

Dries, Jonathan

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**Corporations as the State:
Concessions, Urbanization, and Long-Run
Development in the Copperbelt**

Jonathan Dries, LUISS Guido Carli University

jvdries@luiss.it

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Corporations as the State: Concessions, Urbanization, and Long-Run Development in the Copperbelt

Jonathan Dries*

November 18, 2025

Abstract

During the Scramble for Africa, European colonization relied on private concessionary companies that established distinctive institutional frameworks. This paper provides new empirical evidence suggesting that colonial corporate governance produced divergent long-run development trajectories. I examine two comparable corporations that exploited the Central African Copperbelt: the Union Minière du Haut-Katanga (UMHK) in the Belgian Congo and the Rhokana Corporation (RC) in Northern Rhodesia. The UMHK's "Labour Stabilization Programs" incentivized permanent family resettlement, fostering community stability and urban agglomeration economies, policies absent at the RC. Using two spatial regression discontinuity designs, I show that the UMHK concession generated higher urbanization rates and persistent improvements in wealth, education, and health outcomes today, along with enduring positive effects on women's empowerment and decision-making power over household spending. In contrast, I find no comparable evidence for the RC, and a spatial difference-in-discontinuities analysis indicates the developmental divergence is driven by UMHK's labour policies.

Keywords: Colonialism, Concessions, Corporate governance, Long-run development, Urbanization

JEL Codes: N37, O43, R11

*Department of Economics and Finance, LUISS Guido Carli University, Rome, Italy (jvdries@luiss.it).

1 Introduction

Private concessions were the prevailing form of colonial exploitation during the Scramble for Africa, raising a critical question: how did the distinct corporate policies of these companies affect long-term development? This question remains highly relevant as a “new scramble for Africa” unfolds, marked by a renewed great power competition for resources and influence over the continent [1]. While these colonial corporations shared a for-profit motive, they were far from uniform. Wielding state-like powers, their labour institutions and local investments diverged, shaped by historical contingencies and the colonial vision of the metropole. One corporation might view the cultivation of a stable local community as beneficial for its long-term success, while another might pursue a more extractive labour model with minimal social investment. This paper argues that such policy differences have strong, persistent effects on long-run economic development.

This paper isolates the effects of corporate policy by exploiting institutional heterogeneity in a uniquely homogeneous setting: the Central African Copperbelt. The region, divided between today’s Democratic Republic of the Congo (DRC) and Zambia by colonial-era borders, hosted two powerful mining concessions: the Union Minière du Haut-Katanga (UMHK) in the Belgian Congo and the Rhokana Corporation (RC) in Northern Rhodesia. These corporations operated in a comparable context – sharing an industry, location, and time period – and faced similar challenges, such as fluctuating copper prices and scarce local labour. Crucially, however, their policy responses to these shared pressures differed, creating a natural experiment. This divergence offers a rare opportunity to compare their long-term local effects using a spatial difference-in-discontinuities design.

The research design is validated by the exogenous nature of the concession boundaries, creating ideal conditions for geographical regression discontinuity analyses (Keele and Titunik, 2015). These boundaries do not align with precolonial ethnic territories or contemporary

¹See *The Economist*, “The New Scramble for Africa,” March 7, 2019. www.economist.com/the-new-scramble-for-africa.

political divisions. Initially granted as vast prospecting zones, they also do not systematically map onto the major mineral deposits, which were only identified later. This exogeneity is reinforced by the broader historical context, as the overarching colonial border separating the two regions was itself arbitrarily drawn by European powers in 1894, with little knowledge of local geography or resource wealth. Both corporations operated for roughly half a century before being nationalized post-independence, allowing for a clear analysis of the persistent legacies of their temporary corporate rule.

Analysis of georeferenced data from the 2007 and 2014 Demographic and Health Surveys (DHS) for the DRC and Zambia supports the hypothesis that concession policies themselves created divergent legacies, revealing a striking divergence in long-term development. Inside the former UMHK concession, the results are robustly positive. Households are significantly wealthier, and individuals achieve, on average, two additional years of schooling and are 30 percentage points more likely to be literate. Health outcomes are also better, with women and children being taller for their age. Women within the former UMHK concession also exhibit greater economic empowerment, receiving more formal, cash-based pay and exercising more power over household spending decisions.

Conversely, no sharp discontinuity in development outcomes, positive or negative, is found at the former RC concession boundary. This 'null' finding is itself revealing, as it suggests the RC's corporate model was not a significant institutional departure from the prevailing colonial framework in the rest of Northern Rhodesia. This lack of a unique RC legacy reinforces the interpretation that it was UMHK's paternalistic approach, not merely the presence of a corporation, that drove the divergent long-run outcomes. A formal comparison confirms that the developmental discontinuities at the UMHK border are significantly and positively different from those at the RC border, isolating the impact of UMHK's distinct policies.

The paper identifies corporate labour policy as the primary mechanism explaining these divergent outcomes. Following the Great Depression, the two corporations adopted starkly

different strategies to manage their workforce. The UMHK pivoted from coercive practices to “Labour Stabilization Programs,” which used long-term contracts and extensive non-wage benefits to encourage the permanent settlement of miners and their families. This included company investments in healthcare, skills training, and education for workers’ children. In sharp contrast, the RC adopted the South African model of circular migration, favouring seasonal contracts and actively discouraging permanent settlement to prevent “detrribalization”. The RC also enforced a rigid “colour bar,” which reserved semi-skilled positions for Europeans and locked African labourers into low-skill jobs. This historical divergence shows that colonial institutions were not static; the UMHK’s later, more inclusive policies appear to have overcome the legacy of its earlier forced-labour regime.

These labour policies generated persistent developmental legacies through a novel indirect channel: their influence on urbanization and spatial development. By fostering stable communities, the UMHK’s strategy spurred greater urban growth and the development of agglomeration economies. This legacy remains visible today: the former concession area has significantly more built-up surface area and its households report substantially greater access to electricity and piped water. In contrast, the RC’s circular migration approach hindered this process of urban formation. The sharp divergence in spatial development patterns suggests that corporate-driven urbanization is a powerful channel for institutional persistence and that the legacies of extractive regimes are not monolithic.

This paper contributes to a large body of literature showing the persistent and heterogeneous legacy of colonial institutions (Acemoglu et al., 2001; Michalopoulos and Papaioannou, 2020), including precolonial characteristics, the slave trade, and geography (Porta et al., 1998; Numm, 2008; Huillery, 2009; Michalopoulos and Papaioannou, 2013, 2014; Alsan, 2015; Wantchekon et al., 2015; Cagé and Rueda, 2016, 2020; Lowes and Montero, 2021b). First, it moves beyond identifying the aggregate effects of these institutions by isolating the impact of specific corporate policies. A rich body of research, sparked by Dell (2010), uses geographical regression discontinuity designs to estimate these long-term effects. This work has

documented both beneficial legacies from investment in human capital and infrastructure (Dell and Olken, 2020; Méndez and Van Patten, 2022) and harmful ones from coercion and violence (Dell, 2010; Lowes and Montero, 2021a). By comparing two corporations with similar inherent characteristics, but with divergent labour strategies, this study can distinguish the effects of governance from the general presence of a concession – a challenge for studies that examine singular institutions (Michalopoulos and Papaioannou, 2020).

Second, this paper proposes and provides evidence for a novel mechanism linking colonial policy to modern development. It contributes to the literature on agglomeration economies in developing countries (Duranton and Puga, 2004; Melo et al., 2009; Jedwab et al., 2017; Grover et al., 2023; Donovan et al., 2024) by demonstrating how corporate labour policies that incentivized family settlement historically shaped urbanization patterns. Third, the analysis extends to under-explored gendered outcomes, showing that these historical corporate policies had lasting effects on women’s autonomy, including their use of modern contraception and attitudes toward domestic violence (see Bailey, 2006; Bailey et al., 2012; Bailey and Lindo, 2017; Ojha and Babbar, 2024). Finally, I provide complementary evidence for the literature on colonial transportation infrastructure (Storeygard, 2016; Jedwab and Moradi, 2016; Bonfatti and Poelhekke, 2017; Donaldson, 2018; Banerjee et al., 2020; Jedwab and Storeygard, 2022), corroborating the hypothesis that extractive “mine-to-port” infrastructure may not foster broad-based local development.

The remainder of the paper is structured as follows. Section II provides the historical context for the two corporations. Section III details the data sources. Section IV presents the empirical strategy and baseline empirical results. Section V explores the mechanisms driving the divergent outcomes. Section VI concludes.

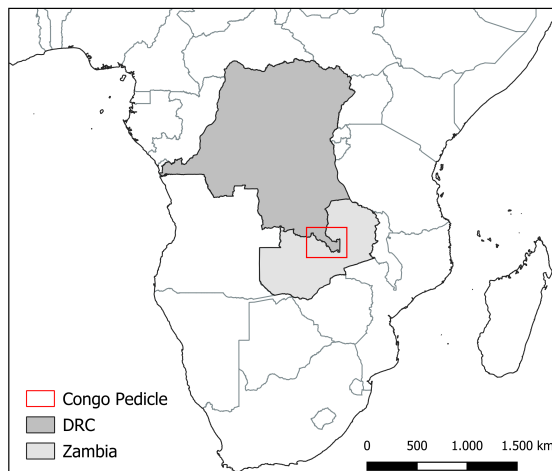


Figure 1: The Congo Pedicle in the Central African Copperbelt

2 Historical Framework

2.1 Copperbelt Concessionary Companies

The 1884-1885 Berlin Conference established general areas of influence in Africa, while specific borders were later decided during bilateral negotiations. Figure 1 shows the colonial border of the Congo pedicle, resulting from the Anglo-Belgian agreement of 12 May 1894. This division between the BSAC and the CFS initiated fundamental changes in the region due to differences in official colonial policy: the British reliance on Indirect Rule and the Belgian paternalistic principle of *dominer pour servir*². These heterogeneous colonial state-corporate relationships influenced the corporations' institutional responses to shared pressures, including fluctuating copper prices and labour scarcity.

