persist until the present day. Below, we provide a selective overview of our findings.

Data

To test the effect of the cash crop revolution and the economic organization of the colonial state on spatial inequality in Africa, we have built an original dataset that includes historical primary commodity production data by volume, at the lowest-level administrative unit for which we could find data, and matches it to historical administrative maps to capture subnational variation in the cultivation of cash crops and extraction of minerals. Administrative maps and production data are primarily drawn from the post-World War II era, thus representing the economic footprint of colonialism on the eve of independence. Our dataset covers 28 former colonies and Liberia and Ethiopia and focuses on the most important primary commodities -— those that make up at least 10 percent of total exports at the end of colonialism. (See Table below). We standardize volume of production by district into real 1960 US$ using export data from the United Nations' Yearbook of International Trade Statistics. In addition to primary commodity production, we have also collected district-level data on the population of European settlers from colonial censuses. See the Data Appendix for a detailed list of sources used to construct this dataset.

Analysis

We conduct a series of analyses to test for the hypothesized immediate and long-run effects of colonial resource extraction. In a first step, we examine whether resource production predicts colonial settlement and investments at the eve of independence. Subsequently, we analyze whether these short-term effects persist throughout the post-colonial period and correlate with spatial inequality today. For each outcome variable, we estimate simple OLS models with colonial districts as the unit of analysis. All models include country-fixed effects to account for unobserved heterogeneity across colonies that may bias our results. Thus, we make sure that neither colony- or empire-level policies and institutions nor country-level differences in geographic endowments or pre-colonial historical trajectories drive any of our findings. In addition, all effects are identified as deviations from the country mean and can therefore be interpreted as measures of district-level inequality measures within former colonies.

To reduce omitted variable bias at the subnational level, all models include a set of geographic and historical control variables that may plausibly correlate with both resource extraction and subnational development outcomes. To capture the importance of locational fundamentals, we add a general agricultural suitability score (Ramankutty et al., 2002), a measure of terrain ruggednees (Shaver, Carter and Shawa, 2016), a malaria stability index from Kiszewski et al. (2004), predicted TseTse fly suitability from the FAO Animal Health and Production Division, the district's centroid distance from the closest sea cost, and a dummy indicating if the district is intersected by a navigable river. The agricultural suitability score is based on climate and soil conditions conducive to agriculture. In combination with the other geographic control variables, it captures geographic endowments favorable to human settlement, the early adoption of agriculture, increased specialization and trade and more complex forms of social organization.

With respect to historical factors operating before or at the time of the Scramble, we include centroid distances to European trade routes in 1900 (Ajayi and Crowder, 1985), to the next city with more than 1000 inhabitants in 1890 (Jedwab and Moradi, 2016), and to the first capital city under European rule. In addition, we use a map from Nathan

Nunn (2008) and replication data from Nunn and Wantchekon (2011) to calculate, for each district, mean political centralization and exposure to the slave trade in pre-colonial times. The underlying data on ethnic group-level political centralization comes from George Peter Murdock (1959, 1967). Seminal work by Nunn and Wantchekon (2011) and Michalopoulos and Papaioannou (2013) has shown both the slave trades and pre-colonial centralization to predict variation in subnational development outcomes today. Trade routes and cities capture centers of economic activity that predate the cash crop revolution and full European colonization.

Our main explanatory variable is the production value of export resources per square kilometer measured in 1960 US Dollar. We standardize this variable to mean 0 and standard deviation 1; thus coefficients can be interpreted as the predicted change in the dependent variable in response to a one-standard deviation increase in resource value per square kilometer. We also construct resource variables measuring revenues from crop and mineral production only in order to check whether effects differ for different types of commodities. We also estimate models with logged predictors to account for the right-skewed distribution of our resource variables and reduce the weight of outliers. However, we have no strong theoretical priors to prefer either the linear or logarithmic functional form. To address concerns about spatial dependence, we conservatively cluster all standard errors at the country level or estimate Conley (1999) standard errors that allow for smoothly decaying spatial dependence up to a distance cutoff of 2000 km.[6] We first present results from our simple fixed effects specifications, before we move to instrumental variable models that seek to causally identify the effect of cash crop production and colonial investments and population densities.

Baseline Fixed Effects Models

We begin with an analysis of European population shares at the district level. The data comes from the official colonial censuses described above. The presence of European administrators, farmers, or missionaries is a useful proxy of colonial state presence which

[6]We experimented with distance cutoffs between 50 and 4000 km. The standard errors produced with a 2000 km cutoff are always among the most conservative estimates.

varied significantly both across and within colonies. European settlement has been argued to predict colonial investments in state capacity, institutions, and physical infrastructure (Acemoglu, Johnson and Robinson, 2001; Jedwab, Kerby and Moradi, 2017).

Table 1: Fixed Effects Models of European Settler Share in Total Population, ca. 1960

	(1)	(2)	(3)	(4)	(5)	(6)
Resource Value per sqkm	0.240***					
	(0.032)					
	[0.040]***					
Crop Value per sqkm		0.192***				
		(0.073)				
		[0.049]***				
Mineral Value per sqkm			0.213***			
			(0.008)			
			[0.027]***			
Resource Value, log				0.059***		
				(0.021)		
				[0.011]***		
Crop Value, log					0.050**	
					(0.021)	
					[0.012]***	
Mineral value, log						0.104***
						(0.028)
						[0.020]***
Observations	741	741	741	741	741	741
Adjusted R^2	0.461	0.449	0.457	0.467	0.456	0.458
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes	Yes	Yes

Country-clustered standard errors in parentheses.
Conley standard errors with distance cutoff at 2000 km in square brackets.
*p<0.1; **p<0.05; ***p<0.01

European Settlement. Table 2 reports the results of models with the natural logarithm of settler share as dependent variable.[7] All coefficients on the resource variables are positive and significant at the 1% level. On average, a district with a one-standard deviation higher resource value per square kilometer has about 27% more settlers as a share of its total population ($\exp(.240) - 1 = 0.271$). Substantively speaking, this effect is comparable in size with a one-standard deviation decrease in malaria suitability or moving from a district 350 km away from the capital to one that is only 200 km away (calculations based on Model 1). The effect of a one-standard deviation change in natural resources in the log model in column 4 of Table 2 is comparable in size to the effect of a 1.6 standard deviations decrease in malaria suitability or moving from distance of 350 km from the capital to a district that is 250 km closer. The disaggregation into minerals

[7] we add a small number (1^{-7}) to keep all observations with a settler share of zero in our sample.

and cash crops reveals that mining districts have higher shares of European settlers than their cash-crop producing counterparts.

