Blood Rubber*

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Abstract: We examine the legacy of one of the most extreme examples of colonial extraction, the rubber concessions granted to private companies under King Leopold II in the Congo Free State, the present-day Democratic Republic of Congo. The companies used violent tactics to force villagers to collect rubber. Village chiefs were co-opted into supporting the rubber regime, and villagers were severely punished if they did not meet the rubber quotas. We use a regression discontinuity design along the well-defined boundaries of the ABIR and Anversoise concessions to show that historical exposure to the rubber concessions causes significantly worse education, wealth, and health outcomes. We then use survey and experimental data collected along a former concession boundary to examine effects on local institutions and culture. We find a negative effect on local institutional quality and a positive effect on culture. Consistent with the historical co-option of chiefs by the concession companies, village chiefs within the former concessions are more likely to be hereditary, rather than elected, and they provide fewer public goods. However, individuals within the concessions are more trusting, more cohesive, and more supportive of sharing income. The results suggest that colonial extraction may have different effects on institutions and culture.

Keywords: Africa, development, culture, institutions, colonialism.

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1. Introduction

A large literature examines the origins of sub-Saharan Africa's comparative development. Of particular interest has been the role of pre-colonial and colonial institutions. Pre-colonial ethnic-group level characteristics such as political centralization and exposure to the slave trade are important for understanding present day development (Gennaioli and Rainer, 2007, Michalopoulous and Papaioannou, 2013, 2014, Alsan, 2015, Nunn, 2008). Similarly, a large body of literature suggests that colonial institutions, and in particular colonial identity, have influenced African development (La Porta, López de Silanes, Shleifer and Vishny, 1998, Acemoglu, Johnson and Robinson, 2001).

Colonial rule was a bundle of goods comprised of investments and extraction. Investments in education, health, and infrastructure, either by the colonial state or missionaries, have been shown to have persistent, often positive, effects on development outcomes. However, colonial institutions also comprised elements of extraction (Heldring and Robinson, 2012). For example, the use of labor coercion was nearly universal (van Waijenburg, 2015). A common strategy was to use indirect rule – the co-option of local institutions – to achieve a colonial goal (Mamdani, 1996, Acemoglu, Reed and Robinson, 2014). While the effects of investments made by colonial governments have been studied (Huillery, 2009, Cage and Rueda, 2016, 2017, Osafo-Kwaako, 2012, Wantchekon, Klasnja and Novta, 2015, Lowes and Montero, 2017, Glaeser, La Porta, Lopez-De-Silanes and Shleifer, 2004), there is much less evidence on the effects of colonial extraction in Africa.

We examine one of the most extreme cases of colonial extraction, the Congo Free State (CFS). The CFS, what is today the Democratic Republic of Congo (DRC), was the personal colony of King Leopold II of Belgium between 1885 and 1908. Leopold designated large parts of the CFS as concessions to private companies. The companies used extremely violent tactics to force villagers to collect rubber. Historians have noted that the rubber concessions granted under Leopold II had disastrous consequences for local populations. As Hochschild describes, "the world has managed to forget one of the great mass killings of recent history...it was unmistakably clear that the Congo of a century ago had indeed seen a death toll of Holocaust dimensions" (Hochschild, 1998, pp. 3-4). In fact, an estimated 10 million people, approximately half of the population of Congo, died between 1880 and 1920 (Vansina, 2010, Hochschild, 1998). Despite the magnitude of the event,

scholars have yet to empirically examine its implications for present-day development.

Exposure to the rubber concessions was characterized by the extraction of rubber, violence, and the use of local institutions, namely village chiefs, to enforce rubber quotas. The concession companies were given monopoly rights over natural resource extraction within the concession boundaries. European agents had monetary incentives tied to rubber production and were encouraged to use whatever means necessary to collect rubber. In fact, they were given state resources, primarily soldiers from the CFS armed forces (the *Force Publique*) and a state mandate to use coercive means, to reach their rubber extraction goals. The other critical component of exposure to the concession companies was the use of indirect rule. Historical accounts of the rubber concession period highlight how the rubber companies forced village chiefs to support the rubber regime. Those who did not support the rubber regime were killed and replaced by outsiders willing to enforce the rubber quotas (Harms, 1975).

The historical episode is particularly well-suited to examining the effects of exposure to colonial extraction because, unlike in other contexts where colonial governments or associated businesses also made investments for production (e.g. see Juif and Frankema (2017) for an example from southwestern DRC or Dell and Olken (2017) for an example from Indonesia), these companies did not make productive investments in these areas. Rubber is a unique commodity in that it requires little capital investment to be collected and does it not require training of the labor force. The primary input is labor, and the concession areas are connected to river networks so that there was no need to invest in road infrastructure. Thus, the key focus was extraction.

We use the well-defined boundaries of the two largest rubber concessions, ABIR and Anversoise, to examine the long-run effects of colonial extraction on economic development. The boundaries of ABIR and Anversoise were determined at a time when there was little knowledge of the geography of the interior of Congo. Thus, the CFS used the extent of river basins, which are defined as a river and its tributaries, and a 25 kilometer buffer around the river basins to define the boundaries of the concessions (Harms, 1975). Consistent with the idiosyncratic manner in which the historical boundaries were determined, we demonstrate that those areas designated as concessions are geographically similar to the areas just outside of the concessions.

We use Demographic and Health Survey (DHS) data from 2007 and 2014 to estimate the effects of historical extraction on present-day education, wealth, and health outcomes. Using a geographic regression discontinuity design, we find that individuals from the former concessions

areas have significantly worse education, wealth, and health outcomes than individuals from just outside the former concessions. We analyze the DHS data by age cohort and find that there is little evidence of convergence in years of education, wealth, or height-for-age over time. We also use archival data to digitize the locations of posts where European agents were located within the rubber concessions. We create proxies for intensity of exposure to the rubber concessions at the post level: the length of time a post was in existence and estimates of the quantity of rubber collected by villages around the posts. We find that greater intensity of exposure to rubber extraction is correlated with lower wealth today for villages near posts.

We address several possible concerns with examining the effects of the historical rubber concessions: the use of river basins (plus the 25 km buffer) to define boundaries, selective migration, and subsequent colonial or missionary investment. First, we test whether the results reflect some inherent characteristic of residing within major river basins, rather than the effects of the rubber regime, by estimating our main specification across all major river basins in the DRC. Our estimates for the two rubber concessions are larger and more negative than the estimated effects on years of education for all other major river basins in DRC, suggesting that our results are not a consequence of using river basins to delineate the borders, but rather that the concessions were present in these river basins. Second, we test whether the observed results are driven by selective migration. We conduct several analyses to test what the extent of selective migration would have to be to fully explain our results and whether we observe differences in effect sizes between places where it is easier to migrate across the border relative to places where it is harder to migrate across the border. Finally, we digitize historical data to test for differential subsequent Belgian colonial investment and missionary presence. We find no evidence that selective migration, Belgian investments, or missionary presence explain our observed results.

When examining the effects of colonial extraction, there is naturally an interest in understanding the channels through which these effects persist. Various theories have been proposed for the origins of economic prosperity, and thus as potential fundamental channels, including institutions, culture, and geography (e.g. Acemoglu and Robinson, 2012). We examine the effect of exposure to the rubber regime on local institutions and on culture. Institutions are defined as external "rules" that shape individuals' expected payoffs from different actions, and culture is

defined as the collection of beliefs and values of individuals.[1] We look at the effects of colonial extraction on both institutions and on culture because it is not clear that the effects should move in the same direction, i.e. undermine both local institutions and undermine culture.

To examine how exposure to colonial extraction has affected local institutions and culture, we collected survey and experimental data in Gemena, DRC, a town on the border of the former Anversoise concession. Gemena was created after the end of the concession era; therefore, those who live there are migrants themselves or decedents of migrants. Our analysis compares individuals in Gemena with ancestors from inside the former concessions to individuals with ancestors from outside the former concessions. Thus, everyone in the sample has a "village of origin" – the place where they and their family are from, even if they were not born there and do not currently reside there – along the concession boundary. By considering a population that currently lives in the same institutional environment, we are better able to isolate the impact of the rubber concession period on culture. To address concerns about using a sample of migrants, we present robustness to looking at only first generation migrants and only second generation and higher migrants, in addition to showing balance on reasons for migration.

Using our original survey data, we first examine how colonial extraction has affected local institutions. We test whether villages of origin within the former concessions have lower quality village institutions as measured by: (i) the selection mechanism for the chief (elections versus hereditary) and (ii) the extent to which the chief provides various public goods for the village. We find that village chiefs within the former concessions are 17 percentage points less likely to be elected to their position and are more likely to be hereditary. Given that we generally believe elected leaders (rather than hereditary leaders) are more accountable to their constituents, this suggests that leaders in villages in former concession areas are less accountable. Consistent with this, the village chiefs inside the former concessions are also less likely to provide critical public goods, such as road maintenance and conflict arbitration. Across these various measures, villages in the former rubber concessions have worse local institutions and lower provision of public goods.

We then examine how exposure to the rubber concessions has affected culture, which we define as the beliefs and values held by individuals. We measure several different cultural

[1] For evidence on the importance of institutions for development, see North (1990), Acemoglu et al. (2001), Acemoglu and Robinson (2012), Johnson and Koyama (2017). For evidence on the importance of culture for development, see Greif (1994a), Nunn and Wantchekon (2011).

traits, including trust, social cohesion, altruism, and support for sharing income, using both survey and experimental measures. First, we examine how trust was affected as result of the rubber period. This is particularly important because previous work has highlighted a positive correlation between trust and growth (Algan and Cahuc, 2010). If those areas exposed to colonial extraction are now less trusting, then this may explain their relative underdevelopment. Using survey questions on trust in a variety of other individuals or groups, we find that individuals from areas exposed to the rubber concessions are *more* trusting of others than those just outside the former concessions. We are unable to distinguish a differential effect for "in-group" versus "out-group" trust.

Because the historical narrative describes how communities responded to the concessions by increasing reliance on social ties and informal insurance, we then examine measures of social cohesion and support for sharing income. We provide evidence that individuals from the former concession areas report feeling closer to a variety of others and are more likely to agree with statements asking whether money earned by both luck and effort should be shared with others. Additionally, in an experimental task designed to test support for sharing income, individuals from concession areas are more likely to redistribute money from another player's earned endowment. Consistent with stronger beliefs in the importance of sharing, we find lower levels of income inequality (as measured by the standard deviation of and the inter-quartile range of the DHS wealth factor score) within DHS clusters inside the former concessions. These results of greater trust and cohesion and greater support for sharing income are surprising given that a large literature, primarily on Europe, shows that good institutions and "good" culture are positively correlated in the cross-section (see e.g. Guiso, Sapienza and Zingales, 2004, 2016, Tabellini, 2010, Valencia Caicedo, 2015, Gächter and Schulz, 2016). However, a growing literature on sub-Saharan Africa suggests that this need not be the case: bad institutions may actually be correlated with "good" culture (Acemoglu et al., 2014, Lowes, Nunn, Robinson and Weigel, 2017).

Finally, we examine the broader implications of the Leopold II concession system for the development of DRC as a whole, which is one of the least developed countries in the world.[2] Large parts of the CFS were granted as concessions during the CFS era. While the boundaries of the other concessions are less plausibly exogenous because they existed for longer periods of time under different political regimes, focused on the extraction of resources other than rubber,

[2] DRC is ranked 176 of 188 in the UN's 2016 Human Development Index.

and coincide with present day political boundaries, we can implement a similar RD design for all concession boundaries in the Congo. We find that being inside any former concession in DRC is correlated with worse development outcomes. For the 60% of the country that was part of a former concession, wealth would be 15% higher had these areas not been part of a concession. This is equivalent to increasing GDP per capita inside all former concessions areas from around $750 to $900. Understanding the effects of exposure to colonial extraction is relevant more generally because various forms of labor coercion and indirect rule were practiced in most African colonies.

We contribute to several literatures. Most broadly, we provide evidence on the effects of an historical event of significant magnitude that has yet to be examined quantitatively. This, in its own right, is of importance. After the slave trade, the Leopold II concession system is arguably one of the most important events in modern African history. Joseph Conrad, author of *Heart of Darkness*, describes this era as "the vilest scramble for loot that ever disfigured the history of human conscience and geographical exploration". We show that the rubber concessions granted by Leopold II have large and significant negative effects on economic development. This finding is related to a literature on the economic effects of mass exterminations, such as the Holocaust, the Rwandan genocide, and the expulsion of the Moriscos (Acemoglu, Hassan and Robinson, 2011, Rogall and Yanagizawa-Drott, 2014, Chaney and Hornbeck, 2016).

We contribute to the literature on comparative African development by demonstrating the negative effect of exposure to colonial extraction. An important set of studies using cross-country evidence found a large negative effect of colonialism on modern outcomes (La Porta et al., 1998, Acemoglu et al., 2001). However, other work suggests that the investments made by colonial regimes in public goods such as education and health continue to have important positive benefits (Huillery, 2009, Cage and Rueda, 2016, 2017, Wantchekon et al., 2015). In this paper, we are able to isolate the long-run effects of colonial extraction, rather than other possible confounding factors, by comparing areas that are geographically and culturally similar, had no differential colonial or missionary investment, and are presently under the same national institutions, but that had differential exposure to colonial extraction. Cross-country evidence is ill-suited to studying this particular question, while the sub-national variation in our setting lends itself to isolating the role of colonial extraction relative to other factors.

Relatedly, we also contribute to the literature on how indirect rule undermines accountability

of local leaders (Mamdani, 1996). For example, Acemoglu et al. (2014) show that indirect rule has led to worse development outcomes but higher levels of social capital in Sierra Leone. We are able to leverage the exposure to the rubber regime, and the resulting variation in exposure to indirect rule, to provide evidence that indirect rule has been particularly detrimental to the quality and accountability of local leaders.