In 1891, the province of Katanga was initially set up as a concession under the name *Compagnie du Katanga* to deter British interference in the region. By 1899, King Leopold II had entrusted its administration to the private *Comité Spécial du Katanga* (CSK). Operating largely independently and reporting directly to Brussels, the CSK later partnered with British Tanganyika Concessions Limited (TCL) in 1906 to establish the *Union Minière du*

²A phrase coined in 1948 by the Belgian Congo's Governor-General Pierre Ryckmans, justifying authoritarian colonial rule with rapid social and economic development (Ryckmans, 1948).

Haut Katanga (UMHK). The UMHK was granted extensive private concessions for copper exploitation in southern Katanga. The corporation retained this copper mining monopoly even after the Belgian state assumed formal control over the Congo in 1908 ³.

Katanga's rich surface copper oxide deposits (7 to 15 per cent copper) facilitated easy extraction in the form of low-tech open pit style mines (Coleman, 1971). Production began in 1912 and the UMHK became the 3rd largest copper producer in the world by the 1920s, accounting for 6% of world output (Perrings, 1979). It also became the number one global cobalt producer and an early uranium producer, holding a virtual world monopoly until WWII ⁴. Figure 2 illustrates the state of all mining concessions at the eve of Congolese independence. Notably, the UMHK concession area remained unchanged throughout its 60 years of operation (1906-1966).

In parallel, Northern Rhodesia's early years were similarly shaped by private interests. Founded by the colonial entrepreneur Cecil John Rhodes, the BSAC governed the colony until 1924. Northern Rhodesian mineral deposits were first discovered in 1902 at Bwana Mkubwa (now Ndola). Although the BSAC created the Nkana concession in 1911, these were initially low-grade oxide ores unprofitable for large-scale mining (Slinn, 1971). The local copper mining industry took off from the mid 1920s, about 15 years after it first developed in Katanga. This was driven by advancements in froth flotation mineral processing that enabled the profitable extraction of abundant sulphide deposits in Nkana, despite their lower percentage of pure copper compared to high yield Katangan veins (Mouat, 1996; Burdette et al., 1990). At this time, the Nkana concession was being extensively drilled and developed by the Bwana Mkubwa Company, the Rhodesia Congo Border Company (RCBC), and the Anglo-American Company (AAC) (Munene, 2018).

In 1931, these three Copperbelt mining companies consolidated into the Rhokana Corporation (RC) – named after Rhodesia and Nkana. This historical merger was driven by

³The CFS of King Leopold II was taken over by the Belgian government in 1908 under international pressure, leading to the creation of the Belgian Congo.

⁴The uranium for the Manhattan Project originated for over 90% from Katanga (Laporte, 2017).



Figure 3: Map of Northern Rhodesia’s Mining Concessions

Notes. The Nkana concession is the small area in the centre north of Northern Rhodesia. The map was created by the Anglo American Company and presents the situation of mining concessions right before the RC merger in 1929. This version comes from [Frederiksen \(2013\)](#), adapted from a report by the AAC.

several motives: to more easily raise fresh capital, secure a better bargaining position for output restriction discussions with other large copper producers, and negotiate more effectively with the BSAC and Northern Rhodesian administration ([Alford and Harvey, 1980](#); [Munene, 2018](#)). The RC’s attention centered on the Nkana concession, discontinuing the development of the Nchanga mines and any active prospecting in the RCBC. Figure 3 shows the Nkana concession located within the RCBC at RC’s inception ([Brooks, 1944](#)). The corporation became the largest Copperbelt mining company, responsible for over half of Northern Rhodesia’s copper output ([Munene, 2018](#)), remaining in continuous operation until 1969.

2.2 Colonial Labour Institutions

In October 1929, the New York Stock Exchange crashed, triggering a global economic downturn and financial turmoil. Between 1929 and 1931, global copper prices halved as world consumption declined (Munene, 2021). This fall in commodity prices, production, and consumption marked a pivotal moment of institutional transformation for the copper industry in both the Belgian Congo and Northern Rhodesia.

Falling profits – driven by rising labour and recruitment costs, coupled with declining metal prices – forced the UMHK to reassess its previously violent, short-term, and high-turnover labour policy⁵. The labour commission of 1924-25 already recommended establishing a more stable, skilled African workforce. In the initial stages of the economic downturn, the mines were able to easily shed their precarious migrant and foreign labour. Further decreased profits during the Great Depression prompted the adoption of a new colonial vision. The UMHK fully embraced its “Labour Stabilization Programs” – policies aimed at stabilizing its labour supply (Perrings, 1979; Ferguson, 1999). This paternalistic approach permeated nearly every aspect of life within the concession. Miners were expected to sign stable, restrictive, longer-term contracts, binding them to the mines for extended periods. As African workers often left families in their home villages, the UMHK encouraged permanent family resettlement (including wives and children). Family housing was offered as a part of the miners’ benefits. Moreover, women and children were not only accepted to secure necessary labour, but also as a source of both morale and future labour:

“Women and children at U.M. [UMHK] are treated as being the mine’s strength and under their discipline and control. Schools are provided and women participate e.g. in horticulture.”

(Juif and Frankema, 2018)

Investment into children’s education was viewed as both a charitable activity and an investment yielding future returns (the next generation of mine employees). Marriage and

⁵Early UMHK operations relied on coerced labour recruited by Robert Williams and Company (TCL subsidiary), which was later managed by the *Bourse du Travail du Katanga* (BTK) – a state–corporate alliance that violently extracted labour from rural areas (Gordon, 2001).

childbirth were incentivized: UMHK provided bride prices as signing bonuses for unmarried men and payments for newborns. [Juif and Frankema \(2018\)](#) quantifies labour stabilization in Katanga: forced labour recruitment fell from 75% of total workers before the programs to only 10% in the 1950s. Females as a percentage of male population in UMHK compounds evolved from 28% in the early 1920s to over 80% near independence. The percentage of married indigenous labourers, the birth rate, and the number of children per 100 workers at the UMHK all doubled over the first decade of labour stabilization.

Similarly, increased investment in African worker skills was an integral part of the labour stabilization programs. Such investment was only profitable with sufficiently long-term employment, a three-year threshold was deemed necessary for workers to integrate and justify skill investment. A key motivating factor was that medium skilled black employees were significantly cheaper than their white counterparts. In 1938, 65% of the workforce was still on contracts shorter than three years. By 1950, this percentage fell to 23.9% ([Juif and Frankema, 2018](#)).

In contrast, though the beginnings of large-scale mining in Northern Rhodesia coincided with the Great Depression, threatening to stall the industry in its infancy, its impact was less disruptive for Northern Rhodesia compared to the Belgian Congo ([Munene, 2021](#)). Multiple scholars have identified labour as the crucial factor ([Perrings, 1979](#); [Butler, 2007](#); [Larmer, 2017](#)). The RC mines relied on a larger share of cheap, abundant, unskilled African labour. Colonial-era scholars contemporaneously highlighted this imbalance, noting its far-reaching effects on African miners' social and economic life ([Wilson, 1942](#); [Saffery, 1943](#)).

As the Northern Rhodesian Copperbelt expanded in the late 1920s, the RC quickly adopted labour policies similar to those in South Africa. It featured predominantly seasonal contracts and circular migrant labour, eschewing permanent contracts and resettlement. Workers were encouraged to return to their home villages after their contracts were over. This system was motivated by the Northern Rhodesian government's fears of "detrribalization." Administrators expected that labour stabilization would accelerate urbanization, reducing

tribal authority and strength. The authorities feared widespread severance of tribal identity could lead to social unrest.

Beyond contractual organization, the Copperbelt mines also introduced the South African dual (skilled and unskilled) labour structure, designed to maximize profits (Mhone, 1982). The mining sector required both skilled and unskilled labour in development, construction, and production. Most Africans lacked formal education and could not supply skilled labour, which was reserved for Europeans through a tight industrial “colour bar” (i.e., strong segregation). Unlike their northern neighbours, African workers in Northern Rhodesia were explicitly barred from medium-skilled jobs. Additionally, investment in African labour skills was simply unprofitable due to the use of seasonal, short-duration contracts.