Transportation Infrastructure. Recent work has convincingly shown that colonial investments into transportation infrastructure had long-lasting effects on economic development (Donaldson, N.d.; Jedwab and Moradi, 2016). Reductions in transport costs may drastically increase the profitability of natural resource extraction and increase colonial revenues. In the next set of analyses, we explore whether colonial resource production and investments in roads and railways occurred in the same locations. First, we focus on road networks in 1960. We have digitized historical Michelin paper maps of African roads.[8] For the present purpose, we only focus on paved and improved roads, i.e. either laterite or fully bituminized roads that have been newly built or upgraded from lower quality roads throughout the colonial era.

Table 2: Fixed Effects Models of Mean Distance to Paved or Improved Road, 1960

	(1)	(2)	(3)	(4)	(5)	(6)
Resource Value per sqkm	−0.123***					
	(0.009)					
	[0.016]***					
Crop Value per sqkm		−0.074***				
		(0.021)				
		[0.021]***				
Mineral Value per sqkm			−0.113***			
			(0.004)			
			[0.013]***			
Resource Value, log				−0.022**		
				(0.009)		
				[0.005]***		
Crop Value, log					−0.017**	
					(0.008)	
					[0.005]***	
Mineral value, log						−0.043**
						(0.018)
						[0.013]**
Observations	839	839	839	839	839	839
Adjusted R^2	0.598	0.587	0.596	0.595	0.589	0.592
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes	Yes	Yes

Country-clustered standard errors in parentheses.
Conley standard errors with distance cutoff at 2000 km in square brackets.
*p<0.1; **p<0.05; ***p<0.01

To arrive at a measure of road density, we transform each colonial district into a 5×5 km grid and calculate the mean distance of each cell centroid to the next road

[8] Burgess et al. (2015) use the same Michelin maps for their study of road building in Kenya.

that is either paved or improved. We aggregate this variable to the district level by taking the mean. We use the log of this variable as the dependent variables of the models presented in Table 3.[9] All resource variables enter negative and significant indicating higher investments in road building in districts that produced natural resources. Districts with one standard deviation above zero resource production had about 12% higher road densities in 1960 than their non-producing counterparts. This effect is equivalent to comparing two districts 350 and 250 km away from the capital. Again, the coefficients for mineral resources are larger than the ones for cash crops.

Table 3: Fixed Effects Models of Road Density (Paved or Improved), 1998

	(1)	(2)	(3)	(4)	(5)	(6)
Resource Value per sqkm	0.102***					
	(0.016)					
	[0.018]***					
Crop Value per sqkm		0.097***				
		(0.020)				
		[0.024]***				
Mineral Value per sqkm			0.088***			
			(0.005)			
			[0.011]***			
Resource Value, log				0.031***		
				(0.006)		
				[0.006]***		
Crop Value, log					0.030***	
					(0.007)	
					[0.006]***	
Mineral value, log						0.041***
						(0.012)
						[0.009]***
Observations	839	839	839	839	839	839
Adjusted R^2	0.357	0.354	0.354	0.369	0.365	0.355
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes	Yes	Yes

Country-clustered standard errors in parentheses.
Conley standard errors with distance cutoff at 2000 km in square brackets.
*p<0.1; **p<0.05; ***p<0.01

Tables 4 and 5 investigate whether the resource-transportation nexus found in 1960 has persistent effects on the modern-day road network. We use a digitized version of the 1998 Michelin maps from Jedwab and Moradi (2016) to calculate, for each district, the length of paved or improved roads per square kilometer. We use the natural logarithm of this variable as dependent variable. The results reported in Table 4 suggest that historical resource extraction strongly predicts road density today. All coefficients are positive and

[9] Before taking the logarithm, we add a constant of 1 to keep all districts without paved or improved roads in the sample.

significant and comparable in size to results from the analysis of road densities in 1960 (Table 3). Table 5 adds the log of mean distance to road in 1960 as a control variable to check whether post-colonial road building has moderated or amplified the colonial concentration on resource-rich areas. Since we are not using the exact same road density measure in 1960 and 1998, the results have to be regarded as preliminary. Nonetheless, the positive and significant coefficients show that, if anything, cash crop and mineral producing districts continued to receive more investments in road-building than less well-endowed regions.

Table 4: Fixed Effects Models of Road Density (Paved or Improved), 1998

	(1)	(2)	(3)	(4)	(5)	(6)
Resource Value per sqkm	0.046***					
	(0.015)					
	[0.015]***					
Crop Value per sqkm		0.063***				
		(0.023)				
		[0.027]**				
Mineral Value per sqkm			0.036***			
			(0.007)			
			[0.010]***			
Resource Value, log				0.021***		
				(0.006)		
				[0.006]***		
Crop Value, log					0.022***	
					(0.007)	
					[0.006]***	
Mineral value, log						0.021***
						(0.008)
						[0.007]***
Mean Dist. to Road, 1960, log	−0.456***	−0.461***	−0.459***	−0.442***	−0.450***	−0.458***
	(0.040)	(0.041)	(0.040)	(0.036)	(0.038)	(0.041)
	[0.045]***	[0.044]***	[0.045]***	[0.045]***	[0.045]***	[0.044]***
Observations	839	839	839	839	839	839
Adjusted R^2	0.431	0.431	0.430	0.439	0.438	0.431
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes	Yes	Yes

Country-clustered standard errors in parentheses.
Conley standard errors with distance cutoff at 2000 km in square brackets.
*p<0.1; **p<0.05; ***p<0.01

Table 6 reports results for a similar analysis of railroad densities in 1960. We use the replication data by (Jedwab and Moradi, 2016) to construct the length of railroads per 1000 square kilometer and take the natural logarithm of this measure plus a small constant as dependent variable. The results look very similar to what we find for colonial road networks. Natural resource extraction and transportation infrastructure cluster in the same districts and the association is more pronounced for mining than for cash crop districts.