We also provide evidence on the relationship between institutions, culture, and development. We do this in two ways. First, we highlight how exposure to colonial extraction may have had unexpected effects on culture. Previous work has found that exposure to the slave trade may have undermined trust (e.g. Nunn and Wantchekon, 2011). However, a literature from political science, psychology, and evolutionary anthropology suggests that negative shocks, particularly from external threats, may actually increase social cohesion (Henrich, 2004, 2016, Boyd and Richerson, 1985, Bauer, Cassar, Chytilová and Henrich, 2014).[3] We demonstrate a persistent positive effect on culture as a result of the rubber period. While our results are different from Nunn and Wantchekon (2011), this highlights how the relative position of the perpetrator, e.g. a neighbor or family member versus a representative of the colonial regime, matters for subsequent trust outcomes.

We also demonstrate that, contrary to cross-sectional evidence primarily from Europe (Guiso et al., 2004, 2016, Tabellini, 2010, Gächter and Schulz, 2016), "good" institutions are not necessarily positively correlated with "good" culture. In fact, we find that worse local institutions are correlated with more pro-social values and beliefs in this context. This speaks to a growing theoretical literature that adopts an evolutionary perspective on the development of institutions and culture and under what conditions they may act as substitutes or complements (Greif, 1994b, 2006, Alesina and Giuliano, 2015, Besley and Persson, 2016, Greif and Tabellini, 2017, Bisin and Verdier, 2017). The long-run effect of exposure to extractive institutions, or other such critical junctures, likely depends on these cultural and institutional dynamics. While we cannot speak directly to the interaction between institutions and culture – as we can only identify the effects of colonial extraction on our outcomes – the results suggest that institutions and culture need not

[3] For example, Bauer, Blattman, Chytilová, Henrich, Miguel and Mitts (2016) provide an analysis of nearly 16 studies that examine the relationship between violence and social norms. The evidence they review suggests that violence can increase norms of local cooperation but, this increase does not necessarily improve subsequent development. This is consistent with an evolutionary perspective that emphasize the importance of local cooperation in the face of an external threat.

move in the same direction.[4]

Finally, we contribute to the literature on the long-run effects of labor coercion, a common element of colonial extraction in Africa and a common feature of labor relations for much of human history. Our paper is related to Dell (2010), who examines the long-run impacts of the mining *mita* in Peru, Nunn (2008), who documents the long-run effects of the slave trade, Dippel, Greif and Trefler (2017), who provide evidence on how labor coercion was effective in the British West Indies, and Acemoglu and Wolitzky (2011), who model how labor coercion affects effort in a principal-agent framework. Interestingly, we find negative estimates of a similar magnitude to Dell (2010). However, the colonial experience of Africa was vastly different from that of Latin America, and the "treatments" differ greatly across contexts – in particular with regard to the use of indirect rule. Additionally, by collecting survey and experimental data in the field, our paper is able to provide evidence on both institutional and cultural changes internal to those areas exposed to colonial extraction.

The paper is organized as follows. Section 2 provides historical background on the Congo Free State and the rubber concessions. Section 3 describes the data and the empirical strategy and presents the main empirical results from the DHS data. Section 4 describes the data collection along a former concession boundary and presents results on the effects of the rubber concessions on local institutional quality and culture. Section 5 evaluates the broader implications of the concessions granted under Leopold for the whole of DRC. Finally, Section 6 concludes.

2. The History of the Rubber Concessions

By the mid-1870s, European powers had made claims to most parts of Africa. However, the center of Africa remained largely unexplored. In a bid to make Belgium a colonial power, King Leopold II of Belgium convinced other European colonial powers of his philanthropic goals in Congo, including his mission to end the slave trade. The British, French, and German governments acquiesced to Leopold's interest in Congo to avoid conflict with each other over their own colonial aspirations. Thus, the CFS was created in 1885 as the personal colony of Leopold. According to

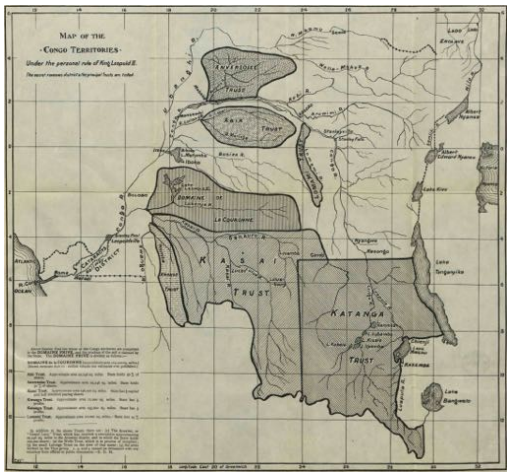
[4] Theoretically, the work by Bisin and Verdier (2017) is most closely related to how we approach understanding the legacy of the rubber concession system. The authors model the joint evolution of culture and institutions and highlight under what conditions cultural and institutional dynamics act as complements or substitutes. The authors write that in a society where culture and institutions are substitutes, good civic culture, for example, dampens the incentive to build better institutions.

the Berlin conference in which the borders of the CFS were outlined, Congo was to remain a free trade zone for individuals of all nationalities.

2.1. Concessions in the Congo Free State

Leopold needed to demonstrate continued state presence in the Congo in order to retain his rights over it. This proved a costly endeavor. By 1890, Leopold had invested 19 million francs in the Congo, nearly the entirety of his father's fortune (Van Reybrouck, 2014, p. 70). In 1891 and 1892, in an attempt to increase revenues and contrary to the spirit of the Berlin agreement, he declared all lands and any raw materials found on these lands to be the property of the CFS. This decree divided Congo into three areas. The first area was the *domaine privé*, which was property of the state. Areas of the *domaine privé* were divided into concessions given to private companies. The two largest concessions granted in the *domaine privé* were Anglo-Belgian India Rubber Company (ABIR) and Anversoise (Waltz, 1918, pp. 34-36). An additional part of the *domaine privé* was allocated as private land for the king himself, called the *domaine de la couronne*. A second area, called the "closed area," was to be settled as circumstances allowed. Most of this area was eventually allocated to the Katanga Company in the southwest. The rest of the country was primarily a "free trade zone" where individuals of any nationality could engage in trade. The Kasai region in the South and Southeast remained open to free trade until 1902, when the Kasai trust was established. See Figure 1 for a map of the concessions as of 1904.

Figure 1: 1904 Map of Concessions Granted By Leopold II



Note: The two most northern concessions are Anversoise and ABIR.

The administration of the various areas of the CFS varied depending on whether they were part of a concession, the concession's timing and duration, and the natural resources present in the area. The ABIR and Anveroise concessions were the largest focusing on the collection of rubber and existed for 14 years, from 1892 to 1906. The Kasai area was partially under the free trade regime, then part of a concession company from 1902 to the mid-1950s. The Katanga area was part of a concession, though the extraction focused primarily on copper, rather than rubber. The ABIR and Anversoise concessions differed from these other concessions in that their borders were defined by the extent of river basins, their borders do not coincide with present day political boundaries, they existed for a short period of time, and the concessions focused almost exclusively on the collection of rubber. While most of the paper focuses on the ABIR and Anversoise concessions, we return to an examination of all of the concessions granted during the CFS in Section 5.

2.2. *Creation of ABIR and Anversoise*

ABIR and Anversoise were created in the Upper Congo Basin shortly after the invention of the pneumatic tire in 1890, which lead to a dramatic increase in the demand for natural rubber. The Upper Congo Basin had immense natural rubber resources, and Leopold finally saw an opportunity for profits. The state had limited manpower and capacity, so Leopold established concessions to be given to private companies for the exploitation of rubber.

Because most of the interior of DRC was uncharted at the time, the concession boundaries were defined using salient geographic characteristics such as major rivers and their basins (Harms, 1975). The contracts establishing the agreements between the CFS and ABIR and Anversoise confirm that salient geographic characteristics determined the concession boundaries. ABIR was established in 1892 and given rights over the Maringa-Lopori basin. This concession area was defined by two rivers and their tributaries: the Maringa river and the Lopori river, plus a 25 km buffer area around them.[5] In the same year Anversoise was created and given extraction rights in

[5] The initial contract between the Secretary of the Interior of the CFS, Mr. Eetvelde, and Mr. J.T. North and Alexis Mols, representatives of the Société Anonyme Anglo-Belgian-India-Rubber and Exploration Company defines the boundaries of ABIR as follows: "The State of Congo concedes to the undersigned on the other part under the conditions stated in this contract and for a period of 30 years starting today, the right to exploit rubber, gum copal and other products of the forest situated on state lands in the basin of the Lopori and the Maringa, from and including Basakusu and to include the forest situated in an area of 10 kilometers around this post. The state will provide all facilities for such exploitation that will be with the assistance of the District Commissioner and at the sole risk and peril of the concessionary" (Waltz, 1918, p. 372). Article 4 of the document specifies rights to an area of 25 km around each post.

the Mongala river basin, defined by the Mongala river and its tributaries.[6] Figure 2 presents the boundaries of the ABIR and Anversoise concessions.

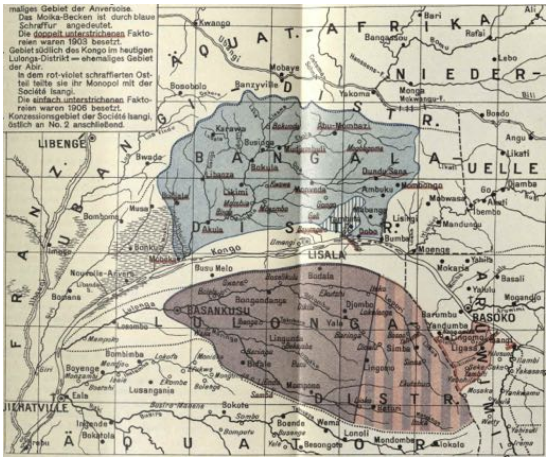
To see that the boundaries of the concessions do in fact conform to the definitions as stated in the founding contracts, Figure 3 illustrates the concession boundaries and the associated river basins. The concession borders appear to align almost exactly with the extent of the river basins. Additionally, Figure 3 shows the locations of the posts established by the concession companies. The posts all fall within the boundaries of the concessions. In Appendix B, we digitize all rivers in the area from a 1906 map to demonstrate that there are many rivers outside of the concession boundaries that are not part of the relevant river basins. In return for the land granted to the concession companies, the state would collect 2% of the companies' profits. Leopold himself was a majority stake holder in ABIR and Anversoise (Harms, 1975). Areas just outside of the concessions continued to be free trade zones, in which individuals of all nationalities could trade with locals, but these individuals did not have the same rights and resources granted to the concession companies.

2.3. Rubber Collection

The concession companies forced individuals within their concessions to collect rubber as a form of paying taxes. Rubber was a unique commodity because collection of rubber required little capital investment, in contrast to the collection of other natural resources such as diamonds or minerals, nor did it require the training of the labor force. The intensity of rubber extraction in concession areas was thus linked to the supply and productivity of labor. Once the rubber concessions were allocated, the companies set up posts within the concessions to collect rubber. One or two European agents would be assigned to each post within a concession. They would survey surrounding villages and make a census of the number of adult men in the village. Concession companies set quotas for the collection of rubber based on these population censes (which, unfortunately, we have been unable to locate and were reportedly destroyed). Male villagers were required to deliver a quota of about 4 kilos of dried rubber every 2 weeks. In

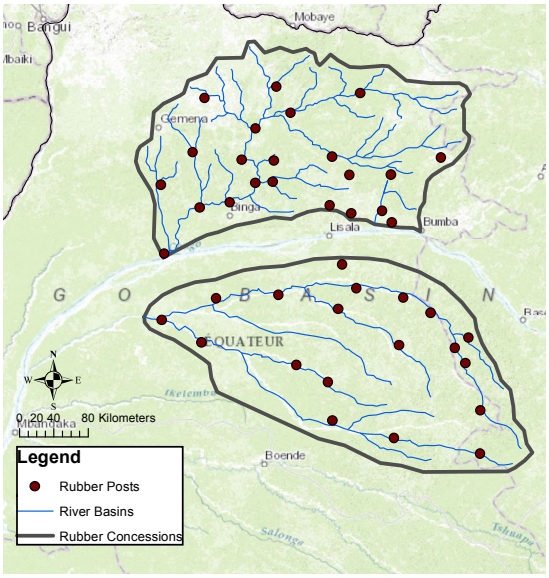
[6] This concession was defined as the area north of part of the Congo River up to the former international border between the CFS and French Equatorial Africa. The initial contract between the Secretary of the Interior of CFS, Mr. Eetvelde, and Mr. Alexander de Browne de Tiège, representative of Anversoise defines the boundaries of the Anversoise concession as follows: "The Congo State accords to the undersigned on the other part, under the conditions indicated in the present contract and for a term of 50 years starting today...the concession of the forests in the state land situated in the basin of the Mongala, with the exclusive right to exploit the rubber, gum copal, and all the other products of the forest" (Waltz, 1918, p. 352).

Figure 2: ABIR and Anversoise Rubber Concessions



Notes: The Anversoise rubber concession is the northern concession and the ABIR concession is the southern concession Waltz (1918).

Figure 3: Concessions, Posts, and River Basins



Notes: The Mongala river basin is the northern basin and the Maringa-Lopori river basin is the southern basin.

addition, villages were required to provide food and supplies to maintain nearby posts (Harms, 1983, 1975).

Most rubber collected during the CFS era was from the vine *landolphia*, which is delicate and easily damaged, rather than from the more hearty rubber trees, *funtumia elastica*, which were more prevalent in the French Congo and West Africa (Harms, 1975). Rubber collection was both time intensive and physically demanding. Individuals would travel deep into the jungle, find a rubber vine, make incisions in the vine to let the sap trickle out, and then allow the sap to dry. This process could take days, particularly as rubber supplies dwindled and untapped rubber vines became more difficult to find. Over time it became increasingly difficult for people to meet the rubber quotas. For example, men in the Baringa area would spend around 10 days of every 14 in the forest collecting rubber (Harms, 1983). By the time individuals had met the rubber quota for the current two weeks, it would be time to collect for the following two weeks.