3 Data

The primary data on development outcomes come from two waves of the Demographic and Health Surveys (DHS), conducted in 2007 and 2014 for the DRC and Zambia (ICF, 2014). Observations are recorded at the individual or household level and grouped into georeferenced DHS clusters. In addition to standard demographic information, the surveys collect detailed data on household wealth, health, and education. I further incorporate variables from the DHS dedicated women’s questionnaires, which cover remuneration, economic decision-making, reproductive health, and attitudes towards domestic violence. These data are then linked to digitized historical concession boundaries, obtained from maps produced by the Belgian Ministry of Colonies for the UMHK (Académie Royale des Sciences d’Outre-Mer, 1954), and by Rhodesian Anglo American for the RC (Frederiksen, 2013). Figure 4 shows the UMHK concession boundary alongside DHS clusters located within 200 km in the DRC; Figure 5 shows the Nkana concession boundary and clusters within 100 km in Zambia.

To control for environmental and spatial heterogeneity, I incorporate a range of geographic variables, compiled into a GIS dataset from diverse sources. The digital elevation model (DEM) and slope data are sourced from the EU’s Copernicus programme and have a spatial resolution of 30 meters. The total ruggedness index originates from Nunn and Puga (2012) and is publicly available. Rainfall data from the Global Climate Database include the first and second moments of monthly precipitation, averaged over twelve months to construct annual measures. Soil quality is computed from soil carbon and nitrogen levels provided by the Atlas of the Biosphere (University of Wisconsin–Madison), using the formula described in the online appendix of Michalopoulos (2012).

I also incorporate data on precolonial societal characteristics from the Ethnographic Atlas (Murdock, 1967), along with measures of exposure to the Atlantic and Indian Ocean slave trades from Nunn and Wantchekon (2011), as proxies for long-run institutional and demographic influences on contemporary development outcomes.

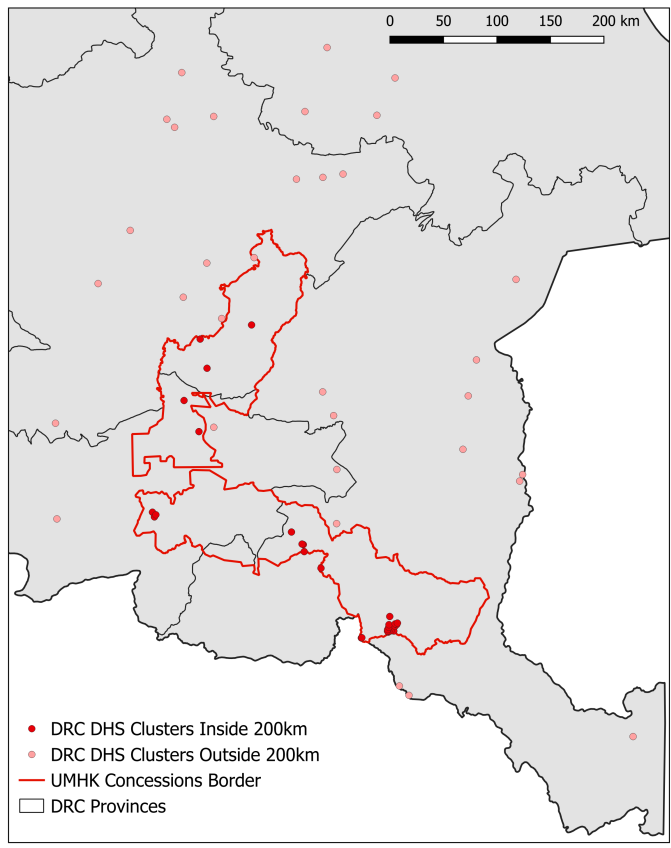


Figure 4: UMHK Concession Boundary and DHS Clusters in the DRC

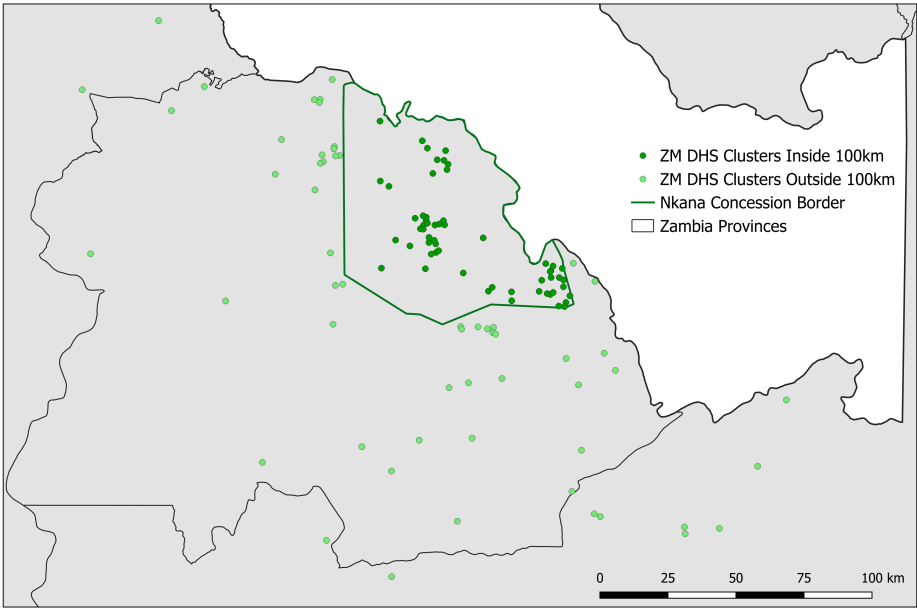


Figure 5: Nkana Concession Boundary and DHS Clusters in Zambia

Historical access to services is captured using data on colonial-era healthcare infrastructure and missionary presence, reconstructed from colonial maps and archival sources for both the Belgian Congo and Northern Rhodesia. Information on healthcare facilities, apothecaries, and missionary posts in the Belgian Congo was digitized from additional maps in the *Atlas du Congo* and georeferenced using QGIS (Académie Royale des Sciences d’Outre-Mer, 1954). Data on healthcare facilities and missionary posts in Northern Rhodesia are sourced from Chiseni (2024). This comprehensive dataset on missionary posts addresses and improves upon the limited spatial accuracy and endogeneity bias present in earlier data on colonial missions in Africa (See Jedwab and Storeygard, 2022).

To proxy contemporary economic activity and population density, I integrate several indicators of urbanization, partly drawn from the DHS. Specifically, nightlights and built-up surface data are included in the DHS auxiliary geo-covariate files at the cluster level (ICF, 2014). The nightlights composite index is measured by the Visible Infrared Imaging Radiometer Suite (VIIRS). Built-up surface data are sourced from the Global Human Settlement Layer (GHSL) project, part of the European Union’s Copernicus programme. Data on electricity and water access are also included in the baseline DHS. Post-independence transportation networks (circa 1968) were digitized from the *Perry-Castaneda Map Collection* in the UT Map Library using QGIS. More recent data on Congolese healthcare and transportation infrastructure (2010) are sourced from *Le Référentiel Géographique Commun*, the DRC’s central GIS repository.

4 Development Outcomes

4.1 Empirical Strategy

I estimate the impact of exposure to colonial concessions and their private corporations on development outcomes using a geographic regression discontinuity (RD) design.

Table 1: UMHK Summary Statistics (200km Bandwidth)

Variable	Outside Concession			Inside Concession		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Panel A: Development Outcomes						
Wealth index	5,642	2.531	1.304	5,096	4.354	1.126
Log(wealth score)	5,642	-6.207	8.726	5,096	7.892	8.567
Years of education	5,624	3.031	3.641	5,080	4.878	4.874
Literacy	1,559	0.538	0.499	1,466	0.839	0.368
Woman ht./age pctl.	543	15.117	20.394	479	30.928	27.870
Child ht./age pctl.	565	23.122	34.458	497	33.188	36.157
Panel B: Women's Empowerment						
Modern use (contraception)	1,057	0.017	0.129	982	0.093	0.290
Modern knowledge (contraception)	1,057	0.799	0.401	982	0.883	0.322
Arguing (domestic violence)	1,024	0.663	0.473	957	0.511	0.500
Refusing sex (domestic violence)	989	0.569	0.495	909	0.403	0.491
Remuneration	859	2.073	0.929	548	2.385	0.940
Household purchases	269	0.770	0.719	397	0.776	0.702
Panel C: Urbanization						
Nightlights	5,642	0.036	0.128	5,096	8.214	7.711
Built-up surface	5,642	0.037	0.107	5,096	0.541	0.362
Electricity	5,642	0.041	0.198	5,096	0.595	0.491
Water	5,642	0.122	0.328	5,096	0.684	0.465

Notes. The table reports summary statistics for the sample restricted to observations within 200km of the UMHK concession boundary. "Outside Concession" refers to units with 'distance' $j = 0$ (control group), and "Inside Concession" refers to units with 'distance' $j = 0$ (treatment group). See notes in Tables [4](#), [5](#) and [13](#) for detailed variable definitions.

The baseline specification is:

$$Y_{i,c} = \alpha + \beta \text{Concession}_{i,c} + f(\text{geolocation}_c) + \gamma \mathbf{X}_i + \epsilon_{i,c} \quad (1)$$

Here, $Y_{i,c}$ is the outcome variable for individual i from DHS cluster c . $\text{Concession}_{i,c}$ is an indicator equal to 1 if DHS cluster c is inside the concession area and 0 otherwise. $f(\text{geolocation}_c)$ is the RD polynomial, controlling for smooth functions of geographic location. \mathbf{X}_i is a vector of individual-level covariates, including sex, age, age squared, and survey year. Finally, $\epsilon_{i,c}$ is the error term, with standard errors clustered at the DHS cluster level.