Table 5: Fixed Effects Models of Railroad Density, 1960

	(1)	(2)	(3)	(4)	(5)	(6)
Resource Value per sqkm	0.565***					
	(0.076)					
	[0.108]***					
Crop Value per sqkm		0.432**				
		(0.198)				
		[0.173]**				
Mineral Value per sqkm			0.502***			
			(0.027)			
			[0.083]***			
Resource Value, log				0.126***		
				(0.033)		
				[0.025]***		
Crop Value, log					0.100***	
					(0.027)	
					[0.023]***	
Mineral value, log						0.212***
						(0.079)
						[0.066]***
Observations	839	839	839	839	839	839
Adjusted R^2	0.357	0.354	0.354	0.369	0.365	0.355
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes	Yes	Yes

Country-clustered standard errors in parentheses.
Conley standard errors with distance cutoff at 2000 km in square brackets.
*p<0.1; **p<0.05; ***p<0.01

Population Density. The economic literature on path dependency and spatial equilibria points to the significance of high population densities and city growth as important indicators of economic agglomeration and development clusters. In fact, Jedwab and Moradi (2016) show that colonial investments had a significant role to play in spurring the emergence and growth of African cities. In the following, we present results from OLS models with logged population densities in 1960 and 2000 as the dependent variables and colonial resource production as the main predictors. The population estimates utilized for Tables 6–8 come from the UNEP/GRID Sioux Falls data set, whereas in Table 9, we employ data from the History Database of the Global Environment(Klein Goldewijk, Beusen and Janssen, 2010, HYDE). The advantage of the latter data source lies in the fact that it also provides estimates for pre-colonial population densities, which we can use as a baseline control variable. On the downside, the HYDE data is more heavily modelled in that it combines historical statistics with land use data and current-day population densities to project population figures back in time. It has to be noted that due to ir-

Table 6: Fixed Effects Models of Population Density in 1960, UNEP Data

	(1)	(2)	(3)	(4)	(5)	(6)
Resource Value per sqkm	0.168***					
	(0.017)					
	[0.023]***					
Crop Value per sqkm		0.140***				
		(0.042)				
		[0.035]***				
Mineral Value per sqkm			0.148***			
			(0.006)			
			[0.014]***			
Resource Value, log				0.039***		
				(0.008)		
				[0.006]***		
Crop Value, log					0.033***	
					(0.006)	
					[0.006]***	
Mineral value, log						0.060**
						(0.025)
						[0.016]***
Observations	839	839	839	839	839	839
Adjusted R^2	0.604	0.595	0.600	0.610	0.601	0.598
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes	Yes	Yes

Country-clustered standard errors in parentheses.
Conley standard errors with distance cutoff at 2000 km in square brackets.
*p<0.1; **p<0.05; ***p<0.01

Table 7: Fixed Effects Models of Population Density in 2000, UNEP Data

	(1)	(2)	(3)	(4)	(5)	(6)
Resource Value per sqkm	0.190***					
	(0.016)					
	[0.024]***					
Crop Value per sqkm		0.126***				
		(0.037)				
		[0.033]***				
Mineral Value per sqkm			0.172***			
			(0.006)			
			([0.016]***			
Resource Value, log				0.037***		
				(0.010)		
				[0.008]***		
Crop Value, log					0.030***	
					(0.008)	
					[0.007]***	
Mineral value, log						0.073***
						(0.026)
						[0.016]***
Observations	839	839	839	839	839	839
Adjusted R^2	0.637	0.625	0.634	0.636	0.629	0.634
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes	Yes	Yes

Country-clustered standard errors in parentheses.
Conley standard errors with distance cutoff at 2000 km in square brackets.
*p<0.1; **p<0.05; ***p<0.01

regular and low-quality census-taking in the colonial age, historical population data for the African continent have to be treated as best guesses (Frankema and Jerven, 2014). Notwithstanding these concerns, historical population estimates may reveal informative patterns.

Tables 6 and 7 show that resource-rich colonial districts were significantly more densely populated and also have higher densities today. The coefficients in the 2000 models are comparable in size to those in the 1960 regressions. Table 8 adds 1960 population densities to the models with population density in 2000 as outcome variable. The coefficients on our resource variables are drastically reduced and are indistinguishable from 0 in three out of six models. This is broadly in line with the results in Jedwab and Moradi (2016), who demonstrate that the new spatial equilibrium due to colonial investment is already reached in 1960 and although it persists to the present day, populations close to colonial railways do not grow faster post independence. If at all, Table 11 points to continuously faster growth of mining areas after 1960, although the effect sizes are substantively quite small.

Table 9 reports the results from the HYDE models in which we control for the log of estimated population density in 1880. In this sense, the coefficients come closer to identifying the association between resource production and population growth over the whole colonial period than the previous models that lack a baseline estimate. The fact that the historical estimates from the HYDE data set are back-projections of more recent population figures should bias our coefficients towards zero. Nonetheless, four out of six coefficients are positive and statistically highly significant predicting about 3% faster population growth per standard deviation of resource production.

Subnational Development Today. In the final set of our baseline analyses we examine whether the early advantage of resource-producing areas in terms of colonial investments and population densities translates into higher levels of local development today. We use nighttime luminosity data from the Defense Meteorological Satellite Program's Operational Linescan System (DMSP-OLS), provided by the US National Oceanic and Atmospheric Administration (National Geophysical Data Center, 2014). Night lights

Table 8: Fixed Effects Models of Population Density in 2000, UNEP Data

	(1)	(2)	(3)	(4)	(5)	(6)
Resource Value per sqkm	0.023**					
	(0.010)					
	[0.008]***					
Crop Value per sqkm		−0.014				
		(0.022)				
		[0.020]				
Mineral Value per sqkm			0.026***			
			(0.008)			
			[0.008]***			
Resource Value, log				−0.001		
				(0.005)		
				[0.003]		
Crop Value, log					−0.003	
					(0.005)	
					[0.003]	
Mineral value, log						0.014**
						(0.005)
						[0.005]*
Population Density 1960, log	0.990***	0.999***	0.990***	0.998***	1.000***	0.989***
	(0.042)	(0.041)	(0.041)	(0.040)	(0.040)	(0.040)
	[0.022]***	[0.022]***	[0.022]***	[0.021]***	[0.021]***	[0.021]***
Observations	839	839	839	839	839	839
Adjusted R^2	0.923	0.923	0.923	0.922	0.923	0.923
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes	Yes	Yes

Country-clustered standard errors in parentheses.
Conley standard errors with distance cutoff at 2000 km in square brackets.
*p<0.1; **p<0.05; ***p<0.01

Table 9: Fixed Effects Models of Population Density in 1960, HYDE Data

	(1)	(2)	(3)	(4)	(5)	(6)
Resource Value per sqkm	0.029***					
	(0.004)					
	[0.004]***					
Crop Value per sqkm		−0.005				
		(0.014)				
		[0.009]				
Mineral Value per sqkm			0.030***			
			(0.002)			
			[0.003]***			
Resource Value, log				0.006***		
				(0.002)		
				[0.001]***		
Crop Value, log					0.005***	
					(0.002)	
					[0.001]***	
Mineral value, log						0.008
						(0.006)
						[0.004]
Population Density 1880, log	1.186***	1.196***	1.188***	1.186***	1.190***	1.191***
	(0.031)	(0.033)	(0.031)	(0.030)	(0.031)	(0.031)
	[0.017]***	[0.018]***	[0.017]***	[0.017]***	[0.018]***	[0.017]***
Observations	839	839	839	839	839	839
Adjusted R^2	0.972	0.971	0.972	0.972	0.972	0.971
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes	Yes	Yes