2.4. Violence

The concession companies maintained militias comprised of sentries who were responsible for ensuring compliance with the rubber quotas. Generally, the sentries were outsiders recruited

from other areas of Congo; this strategy was purposefully selected to ensure that sentries were willing to use violence against villagers. Approximately 25 to 80 "post sentries" armed with rifles were assigned to each new post established. An additional 65 to 100 "village sentries," armed with muzzle-loading cap guns, were stationed in the villages surrounding the posts. In 1903, one ABIR post received 17,600 cartridges for the Albini rifles used by the post sentries (Harms, 1983). To prevent waste, soldiers were required to provide a human hand for every bullet used. The human hands were then smoked for preservation and collected by the European agents.

Individuals were severely punished if they failed to meet their rubber quota. The sentries from the concession companies' private militias were primarily responsible for carrying out these violent tactics. However, the European agents also engaged in the imprisonment, torture, and killing of villagers. Punishment could take many forms. For example, individuals could be imprisoned and forced to work. Their family members could be held for ransom until the quota was fulfilled. Individuals could also be subjected to various forms of physical violence, including whipping by the *chicotte* (a whip made of hippopotamus hide), burning with gum copal, or death. The chief of the village could also be imprisoned if his village did not meet the quota. In July 1902, records indicate that 44 chiefs were imprisoned in the villages around a single post (Harms, 1983).

Testimony collected by Robert Casement, a British consul sent to Congo to investigate accusations of atrocities, documents the intensity of the violence. First hand African accounts illustrate the extent of the violence:

> *"When I was still a child, the sentries shot at the people in my village because of the rubber. My father was murdered: they tied him to a tree and shot and killed him, and when the sentries untied him they gave him to their boys, who ate him. My mother and I were taken prisoner. The sentries cut off my mother's hands while she was still alive. Two days later, they cut off her head."* (Janssens, 1904)

If the sentries faced any resistance, they were able to call on soldiers from the *Force Publique* to provide support. In fact, the director of ABIR and the commander of the State police were stationed together in Basankusu, one of the first posts established by ABIR.

2.5. Political Capture and Indirect Rule

A tactic employed by sentries to ensure rubber production was to undermine and co-opt local authority. One of the sentries in each village was assigned the position of *kapita*, or head sentry

for that village. In fact, *kapita* is a Lingala word used today to denote "village chief". Once in the village, the *kapita* would recruit eight to ten people to serve as bodyguards. He then began the process of asserting his authority over the villagers. To do so, he would attack men in positions of esteem or authority. For example, lineage headman were required to carry soil and rubbish alongside slaves. Anyone who challenged the *kapita* could be flogged or killed. Non-compliant chiefs were replaced, killed, or held captive. The sentry used his power to acquire food, women, and luxury items. Some sentries would leave their one year term in a village with five to six wives (Harms, 1974).

The *kapitas* severely undermined the prestige, authority, and wealth of lineage headmen and village chiefs. The village headmen were "shamelessly degraded in the eyes of their people, made to fetch and carry for soldiers, cast into chains and flung into prison" (Morel, 1904). Though they were still considered to have important connections to ancestors, the headmen no longer had the authority to make important decisions. They were unable to protect their lineage from the brutality and terror imposed by the sentries. Additionally, since most able-bodied men were required to collect rubber in the forest, there was a power vacuum in the village that was filled by the *kapita*. In fact, some sentries began to take on the responsibilities previously allocated to lineage headmen, such as settling disputes among lineage members. Finally, the sentries would take the wealth from lineage headmen, including marrying their daughters and wives (Harms, 1974).

2.6. Social Responses

During the rubber concession period, local villagers faced immense challenges and social stress. Aside from the violence, the rubber regime had other disastrous effects, such as the spread of disease and famine. As villages lacked the manpower to maintain and cultivate fields, agricultural production decreased. Historians have highlighted how the rubber period "demanded social adaptation and new forms of cooperation and mutual aid" (Nelson, 1994, p.102). Villagers had to develop alternative coping mechanisms as they faced a brutal rubber regime and local leaders who were unable to protect them.

According to oral histories of the Mongo people, who resided in the ABIR concession (see Figure A2b in Appendix B), the rubber period was associated with an increased reliance on horizontal ties and cooperation among villagers of the same age grade. These horizontal ties

served several purposes. First, these "pacts of friendship and mutual aid between age-mates facilitated the social mobility required in the search for rubber" (Nelson, 1994, p.110), as people were often forced to collect rubber in groups far away from their village. These forms of cooperation would guarantee access to shelter and protection when young men were out searching for rubber. Second, the increased reliance on forms of mutual insurance were critical as they allowed individuals to "by-pass the corrupt or ineffective rule of their elders," who had been targeted by the rubber agents and the *kapitas* (Nelson, 1994, p.111). Elders could no longer be relied upon to protect the community or fulfill important leadership functions. In essence, as formal institutions were no longer reliable, mutual insurance systems strengthened in response. Finally, the increased reliance on mutual insurance sought to provide stability at a time of great uncertainty. Individuals were expected to help each other meet the demands of day-to-day subsistence, such as clearing and harvesting fields and constructing houses, and age-mates would share food, shelter, and land. The oral histories of the Mongo people highlight how social institutions adapted to the demands of the rubber regime.

2.7. Aftermath

Though the CFS government objected in principle to the violence, in practice it allowed and encouraged it. The effectiveness of the labor coercion allowed the concession companies to make exorbitant profits. The price of rubber went from 6.20 francs per kilo in 1894 to over 10 francs per kilo in 1898. The cost incurred by the concession companies to "purchase" a kilo of rubber in CFS and ship it to Antwerp was approximately 1.35 francs (Harms, 1983). The magnitude of profits earned by the concession companies led one contemporary observer to note "ABIR has in a single fiscal year made a net profit that represents more than twelve times the initial capital investment. Such a result is perhaps without precedent in the annals of our industrial companies" (Plas and Pourbaix, 1899).

By 1905, the natural rubber supplies were nearly exhausted in the Upper Congo Basin. Due to depleted rubber supplies and increasing condemnation of their labor practices in Europe, ABIR and Anversoise left CFS in 1906. In 1908, the CFS became a Belgian colony and after 1910, competitive production of rubber from *hevea* plantations in Southeast Asia and South America, along with the invention of synthetic rubber, led to a large decrease in rubber prices (Harms, 1975).

The regime of rubber extraction had disastrous effects on the local population. Villages subjected to labor coercion were unable to tend to their fields, leading to low yields and famine. Sentries raided local livestock. Malnourished individuals became particularly susceptible to disease, including the increasingly rampant sleeping sickness (Harms, 1983). The brutality of the rubber collection tactics resulted in the deaths of an estimated 10 million people and earned the policies the nickname "*Red Rubber*" (Vangroenweghe, 1985).

3. The Effects of the Rubber Concessions on Development

3.1. Data

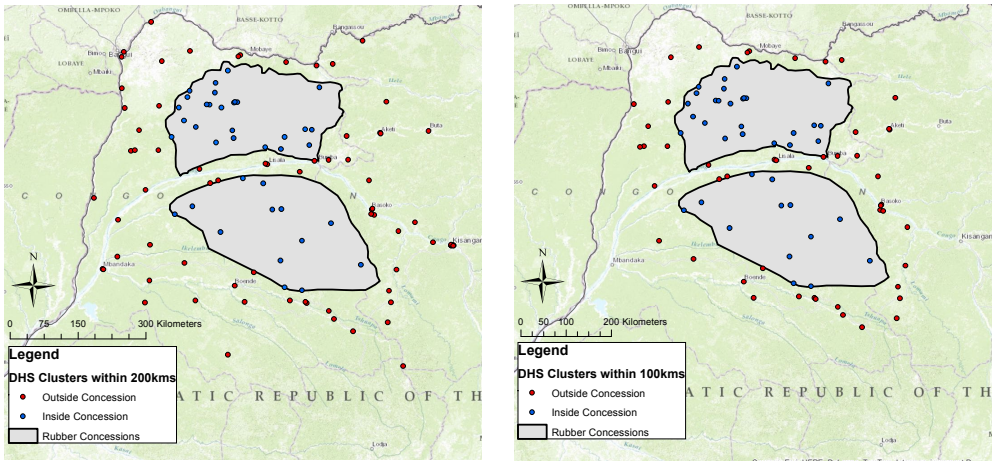
To examine the long run impact of the rubber concessions we first combine Demographic and Health Survey (DHS) data from 2007 and 2014 with detailed maps of the boundaries of ABIR and Anversoise. The DHS surveys from the DRC provide detailed information on education, assets, and health outcomes for individuals in many villages. These data sources and the variables used in our analysis are described in detail in Appendix A. We also attempted to use nightlight data as a measure of development. However, as shown in Figure A3b in Appendix B, the area of interest in DRC has little nightlight.

The maps of the rubber concessions are from Waltz (1918). This resource describes all of the concessions given by King Leopold II. This includes details on the physical boundaries of the concessions and the year when each concession was granted. Figure 2 is a map of the concessions of interest: ABIR and Anversoise. These were the largest concessions in the Upper Congo Basin, and the largest concessions that focused exclusively on rubber (Vangroenweghe, 1985). Figure 4 provides a map with the rubber concession borders and the DHS clusters from 2007 and 2014 that are within 200 kms and 100 kms of the borders of the rubber concessions.

3.2. Summary Statistics

Table 1 presents simple differences in means inside and outside the concession areas for variables from the DHS. We restrict our analysis for these differences in means to observations that are within 200 kms of the rubber concession borders in order to compare relatively similar areas. Simply comparing differences in means, it appears that the concession areas are less educated, less wealthy, and have worse health outcomes than the areas just outside the concession borders.

Figure 4: Maps of Clusters from the DHS 2007 and 2014 for DRC - Within 200 km and 100 km



(a) Within 200km (b) Within 100km

We have also examined these differences in means between areas inside the former concessions and areas outside the concessions for bandwidths of 100 kms and 50 kms and for all DHS clusters in the DRC. The summary statistics are generally consistent with Table 1.

3.3. *Empirical Strategy*

A concern with the simple differences in means presented in Table 1 is that the rubber concession areas might be different along a number of dimensions. Specifically, the rubber concessions might have been chosen strategically for certain characteristics that could also affect development today. For example, these areas might be more suitable for certain crops or have been populated by ethnic groups with different cultures. However, whether an area was exposed to rubber extraction is a deterministic and discontinuous function of whether or not a village fell inside the concession boundaries. As described in Section 2, these concession were granted at a time when much of the Congo had not been explored. The concession boundaries were defined by salient geographic characteristics - in this case, rivers and river basins. Thus, the concession boundaries are unlikely to have been selected based on local characteristics that also vary discontinuously at the concession border.

We can estimate the causal effect of exposure to the rubber concessions on the outcomes of interest by estimating the following regression discontinuity (RD) specification:

$$y_{i,v} = \alpha + \gamma RubberConcession_{i,v} + f(location_v) + \mathbf{X}_i\beta + \phi_{j(v)} + \varepsilon_{i,v} \quad (1)$$

Table 1: Summary Statistics

	Individuals Within 200 kms of Concession Borders			
	Mean Inside	Mean Outside	Clustered S.E.	(p-value)
Educational Attainment	1.013	1.409	(0.069)	0.0003
Obs	1,843	3,894	–	–
Years of Education	4.228	6.289	(0.368)	0.0006
Obs.	1,837	3,891	–	–
Literacy	0.884	1.283	(0.071)	0.0002
Obs.	1,836	3,870	–	–
Wealth Index	1.824	2.505	(0.156)	0.0009
Obs.	1,843	3,894	–	–
Wealth Score	-54,511	-18,419	(9,494)	0.0008
Obs.	1,843	3,894	–	–
Women Ht/Age Percentile	2,469	2,994	(204.8)	0.012
Obs.	545	1080	–	–
Child Ever Vaccinated	107.0	264.2	0.037	0.033
Obs.	599	1070	–	–
Child Ht/Age Percentile	2,314	2,633	182.1	0.082
Obs.	557	1055	–	–

Notes: The data are from the DHS 2007 and 2014 DRC surveys. Standard errors are clustered at the DHS cluster level. There are 109 clusters within 200 kms of the historical rubber borders. Educational Attainment is a 0 to 3 categorical variable where 0 is no education and 3 is higher education. Literacy is a 0 to 2 categorical variable where 0 is cannot read at all and 2 is able to read a whole sentence. Wealth Factor is an index generated by the DHS using principle component of asset ownership. Wealth Index is a 1 to 5 categorical variable where 1 is poorest quintile and 5 is richest quintile from the Wealth Factor Score. Ht/Age Percentile divides each respondent's height by their age and finds their percentile in the sample and normalizes this percentile to be within 0 and 10000. The DHS only records respondent's height and weight for a subsample of the female population. Child Ever Vaccinated is an indicator variable equal to one if the child has ever received a vaccination. Child Ht/Age Percentile divides each children's height by their age and finds their percentile in the sample and normalizes this percentile to be within 0 and 10000. See Data Appendix for more details.

where $y_{i,v}$ is our outcome of interest for individual i in village v; $RubberConcession_{i,v}$ is an indicator equal to 1 if v is inside a rubber concession area and equal to 0 otherwise; $\mathbf{X}_i$ is a vector of covariates for individual i such as gender, age, and age squared; $\phi_{j(v)}$ represent district fixed effects;[7] $f(location_v)$ is the RD polynomial, which controls for smooth functions of geographic location for village v. For our baseline results we use a linear polynomial in latitude and longitude as suggested in recent work by Gelman and Imbens (2016). We also present results using cubic polynomials in distance to the concession borders and cubic polynomial in latitude and longitude. We check robustness to using various other forms of the RD polynomial.