The baseline specification uses a local linear polynomial in distance to the boundary, estimated separately on each side (Gelman and Imbens, 2019), and follows best practices for spatial regression discontinuities (Calonico et al., 2014a,b; Cattaneo et al., 2016, 2019). This involves calculating the optimal bandwidth through a Mean Squared Error (MSE)-minimizing procedure. For robustness, I also present results using a wider, fixed bandwidth of 200 km, ensuring approximately balanced clusters on either side of the boundary.

The coefficient of interest, β , captures the effect of being located just inside a former colonial concession. Causal interpretation relies on the assumption that concession boundaries are orthogonal to pre-concession local geography and demography. This central continuity assumption is critical for causal identification, as pre-existing differences in geography, culture, or political organization could otherwise confound contemporary development outcomes (e.g., Nunn, 2008; Alsan, 2015; Lowes et al., 2017). Under this assumption, any local discontinuities in outcomes can be attributed to colonial corporate exposure.

To assess whether units on either side of the boundary are valid counterfactuals, I show that geographic and precolonial demographic variables vary smoothly around the concession borders. Table 2 presents summary statistics and RD estimates for geographic variables near the UMHK concession boundaries. This balance test utilizes a 20 km by 20 km cell grid, with variable values averaged for each cell. The RD estimates are derived from a version

Table 2: UMHK Concession Boundary Geography

UMHK	Bandwidth 100 km			RD Estimates	
	Inside	Outside	Std. err.	RD coefficient	Std. err.
	(1)	(2)	(3)	(4)	(5)
Elevation	1133.73	1114.78	(97.19)	-2.93	(132.85)
Ruggedness	106.21	86.39	(8.55)**	-4.74	(21.89)
Rainfall (avg.)	1148.09	1184.69	(24.30)	-10.12	(30.59)
Rainfall (st. dev.)	10.89	11.51	(1.36)	-0.43	(2.62)
Land suitability	96.98	96.48	(0.21)**	0.06	(0.25)
Malaria suitability	6.45	7.04	(1.28)	-0.05	(1.82)

Notes. The unit of observation is a 20 km by 20 km grid cell. Columns (1) and (2) present the mean of the corresponding variable. Column (3) presents clustered standard errors for the difference in means clustered at the territory level. Inside and Outside indicate whether a grid cell is inside or outside the former concession area respectively. Columns (4-5) use the average of all optimal bandwidths (120 km for the UMHK, 24km for the RC) as determined using the procedure suggested by Cattaneo et al. (2019). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

of specification (1), adapted to the grid-cell level by averaging outcomes within each cell. Standard errors are clustered at the territory level for geographic characteristics.

I find that geographic characteristics vary smoothly around the concession boundaries, supporting the validity of the identification assumption. Moreover, most of these geographic characteristics are also balanced over the entire bandwidths. These results strongly suggest that the concession areas were not significantly different from the surrounding regions in terms of geography prior to the concessions.

For pre-colonial demographics, I use ethnic group data from the Ethnographic Atlas (Murdock, 1967). I also incorporate variables related to the Atlantic and Indian slave trade, created by Nunn and Wantchekon (2011) and aggregated at the ethnic group level. Table 3 shows no significant difference in the makeup of pre-colonial demography at or near the UMHK concession boundary. Crucially, the concession boundary does not align with any pre-colonial ethnic group boundaries, further supporting the identification strategy.

A potential concern in this empirical setting is that concession boundaries may correlate with mineral deposits rather than being randomly drawn. However, this does not under-

Table 3: UMHK Concession Boundary Demography

UMHK	Bandwidth 200 km			RD Estimates	
	Inside	Outside	Std. err.	RD coefficient	Std. err.
	(1)	(2)	(3)	(4)	(5)
No. enslaved (Atlantic)	964.97	430.79	(443.49)	327.61	(514.59)
No. enslaved (Indian)	0	223.93	(257.63)	81.39	(92.63)
Population density	-0.51	-0.11	(0.35)	0.02	(0.38)
Centralization	0.77	0.96	(0.19)	-0.11	(0.25)
Polygynous	0.74	0.76	(0.14)	-0.10	(0.32)
Hereditary headman	1	0.96	(0.05)	-0.02	(0.02)

Notes. The unit of observation is a 20 km by 20 km grid cell. Columns (1) and (2) present the mean of the corresponding variable. Column (3) presents clustered standard errors for the difference in means clustered at the ethnic group level. Inside and Outside indicate whether a grid cell is inside or outside the former concession area respectively. Columns (4-5) use the average of all optimal bandwidths (120 km for the UMHK, 24km for the RC) as determined using the procedure suggested by Cattaneo et al. (2019). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

mine identification. Concessions were initially granted as prospecting and exploration zones (e.g., *blocs à droits exclusifs de recherches* in the Belgian Congo; prospecting concessions in Northern Rhodesia), and only later expanded to include mine-specific exploitation rights. As a result, concession boundaries do not systematically align with the location of major mineral deposits, reinforcing the validity of the RD design.

4.2 Results

Exposure to the UMHK is associated with consistently positive long-term development outcomes across household wealth (Panel A), individual education (Panel B), and health indicators (Panel C), as reported in Table 4. Households within the former UMHK concession area are approximately one standard deviation wealthier, individuals attain on average two additional years of schooling, and literacy rates are substantially higher, by approximately 30 percentage points. Women and children are also significantly taller for their age, consistent with improved early-life health and nutritional conditions. These results indicate persistent effects of past colonial corporate policies on contemporary development outcomes.

This wide range of benefits challenges common narratives about the universally extractive nature of colonial concessions in Africa. The fact that these effects remain observable decades after the collapse of the UMHK underscores the durability of corporate institutional environments. The magnitude of these effects – particularly the sharp increase in education and literacy – suggests not only greater investment but also a shift in household-level human capital accumulation, likely tied to the UMHK’s efforts to stabilize and incentivize long-term family settlement. Further, the main findings are robust to alternative specifications, such as using a local quadratic polynomial, as shown in the tables in Appendix A.5.

Figure 6 presents RD plots illustrating discontinuities at the UMHK boundary for each outcome in Table 4. The running variable is the distance to the UMHK concession boundary. A linear fitted trend is estimated on both sides of the discontinuity at the border (0 km). Each plot shows a sharp discontinuity at the boundary, visually supporting a causal interpretation of the main results.

The legacy of the UMHK’s paternalistic policies also extends to women’s contemporary outcomes, an uncommon feature in studies of historical institutional legacies. Gender-related outcomes are markedly better within the former UMHK concession. Women’s ability to access and use modern contraception is a key determinant of their broader life outcomes (Bailey, 2006; Bailey et al., 2012; Bailey and Lindo, 2017). Panel A of Table 5 shows a significantly higher rate of modern contraceptive use in the former concession area. This difference is not driven by greater awareness, as knowledge of modern methods does not vary significantly across the boundary. Importantly, higher contraceptive use is not accompanied by greater acceptance of domestic violence, suggesting broader social empowerment (cf. Ojha and Babbar, 2024). Panel B of Table 5 presents results on female attitudes towards domestic violence. In general, women residing in the former UMHK concession area find domestic violence less justified. Specifically, they more often believe that refusing sex or arguing with their husband does not justify violence.

Table 4: UMHK Concession and Economic Development

	(1)	(2)	(3)	(4)
Panel A: Asset Wealth	Wealth index		Log(wealth score)	
UMHK	2.054***	1.987***	17.099***	16.628***
	(2.603)	(2.848)	(2.763)	(2.947)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	8,992	10,738	8,992	10,738
Clusters	27 28	33 28	26 28	33 28
Bandwidth	121.59	200.00	122.33	200.00
Mean dep. var.	3.609	3.396	1.920	0.484
Std. dev. dep. var.	1.468	1.525	11.050	11.154
Panel B: Education	Years of education		Literacy	
UMHK	2.305**	2.328***	0.337**	0.358***
	(2.524)	(2.837)	(2.415)	(2.852)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	8,962	10,704	2,372	3,025
Clusters	27 28	33 28	27 28	33 28
Bandwidth	118.84	200.00	111.49	200.00
Mean dep. var.	4.095	3.908	0.717	0.684
Std. dev. dep. var.	4.452	4.369	0.450	0.465
Panel C: Health	Woman ht./age pctl.		Child ht./age pctl.	
UMHK	15.769**	16.412**	17.687*	16.138*
	(2.297)	(2.482)	(1.811)	(1.715)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	808	1,022	867	1,062
Clusters	24 28	33 28	25 28	33 28
Bandwidth	110.29	200.00	117.71	200.00
Mean dep. var.	24.624	22.528	28.388	27.833
Std. dev. dep. var.	26.117	25.431	35.607	35.603

Notes. Standard errors are clustered at the DHS cluster level. All regressions include a local linear specification estimated separately on each side of the concession boundary and use a triangular kernel. Optimal bandwidths are chosen using the MSE-minimizing procedure suggested by Cattaneo et al. (2019) and are reported in km. Regressions control for sex, age, age squared, and survey year. Literacy is an indicator variable equal to 0 if the respondent cannot read at all and 1 otherwise. Wealth score is an index generated by the DHS using the principal 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 score. Respondent ht./age pctl. is measured for a subset of female respondents and divides each respondent's height by her age and finds her percentile in the entire sample. Similarly, Child ht./age pctl. was asked to a subset of children and divides each child's height by his or her age and finds his or her percentile in the entire sample. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