Country-clustered standard errors in parentheses.
Conley standard errors with distance cutoff at 2000 km in square brackets.
*p<0.1; **p<0.05; ***p<0.01

Table 10: Fixed Effects Models Nighttime Luminosity, 2013

	(1)	(2)	(3)	(4)	(5)	(6)
Resource Value per sqkm	0.328***					
	(0.043)					
Crop Value per sqkm		0.275***				
		(0.060)				
Mineral Value per sqkm			0.288***			
			(0.012)			
Resource Value, log				0.057***		
				(0.018)		
Crop Value, log					0.039***	
					(0.015)	
Mineral value, log						0.136***
						(0.034)
Observations	839	839	839	839	839	839
Adjusted R^2	0.590	0.581	0.586	0.585	0.577	0.588
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes	Yes	Yes

*p<0.1; **p<0.05; ***p<0.01
Country-clustered standard errors in parentheses.

Table 11: Fixed Effects Models Nighttime Lights per Capita, 2013

	(1)	(2)	(3)	(4)	(5)	(6)
Resource Value per sqkm	0.325***					
	(0.030)					
Crop Value per sqkm		0.225***				
		(0.062)				
Mineral Value per sqkm			0.293***			
			(0.008)			
Resource Value, log				0.036*		
				(0.020)		
Crop Value, log					0.018	
					(0.015)	
Mineral value, log						0.113**
						(0.046)
Observations	839	839	839	839	839	839
Adjusted R^2	0.557	0.542	0.553	0.540	0.535	0.548
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes	Yes	Yes

*p<0.1; **p<0.05; ***p<0.01
Country-clustered standard errors in parentheses.

have been demonstrated to closely approximate economic activity and wealth at fine-grained spatial resolutions (Elvidge et al., 1997; Henderson, Storeygard and Weil, 2011; Chen and Nordhaus, 2011). Our dependent variable in Table 10 is the log of mean night-light intensity per district in the year 2013. In Table 11, we re-estimate all models using per capita night lights as the dependent variable to ensure that luminosity captures differences in economic activity and not mereley population. We use population densities in 2010 from the Gridded Population of the World database to construct a per capita measure of luminosity.

All coefficients in Table 10 enter with positive signs and are statistically and economically highly significant. A one-standard deviation higher value of resource production in 1960 is associated with about 38% more night lights today. Comparing the resource effects to the effect of capital distance leads to similar conclusions as in the physical infrastructure and population density regressions above. Turning to Table 11, the log-linear models of per capita night lights show largely identical results as the first three models in Table 10. The log-log specifications in columns 4–6 in Table 11 produces somewhat smaller and less significant estimates, but only the coefficient on crop value turns insignificant. Taken together, the fixed effects analyses support the notion that colonial settlements, investments, and population densities clustered in areas of resource extraction and that the extractive colonial equilibrium persists until today. In the Appendix to this paper we also present results that use household wealth and electricity access from the DHS surveys as measures of modern-day subnational development. The results are very much in line with what we find for per capita nightlights. We furthermore show that the persistence of the colonial equilibrium is unlikely to be a mere effect of continuously high levels of agricultural productivity in cash crop zones. Controlling for FAO estimates of crop production values in 2000 only marginally reduces our estimates, which lends additional support that the path-dependent effects of colonial investments in cash crop areas have a significant role to play.

Instrumental Variables

Establishing causality from the cross-sectional regressions reported above is challenging. While country-fixed effects and the extensive set of geographic and precolonial controls is likely to minimize omitted variable bias, there may still be unobserved factors at the district-level that correlate with colonial resource extraction and local development outcomes. Another concern is reverse causality. Do local resources cause colonial investments and faster population growth or might it be the case that investments occur for other than resource-related reasons and only later spur cash crop farming and mining. A third potential source of bias is measurement error in our main independent variables. If our data measures district-level export values with unsystematic error, our estimates are biased towards zero.

To address these potential sources of bias, we run 2SLS-IV models to identify the causal effects of colonial cash crop extraction on colonial settlements, investments, and population densities at independence. We use cash crop-specific agro-climatic suitability scores from the FAO's Global Agro-Ecological Zones (FAO GAEZ) database as instruments for actually observed levels of cash crop production. The scores are based on a model which uses data on soil type, nutrient availability, terrain conditions, and climate as inputs. Since our analyses pool all colonies and thus do not distinguish between specific crops, we build an aggregate measure of cash crop suitability across the nine crops that occur both in our data set and in the FAO GAEZ data. These crops are cocoa, coffee, cotton, groundnuts, oil palm, tobacco, tea, sugarcane, and bananas. The suitability scores come in the form of rasters with a resolution of 0.083 decimal degrees (roughly 10 km at the equator) and take on values between 0 and 100. To construct the instrument, we first calculate, for each raster cell, the maximum of the nine crop suitabilities to arrive at a highly localized estimate of the probability that any cash crop is produced. In a second step, we take the district-level mean of these cell-level suitability maximums to serve as our proxy for aggregate cash crop suitability.

To serve as valid instrument for colonial cash crop production, this measure of cash crop suitability has to predict actual production and satisfy the exclusion restriction. First stage results indicate satisfactory strength of the instrument. The exclusion restriction requires the instrument to only influence colonial settlement, investment, and population density through its impact on colonial production and not through other causal channels. If particularly fertile soils – for colonial cash crops and other agricultural produce – correlate with an earlier adoption of agriculture and the associated development of more complex societal norms and institutions, our exclusion restriction may not hold. To alleviate this and similar concerns, we also include general agricultural suitability that is not specific to colonial cash crops and the other geographic control variables discussed above. If the impact of cash crop suitability net of generally favorable conditions for agriculture still yields substantively and statistically significant estimates, we have stronger reasons to believe that any found association between colonial production and development outcomes is not merely a spurious correlation.