We limit our analysis to observations within 200 kms, 100 kms, and 50 kms of the concession boundaries as this restricts the range in which unobservable parameters can vary. We calculated the Imbens-Kalyanaraman optimal bandwidth for several of our outcomes of interest with dis-

[7] Specifically, for $\phi_{j(v)}$, $j(v)$ represents the function mapping each village v to district $j(v)$. In our area of interest, there are two provinces (Equateur and Orientale), eight districts, and 34 territories. In 2015, DRC underwent a decentralization process that created 26 provinces out of the original 11. All of our analysis uses the political units from before decentralization.

tance to the border as the running variable. The optimal bandwidth was generally between 75 and 125 kilometers depending on the outcome.

Our coefficient of interest is γ: the effect of being just inside the concession area on our outcome of interest. The intuition behind this specification is that concession borders arbitrarily allocated some villages to be part of the concessions and others to be just outside the concessions. These villages should have similar geography, culture, history, and institutions prior to the concession era, allowing us to identify the effect of rubber extraction on contemporary outcomes. This RD approach has been used in multiple settings to examine the effects of historical events, such as in Dell (2010), Miguel and Roland (2011), Grosfeld, Rodnyansky and Zhuravskaya (2013), Michalopoulous and Papaioannou (2014), Becker, Boeckh, Hainz and Woessmann (2015), Fontana, Nannicini and Tabellini (2016).

The RD approach presented in equation (1) requires two identifying assumptions. The first assumption is that all relevant factors before the concessions were granted varied smoothly at the concession boundaries. This assumption is needed to ensure that individuals located just outside the concessions are an appropriate counterfactual for those located just inside them. For example, it would be a problem for identification if Leopold selected the borders strategically, capturing only rubber-suitable areas or areas that had greater population density. However, the historical evidence presented in Section 2 suggests that Leopold did not have much information on the interior of Congo in 1892. This is consistent with the evidence presented by Michalopoulous and Papaioannou (2014, 2016), who point out that colonizers drew African borders in an arbitrary manner.

To assess the plausibility of this first assumption, Panel A of Table 2 estimates specification (1) for important geographic characteristics such as altitude, precipitation, and soil suitability and finds balance on these geographic characteristics. This analysis is at the 20km by 20km grid cell level. These results are presented both with standard errors clustered at the territory level and Conley standard errors with a cut-off window of 50 kms to account for spatial auto-correlation (Conley, 1999). The results are robust to the use of different cut-offs for the Conley standard errors. For the clustered standard errors, we cluster at the territory level, the lowest administrative level for which there is spatial data. For some bandwidths, the number of clusters is slightly below thirty, potentially leading to overly optimistic standard errors (Cameron, Gelbach and Miller, 2008). However, the clustered standard errors tend to be quite consistent with the Conley

standard errors. In addition to showing balance at the grid cell level, we also show balance on geographic characteristics at the DHS cluster level in Appendix H.2.

Ideally we would also present balance on pre-colonial demographic characteristics. However, we have not been able to find pre-colonial demographic data for the DRC. The Ethnographic Atlas has interesting variables, but we are hesitant to use this as a pre-colonial demographic measure since the data was collected during the colonial era. Additionally, it does not have many data points for our area of interest. Reassuringly, the concession borders do not align with Murdock ethnic group borders (see Appendix Figure A2b) nor do they align with present day political borders.

Panel B of Table 2 presents results from estimating specification (1) for river characteristics such as navigable river density and access to rivers. Rivers are a particularly important geographic features for the area because they are one of the main forms of transportation. Appendix Figure A1 visually presents the extent of river networks. We find balance on these important geographic characteristics, especially for smaller bandwidths, suggesting that the areas inside and outside the concession are comparable along the border.

The second important assumption for this regression discontinuity approach is that there was no selective sorting across the RD threshold when the concession borders were established. Selective sorting would require certain villages be able to select out of being allocated to a concession. This is unlikely to have happened given that villages were unable to negotiate the boundaries of the concessions.

An important related concern is selective migration either during the rubber era or subsequently, which would be considered an outcome of the rubber concessions. It is likely that some migration took place during the rubber era, as individuals tried to avoid the rubber demands and the associated violence. Unfortunately, there is no data available to quantify the magnitude of migration during the rubber era. We can only highlight the difficulties associated with migration. Anecdotal evidence from Harms (1975) suggests that the rubber companies greatly controlled migration (using the village censes they collected themselves) and forced people to remain in their villages. Harms (1975) notes that local chiefs were held accountable when individuals that migrated did not meet their quotas, incentivizing chiefs to prevent migration. Finally, since the concessions were defined by the extent of river basins, and rivers were used for transport, migration outside of the concessions would likely have been difficult.

Table 2: Balance on Geographic and River Characteristics

	Panel A: Geographic Characteristics								
	Elevation			*Precipitation*			*Soil Suitability*		
Sample Within:	200 kms	100 kms	50 kms	200 kms	100 kms	50 kms	200 kms	100 kms	50 kms
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inside Concession	-14.84*	-3.942	0.219	0.268	-1.266	-1.18	0.016	-0.001	-0.003
	(7.418)	(5.959)	(5.259)	(2.323)	(1.974)	(1.571)	(0.013)	(0.017)	(0.020)
	[5.415]	[5.333]	[5.214]	[1.230]	[1.100]	[1.041]	[0.012]	[0.013]	[0.015]
Observations	1,350	853	504	1,350	853	504	158	106	60
Clusters	34	29	25	34	29	25	34	29	25
Mean Dep. Var.	435	433	436	80	75	73	0.060	0.068	0.064
	Panel B: River Characteristics								
	Navigable River Density			*Access to Navigable Rivers*			*Access to Any River*		
Sample Within:	200 kms	100 kms	50 kms	200 kms	100 kms	50 kms	200 kms	100 kms	50 kms
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inside Concession	-1.647	-0.238	3.269	-0.005	-0.005	0.052	-0.112**	-0.087	-0.091
	(2.111)	(2.428)	(3.150)	(0.039)	(0.047)	(0.065)	(0.052)	(0.058)	(0.071)
	[2.362]	[2.403]	[2.802]	[0.040]	[0.044]	[0.053]	[0.045]	[0.049]	[0.057]
Observations	1,353	853	504	1,353	853	504	1,353	853	504
Clusters	34	29	25	34	29	25	34	29	25
Mean Dep. Var.	12.559	10.329	10.577	0.225	0.215	0.216	0.516	0.478	0.425

Notes: The estimated regressions use a linear polynomial in latitude and longitude as the RD polynomial. We include district fixed effects. Elevation and precipitation come from the Global Climate Database created by Hijmans, Cameron, Parra, Jones and Jarvis (2005). This data provides monthly average rainfall in millimeters and elevation measures in meters. *Precipitation* is a measure of the average yearly precipitation (in millimeters of rainfall per year) for each 20km by 20km grid cell. *Elevation* calculates the average elevation in meters for each 20km by 20km grid cell. *Soil Suitability* is from Ramankutty, Foley, Norman and McSweeney (2002) and Michalopoulos (2012). It is an index from 0-1, with higher values indicating higher soil suitability for agriculture. *Navigable River Density* is defined as total length in meters of navigable river in each grid divided by the grid's surface area in kilometers squared. *Access to Navigable Rivers* and *Access to Any River* is an indicator variable equal to one if a grid cell contains a navigable river or any river. Data on navigable rivers and rivers in the DRC is from the *Referentiel Geographique Commun* (2010). We present standard errors clustered at the territory level in ( ) and Conley standard errors in [ ] (assuming a cut-off window of 50 kms). * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

While we are unable to analyze migration during the rubber era, we are able to use present-day DHS data to examine what the extent of current selective migration would have to be to explain our results. In Appendix F, we examine the sensitivity of the results to selective migration and to heterogeneity by ease of migrating from inside the concession to outside the concession boundaries. Rates of selective migration would have to be quite high to fully explain our results and there is no evidence of differential effects based on ease of migration.

3.4. First Stage

While it is not required to show a first stage for an RD analysis, we can examine whether the probability of having a "commercial post" is higher within the concession boundaries. A commercial post corresponds to places where rubber is collected and traded. In Appendix H.1 we present digitized maps of commercial posts and show that the former concession areas are

much more likely to have had commercial posts. If there were no "first-stage" in the sense that the concession areas were not more likely to be exposed to the rubber extraction, then it is unlikely we would find effects of being inside a former concession. Additionally, if the RD were "fuzzy" such that the concession boundaries were not perfectly respected, this would bias our coefficients toward zero. Ideally, we would have detailed granular data of exposure to violence or rubber production. We have been unable to find such data, though in Section 3.8 we examine the correlation between post level rubber production for a six month period of 1904 for which we were able to find data and wealth today.

3.5. Regression Discontinuity Results

To examine the long-run effects of exposure to the rubber concessions, we analyze 2007 and 2014 DHS data on education, wealth, and health. All variables are defined in the table notes. We first focus on education and present results for observations within 200 kms, 100 kms, and 50 kms of the concession borders. Table 3 reports estimates for specification (1) for different education outcomes. We display results using a linear polynomial in latitude and longitude in Panel A, third-order polynomials in distance to the concession border in Panel B, and third-order polynomials in latitude and longitude in Panel C. Section 3.6 discusses additional RD polynomials and other robustness checks, including doing the analysis separately for each concession. The results in Table 3 are consistent with the summary statistics from Table 1: areas inside the concession have significantly lower levels of education across all specifications and bandwidths. Individuals just inside the former rubber concessions are estimated to have approximately 1.5 fewer years of education than individuals just outside the concessions.

The results for years of education can be seen graphically in Figures 5 and 6. Figure 5 presents a standard RD plot, with distance to the border as the running variable and a local linear trend to each side of the discontinuity. For both years of education and literacy there is a clear discontinuity at the concession border. Figure 6 presents a geographic scatterplot of the DHS clusters shaded with the average years of education in each cluster. The background shows predicted values for a finely spaced grid of longitude-latitude coordinates from a regression using a cubic polynomial in latitude and longitude and the $RubberConcession$ indicator variable. The plot can thus be used to assess how well the RD fit is approximating the data across space. The

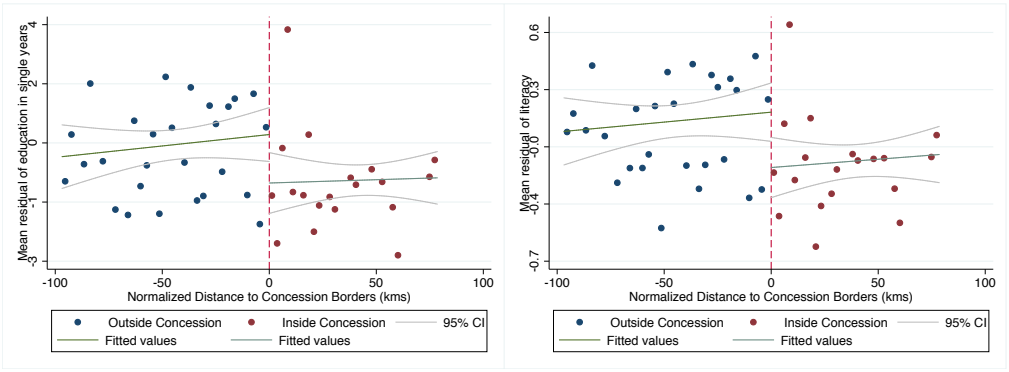
spatial plot suggests that the RD polynomial is capturing some of the heterogeneity in outcomes across space and that there is indeed a discontinuity at the concession borders.

Table 3: Rubber Concessions and Education RD Analysis

	Years of Education			*Literacy*		
Sample Within:	200 kms	100 kms	50 kms	200 kms	100 kms	50 kms
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Linear Polynomial in Latitude and Longitude					
Inside Concession	-1.100***	-1.385***	-1.648***	-0.226***	-0.284***	-0.345***
	(0.339)	(0.338)	(0.387)	(0.069)	(0.070)	(0.080)
	Panel B: Cubic Polynomial in Distance to Concession Border					
Inside Concession	-1.174***	-1.373***	-1.696***	-0.230***	-0.277***	-0.367***
	(0.338)	(0.336)	(0.375)	(0.070)	(0.070)	(0.076)
	Panel C: Cubic Polynomial in Latitude and Longitude					
Inside Concession	-1.540***	-1.594***	-1.532***	-0.299***	-0.333***	-0.365***
	(0.376)	(0.371)	(0.415)	(0.078)	(0.082)	(0.083)
Observations	5,670	4,274	2,623	5,648	4,266	2,619
Clusters	110	85	52	110	85	52
Mean Dep. Var.	5.628	5.109	5.209	1.170	1.065	1.077

Notes: Standard errors are clustered at the DHS cluster level. We include district fixed effects and control for age, age squared and gender. *Literacy* is a 0 to 2 categorical variable where 0 is cannot read at all and 2 is able to read a whole sentence. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Figure 5: Standard RD Plots for Education Outcomes



(a) Years of Education - 100 kms

(b) Literacy - 100 kms

Figure 6: Spatial RD Plot for Years of Education

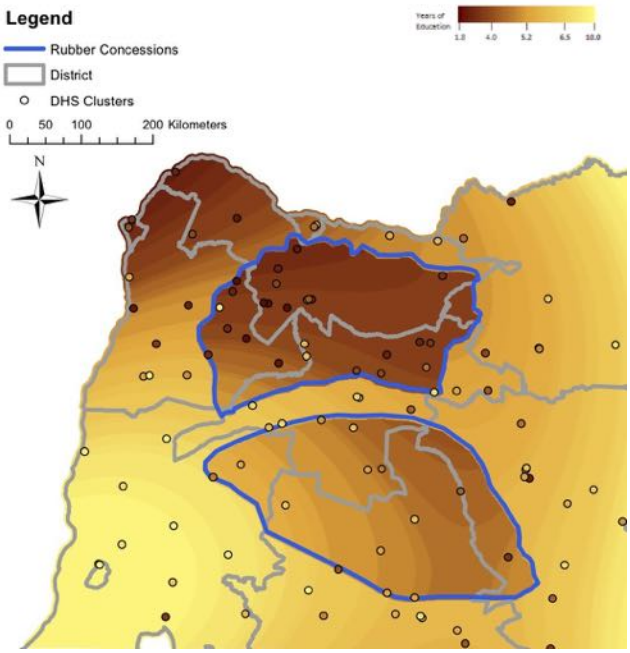


Table 4 reports estimates for specification (1) for the wealth measures available in the DHS survey. For the wealth and health outcomes, the standard and the spatial RD plots are presented in Appendix B. Individuals in villages inside the former rubber concessions are approximately 15% less wealthy than similar individuals outside the rubber concessions. In standard deviation terms, areas inside the former concessions are about 0.3 standard deviations less wealthy.