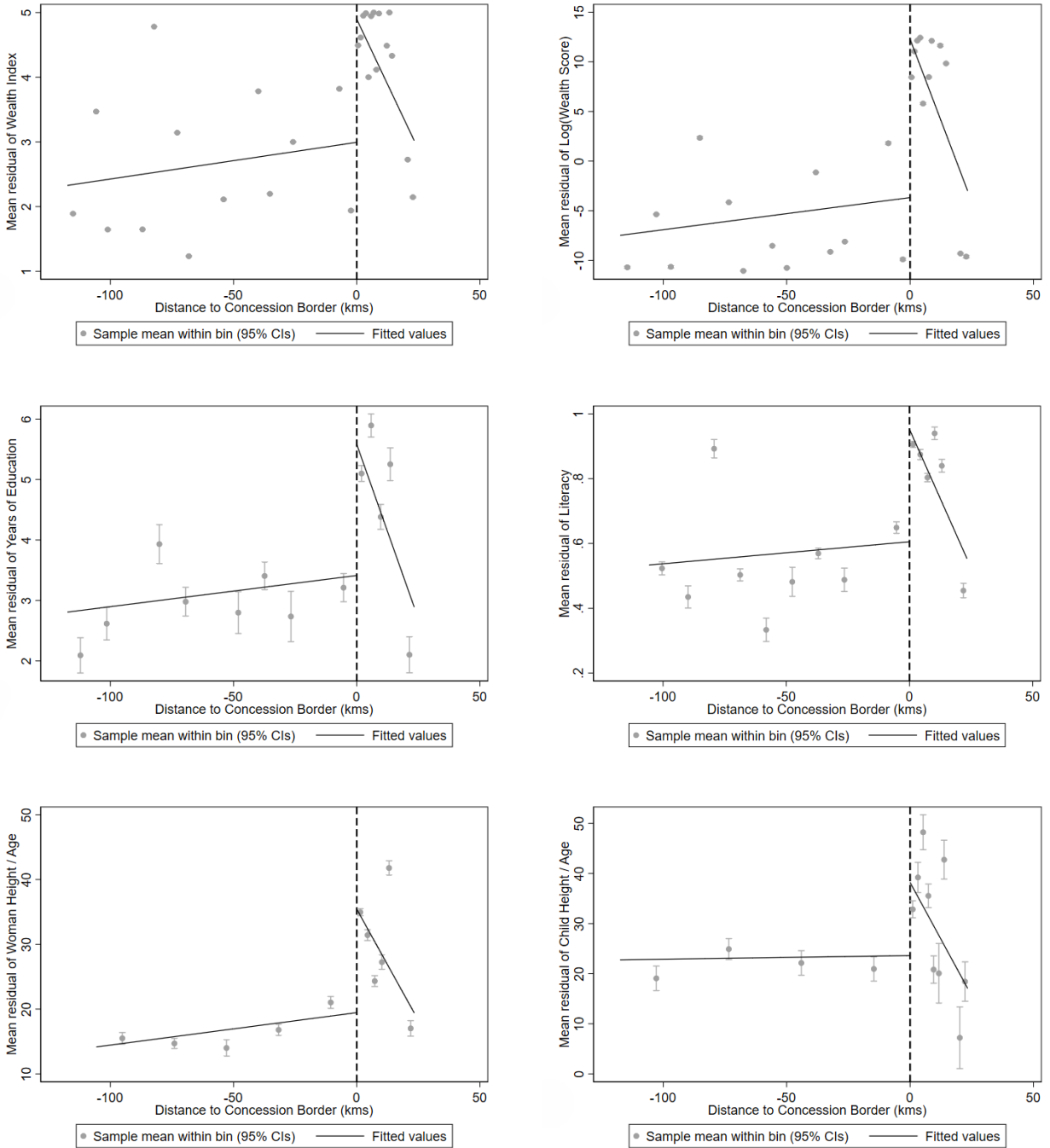


Figure 6: UMHK RD Plots for Development Outcomes

Notes. The figure displays the RD plots for development outcomes and the mean value of each outcome variable at the optimal amount of bins as recommended by Cattaneo et al. (2019) along the running variable (distance to the UMHK concession boundary), including a local linear trend estimated separately on each side of the discontinuity.

Women’s economic outcomes reinforce this positive legacy. Panel C in Table 5 presents gender outcomes in terms of income and expenses. The remuneration variable, serving as an indicator of women’s economic compensation and the formalization of their work, represents an earnings scale ranging from no payment whatsoever, to payments in-kind, to mixed in-kind and cash payments, to full wages in cash. The variables on the expense side of household finance represent the degree to which women have a final say in the decision-making process of both large household purchases and smaller daily purchases. Women are more frequently compensated for their work, with a higher likelihood of receiving cash payments. They also report greater influence over both major and routine household spending decisions.

Taken together, the evidence suggests that women in the former UMHK area enjoy greater reproductive autonomy, better earnings, and more household decision-making power than women in comparable nearby regions. These gendered effects provide suggestive evidence that paternalistic labour institutions, when tied to family settlement and social provisioning, may have unintended but persistent effects on women’s empowerment.

A potential limitation of this analysis is that the DHS data clusters are randomly displaced to maintain the confidentiality of the respondents. This random displacement can be up to 2 km for all urban clusters, up to 5 km for 99% of the rural clusters, and up to 10 km for 1% of the rural clusters. This displacement introduces a specific form of non-classical measurement error in the forcing variable (distance to the boundary). While this complicates the standard interpretation, the resulting misclassification of units near the cutoff is, in this context, still most likely to attenuate the estimated discontinuity. Nonetheless, as noted by Lowes and Montero (2021a), the results of an RD approach may be driven by incorrectly assigned clusters right along the boundary.

Given the narrow shape of the UMHK concession area, “donuthole” estimations excluding clusters near the boundary are impractical. However, as the DHS GPS displacement algorithm does not allow clusters to cross internal administrative boundaries, major urban clusters like Lubumbashi, Likasi, and Kolwezi remain correctly assigned within the conces-

Table 5: UMHK Concession and Women's Outcomes

	(1)	(2)	(3)	(4)
Panel A: Contraception	Modern use		Modern knowledge	
UMHK	0.072**	0.075**	0.145	0.099
	(2.108)	(1.980)	(1.138)	(1.219)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	1,849	2,039	1,683	2,039
Clusters	27 28	33 28	27 28	33 28
Bandwidth	157.81	200.00	120.64	200.00
Mean dep. var.	0.059	0.053	0.858	0.840
Std. dev. dep. var.	0.236	0.225	0.349	0.367
Panel B: Domestic Violence	Arguing		Refusing sex	
UMHK	-0.172**	-0.177**	-0.244***	-0.268***
	(-2.121)	(-2.266)	(-2.569)	(-2.629)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	1,636	1,981	1,560	1,898
Clusters	25 28	33 28	27 28	33 28
Bandwidth	122.11	200.00	121.91	200.00
Mean dep. var.	0.461	0.465	0.475	0.489
Std. dev. dep. var.	0.358	0.361	0.500	0.500
Panel C: Income & Expenses	Remuneration		Household purchases	
UMHK	1.016*	0.872**	0.182**	0.177**
	(1.915)	(2.212)	(2.473)	(2.344)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	1,024	1,407	569	666
Clusters	27 28	33 28	9 12	9 12
Bandwidth	111.72	200.00	114.38	200.00
Mean dep. var.	2.243	2.195	0.766	0.773
Std. dev. dep. var.	0.951	0.945	0.700	0.708

Notes. Standard errors are clustered at the DHS cluster level. All regressions include a local linear specification estimated separately on each side of the concession boundary and use a triangular kernel. Optimal bandwidths are chosen using the MSE-minimizing procedure suggested by [Cattaneo et al. \(2019\)](#) and are reported in km. Regressions control for age, age squared, and survey year. Modern use is an indicator variable equal to 1 if the respondent does use modern contraception methods and 0 otherwise. Similarly, modern knowledge is an indicator variable equal to 1 if the respondent does know of modern contraception methods and 0 otherwise. Arguing and Refusing sex are indicator variables based on the 5 DHS questions on different domestic violence justifications. Remuneration is a 1 to 4 categorical variable where 1 is unremunerated work and 4 is fully cash-based remunerated work. Household purchases is an aggregated 1 to 4 categorical variable representing women's degree of final say in daily purchases and large purchases, ranging from no say to full say. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

sion area. This reduces the risk that misclassification drives the observed discontinuities. As this misclassification of treatment status near the boundary is non-classical, it could theoretically bias the results in either direction; however, in spatial settings, this fuzziness at the cutoff most often leads to an attenuation of the true effect. Accordingly, the estimated discontinuities may represent a lower bound on the true impact.

In sum, these findings collectively provide robust evidence of the enduring positive impacts of the UMHK’s presence, not only on overall economic development and human capital but also on various dimensions of women’s empowerment, highlighting the long-term legacy of colonial corporate governance.

5 Mechanisms of Divergence

5.1 Comparative Development Effects

Assessing whether the lasting effects of the UMHK concession reflect its broader corporate strategies requires a comparison to outcomes under the RC concession. I first compare long-run development outcomes across the UMHK and RC concessions, and then examine how differences in corporate governance help explain the divergence.