This instrumental variable setup is similar in spirit to an intention-to-treat analysis in medical research where treatment assignment is often used as an exogeneous instrument for actual treatment. In many cases, patients' willingness and ability to comply with the assigned treatment is influenced by factors that may affect health outcomes through other channels than the treatment itself. In keeping with the analogy, cash crop suitability can be seen as nature's intention to treat certain areas with cash crops. Whether or not we see actual production taking place in the colonial age then depends on both suitability and other geographic, political, and economic factors that may also play a role in setting the pace for colonial investment, economic agglomeration and local development.

Table 12: 2SLS-IV Models of Colonial Footprint, ca. 1960

	Settler Share	Dist. Road	Railroads
Crop Value pre sqkm, log	0.135***	−0.118**	0.159
	(0.051)	(0.047)	(0.113)
	[0.041]***	[0.031]***	[0.078]*
Observations	745	839	843
Adjusted R^2	0.392	0.366	0.312
First Stage F	37.71	32.79	27.3
Country Fixed Effects	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes

Country-clustered standard errors in parentheses.
Conley standard errors with distance cutoff at 2000 km in square brackets.
*p<0.1; **p<0.05; ***p<0.01

Table 12 reports the results of 2SLS-IV regressions focussing on European settlement as well as colonial investments in roads and railroads. The coefficients all point in the expected direction but are somewhat less precisely estimated than in the 'naïve' fixed-effects models. The effects on railroad density only reach significance when we use Conley (1999) standard errors to account for spatial correlation. All other coefficients are significant at the 5% or 1% level. Table 13 shows results from 2SLS-IV models of population densities. In terms of sign and significance, the estimates are very much in line with what we find in Tables 6–9. The IV coefficients in Tables 12 and 13 are consistently larger in size than in the OLS regressions above. This may be due to significant measurement error in our main predictors, heterogeneous treatment effects between districts 'complying' with the cash crop suitability instrument, or the distribution of these 'compliers' along the range of our continuous endogeneous regressor (logged crop production per sqkm). While we are hesitant to rush to conclusions about effect sizes, the IV results strengthen our confidence that the results reported above are more than a mere artifact of unobserved heterogeneity across districts or reverse causation.

Table 13: 2SLS-IV Models of Population Densities

	UNEP 1960	UNEP 2000	UNEP 2000	HYDE 1960
Crop Value per sqkm, log	0.135***	0.156***	0.025	0.023**
	(0.050)	(0.053)	(0.030)	(0.011)
	[0.043]***	[0.045]***	[0.017]	[0.009]***
Population Density 1960, log			0.967***	
			(0.058)	
			[0.032]***	
Population Density 1880, log				1.171***
				(0.030)
				[0.022]***
Population Density 1960, log				
Observations	839	839	839	839
Adjusted R^2	0.445	0.456	0.914	0.967
First Stage F	32.79	32.79	20.47	24.02
Country Fixed Effects	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes

Country-clustered standard errors in parentheses.
Conley standard errors with distance cutoff at 2000 km in square brackets.
*p<0.1; **p<0.05; ***p<0.01

Conflict Analyses

After establishing a close connection between colonial export production, infrastructure investments, population densities, and long-term development, we now investigate the role of these legacies when it comes to political violence.

Higher levels of wealth, electricity, and transportation infrastructure in areas of colonial commodity production can be expected to reduce the incidence of armed rebellions. Especially the increased infrastructural power that comes with a more developed transportation network should make it easier for the state to control and police former areas of colonial export production. On the other hand, the continued concentration of economic activity around a small number of export commodities may make these areas particularly vulnerable to weather or price shocks. Which of these effects dominate and how they play together is, eventually, an empirical question.

At the present stage of this paper, we limit our analysis to cash crops and exclude mineral resources from the analysis. To test how the effect of economic shocks plays out in cash crop areas, we combine our historical data described above with an updated version of the ACLED conflict event data provided by the University of Colorado, Boulder via the replication data of Witmer et al. (2017). Their conflict event data is aggregated to a 1 degree times 1 degree grid of Sub-Saharan and contains monthly observations from 1980–2012. We collapse their data to cell-year format and also use their climate data (temperature and precipitation) as well as some controls. To assign our historical cash crop data to the grid, we code a dummy for all cells that fall into districts producing cocoa, coffee, cotton, palm, or groundnuts. These five crops made up more than 80% of all cash crop revenues in Sub-Saharan Africa as of 1960.

Cross-Sectional Correlations. In a first step, we perform a descriptive cross-sectional analysis in which we regress the logged sum of conflict events between 1980 and 2012 on our cash crop dummy. We estimate OLS models with country fixed effects and report standard errors clustered at the country level. As control variables, all models include cell population from the Gridded Population of the World database as well as a variable from Witmer et al. (2017) that for each country year counts the number of Factiva news reports unrelated to violence. This variable is assigned to cells by population-weighting and addresses concerns about reporting bias in the conflict event data. In the cross-sectional analysis, we take the mean of this variable over the period 1980–2012. Of course, the cross-sectional results have to be taken with a large grain of salt and may be subject to severe omitted variable bias. Table 14 shows the results. The coefficients on the cash crop dummy are substantively small and statistically indistinguishable from zero. The sign is positive for all but the riot event type, indicating that cash crop areas, on average, see neither more or less conflict than other cells. This may come as a surprise if one expects higher levels of local state capacity and infrastructure to dampen conflict risk. However, continued economic dependence on cash crop exports and an increased vulnerability to economic shocks may also be at play here. In what follows, we more carefully distinguish these two mechanisms.

Table 14: Cash Crops and Violent Events

	ACLED Events			
	All	Battles	Riots	vs. Civilians
	(1)	(2)	(3)	(4)
Cash Crop Dummy	0.005	0.015	−0.087	0.044
	(0.088)	(0.093)	(0.053)	(0.069)
Country-FE	yes	yes	yes	yes
Observations	2,062	2,062	2,062	2,062
Adjusted R^2	0.550	0.492	0.522	0.506

Country-clustered standard errors in parantheses

Temperature Shocks. More specifically, we examine wether temperature shocks affect cash crop cells more or less heavily than other regions. To that end we run OLS models with the logged ACLED event count as a dependent variable.[10] All models include cell and year or country-year fixed effects to approximate a difference-in-differences analysis. The main explanatory variable is the cell-specific and time-varying temperature anomaly score from the University of East Anglia's Climate Research Unit lagged by one year[11]. We also include an interaction term of temperature and the cash crop cell dummy. We

[10] Estimating linear probability models with incidence dummies instead of counts yields similar results

[11] Using contemporaneous values does not substantively alter results

report Conley standard errors with a distance cutoff of 600 km and a temporal cutoff of 33 years to account for spatial and temporal correlation in the error term.