Finally, Table 5 reports estimates for specification (1) for different health outcomes and finds evidence that individuals from inside the former concessions have worse health outcomes. Children inside the former concessions have approximately 5 percentage points lower height-to-age percentile and have about 6.5 percentage points lower vaccination rates; similarly, women are approximately 7 percentage points lower in the height-to-age percentile. Overall, we find evidence that individuals residing in villages inside the former rubber concessions are less educated, less wealthy, and have worse health outcomes today than individuals in villages outside the former rubber concessions.

3.6. Robustness of DHS Results

There are three main empirical concerns for the DHS results presented in Tables 3-5: robustness to alternative RD specifications, random displacement of DHS clusters, and the use of basins to define borders. The first concern is whether the results are robust to alternative specifications of

Table 4: Rubber Concessions and Wealth RD Analysis

	Wealth Index			*Wealth Factor*		
Sample Within:	200 kms	100 kms	50 kms	200 kms	100 kms	50 kms
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Linear Polynomial in Latitude and Longitude					
Inside Concession	-0.503***	-0.582***	-0.682***	-11,235*	-17,540***	-22,610***
	(0.142)	(0.143)	(0.200)	(5,720)	(5,152)	(7,115)
	Panel B: Cubic Polynomial in Distance to Concession Border					
Inside Concession	-0.475***	-0.541***	-0.530**	-11,583**	-16,430***	-17,221**
	(0.146)	(0.153)	(0.203)	(5,643)	(5,396)	(7,147)
	Panel C: Cubic Polynomial in Latitude and Longitude					
Inside Concession	-0.697***	-0.771***	-0.582***	-18,574***	-22,374***	-17,182**
	(0.171)	(0.194)	(0.196)	(6,734)	(6,551)	(6,756)
Observations	5,679	4,281	2,627	5,679	4,281	2,627
Clusters	110	85	52	110	85	52
Mean Dep. Var.	2.287	2.034	2.101	-30014	-46330	-43799

Notes: Standard errors are clustered at the DHS cluster level. We include district fixed effects and control for age, age squared, and gender. *Wealth Factor* is an index generated by the DHS using principle component of asset ownership. *Wealth Index* is a 1 to 5 categorical variable where 1 is poorest quintile and 5 is richest quintile from the Wealth Factor Score. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

the RD-polynomial. We find that our wealth and education results are robust to parsimonious polynomials in latitude and longitude (linear, quadratic, cubic polynomials), but our results begin to lose significance with higher-order polynomials (fourth order polynomials and above). The results for these specifications are in Appendix C.1. Nevertheless, the coefficient magnitudes and signs all remain similar across most specifications, suggesting that we lose significance with higher-order polynomials due to over-fitting rather than to more precise estimation. The health results are less robust to higher-order RD polynomials compared to the education and wealth results; however, these questions are only asked to a subsample of the population (about a third of all women and children) so we lose power in the analysis.

We also test robustness to alternative euclidian distance specifications, where we modify $f(.)$ in equation (1) to be a function of distance to the former concession border, rather than a function of latitude and longitude. Once again, our results are robust to parsimonious polynomials in distance to the former borders (linear, quadratic, cubic, interacted-linear, interacted-quadratic) but begin to lose significance with higher-order polynomials in distance (interacted third-order, interacted-quartic). These results are presented in Appendix C.1. By "interacted" polynomial we

Table 5: Rubber Concessions and Health RD Analysis

	Child Ever Vaccinated			*Child Ht/Age Percentile*			*Respondent Ht/Age Percentile*		
Sample Within:	200 kms (1)	100 kms (2)	50 kms (3)	200 kms (4)	100 kms (5)	50 kms (6)	200 kms (7)	100 kms (8)	50 kms (9)
	Panel A: Linear Polynomial in Latitude and Longitude								
Inside Concession	-0.077**	-0.075**	-0.069	-338.4**	-401.5**	-551.4**	-682.9***	-790.7***	-868.1***
	(0.035)	(0.035)	(0.043)	(162.7)	(167.6)	(231.8)	(214.3)	(211.9)	(277.8)
	Panel B: Cubic Polynomial in Distance to Concession Border								
Inside Concession	-0.081**	-0.081**	-0.093**	-477.6***	-517.5***	-675.6***	-720.6***	-794.2***	-855.3***
	(0.035)	(0.036)	(0.044)	(181.5)	(176.1)	(185.6)	(209.1)	(216.6)	(268.7)
	Panel C: Cubic Polynomial in Latitude and Longitude								
Inside Concession	-0.051	-0.037	-0.072	-501.2***	-623.9***	-483.3**	-770.5***	-867.4***	-808.9***
	(0.042)	(0.051)	(0.052)	(189.4)	(188.5)	(187.2)	(231.9)	(250.6)	(301.2)
Observations	3,184	2,556	1,605	1,314	822	822	1,589	1,218	758
Clusters	110	85	52	110	85	52	110	85	52
Mean Dep. Var.	0.814	0.797	0.793	2523	2468	2472	2689	2602	2628

Notes: Standard errors clustered at the DHS cluster level. We include district fixed effects in all regressions. We control for age and age squared. We examine the DHS health questions asked to a subset of female respondents. Respondent *Ht/Age Percentile* divides each respondent's height by her age and finds her percentile in the entire sample and normalizes this percentile to be within 0 and 10000. Similarly, Child *Ht/Age Percentile* divides each child's height by his or her age and finds his or her percentile in the entire sample and normalizes this percentile to be within 0 and 10000. *Child Ever Vaccinated* is an indicator variable equal to one if the respondent's child has ever been vaccinated. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

mean that we interact the "Inside Concession" indicator with all terms in the polynomial. Again, the estimated coefficients from the distance to border specifications generally have the same sign and are of similar magnitudes as the latitude-longitude specifications from Tables 3-5. Overall, we find that our results are robust to alternative RD polynomials.

A second potential issue is that the DHS randomly displaces the coordinates of the clusters in order to maintain the confidentiality of the respondents. The GPS coordinates for the DHS clusters are displaced by up to 5 km for all urban clusters and 99% of rural clusters, and up to 10 km for 1% of rural clusters. Importantly, this displacement is random and simply induces classical measurement error. This would bias our coefficient towards zero. However, with the regression discontinuity approach, one might be concerned that the results are being driven by clusters right along the border that might be incorrectly assigned to inside or outside the concession because of the random displacement. Thus, we estimate our regression discontinuity results with a "donut-hole" of 5 kms in Appendix C.2 and find that the results are robust to excluding observations very close to the border. The results hold with alternative donut holes, for example, with a 10 km exclusion criterion. This provides evidence that the results are not being driven by these potentially mis-classified clusters.

In Appendix C we show our results are robust to the following additional robustness tests. We analyze the results looking at each concession individually to ensure that the results are not being driven by one particular concession. We analyze results dropping observations along the Congo river to address concerns that villages along the Congo river are different than those farther away from the river. We present the results at the DHS cluster level, rather than the individual level since assignment to treatment occurs at the village level (however, note that including individual level controls increases precision). We present results without district fixed effects and results with Conley standard errors to address spatial auto-correlation. Finally, in Appendix E we find no evidence of differential missionary presence or subsequent colonial investment, and in Appendix H, we examine whether road network density, population density, or conflict explain our observed results.

3.7. Falsification Exercise: Major River Basins in DRC

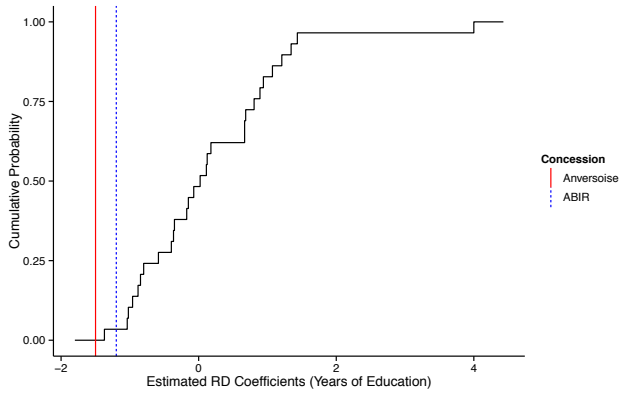
A possible concern with the results presented in Section 3.5 is that because the concession borders were drawn using major river basins as the salient geographic feature for the borders, the results reflect some inherent characteristic of river basins, rather than exposure to colonial extraction. To assess this claim, we conduct a falsification exercise where we run our main specification across all major river basins in DRC using the HydroBASINS data from Lehner and Grill (2013) to examine how our estimated effects for the former concessions correspond to the estimated effects for all other major river basins in DRC. See Appendix D for a detailed explanation of the HydroBASINS data, the algorithm used in the construction of the river basin layers, and the implementation of the falsification exercise.

Figure 7 presents the empirical cumulative distribution of the RD estimates for education for all major river basins in DRC, excluding the basins corresponding to the Anversoise and ABIR concession boundaries. We do this falsification exercise with years of education as the outcome variable because it is likely most comparable across DRC. On average, being inside a river basin is associated with more years of education. To highlight where the corresponding RD estimates for ABIR and Anversoise would fall relative to these estimated basin effects, we include in solid-red the RD estimate corresponding to the Anversoise concession border and in dashed-blue the RD estimate corresponding to the ABIR concession border. The Anversoise estimate falls on the far-left of the distribution and there is no river basin that has as negative an estimate, while the

ABIR estimate is also on the far-left of the distribution and is more negative than the effect of all but one other river basin. The ABIR estimate falls in the bottom 3.44% of this river basin RD estimate distribution while Anversoise falls in the 0.0% of this distribution.

Appendix D presents results using alternative RD specifications as well as the results using the river basin borders from HydroBASINS used to define the ABIR and Anversoise concessions rather than the actual concession borders. The results are very similar. This falsification exercise presents important evidence that the results presented in Section 3.5 are not a consequence of the concessions being drawn using river basins, but instead suggests that our estimates represent the impacts of exposure to colonial extraction during the rubber period.

Figure 7: Empirical Cumulative Distribution of RD Estimates for Major River Basins in DRC



Cumulative Distribution and Concession Estimates

Notes: The estimates use our baseline RD specification – linear latitude-longitude – within a bandwidth of 100 km from the river basin borders. The solid-red line presents the RD estimate corresponding to the Anversoise concession border and the dashed-blue line presents the RD estimate corresponding to the ABIR concession border. See Appendix D for details on the implementation of this falsification exercise.

3.8. Analysis Using Historical Post Level Data

As a complement to the RD analysis, we analyze post-level rubber production data from 1904 for ABIR. We combined data on rubber production from the Belgian Foreign Public Service Foreign Affairs archives with data from the De Ryck Collection, a collection of Congo colonial manuscripts at the University of Wisconsin library. We were able to compile data on rubber production for 19 posts within the ABIR concession between July and December 1904 (see Figure 3 for map of post locations) (de Ryck, 1885-1954). We use these measures of production as a proxy for intensity of exposure to extractive institutions. We match DHS clusters to rubber posts within 50 kilometers. Even though we are limited by the small number of DHS clusters near former

rubber posts, we find that individuals within DHS clusters close to posts that produced more rubber during these 6 months of 1904 are less wealthy today, as seen in Figure 8. Note that once controls are added in Figure 8, there is more variation within a bin, which is why there appear to be more observations in the binscatters. To the extent that rubber production captures the intensive margin of exposure to colonial extraction, these results suggest that greater exposure indeed leads to worse development outcomes. While the results are not statistically significant when we include individual and geographic controls as demonstrated in Column (2) of Table 6, the magnitude of the effect remains remarkably consistent with this inclusion, suggesting that the results lose statistical significance due to the small sample size.

Table 6: Post Level Rubber Production in 1904, Year of Post Establishment, and Wealth

	Wealth Index		*Wealth Index*	
	(1)	(2)	(3)	(4)
Rubber Production in 1904	-0.0252***	-0.0220	–	–
	(0.008)	(0.016)	–	–
Year Post was Established	–	–	0.0383*	0.0382**
	–	–	(0.021)	(0.018)
Observations	704	704	704	704
Clusters	16	16	16	16
Controls	N	Y	N	Y
Mean Ind. Var.	7.969	7.969	1898	1898

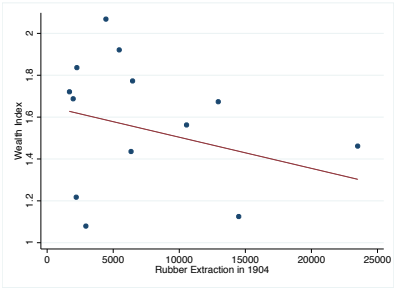
Notes: *Rubber Production in 1904* measures production in tons for the last six months of 1904 for ABIR posts. We match DHS clusters to the closest ABIR post and limit the sample to clusters within 50 kms of the former ABIR posts. We cluster standard errors at the DHS cluster level. In columns (2) and (4) we include district fixed effects and control for age, age squared, gender, survey year as well as latitude and longitude. *Wealth Index* is a 1 to 5 categorical variable where 1 is poorest quintile and 5 is richest quintile from the Wealth Factor Score. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

As an alternative measure of intensity of exposure, we use year of post establishment. Posts within ABIR were established between 1892 and 1903. We find that individuals close to posts that were operating for more years are also worse off. These results are presented in Table 6 and in Figure 8, and they suggest that some of the heterogeneity in development outcomes near the former concessions can be explained by the intensity of extraction during the Congo Free State period.