The relative effect of exposure to each concession is estimated using a spatial difference-in-discontinuities (diff-in-disc) design. This design estimates δ by fitting linear regressions on either side of each boundary (2×2), following [Grembi et al. \(2016\)](#). The empirical estimation compares the discontinuities at the UMHK boundary to those at the RC boundary, while controlling for differences across the interior and exterior of each concession. This involves estimating two linear regressions on either side of each boundary:

$$\begin{aligned}
 Y_{i,c,b} = & \alpha + \beta \text{Concession}_{i,c,b} + f(\text{geolocation}_{c,b}) + \gamma \mathbf{X}_{i,b} \\
 & + \text{UMHK}_b [\zeta + \delta \text{Concession}_{i,c,b} + f(\text{geolocation}_{c,b}) + \eta \mathbf{X}_{i,b}] + \epsilon_{i,c,b}
 \end{aligned}
 \tag{2}$$

where the coefficient of interest is δ . $Y_{i,c,b}$ is the outcome for individual i in cluster c near

boundary b . $UMHK_b$ is an indicator equal to 1 if the observation is located near the UMHK concession boundary and 0 otherwise. $\epsilon_{i,c,b}$ is the error term. Other variables follow the baseline specification, with the addition of the concession boundary indicator b , analogous to the post-treatment indicator in standard diff-in-disc settings (Grembi et al., 2016).

Appendix A.2 shows that geographic and precolonial characteristics vary smoothly across both concession boundaries, supporting the identification strategy. Appendix A.3 also addresses potential contamination from the obsolete RCBC. For the comparison to be valid, the colonial border must not have been determined by mineral endowments. Otherwise, any observed divergence could reflect initial resource inequality rather than institutional differences.

Historical accounts confirm that the border reflected factors like hunting grounds and river basins, not mineral deposits (Gordon, 2001). For example, negotiations with local chiefs emphasized hunting rather than control over resources. The Congo pedicle – the only area of real contention – lacked significant mineral deposits. Instead, most copper ore deposits lie further west, where the border was easily determined by the Congo-Zambezi river watershed. Moreover, the region’s true mining potential was only discovered more than a decade after the boundary was drawn.

Table 6 reports the diff-in-disc estimates for key household and individual outcomes. Discontinuities are consistently larger at the UMHK boundary, indicating stronger long-run effects. The only exception is children’s height, where the relative difference is less pronounced. This weaker finding may reflect the influence of more immediate, non-institutional determinants of child welfare across both concessions, which will be explored in the following section.

The broader pattern supports the interpretation that UMHK’s institutional model generated more durable development gains, while the RC’s approach left fewer lasting benefits for its communities. The full regression discontinuity results for each concession are available in Appendix A.4. Together, these findings point to differences in corporate institutions – not

Table 6: Difference-in-Discontinuities and Economic Development

UMHK	Bandwidth 50 km		Bandwidth 100 km	
	DiDisc coefficient	Std. err.	DiDisc coefficient	Std. err.
	(1)	(2)	(3)	(4)
Panel A: Asset Wealth				
Wealth index	1.675	(0.049) ^{***}	1.266	(0.039) ^{***}
Log(wealth score)	14.393	(0.299) ^{***}	11.572	(0.250) ^{***}
Panel B: Education				
Years of education	1.715	(0.175) ^{***}	1.494	(0.144) ^{***}
Literacy	0.236	(0.044) ^{***}	0.220	(0.037) ^{***}
Panel C: Health				
Woman ht./age pctl.	10.938	(4.624) ^{**}	11.576	(3.790) ^{***}
Child ht./age pctl.	8.144	(6.054)	9.389	(5.142) [*]

Notes. Columns (1) and (3) present the Difference-in-Discontinuity coefficients, respectively using 50 km and 100 km bandwidths. These coefficients are interpreted as the effect on the discontinuity of being at the border of the UMHK concession, with the RC concession boundary acting as baseline. Columns (2) and (4) display the corresponding standard errors. Regressions control for sex, age, age squared, and survey year. Wealth score is an index generated by the DHS using the principal 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 score. Literacy is an indicator variable equal to 0 if the respondent cannot read at all and 1 otherwise. Respondent ht./age pctl. is measured for a subset of female respondents and divides each respondent’s height by her age and finds her percentile in the entire sample. Similarly, Child ht./age pctl. was asked to a subset of children and divides each child’s height by his or her age and finds his or her percentile in the entire sample. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

geography or resources – as the key driver of divergent long-run development trajectories. The next section explores the institutional and spatial channels through which the divergence persisted.

5.2 Paths to Persistence

The central institutional divergence between the UMHK and RC concessions lies in their distinct corporate responses to a shared constraint: the inability to use wages as a competitive instrument. These divergent strategies shaped not only immediate labour conditions but also produced lasting differences in urban formation and infrastructural development. While existing literature identifies labour policy as a key determinant of colonial institutions’ developmental legacies (Chiovelli et al., 2025), this paper highlights a novel, indirect

channel: corporate labour strategies influenced the pace and permanence of urbanization, thereby shaping the spatial distribution and durability of public infrastructure.

The most direct channel through which firms could have differentiated their labour policies was through wage setting, particularly by offering higher direct compensation. However, a system of wage coordination was implemented across the Central African Copperbelt in the early 1930s. Mining corporations in both the Belgian Congo and Northern Rhodesia agreed to harmonize pay scales to avoid competition for labour. This arrangement rendered wages locally non-instrumental as a recruitment tool. Importantly, this coordination did not suppress overall compensation: Copperbelt miners remained among the best-paid manual labourers in Sub-Saharan Africa (Juif and Frankema, 2018).

In the absence of wage competition, the colonial mining corporations operating in the Central African Copperbelt were compelled to adopt alternative strategies for attracting and retaining labour. The Belgian colonial vision emphasized paternalism, while the British approach was more narrowly extractive. These ideological differences gave rise to distinct institutional responses to labour scarcity on either side of the border. As a result, the non-wage benefits provided to Copperbelt miners began to diverge markedly from the late 1930s onward, with only partial convergence by the time of independence.

The UMHK invested heavily in healthcare provision for its employees and their families. Column (1) of Table 7 indicates a higher density of healthcare facilities and apothecaries within the former UMHK concession area relative to the surrounding region in 1953. By contrast, similar incentives were largely absent in the RC concession, where firms operated under short-term labour contracts that undermined the rationale for long-term welfare investment. As a result, the RC provided only limited healthcare services. Column (2) of Table 7 reflects this divergence, suggesting a lower concentration of healthcare facilities inside the former RC concession area compared to adjacent regions.

Documenting direct corporate investment in education is more challenging, as these services were primarily outsourced to missionaries and religious organizations. Columns (4-7)

of Table 7 offer only weak and statistically insignificant evidence of systematic differences in missionary presence across the two concession areas. This suggests that missionary presence may be an incomplete proxy for educational investment, or that the large, persistent gains in education were driven by a demand-side shift. The UMHK’s “Labour Stabilization Programs,” by fostering permanent family resettlement, likely created a stable, urbanized population with a higher incentive to invest in their children’s human capital, a channel consistent with the broader findings on community stability.

In addition to their direct impacts on human capital and health via education and health-care provision, differences in labour policy influenced broader demographic and spatial patterns. In particular, corporate labour strategies shaped migration and settlement decisions, contributing to a higher rate of urbanization within concession areas. These investments encouraged not only individual labour migration but also the migration of miners’ families, fostering deeper social ties and more permanent settlement within the UMHK concession. Such family-based settlement patterns contributed to the development of more cohesive and stable urban communities, in contrast to the temporary miners’ compounds typical of the RC concession.

The RC’s circular migration model did more than just hinder urbanization; it actively created a distinct and unstable social fabric. By actively discouraging permanent settlement, the RC fostered a demographic imbalance heavily skewed toward male labourers. Historical and anthropological literature (e.g. Chauncey, 1981; Parpart, 1986; Ferguson, 1999) highlights how these temporary, male-dominated compounds created a high demand for female-provided services, leading to precarious gender relations and the prevalence of prostitution rather than stable family formation. This provides a social mechanism for the absence of the positive, long-term women’s empowerment effects that were generated by the UMHK’s family-based policies.