Table 15 and 16 report the results. Rising temperatures are associated with a significantly increased risk of conflict incidence in all eight models. The effects are stronger for organized violence (i.e. battles and violence of armed actors against civilians) than for riots. In Table 15, the interaction term is consistently positive and significant, indicating stronger effects on violence in cash crop cells. In the demanding country-year FE specifications reported in Table 16, the interaction coefficients become insignificant but remain positive in three of four models. Thus, if anything, cash crop cells are more vulnerable to weather shocks than other cells. Any advantage in terms of infrastructure, wealth, and state capacity does not seem to translate into better insurance against weather-induced changes in opportunity costs.

Table 15: Weather Shocks, Cash Crops, and Violent Events

	ACLED Events, 1980–2012			
	All	Battles	Riots	vs. Civilians
	(1)	(2)	(3)	(4)
Temperature (t-1)	0.048***	0.037***	0.009***	0.030***
	(0.011)	(0.008)	(0.003)	(0.007)
Temperature × Cash Crop Dummy (t-1)	0.078***	0.057***	0.013**	0.055***
	(0.015)	(0.012)	(0.007)	(0.011)
Cell FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Country-Year FE	no	no	no	no
Observations	65,984	65,984	65,984	65,984
Adjusted R^2	0.389	0.250	0.413	0.336

Conley standard errors in parantheses (distance cutoff at 600km, temporal cutoff at 33 years)

Price Shocks. To better approximate shocks to export revenues, we also investigate the role of price shocks in cash crop areas. More specifically, we interact cell dummies for cocoa, coffee, palm, cotton, groundnuts with time series of the respective world market prices from Jacks (2013). In cells where multiple cash crops are produced, we calculate a weighted price average based on the district-level production shares from our colonial data. We converted the price indices to real 1960 USD and always use the natural logarithm lagged by one year in our regressions. The dependent variables and estimations strategy are the same as above with temperature shocks. Tables 17 and 18 summarize

Table 16: Weather Shocks, Cash Crops, and Violent Events

	ACLED Events			
	All	Battles	Riots	vs. Civilians
	(1)	(2)	(3)	(4)
Temperature (t-1)	0.052***	0.032***	0.010***	0.040***
	(0.010)	(0.008)	(0.003)	(0.007)
Temperature × Cash Crop Dummy (t-1)	0.007	0.008	−0.001	0.017**
	(0.011)	(0.009)	(0.005)	(0.008)
Cell FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Country-Year FE	yes	yes	yes	yes
Observations	65,984	65,984	65,984	65,984
Adjusted R^2	0.520	0.399	0.485	0.458

Conley standard errors in parantheses (distance cutoff at 600km, temporal cutoff at 33 years)

the results. Unsurprisingly, rising/falling cash crop prices reduce/increase the risk of conflict in cash crop producing cells. The coefficients are negative and significant for all event types with the exception of riots. Our reported findings for temperature and price shocks are well in line with the previous literature on agricultural shocks and conflict (Berman and Couttenier, 2015; McGuirk and Burke, 2017). In the next section, we turn to examining potential offsetting effects of local state capacity inherited from the colonial age.

Table 17: Price Shocks, Cash Crops, and Violent Events

	ACLED Events, 1980–2012			
	All	Battles	Riots	vs. Civilians
	(1)	(2)	(3)	(4)
ln Price× Cash Crops (t-1)	−0.134***	−0.088***	−0.010	−0.102***
	(0.025)	(0.019)	(0.008)	(0.018)
Cell FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Country-Year FE	no	no	no	no
Observations	65,760	65,760	65,760	65,760
Adjusted R^2	0.389	0.250	0.413	0.336

Conley standard errors in parantheses (distance cutoff at 600km, temporal cutoff at 33 years)

Economic Shocks, local road density, and violence. In the first empirical section of the paper, we have shown that colonial cash crop areas have higher road densities at the eve of independence as well as today. Transportation networks are a useful proxy for local state capacity in the form of infrastructural power (Herbst, 2000). Higher levels of local infrastructural power should make it easier for the state to survey, control, and police

Table 18: Price Shocks, Cash Crops, and Violent Events

	ACLED Events, 1980–2012			
	All	Battles	Riots	vs. Civilians
	(1)	(2)	(3)	(4)
ln Price× Cash Crops (t-1)	−0.051***	−0.035**	0.005	−0.024***
	(0.018)	(0.014)	(0.006)	(0.008)
Cell FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Country-Year FE	yes	yes	yes	yes
Observations	65,760	65,760	65,760	65,760
Adjusted R^2	0.520	0.399	0.485	0.350

Conley standard errors in parantheses (distance cutoff at 600km, temporal cutoff at 33 years)

its territory and population and thereby effectively contain potential conflict. To more formally investigate whether such legacies of infrastructural power reduce the impact of economic shocks, we rerun the economic shock models discussed above and add interaction terms of the respective shock variable with logged road densities in 1960. For the moment, we only focus at the total event count and do not disaggregate according to event type. Table 19 presents the results. Column 1 and 2 report the temperature shock models, whereas columns 3 and 4 repeat the price shock analysis. The constitutive terms of the shock variables point in the same direction as in the previous models and are highly significant. The road interactions are also significant in all four models and indicate offsetting effects. In other words, economic shocks affect conflict risk but less so in areas with high road densities.

To facilitate interpretation of the magnitude of these offsetting effects, figure 2 and 3 plot the marginal effects of temperature and price shocks on the logged ACLED event count. The temperature plots show that unusually hot cash-crop-cell-years increase conflict risk more or less across the board. While the effect size diminishes the higher the road density of a cell, it only loses significance at the far right tail of the observed road density distribution. Note that temperature shocks have no significant effects in non-cash-crop cells. A similar picture emerges from the price shock analysis. Price changes significantly affect conflict risk in cash crop cells but the effect gets smaller with road density. Local state capacity as measured by roads needs to be very high for the price effect to disappear.