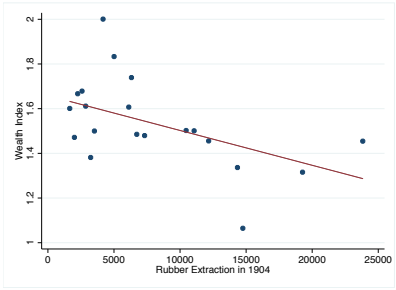
3.9. On a Convergence Path?

It is important to understand whether areas inside the former rubber concessions are actually on a path to convergence with areas outside the former concessions but have simply not caught

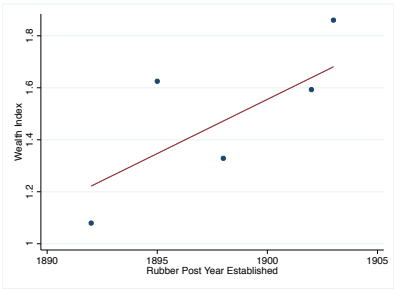
Figure 8: Analysis Using Historical Post Level Data



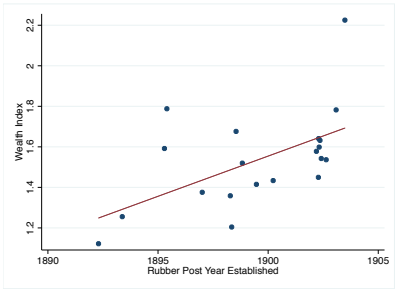
(a) Wealth and rubber production in 1904



(b) Wealth and rubber production in 1904 (controls)



(c) Wealth and year of post establishment



(d) Wealth and year of post establishment (controls)

Notes: We use data on the amount of rubber produced in 19 posts within the ABIR concession between July and December 1904 and match posts to DHS clusters within 50 km of the former posts. Figures (b) and (d) include controls for age, age squared, gender, survey year, latitude and longitude. Rubber Production in 1904 is measured in tons.

up yet. We test for convergence in our setting by examining whether younger cohorts inside the former concessions are "catching up" to similar cohorts outside the former concessions in terms of the development outcomes examined in Tables 3-5. Effectively, we are examining how the effect of being inside a concession varies over time.

To do this, we compare cohorts inside and outside the concessions born within five years of each other by estimating a regression that includes fixed effects for each 5-year cohort along with the interactions between the $InsideConcession$ indicator and cohort fixed effects. Formally, we estimate the following specification for DHS clusters within 200 kms of the concession borders:

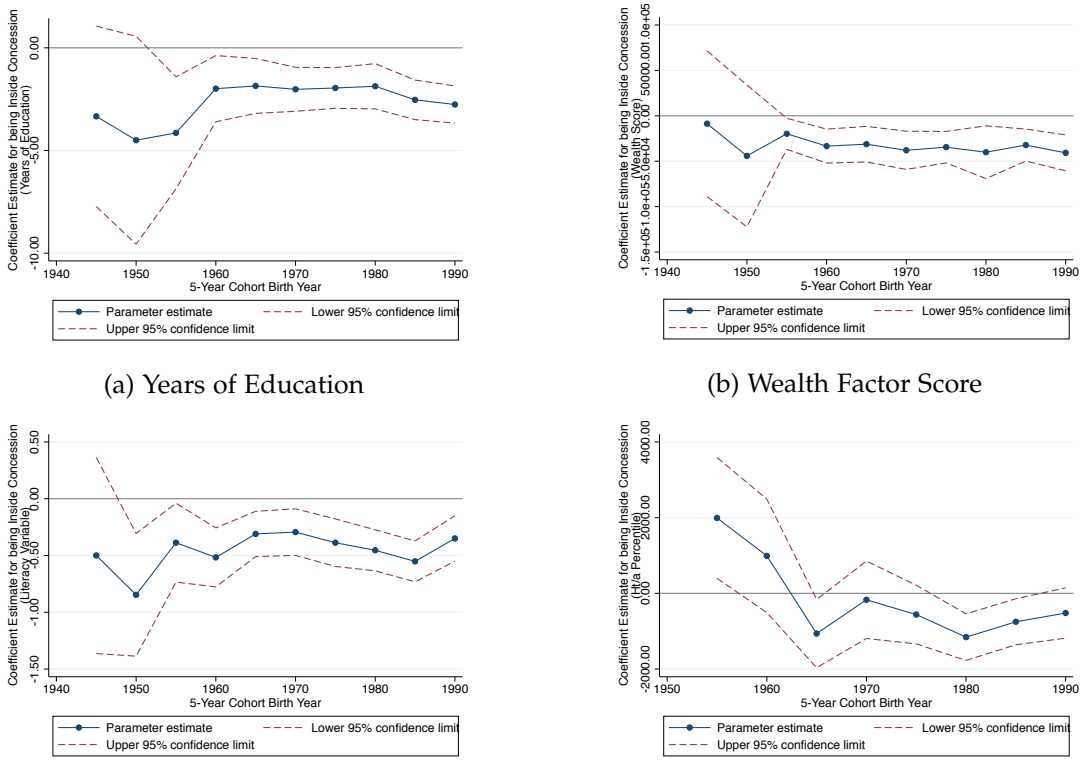
$$y_{i,v} = \gamma InsideConcession_{i,v} + \alpha_y C_y + \gamma_y C_y \times InsideConcession_{i,v} + \mathbf{X}_i\beta + \phi_{j(v)} + \varepsilon_{i,v} \quad (2)$$

where C_y are 5-year cohort fixed effects and the other variables are defined as in equation (1). Note that we are not estimating a distinct RD polynomial for each cohort as that would be too demanding of the data given our sample size.

Figure 9 plots the estimated cohort coefficients for years of education, literacy, height-to-age and wealth. We see no evidence for convergence across cohorts: the estimated coefficients for each cohort are similar, stable and do not get closer to zero for younger cohorts. The one exception

are the estimates for the health outcome, where older cohorts appear to have slightly higher height-to-age percentiles inside the former concessions. This could potentially be explained by selective survival – e.g. for the older individuals we only observe those healthy enough to survive inside the former concessions.

Figure 9: Estimated Cohort Coefficients for Individuals within 200 kms of the Rubber Concessions



(a) Years of Education

(b) Wealth Factor Score

(c) Literacy

(d) Height/Age Percentile

Notes: These figures plot the estimated coefficient for each 5 year cohort indicator interacted with the indicator for being inside a former concession area for observations within 200 kms of the concession borders. The regression also includes cohort fixed effects. Standard errors are clustered at the DHS cluster level. The figures also plot 95% confidence intervals for the coefficients. All outcome variables are from the DHS 2007 and 2014 surveys. The regressions all have 1496 observations. Wealth Factor Score is an index generated by the DHS using principle component on asset ownership. Literacy is a 0 to 2 categorical variable where 0 is cannot read at all and 2 is able to read a whole sentence. Ht/Age Percentile divides each respondent's height by her age and finds her percentile in the entire sample and normalizes this percentile to be within 0 and 10000.

4. The Effects of the Rubber Concessions on Local Institutions and Culture

The historical accounts presented in Section 2 suggest that exposure to the rubber regime affected a series of important outcomes related to local institutions by creating less accountable chiefs and outcomes related to beliefs about the importance of cooperation and sharing by increasing the importance of and reliance on mutual insurance. Thus, we examine how chiefs are selected, whether they provide public goods, and if villagers respect authority. We also test for differences

in culture. We focus on trust, feeling of closeness with others, and survey and experimental measures of support for sharing. The data collection and hypotheses are described in detail below.

4.1. Data Collection

Existing data from DRC does not allow us to measure differences in chief accountability and quality or beliefs on the importance of cooperation and sharing. To better examine these channels, we conducted surveys and collected experimental data in Gemena, DRC. Gemena is the capital of Sud-Ubangi province and is situated near the border of the former Anversoise concession. Gemena is inside the former concession boundary, but less than 10 km away from the border. In the previous analyses, Gemena is consistently an outlier, representing one of the more developed places within the former concessions.

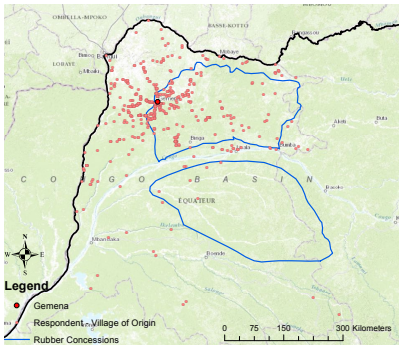
Gemena was created by colonial administrators in the mid-1920s, after the CFS period, and therefore consists primarily of migrants from surrounding areas. Nearly all individuals in our sample identify their "village of origin" as a village outside the town of Gemena. A "village of origin" is the village where an individual's family or ancestors are from. This is a commonly understood concept in this area, and all respondents knew their village of origin. A village of origin is not necessarily synonymous with where an individual is born.

The data were collected between July and August 2015. As there is no census available for the DRC, we created a sampling frame for Gemena using Google satellite imagery from June 2015. We divided Gemena into 89 polygons and estimated the number of households in each polygon (see Figure 10). We selected polygons to visit using two-stage clustered sampling. The probability of selecting a particular polygon was proportionate to its estimated population. We divided our survey into two visits per household to avoid survey fatigue. The first visit consisted of the main survey module and second visit consisted of lab experiments and a short survey. We randomly selected 40 polygons and randomly sampled households within each polygon, for a total sample size of 520 individuals for the first visit and 484 for the second visit. Of those sampled, 49.71% percent identified their village of origin as being from inside the boundaries of one of the former concessions and a total of 511 originate from villages within 200 kms of the former concession boundaries. Figure 11 presents a map of the locations of villages of origin for

our sample, the location of Gemena, and the borders of the former rubber concessions. For more details on sampling and survey methods, see Appendix G.1.

Figure 10: Gemena Polygons for Sampling

Figure 11: Gemena, the Rubber Concessions, and Location of Origin Villages within the Sample



We collect data from a Gemena-based sample and compare individuals with ancestors from inside the former concessions to those with ancestors from outside the former concessions. This approach has two main advantages. First, logistically, it is considerably easier to work in one main town rather than numerous villages in the area as transportation infrastructure is of very poor quality. Second, it allows us to more precisely identify cultural differences: by examining individuals removed from their original institutional environments and who now share the same institutional environment, any differences in behavior in experimental measures or responses to survey questions are capturing differences in internalized cultural norms. This follows the approach in Lowes et al. (2017) and is similar to the strategy employed in Alesina, Giuliano and Nunn (2013) where they compare migrants in Europe to try to understand cultural differences arising from differences in historical plough use in origin countries. However, given that migrants may be different from those who do not migrate, we explore differences in effects across first and second generation migrants. We also compare reasons for migration for individuals from in and outside the former concession boundaries.

Individuals answered a series of questions on demographics, migration history, income, trust and political attitudes. In addition to collecting individual level data, we ask individuals detailed questions about the institutions in their villages of origin. Individuals who were familiar with their village of origin were asked questions on the public goods available in their villages of origin, the responsibilities of the local chief, and the selection mechanism for the village chief. By comparing villages on either side of the concession border, these questions allow us to understand

whether villages inside the former concession have worse local institutional quality. Finally, individuals completed two behavioral experiments and an Implicit Association Test (IAT), which will be described in detail below.

4.2. Summary Statistics

Summary statistics are presented in Appendix G.5 for the survey data by whether or not an individual originates from inside the former concession. On average, individuals from inside the concession have fewer years of education and lower income than those from outside the concession, but these differences are not statistically significant. These differences are quite stark if we look only at first generation migrants (see Appendix G.6). Interestingly, the differences are of very similar magnitude to the DHS results presented in Section 3.5. However, if we examine second generation or higher migrants separately, we find convergence in outcomes. In terms of education and wealth, individuals from inside the concession no longer look different from individuals outside. This has interesting implications for understanding if our observed effects are "place" or "person" specific. It suggests that removing individuals from the former concession areas actually leads to relatively quick convergence in education and wealth outcomes.

A possible concern with data collected in Gemena is differential selective migration based on whether an individual is from the former concession area. To address this concern, Appendix Table A33 presents mean differences on key migration characteristics for individuals from inside and outside the former concessions. Importantly, we find very little evidence of differences in reasons for migration for individuals from inside and outside the concession. Additionally, there is no relationship between being from inside the former concessions and being knowledgeable about one's village of origin, which mitigates concerns about differential knowledge on villages of origin.

4.3. Empirical Approach

To formally test for differences in chief accountability and quality and for differences in beliefs on the importance of cooperation and sharing, we estimate analogous versions of equation (1) as in Section 3.3. The survey data has multiple questions that could be used to test the hypotheses of interest. We present all of our survey-based results using thematic indices that group related questions. We follow Kling, Liebman, Katz and Sanbonmatsu (2004) and Clingingsmith, Khwaja

and Kremer (2009) and compute the average effect size (AES) across outcomes within an index.[8] By grouping multiple questions into an index, we both reduce the chance of finding statistical significance on any individual component of an index (type I error) and also reduce the risk of low statistical power (type II error). For all AES coefficients reported, in Appendix G.8 we include coefficient plots of each of the individual components of the index alongside the estimated AES coefficient.

4.4. Economic Development in Villages of Origin

To verify our own sample relative to the DHS sample, we first examine whether villages of origin within the former concessions are less developed than those just outside the former borders using our survey data from Gemena. We asked individuals about the public goods available in their villages of origin and their perception of the relative wealth of their village of origin. Panel A of Table 7 presents the AES coefficients for two indices: an index of public goods available in the village of origin, and an index of a respondent's subjective measures of the development of their village of origin. All questions included in the index and their response options are reported in the notes of the table. Please note that for all results using AES indexes, we present coefficient plots of the coefficient for the AES estimate and the estimated coefficients individual components in Appendix G.8.

Consistent with the DHS results, villages within the former concession are described as having fewer public goods and are rated as less developed. Interestingly, for the subjective ratings, the coefficients of interest are large and negative but not statistically significant. This highlights a weakness of subjective village ratings: individuals might have been using different reference groups. When we combine the two indexes presented in Table 7 into one measure, the results are very similar in magnitude and significance to the public good index results alone. In general, the survey results are consistent with the results from the DHS results in Section 3.5 that show that places inside the former concessions are less developed today.