This demographic transformation was not just a policy goal but a documented reality: the share of women and children in UMHK compounds rapidly increased, with the female-

Table 7: Concessions and Labour Policy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Healthcare facilities	Apothecaries	in 1924	Missionary Posts	in 1950	
UMHK	0.033** (2.572)	0.102** (2.586)	0.053 (1.429)	-0.007 (-1.098)	0.074* (1.835)		
RC		-0.030* (-1.857)				0.151* (1.959)	
Missionary posts in 1924					0.513*** (3.723)	1.940*** (84.796)	
Bandwidth choice	Wide	Wide	Wide	Wide	Wide	Wide	Wide
Observations	832	154	832	832	154	832	154
Clusters	18	18	18	18	18	18	18
Bandwidth	200.00	100.00	200.00	200.00	100.00	200.00	100.00

Notes. The unit of observation is a 20 km by 20 km grid cell. Columns (1-3-4-6) report cross-sectional results for the UMHK concession (DRC) within a bandwidth of 200 km, and Columns (2-5-7) report cross-sectional results for the RC concession (Zambia) within a bandwidth of 100 km. The dependent variable is the number of facilities or missionary posts in each grid cell. Standard errors are clustered at the territory level. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Difference-in-Discontinuities and Agglomeration

UMHK	Bandwidth 50 km		Bandwidth 100 km	
	DiDisc coefficient	Std. err.	DiDisc coefficient	Std. err.
	(1)	(2)	(3)	(4)
Panel A: Urbanization				
Nightlights	7.830	(0.034) ^{***}	7.150	(0.027) ^{***}
Built surface	0.775	(0.002) ^{***}	0.705	(0.001) ^{***}
Panel B: Infrastructure				
Electricity	0.740	(0.014) ^{***}	0.664	(0.013) ^{***}
Water	0.698	(0.024) ^{***}	0.512	(0.022) ^{***}

Notes. Columns (1) and (3) present the Difference-in-Discontinuity coefficients, respectively using 50 km and 100 km bandwidths. These coefficients are interpreted as the effect on the discontinuity of being at the border of the UMHK concession, with the RC concession boundary acting as baseline. Columns (2) and (4) display the corresponding standard errors. Regressions control for sex, age, age squared, and survey year. Nightlights measures the luminosity of an area during the nighttime hours as measured by the Visible Infrared Imaging Radiometer Suite (VIIRS) (ICF, 2014). Built-up surface is an index ranging from 0.00 (extremely rural) to 1.00 (extremely urban), obtained from the Global Human Settlement Layer (GHSL) project. Electricity and water are indicator variables equal to 1 if the household respectively has access to electricity or piped water (into the dwelling, yard, the neighbour’s dwelling, or a public tap) and 0 otherwise. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

to-male ratio rising from 28% to over 80% and the number of children per worker doubling in the program’s first decade (Juif and Frankema, 2018). This early divergence in family-based settlement seems to have provided the social foundation for the persistent differences observed today.

Urbanization can generate significant welfare gains through agglomeration economies (Duranton and Puga, 2004; Melo et al., 2009; Donovan et al., 2024). Such economies arise from the benefits firms and industries derive from geographical concentration, including shared infrastructure, access to labour pools, and knowledge spillovers (Puga, 2010).

Panel A of Table 8 reveals that the former UMHK concession area is persistently more urbanized relative to its surroundings today than the former RC concession area. This pattern suggests that superior development outcomes may be partially explained by a greater capacity to realize the benefits of agglomeration economies. Panel B of the same table provides further evidence, indicating that utility infrastructure in the UMHK area has not suffered from significant congestion despite its higher urban density. Together, these findings imply

that the early company-driven urban model not only promoted greater urbanization but also established a foundation for more resilient public service provision. UMHK’s investments in healthcare and housing encouraged family migration and long-term settlement, embedding an urban character that has persisted well beyond the colonial period.

However, the benefits of agglomeration economies in developing countries are not unambiguously positive. Rapid urbanization and industrial clustering often generate environmental and social externalities, including congestion, pollution, crime, and rising living costs, which can offset productivity gains (Grover et al., 2023). Consequently, while agglomeration economies remain a powerful driver of development and structural transformation, the effectiveness of these clusters was contingent upon colonial corporate policies and infrastructure investments.

The concept of offsetting dis-economies may also explain the more ambiguous health findings. As noted earlier in Table 6, the relative developmental discontinuity for children’s height, while positive, was less pronounced than for wealth or education. This is consistent with a model where the UMHK’s urbanization drive simultaneously generated positive agglomeration economies (boosting wealth) and negative congestion externalities (partially offsetting health gains via a more complex urban disease environment).

To formally test urbanization as the primary mediating channel, Table 9 repeats the baseline analysis while controlling for a contemporary ‘Urban Household’ indicator. The results are striking: after controlling for current urban status, the UMHK concession coefficient becomes small and statistically insignificant for virtually all major development outcomes, including wealth, education, and health. This finding provides strong evidence for the mechanism. It demonstrates that the historical, corporate-driven divergence in settlement patterns and urbanization fully accounts for the positive development discontinuities observed today.

In sum, these findings reveal a novel mechanism through which colonial corporate labour policies generated persistent developmental legacies. Beyond their immediate effects on worker welfare, labour strategies profoundly shaped long-run patterns of urbanization and

Table 9: Mechanism Test: Urbanization as a Mediator

	(1)	(2)	(3)	(4)
Panel A: Asset Wealth	Wealth index		Log(wealth score)	
UMHK	2.054*** (2.603)	0.312 (1.484)	17.099*** (2.763)	1.876*** (2.822)
Urban Household		2.267*** (13.530)		19.982*** (24.419)
Bandwidth choice	Optimal	Optimal	Optimal	Optimal
Observations	8,992	8,522	8,992	8,206
Clusters	27 28	27 28	26 28	26 28
Bandwidth	121.59	106.20	122.33	98.97
Panel B: Education	Years of education		Literacy	
UMHK	2.305** (2.524)	0.252 (0.681)	0.337** (2.415)	0.015 (0.928)
Urban Household		2.576*** (7.922)		0.409*** (8.697)
Bandwidth choice	Optimal	Optimal	Optimal	Optimal
Observations	8,962	8,962	2,372	2,458
Clusters	27 28	26 28	27 28	26 28
Bandwidth	118.84	123.62	111.49	116.56
Panel C: Health	Woman ht./age pctl.		Child ht./age pctl.	
UMHK	15.769** (2.297)	2.127 (1.302)	17.687* (1.811)	12.747 (1.531)
Urban Household		17.197*** (4.786)		6.618 (1.089)
Bandwidth choice	Optimal	Optimal	Optimal	Optimal
Observations	808	808	867	823
Clusters	24 28	24 28	25 28	25 28
Bandwidth	110.29	115.39	117.71	114.16

Notes. This table tests urbanization as the primary mechanism. Columns (1) and (3) report the baseline optimal bandwidth results from Table 4. Columns (2) and (4) report results from the same specification but add an indicator variable for whether the DHS cluster is classified as urban. "Standard Controls" (included in all regressions) are sex, age, age squared, and survey year. All regressions use a local linear specification and a triangular kernel. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

infrastructure development. Wage coordination constrained direct compensation across the Copperbelt, but divergent colonial ideologies resulted in contrasting approaches to non-wage labour incentives, healthcare investment, and settlement policies. These institutional differences fostered a more urbanized, resilient community in the UMHK concession area, facilitating sustainable structural transformation. This analysis underscores the importance of accounting for the interactions between labour policy, urbanization, and infrastructure in both historical and contemporary development contexts.

Furthermore, while colonial transportation networks are often considered a key driver of development, they do not explain the persistent effects here. Appendix A.6 shows that extractive, mine-to-port infrastructure was not the source of long-run local prosperity.

6 Conclusion

This paper uncovers how divergent labour policies of colonial corporations in neighbouring Belgian and British private concessions within the Central African Copperbelt have generated persistent developmental disparities that endure to this day. Leveraging a spatial regression discontinuity design, I show that the paternalistic labour stabilization strategy pursued by the UMHK – contrasted with the RC’s more extractive approach – fostered not only improved health and education outcomes but also a higher rate of urbanization that facilitated durable infrastructure and agglomeration benefits.

Notably, these results reveal a novel mechanism linking labour policies to long-run development through their influence on settlement patterns and urban resilience, a channel that appears more durable than investments in extractive transportation infrastructure. This finding challenges conventional narratives that focus narrowly on direct wage effects or infrastructure investment alone. Instead, corporate labour institutions played a formative role in shaping the spatial and social fabric underpinning sustained socio-economic development. Moreover, the UMHK’s labour stabilization approach generated enduring positive effects on

women's empowerment, underscoring the critical, often overlooked role of gendered corporate policies in shaping broader social development trajectories.

The implications extend beyond historical analysis and speak directly to contemporary policy. Many 21st-century foreign investment schemes, such as "resource-for-infrastructure" deals and the "enclave" mining models often associated with Chinese investment, functionally replicate the Rhokana Corporation's (RC) framework. These projects are frequently characterized by an imported labour force, minimal local economic integration, and a narrow focus on "mine-to-port" transportation infrastructure, a strategy this paper shows failed to generate broad-based local development.

The divergent legacies documented here serve as a powerful historical warning: an extractive model that neglects local labour inclusion, skills development, and community stabilization is unlikely to foster the durable agglomeration economies or social foundations necessary for broad-based, persistent development. The contrast suggests that sustainable growth requires integrated approaches that consider how labour policies interact with urbanization and infrastructure, and that view local community investment not merely as a cost, but as the central mechanism for long-run success.

Looking ahead, this study points to the importance of incorporating labour and social dimensions – including gender – into both historical institutional research and current development policy design, particularly by exploring how these dynamics play out in other contexts and how policy interventions might replicate the positive aspects of inclusive labour models while avoiding their colonial-era drawbacks.

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Appendix A.1 Timelines

Figures 7 and 8 provide detailed operational timelines that visually map the major historical milestones for the two concessionary companies: the Union Minière du Haut-Katanga (UMHK) and the Rhokana Corporation (RC). The first timeline traces the history of the UMHK from its establishment in 1906, through the introduction of its "Labour Stabilization Programs" following the Great Depression, to its nationalization in 1966. In parallel, the second timeline charts the history of the RC, which was formed through a merger in 1931 and operated until 1969.