Table 19: Cash Crops, Shocks, Roads & Violent Events

	ACLED Events, 1980–2012			
	(1)	(2)	(3)	(4)
Temperature (t-1)	0.038***	0.054***		
	(0.012)	(0.011)		
Temperature (t-1) × Cash Crop Dummy	0.135***	0.040**		
	(0.024)	(0.018)		
Temperature (t-1) × Roads 1960, ln	0.008**	−0.002		
	(0.003)	(0.003)		
Temperature (t-1) × Cash Crops × Roads	−0.028***	−0.012**		
	(0.006)	(0.005)		
ln price (t-1) × Cash Crops			−0.214***	−0.101***
			(0.039)	(0.028)
ln price (t-1) × Cash Crops × Roads			0.035***	0.022***
			(0.009)	(0.007)
Cell FE	yes	yes	yes	yes
Year FE	yes	–	yes	–
Country-Year FE	no	yes	no	yes
Observations	65,984	65,984	68,046	68,046
Adjusted R^2	0.390	0.520	0.383	0.516

Conley standard errors in parantheses (distance cutoff at 600km, temporal cutoff at 33 years)

Figure 1: Marginal Effects of Temperature Shocks (M1 & M2)

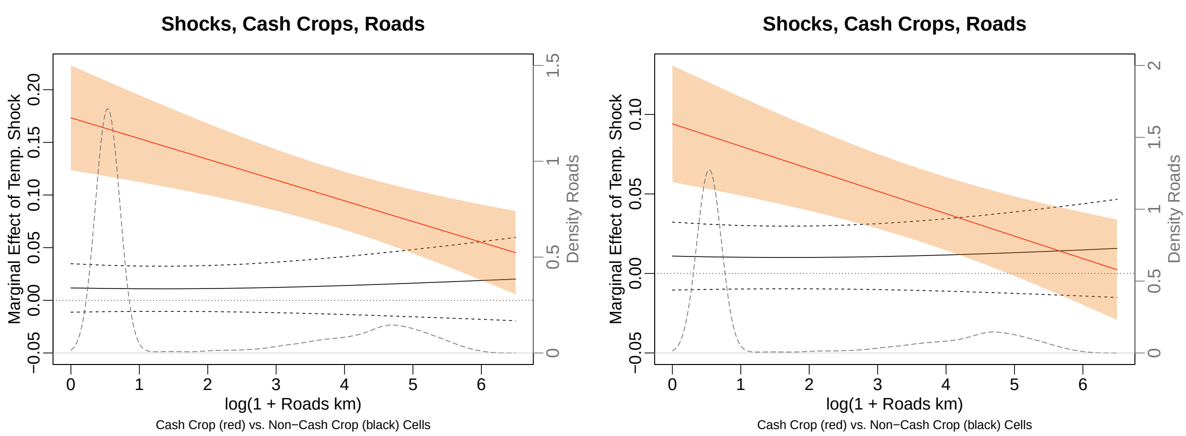
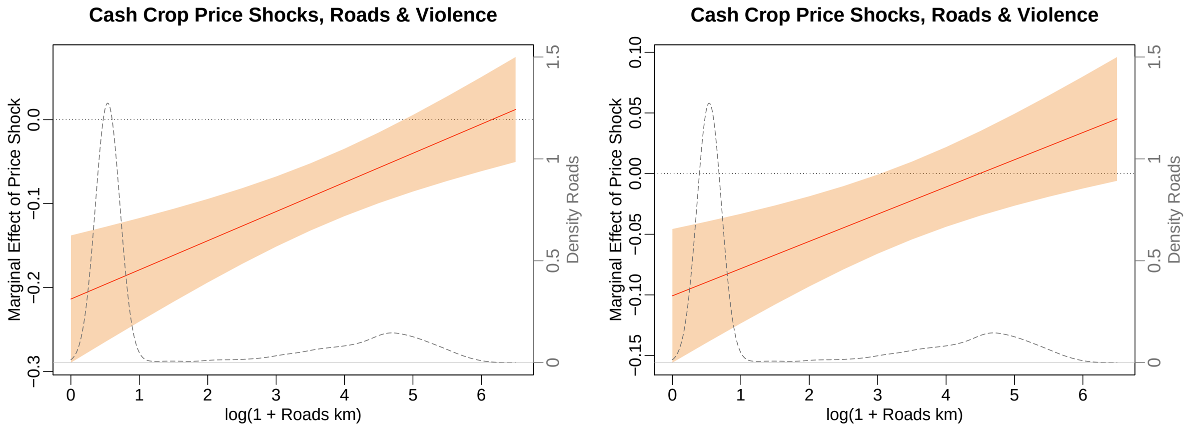


Figure 2: Marginal Effects of Price Shocks (M3 & M4)



Conclusion & Next Steps

Central to Africa's development crisis has been the pernicious combination of the state's inability to provide basic public goods, such as security, throughout its territory and uneven patterns of development that significantly advantage some regions or social groups relative to others (Herbst, 2000; Cederman, Weidmann and Gleditsch, 2011). A prominent literature relates these issues to legacies of extractive colonialism (Acemoglu, Johnson and Robinson, 2001, see e.g.). In this paper, we analyzed the legacies of colonial resource extraction in Sub-Saharan Africa at the subnational scale.

First, we relate historic and contemporary variation in local infrastructure and state capacity to the light and highly localized footprint of colonialism. After the scramble, the European empires sought to develop cost-effective ways of governing their colonies and established what Sara Berry (1992) has called "hegemony on a shoestring." In line with economic historians' work on the topic, we see primary commodity production as the main source of revenue and target of imperial investments in African colonies. Collecting and digitizing historical reports and maps on the geospatial location of production zones in the late colonial age allows us to systematically test this notion. We show that colonial commodity production is a robust predictor of within-country variation in European settlement, colonial investments in physical infrastructure, as well as population densities and subnational development outcomes today.

Second, we empirically illustrate the dual legacies of colonial cash crop extraction on violent conflict 1980–2012. Despite persisting advantages in infrastructure, state capacity, and development, cash crop areas are neither more or less stable than other places. Apart from infrastructure and state capacity, they also inherited their economic dependence on a small number of export commodities from the colonial age. This, in turn, makes them more vulnerable to economic shocks and the associated changes in the opportunity costs of rebellion. We have shown that temperature shocks, if anything, have stronger conflict inducing effects in cash crop areas than elsewhere. In places with extremely high levels of colonial road infrastructure, the effect of temperature and price shocks is offset. However, a majority of cash crop cells with less than ideal infrastructure endowments remains vulnerable.

Further iterations of this project will more thoroughly investigate the mechanisms by which road density reduces conflict risk induced by economic shocks. In addition, we aim to investigate heterogeneity across different crops, countries, and time periods to get a better picture of the scope conditions to the findings reported in this paper.