[8] Specifically, for a set of K grouped outcomes Y^k in an index, with $RubberConcession$ local average treatment effect α_k, the AES is $\gamma = \frac{1}{K}\sum_{k=1}^{K}\frac{\alpha_k}{\sigma_k}$, where σ_k is the standard deviation of outcome k in the comparison group, i.e. individuals from outside the former concessions. To test γ against a null hypothesis of no average effect, we jointly estimate the α_k's in a seemingly unrelated regression framework to account for the covariance between effects α_k. See Kling et al. (2004) for more details.

Table 7: Village Institutions

	Panel A: Development Outcomes					
	Village Public Goods Index (AES Coefficients)			*Village Subjective Ratings Index (AES Coefficients)*		
Sample Within:	200 kms (1)	100 kms (2)	50 kms (3)	200 kms (4)	100 kms (5)	50 kms (6)
Inside Concession	-0.171***	-0.174***	-0.197***	-0.110	-0.122	-0.198
	(0.056)	(0.058)	(0.066)	(0.114)	(0.118)	(0.127)
Observations	317	290	231	211	195	160
Clusters	235	212	166	162	149	121
	Panel B: Chief Quality and Accountability					
	Chief Public Good Index (AES Coefficients)			*Chief Elected*		
Sample Within:	200 kms (1)	100 kms (2)	50 kms (3)	200 kms (4)	100 kms (5)	50 kms (6)
Inside Concession	-0.250***	-0.256***	-0.310***	-0.147*	-0.168**	-0.194**
	(0.095)	(0.097)	(0.107)	(0.078)	(0.079)	(0.085)
Mean Dep. Var.	–	–	–	0.51	0.51	0.52
Observations	274	250	204	277	255	209
Clusters	204	184	147	207	189	151
	Panel C: Respect for Authority					
	Survey Questions Index (AES Coefficients)			*Implicit Association w/ Chiefs Score*		
Sample Within:	200 kms (1)	100 kms (2)	50 kms (3)	200 kms (4)	100 kms (5)	50 kms (6)
Inside Concession	0.203**	0.201**	0.182*	0.020	0.016	0.043
	(0.091)	(0.094)	(0.100)	(0.059)	(0.060)	(0.063)
Mean Dep. Var.	–	–	–	-0.101	-0.088	-0.088
Observations	338	310	254	459	417	322
Clusters	244	222	178	315	285	219

Notes: Standard errors clustered at the origin village level. Regressions include district fixed effects. *Village Public Goods Index* presents Average Effect Size estimates for the following questions (with the number of components for each questions in brackets): (1) What material is the road in your village of origin made of? [2: 0=Sand, 1=Gravel or Pavement] (2) Is your village of origin on a main road? (3) Does your village of origin have a secondary school? [2] (4) Does your village of origin have a Health Dispensary? [2] (5) Does your village of origin have a Hospital? [2] (6) Does the water in your village of origin come from a well? [2: 0=Spring water, 1=Well]. *Village Subjective Ratings Index* presents Average Effect Size estimates for the following questions (with the number of components for each questions in brackets): (1) How would you rate the quality of the primary school in your village of origin? [5] (2) How would you rate the quality of the secondary school in your village of origin? [5] (3) How would you rate the quality of the road in your village of origin relative to other roads in the area? [5] (4) Relative to other villages in the area you have visited, how would your rate your village of origin overall? [5] *Chief Public Good Index* presents Average Effect Size estimates for the following questions: Is the chief in your village of origin responsible for providing (1) road maintenance, (2) new roads, (3) school maintenance, (4) land allocation, (5) protection of property rights, (6) tax collection, (7) jobs, (8) conflict arbitration, and (9) road brushing; all questions answered as a 0 to 2 categorical variable where 0 is Yes, 1 is Partially, and 2 is No. *Chief Elected* is an indicator variable equal to 1 if the village chief of a respondent's origin village is selected by elections. *Respect for Local Authority Index* presents Average Effect Size estimates for the following questions (with number of components for each question indicated in brackets): (1) How much do you trust your village of origin chief? [4], (2) How much do you trust your sub-tribe chief? [4], (3) How satisfied are you with your village of origin chief? [4], (4) Would you vote for your village of origin chief if there were an election held tomorrow? [2], (5) How much confidence do you have in local chiefs? [4]. *Implicit Association w/ Chiefs Score* is the D-Score for the Implicit Association Test that asked respondents to sort sounds of words related to local chief authority, where more positive values indicate a more positive implicit association with local chiefs. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

4.5. Differences in Village Institutions

The first hypothesis we test is whether the rubber concession period caused a long-term deterioration in the quality and accountability of village institutions. This hypothesis is motivated by Mamdani (1996), who argues that the creation of unaccountable chiefs during the colonial period has had long-run negative consequences for development in Africa, and by Acemoglu et al. (2014) who find that places with fewer ruling families in Sierra Leone, and therefore less political competition, have chiefs that provide fewer public goods.

The historical accounts of the rubber period and the oral histories from individuals in Gemena suggest that the position of chief may have been affected by the rubber period (Young, 1965). Individuals from interviews conducted in January 2015 described how the rubber regime co-opted village chiefs, incarcerated non-compliant chiefs and replaced chiefs with individuals that supported the rubber agents. For example, one of our interviewees noted:

> "Chiefs were sometimes given a percentage for organizing [people to collect rubber]. He would be punished otherwise, with beating, and they would choose another chief eventually if the chief did not obey them. They would replace the chiefs with other chiefs who would welcome them." - Interview, Gemena, January 2015

Today, village chiefs are tasked with organizing public good maintenance and construction, resolving conflict, and welcoming outsiders. If the rubber regime altered the accountability and quality of village chiefs, this could explain the worse development outcomes we observe inside the former concessions. We first examine whether there are differences in whether a chief is elected. We interpret elected chiefs as more accountable relative to hereditary chiefs. We then examine differences in the quality of chiefs as measured by provision of public goods. Finally, we examine whether individuals inside the concessions have different respect for authority, as measured by survey questions and an IAT.

Accountability and Quality of Village Chiefs

Panel B of Table 7 presents the results on chief selection mechanism. Chiefs in villages inside the former rubber concessions are 15 percentage points less likely to be chosen by election. Instead, they are more likely to be hereditary, i.e. chosen from a particular lineage or clan within the community. This lineage is known as the "ruling" lineage, and chiefs then tend to come exclusively from this lineage.

To examine whether there are differences in the quality of chiefs, we construct an index that combines all questions on whether chiefs are responsible for providing specific public goods (and their maintenance) in the villages of origin; a lower value on this index suggests chiefs are of lower quality in the sense that they are not considered responsible for providing key public goods at the village level. We find that chiefs inside the former concessions are responsible for providing fewer public goods.

Respect for Chief Authority

An important consideration when examining differences in village institutions is to account for differences in respect for authority. If respect for chief authority is lower inside the concessions due to the rubber concession period, then local chiefs may be less able to organize productive activities, resolve conflicts, and provide order, even if the chiefs themselves and the formal local institutions are of the same quality. Conversely, if individuals report greater respect for authority, this may indicative of social capture, as in recent work on respect for local chiefs in Africa by Acemoglu et al. (2014), who find a negative relationship between trust in chiefs and public good provision by chiefs in Sierra Leone.

To examine respect for village chief authority, we first construct an index of subjective survey questions on confidence and trust in chiefs. We scale all variables so that more positive values indicate greater respect for local chiefs. Because respondents may be unwilling to answer potentially sensitive questions about local political figures truthfully, we also conducted a Single-Target Implicit Association Test (ST-IAT) to measure implicit attitudes towards chiefs. The ST-IAT was developed by Bluemke and Friese (2008) and is a variant of the original IAT. The ST-IAT was created to measure the positivity or negativity of individuals' implicit association toward a single target. [9] In our case, the target group is chiefs. ST-IATs have been used recently in similar settings in the DRC by Lowes et al. (2017), Lowes (2017), and Lowes, Nunn, Robinson and Weigel (2015). See Appendix G.4 for more information on IATs, screenshots of the IAT, the details of the words

[9] During an IAT, respondents sort words related to happiness, words related to sadness, and words related to local chiefs to the left or right side of a touchscreen tablet. The intuition behind the IAT is that if a respondent has a positive view of chiefs, he will have an easier time sorting chief words to the same side as happy words than to the same side with sad words. By examining the difference in the speed at which the respondent sorts the words we can infer their implicit view of chiefs.

we selected, and the protocols for implementation.[10]

With our two measures of respect for authority, we test whether individuals from inside the former concessions have lower respect for authority. Panel C of Table 7 reports the estimates from these two different measures of respect for authority. Individuals from inside the former concessions report that they respect chiefs *more* in the subjective index, even though the results in Panel B suggest the chiefs are of lower quality. The IAT results presented in Panel C demonstrate that there is little difference in implicit views of chiefs: the coefficients are small in magnitude and statistically insignificant. This difference between implicit and subjective measures could be a result of social desirability bias when answering subjective questions, which may influence how individuals respond to questions on local chiefs. This is consistent with Acemoglu et al. (2014), where they argue that lower quality chiefs may be better able to "capture" social society, despite their worse performance as well as recent evidence from India (Anderson, Francois and Kotwal, 2015). Overall, the measures of respect for authority in Panel C suggest that areas inside do not have lower levels of respect for chiefs and that the results of lower public goods provision by chiefs inside the former concessions are not driven by lack of respect for authority.

4.6. Differences in Trust, Social Cohesion, Altruism, and Support for Sharing

We test for differences in culture, specifically: trust, social cohesion, altruism, and support for sharing income. The rubber period may have eroded norms of trust in others. Lower trust in others could potentially explain lower development today, as trust is particularly important for trade in the region.Individuals coped with the violence of the rubber regime and political capture by relying on mutual insurance and horizontal ties. As chiefs were unable to safeguard citizens from exploitation, individuals may have had to increase reliance on forms of informal insurance. Sharing norms are prevalent in Africa and have been argued to be an important aspect of African comparative development (Platteau, 2000). We examine both self-reported beliefs in the importance of sharing and experimental measures of sharing (Jakiela, 2011, Jakiela, Miguel and the Velde, 2014).

[10] Formally, we follow Lowes et al. (2015) and calculate the standard *D-Score* as our inferred measure of the implicit view of chiefs for a given respondent. The *D-Score* is defined as: $\textit{D-Score} = [Mean(latency^{-ve}) - Mean(latency^{+ve})]/SD(latency^{+ve\,and\,-ve})$, where $Mean(latency^{-ve})$ is the average response time in milliseconds for the block in which the chief words are meant to go right, $Mean(latency^{-ve})$ is the average response time for the block in which the chief words are meant to go left, and $SD(latency^{+ve\,and\,-ve})$ is the standard deviation in response times across both blocks. In this *D-Score*. more positive values will indicate more positive implicit views.

Trust in Others

We examine whether trust is different across the former concession borders in Panel A of Table 8 by constructing an index of questions on how much individuals trust various people. We chose these survey questions following work by Johnson and Mislin (2011) and Johnson and Mislin (2012) who demonstrate that trust survey questions have a positive, robust correlation with experimental measures of trust (i.e. amount sent in the trust game). The coefficients on trust inside the former concessions are positive and marginally statistically significant, suggesting that individuals from the former concessions are in fact more trusting than those outside the former concessions. It is therefore unlikely that lack of trust in the former concessions is driving the observed results.

Following the literature on the effects of violence on pro-social norms (Bauer et al., 2016), we check whether there are differences between "in-group" and "out-group" trust. We do not find that individuals exhibit greater in-group trust or less out-group trust, though the effect is slightly larger for in-group trust but not statistically distinguishable from the effect on out-group trust. The coefficient plots for each question individually is located in Appendix G.8.

We also ask respondents how close they feel to people to various groups of people. We present the results on differences in closeness in Panel A of Table 8. We find that individuals from the former concessions report feeling closer to others, both in their village of origin and in Gemena.

These results are potentially surprising given past work that shows a positive correlation between good institutions and good culture. It is also different from Nunn and Wantchekon (2011), who find that areas more exposed to the slave trade exhibit less trust today. This highlights the importance of the perpetrator of the violence. In Nunn and Wantchekon (2011) family and community members turned against each other, while during the rubber era communities faced a threat from outsiders: European agents or sentries from other parts of Congo.