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Empirical Appendix

Table A3: Fixed Effects Models of Household Wealth, DHS Data

	(1)	(2)	(3)	(4)	(5)	(6)
Resource Value per sqkm	0.080***					
	(0.012)					
Crop Value per sqkm		0.065***				
		(0.015)				
Mineral Value per sqkm			0.071***			
			(0.005)			
Resource Value, log				0.009*		
				(0.005)		
Crop Value, log					0.003	
					(0.004)	
Mineral value, log						0.031***
						(0.008)
Observations	670	670	670	670	670	670
Adjusted R^2	0.405	0.388	0.398	0.381	0.375	0.396
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes	Yes	Yes

*p<0.1; **p<0.05; ***p<0.01
Country-clustered standard errors in parentheses.

Table A4: Fixed Effects Models of Electricity Access DHS Data

	(1)	(2)	(3)	(4)	(5)	(6)
Resource Value per sqkm	0.024***					
	(0.005)					
Crop Value per sqkm		0.027***				
		(0.006)				
Mineral Value per sqkm			0.020***			
			(0.002)			
Resource Value, log				0.004**		
				(0.002)		
Crop Value, log					0.002	
					(0.002)	
Mineral value, log						0.007**
						(0.003)
Observations	731	731	731	731	731	731
Adjusted R^2	0.540	0.539	0.537	0.534	0.530	0.534
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes	Yes	Yes

*p<0.1; **p<0.05; ***p<0.01
Country-clustered standard errors in parentheses.

Table A5: Road Density 1998: Controlling for Agricultural Production

	(1)	(2)	(3)	(4)
Crop Value per sqkm (1960)	0.097***	0.089***		
	(0.020)	(0.022)		
Crop Value per sqkm (1960), log			0.030***	0.026***
			(0.007)	(0.007)
Crop Value per sqkm (2000)		0.021**		
		(0.009)		
Crop Value per sqkm (2000), log				0.132***
				(0.043)
Observations	839	839	839	839
Adjusted R^2	0.354	0.357	0.365	0.385
Country Fixed Effects	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes

*p<0.1; **p<0.05; ***p<0.01
Country-clustered standard errors in parentheses.

Table A6: Population Density 2000: Controlling for Agricultural Production

	(1)	(2)	(3)	(4)
Crop Value per sqkm (1960)	0.126***	0.108***		
	(0.037)	(0.039)		
Crop Value per sqkm (1960), log			0.030***	0.025***
			(0.008)	(0.008)
Crop Value per sqkm (2000)		0.044**		
		(0.019)		
Crop Value per sqkm (2000), log				0.185***
				(0.054)
Observations	839	839	839	839
Adjusted R^2	0.625	0.635	0.629	0.651
Country Fixed Effects	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes

*p<0.1; **p<0.05; ***p<0.01
Country-clustered standard errors in parentheses.

Table A7: Night Lights 2013: Controlling for Agricultural Production

	(1)	(2)	(3)	(4)
Crop Value per sqkm (1960)	0.275***	0.251***		
	(0.060)	(0.056)		
Crop Value per sqkm (1960), log			0.039***	0.033**
			(0.015)	(0.014)
Crop Value per sqkm (2000)		0.060***		
		(0.023)		
Crop Value per sqkm (2000), log				0.250***
				(0.050)
Observations	839	839	839	839
Adjusted R^2	0.354	0.357	0.365	0.385
Country Fixed Effects	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes
Precolonial Controls	Yes	Yes	Yes	Yes

*p<0.1; **p<0.05; ***p<0.01
Country-clustered standard errors in parentheses.

Figure A1: Slope of Cash Crop Suitability in First Stage Regression, Conditional on Covariates and Country-Fixed Effects

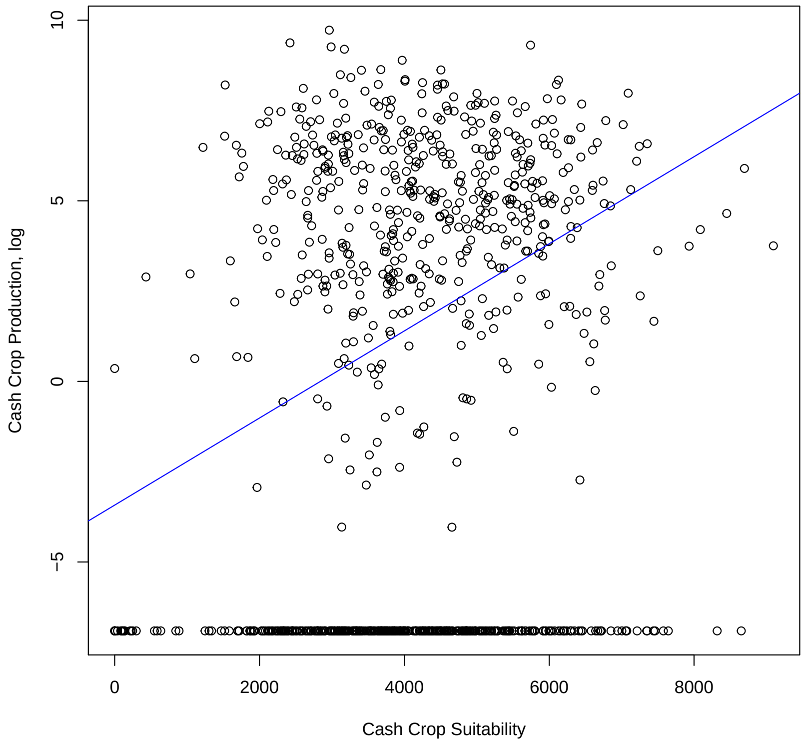

Table A8: Gini Coefficients of Resource Production and Agricultural Suitability

	GINI Coefficient	
Colony/Country	Resources 1960	Agric. Suitability
Angola	0.94	0.37
Belgian Congo	0.47	0.37
Cote d'Ivoire	0.62	0.34
Dahomey	0.60	0.09
Ethiopia	0.75	0.27
French Cameroon	0.82	0.44
French Guinea	0.90	0.15
Gambia	0.63	0.05
Ghana	0.67	0.24
Kenya	0.91	0.23
Liberia	0.87	0.36
Madagascar	0.85	0.33
Mali/Soudan	0.51	0.40
Mozambique	0.79	0.22
Niger	0.92	0.42
Nigeria	0.65	0.16
Northern Rhodesia	0.90	0.13
Nyasaland	0.81	0.13
Central African Republic	0.53	0.55
Rwanda/Burundi	0.47	0.18
Senegal	0.75	0.38
Sierra Leone	0.82	0.18
Somalia	0.94	0.47
Southern Rhodesia	0.76	0.27
Sudan	0.80	0.54
Tanganyika	0.65	0.16
Tchad (Chad)	0.68	0.35
Togo	0.68	0.07
Uganda	0.62	0.29
Zanzibar	0.40	0.00