Strength of Beliefs in Importance of Sharing

To test whether there are differences in beliefs in the importance of sharing, we first construct an index of survey questions asking individuals whether they think it is appropriate to share income in a variety of different situations. The index includes questions on whether you should share your own income when it is earned by luck and when it is earned by work, and whether others

Table 8: Survey and Experimental Measures of Trust and Sharing Beliefs

	Panel A: Trust and Closeness					
	Trust Index (AES Coefficients)			*Closeness to Others Index (AES Coefficients)*		
Sample Within:	200 kms (1)	100 kms (2)	50 kms (3)	200 kms (4)	100 kms (5)	50 kms (6)
Inside Concession	0.122*	0.135*	0.108	0.173**	0.168**	0.243***
	(0.074)	(0.072)	(0.076)	(0.076)	(0.078)	(0.086)
Observations	511	465	365	497	453	354
Clusters	346	313	245	338	306	239
	Panel B: Survey Measures of Sharing Norms					
	For Self (AES Coefficients)			*For Village of Origin (AES Coefficients)*		
Sample Within:	200 kms (1)	100 kms (2)	50 kms (3)	200 kms (4)	100 kms (5)	50 kms (6)
Inside Concession	0.293***	0.280***	0.297**	0.150*	0.148*	0.115
	(0.108)	(0.106)	(0.117)	(0.091)	(0.089)	(0.098)
Observations	498	453	355	348	320	259
Clusters	337	304	237	243	221	176
	Panel C: Experimental Measures of Sharing Norms					
	Dictator Game: Amount Shared			*Effort Task: Share Redistributed*		
Sample Within:	200 kms (1)	100 kms (2)	50 kms (3)	200 kms (4)	100 kms (5)	50 kms (6)
Inside Concession	13.78	15.50	11.88	0.037**	0.038**	0.031*
	(11.69)	(11.90)	(12.50)	(0.015)	(0.015)	(0.016)
Mean Dep. Var.	445	445	448	0.401	0.401	0.402
Observations	482	438	341	481	437	340
Clusters	332	300	232	332	300	232

Notes: Standard errors clustered at the origin village level. Regressions include district fixed effects. *Trust Index* presents Average Effect Size estimates for the following questions: How much do you trust (1) people from your village of origin, (2) people of another tribe, (3) people of your own tribe, (4) people you meet for the first time, (5) your family, (6) your neighbors, (7) people of another nationality, and (8) people of your sub-tribe; all questions answered on a 0 to 4 scale where 0 is Not at All and 4 is Completely. *Closeness to Others Index* presents Average Effect Size estimates for the following questions: (1) How close to you feel to people from your village of origin?, (2) How close to do you feel to people of Gemena?, (3) How close do you feel to people of your own tribe?, (4) How close do you feel to people of your age set from your origin village?, and (5) How close do you feel to people of your age set in Gemena?; all questions answered in a scale from 0 (Not Close at All) to 5 (Very Close). *Sharing Norms Index* presents Average Effect Size estimates for the following questions: (1) If you get money from luck you should share it, (2) If you earn money from hard work you should share it, (3) If someone else earns money from luck they should share it, (4) If someone else earns money from hard work they should share it; all questions answered in a scale from 1 (Strongly Disagree) to 5 (Strongly Agree). *Sharing Norms Index Village of Origin* presents Average Effect Size estimates for the following questions, where all questions start with "How much would someone from your village of origin agree with the following statements", for the same statements listed above. *Dictator Game: Amount Shared* measures the amount sent to an anonymous player 2 in the standard Dictator Game. *Effort Task: Share Redistributed* is the total share taken (weighted by the maximum budget amount possible to take) in the effort task from the anonymous player 1's earned income. It represents an experimental measure of respect for earned income property rights. Two individuals declined participating in the Dictator Game, and one additional individual declined participating in the Reverse Dictator Game. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

should share their income with you when it is earned by luck and when it is earned by work. We also ask the respondent how they think people in their village of origin would respond to the same series of questions to understand their expectations regarding the beliefs of others.

Panel B of Table 8 present the estimates for each of these measures. Individuals from the former concessions are more likely to agree that income should be shared with others. They are also more likely to report that individuals in their villages of origin would also agree that income should be shared. Individuals support sharing income regardless of whether it is earned by work or luck and regardless of whether they are speaking about sharing their own income with others or others sharing with them. Across all of these survey measures, individuals inside the concessions are more likely to believe it is important to share income.

We also collected experimental measures of support for sharing. Individuals in our sample participated in a dictator game (DG) to measure altruism and in a reverse dictator game, to measure support for redistribution. In the standard DG, a player 1 is given an endowment and is asked to allocate it between themselves and a player 2. The reverse DG differs in two key ways from the standard DG. First, the player 1 earns an endowment through an effort task. Second, the player 2 is told how much the player 1 earned and is asked what share of the player 1's earned income they would like to keep for themselves. The amount player 2 decides to take from Player 1's earned income therefore represents a measure of willingness to redistribute.[11]

In the reverse-DG experiment, each respondent is matched to an anonymous, randomly selected individual from Gemena. Additionally, every respondent plays the game twice: once as player 2 where they divide the earned endowment of the player 1 and then as a player 1 where they earn an endowment. Respondents first learned about the general structure of the experiment, the details of the earning task, and then decided whether to participate or not. Before performing the effort task (i.e. the task to earn an endowment as a player 1), subjects decide how they want to take from an anonymous player 1's income. We used the strategy method to elicit these divisions: for each of the 20 possible amounts player 1 can earn in the effort task, respondents would enter the amount they would take for themselves. The share of earned income that player 2 decides to

[11] Variation (i) of the DG has been used before by Hoffman, McCabe, Shachat and Smith (1994) and Cherry, Frykblom and Shogren (2002); subjects tend to be much less generous when they earned their own income, which Farh and Irlenbusch (2000) refer to as *earned property rights*. Variation (ii) on its own changes the standard DG to what is known as a Reverse DG, which has been used many times before (List, 2007). Jakiela (2011) combines these two variations to get a measure of respect for earned property rights and finds that subjects in the US tend to others' respect earned income much more than subjects in Kenya.

take from Player 1's earned income is our measure of support for redistribution.

For the earnings task, we selected a task that could be easily understood by all respondents and for which more effort was rewarded by more income. Subjects played a "clicking-game" on touch screen tablets. In this "clicking-game," a small blue dot appears in a random location on the screen every three seconds and the respondent has one second to push the dot before it disappears. Importantly, this effort task did not rely on physical strength or skill but instead relied on concentration and perseverance. It is purposefully a very boring game. The game lasted five minutes and respondents were paid based on the number of successful "clicks," earning 100 Congolese Francs (approximately $0.10) per 10 successful clicks. Respondent were very engaged in the task and earned on average 700 CF in this task. See Appendix G.2 for more details on the reverse DG with earned income, the protocols used, and the earnings task.

Panel C of Table 8 presents the estimates for the experimental measures of altruism and willingness to redistribute. We find no significant differences in amount sent in the dictator game, thought the coefficient on inside concession is positive. For the reverse dictator game, we find that individuals from the former concessions redistribute a larger share of the other player's earned endowment to themselves. We interpret this as having greater support for redistribution, consistent with the survey measures on sharing that suggest individuals think income should be shared.

One implication of greater support for sharing income is that we would expect villages inside the former concessions to have less income inequality. Consistent with greater support for sharing income, in Appendix H.3, we find lower levels of income inequality within DHS clusters inside the former concessions. We examine both the standard deviation of the wealth score and the inter-quartile range of the wealth score. The benefit of examining the inter-quartile range of the wealth score is that this dispersion measure is invariant to mean shifts in incomes. This means our inequality results are not driven by the fact that individuals inside the concession are on average less wealthy.

The results in Table 8 provide evidence that individuals from inside the former concessions are more trusting, feel closer to others, believe it is important to share income, send more in a dictator game, and redistribute more in a reverse dictator game. The results all point to more pro-social beliefs and values within the former concessions. This may seem counter-intuitive, given the violence and brutality these communities experienced during the rubber era. However,

recent work by Bauer et al. (2016), who review findings from 16 post-conflict settings, have found that individuals exposed to conflict are more pro-social. For example, they are more active in their communities and exhibit more pro-social behavior in experimental measures. The authors highlight that greater cooperation "may arise from the greater value of social insurance. War frequently destroys household assets, and may make victims of violence more dependent on local informal systems of risk-sharing and insurance, especially among kin and neighbors, thus increasing the return to investments in social capital" (Bauer et al., 2016, p.266). Our setting provides evidence that these effects can persist over time, even many generations after the exposure to violence.

4.7. Discussion of Results

The results above indicate that individuals from former rubber concessions (i) originate from villages with less accountable chiefs who provide fewer public goods (ii) are more trusting of others and (iii) are more supportive of sharing earnings. The institutional results provide a plausible explanation for the present day underdevelopment of former concession areas and may help explain how an historical event of short duration continues to matter for development today. The results on culture suggest that individuals from within the former concessions are more trusting, cohesive, and more supportive of sharing as a result of the violence associated with the rubber era.

An important question is whether the differences we observe in institutions and culture are both directly due by the rubber regime, or whether a change in one led to a change in the other. With the existing data and archival resources, we are unable to answer this question definitively. However, guided by the historical accounts, we offer a speculative discussion in this section. While it is possible that both were independently affected by the rubber regime, historians have also highlighted that these changes in institutions and culture could have reinforced each other:

> *"European conquest of the interior caused many Mongo big men to lose their positions of power and prestige and to be replaced by others deemed more loyal to the European state. Traditional forms of social stratification were altered as individuals were forced to cooperate in unprecedented ways to survive. ... These changes, despite their seemingly disparate natures, were intimately interrelated, for they were ultimately rooted in changes ... in work demands and activities [due to the rubber regime]."* (Nelson, 1994, p.97)

Based on oral histories of the rubber era, Nelson (1994) argues that changes to institutions and culture reinforced each other in this setting: as local chiefs were co-opted by the rubber concession agents or replaced with less accountable chiefs, villagers began to rely on each other for survival. This would imply that local institutions and a culture of increased reliance on informal redistribution acted as substitutes.

This is in line with theoretical work by Bisin and Verdier (2017), who highlight the importance of studying both institutions and culture, and who call into question how reasonable it is to focus on one channel or origin for economic prosperity. In fact, Bisin and Verdier (2017, p.38) write that their theoretical work "underlines the fact that the search for a...unique origin for long-term development can be quite an arduous and even sterile undertaking. Focusing more systematically on the positive or negative interactions between culture and institutions along the development process might be more fruitful in terms of historical understanding". Additionally, these results are related to work in anthropology by Scott (2010), who describes numerous cases of how villagers rely more on each other and withdraw from a state when they see the state as illegitimate. More recently, work from Lowes et al. (2017) find that historical state capacity is associated with weaker norms of rule following in the DRC.

An important question is: why did these changes persist? Of course, this cannot be directly tested in our data, but a compelling explanation is that these changes in institutional quality and culture reinforce each other: chiefs are held less accountable and allowed to stay in power since individuals do not rely on their formal institutions as much and instead rely on informal norms for support. Importantly, this is a setting with extremely low central state-capacity, where the central state has made little effort to change development outcomes. Today, we see that both the institutional and cultural channels matter for economic development: worse institutions and stronger beliefs in the importance of sharing income would imply less engagement in risky activities such as trade, entrepreneurship, and cash crop farming. Appendix Table A36 presents survey evidence that suggests that this is in fact the case.

5. External Validity

We have presented evidence that those individuals from the former ABIR and Anversoise concession areas have lower levels of education, wealth, and health today. We argue that this is likely due to the how the rubber era undermined local chiefs and that the increase in trust, cohesion,

and sharing has not been sufficient to offset these negative effects. Given that other concessions were granted during the CFS era, it is natural to examine the broader implications of the Leopold II concession system for the development of DRC. Could the concessions granted under Leopold II help explain why the DRC is one of the least developed countries in the world?

In Appendix I, we present RD results for education, wealth, and health examining all concessions granted in DRC as of 1904 (see Figure 1 for a map of all of the concession boundaries). We present results pooling all of the concessions as well as results excluding ABIR and Anversoise. We find that across all concessions in DRC, individuals experience worse education, wealth, and health outcomes. The coefficients are always negative, though sometimes not significant when ABIR and Anversoise are excluded. The OLS estimates (not presented) are similar to the RD estimates in magnitude and direction. For the 60% of DRC's landmass that was formally part of a concession, wealth would be about 15% higher had they not been part of a concession. While these estimates are unlikely to be causal, given that these other concession boundaries correspond with present day political boundaries and have different histories than ABIR and Anversoise, they are suggestive of the detrimental long run legacy of colonial extraction. Given the almost universal application of colonial extraction in African colonies, these results are important for understanding the comparative development of Africa.

6. Conclusion

We examine the long run effects of one of the most extreme examples of colonial extraction, the rubber concessions granted under Leopold II. This era has been described as an event of holocaust proportions, resulting in the deaths of millions (Hochschild, 1998). We exploit the well-defined boundaries of the ABIR and Anversoise concessions and demonstrate that the 14 year exposure to extractive institutions during the CFS era has affected the development of this region of Congo.

The rubber concession period was characterized by its extreme brutality and violence, earning the period the nickname "*red rubber*," and the use of local institutions to achieve rubber production quotas. Village chiefs were co-opted into enforcing the rubber quotas or were replaced by those who would. Armed sentries and European agents brutally punished individuals who did not meet the designated quotas. Using a geographic regression discontinuity design, we find that the former rubber concession areas have lower levels of education, wealth, and health than areas outside of the concessions. Examining effects by age cohorts, we find no evidence that areas inside

the former concessions are converging to the development levels of areas outside the former concessions. The differences in development inside and outside the former concessions cannot be explained by subsequent differential colonial treatment or missionary presence.

We then examine how local institutions and culture were affected by exposure to colonial extraction. Using original survey and experimental data collected along the boundary of one of the former concessions, we find evidence that there are important differences in local institutional quality inside the former concessions relative to outside. Inside the former concessions, chiefs are less likely to be elected (and are more likely to be hereditary) and provide fewer public goods. We argue that the rubber concessions affected institutional quality, and that this helps explain why these areas are more poor today.

We also examine how the rubber period affected culture. During the rubber era, villagers were forced rely on each other and provide mutual aid and insurance. We present evidence that individuals inside the former concessions today are more trusting, report feeling closer to others, are more likely to state it is important to share with others, and in a reverse dictator game they are more likely to redistribute. In the DHS data, the levels of inequality within villages are lower inside the concessions.

The combined results of lower institutional quality but more "good" cultural traits may be surprising, particularly given evidence from Europe. However, work from evolutionary anthropology and recent theoretical work within economics helps clarify that the effect on institutions and culture need not move in the same direction. One speculative interpretation of these results is that in this setting institutional quality and culture may be acting as substitutes. While "better" culture may partially off-set the negative effects of lower quality institutions, they does not seem to fully off-set them.

We present the first quantitative evidence on the effects of the Congo Free State rubber concessions in the Upper Congo Basin. Although the event was of short duration, it has significantly affected the development of the DRC. We present evidence that the changes to institutional quality and culture likely explain the persistence of the effects. These results have important implications for the development of the DRC as a whole, much of which was granted as a concession during the CFS era. The results also have implications for understanding the relationship between institutional quality and culture. This paper demonstrates how Africa's colonial history and exposure to colonial extraction continue to matter for comparative economic development today.

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