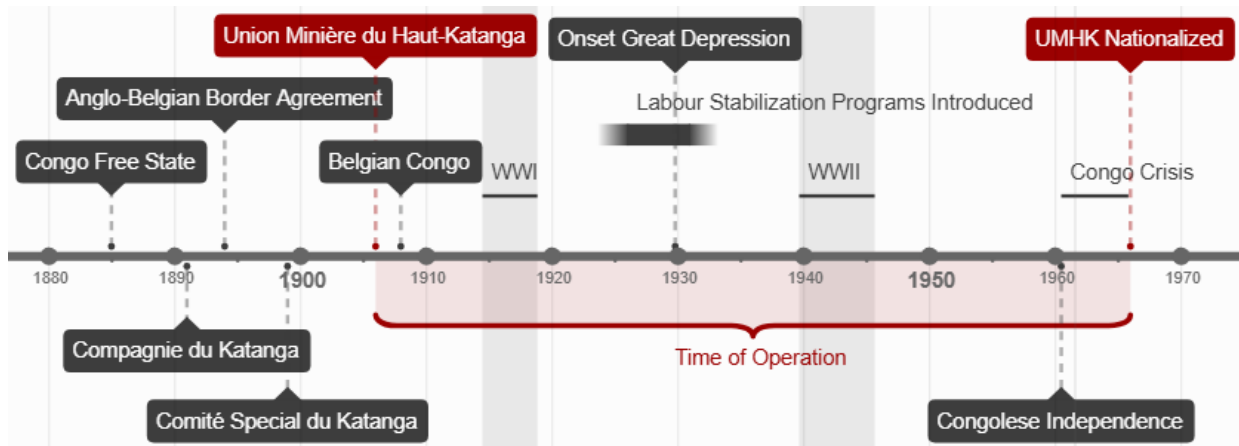


Figure 7: UMHK Concession Timeline

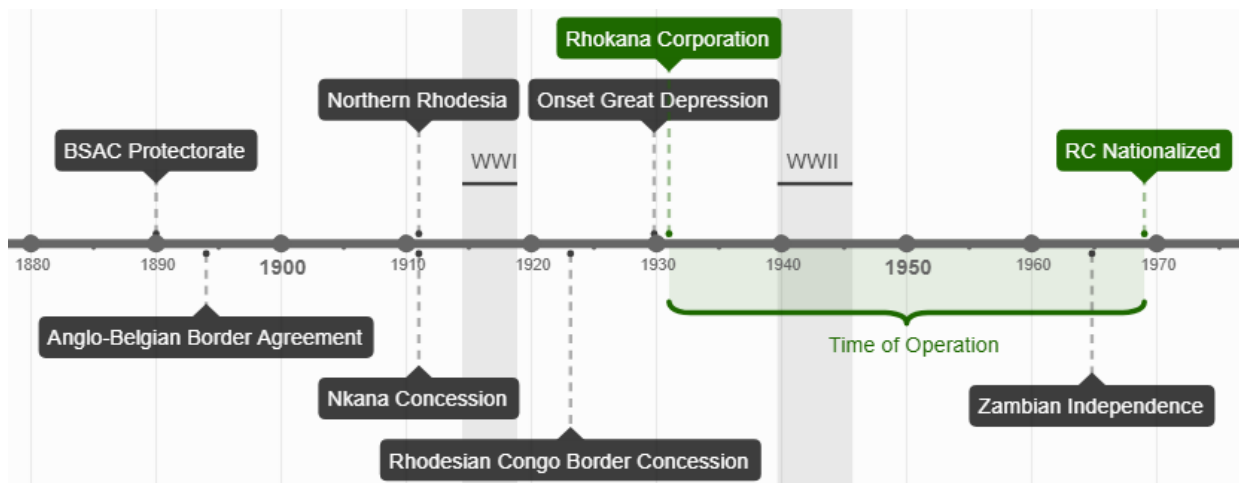


Figure 8: RC Concession Timeline

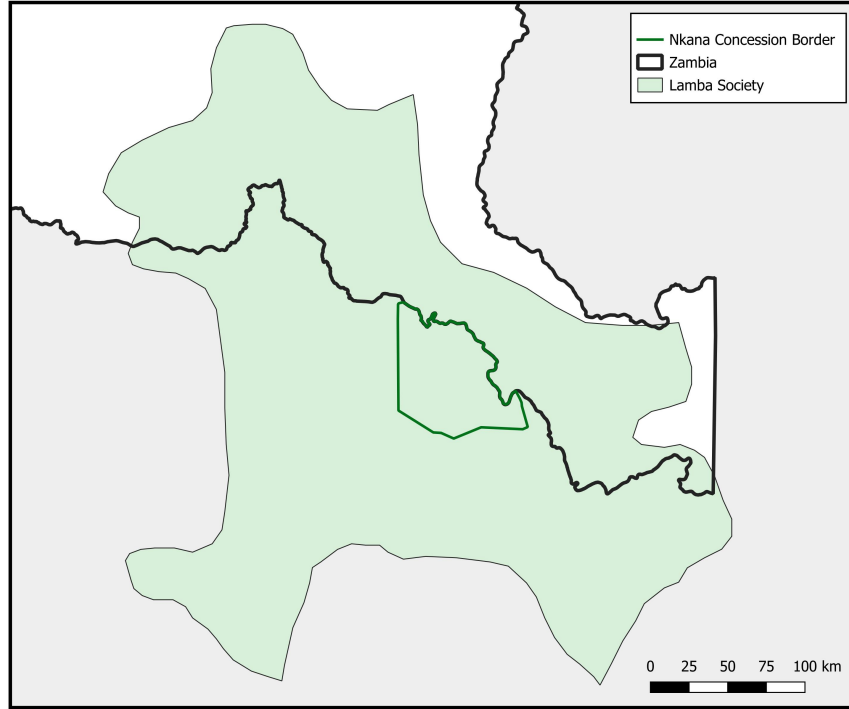


Figure 9: RC Concession Boundary and the Lamba Ethnic Group

Appendix A.2 Balance Tests

Table [11](#) presents summary statistics and estimates of geographic variables near the RC concession boundary. Further, for the RC concession boundary, Figure [9](#) shows that it is trivial to prove the balance of pre-colonial characteristics. The concession (including the 100km bandwidth around it) lies wholly inside the Lamba ethnic group of the EA. Neither does the concession coincide with any contemporary administrative borders.

The central continuity assumption should also hold between the concessions of both colonies for the spatial difference-in-discontinuity design to be valid. This implies that there should not be any geographic or pre-colonial demographic difference-in-discontinuities for both the concession boundaries. Table [12](#) presents difference-in-discontinuity balance tests for the geographic characteristics, using the RD coefficients from Table [2](#) and Table [11](#) at 50km and 100km bandwidths. There is no sign of any large differences in geographic discontinuities around the concession boundaries.

Table 10: RC Summary Statistics (100km Bandwidth)

Variable	Outside Concession			Inside Concession		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Panel A: Development Outcomes						
Wealth index	7,233	3.071	1.346	6,970	4.238	0.921
Log(wealth score)	7,233	-2.482	10.820	6,970	7.605	8.463
Years of education	7,201	4.155	4.162	6,933	5.850	4.710
Literacy	2,622	0.752	0.432	2,890	0.891	0.312
Woman ht./age pctl.	1,377	27.207	25.006	1,556	29.813	25.793
Child ht./age pctl.	1,155	25.742	34.179	923	26.798	32.830
Panel B: Women's Empowerment						
Modern use (contraception)	470	0.560	0.497	488	0.619	0.486
Modern knowledge (contraception)	1,365	0.982	0.131	1,530	0.989	0.105
Arguing (domestic violence)	1,330	0.575	0.547	1,473	0.394	0.536
Refusing sex (domestic violence)	1,280	0.473	0.553	1,411	0.325	0.520
Remuneration	674	2.206	1.258	724	2.448	1.135
Household purchases	843	0.744	0.693	782	0.870	0.649
Panel C: Urbanization						
Nightlights	7,233	2.231	4.114	6,970	7.638	6.496
Built-up surface	7,233	0.176	0.300	6,970	0.401	0.280
Electricity	7,193	0.230	0.421	6,970	0.549	0.498
Water	1,363	0.278	0.448	1,530	0.622	0.485

Notes. The table reports summary statistics for the sample restricted to observations within 100km of the RC concession boundary. "Outside Concession" refers to units with 'distance' $j = 0$ (control group), and "Inside Concession" refers to units with 'distance' $j = 0$ (treatment group). See notes in Tables [4](#), [5](#) and [13](#) for detailed variable definitions.

Table 11: RC Concession Boundary Geography

RC	Bandwidth 50 km			RD Estimates	
	Inside	Outside	Std. err.	RD coefficient	Std. err.
	(1)	(2)	(3)	(4)	(5)
Elevation	1266.40	1260.77	(17.21)	-33.29	(29.16)
Ruggedness	72.54	75.40	(9.20)	0.57	(5.37)
Rainfall (avg.)	1224.61	1167.70	(9.18) ^{***}	7.27	(7.74)
Rainfall (st. dev.)	5.56	8.37	(0.68) ^{***}	-1.42	(2.45)
Land suitability	96.91	96.99	(0.04) [*]	-0.05	(0.04)
Malaria suitability	4.00	4.27	(0.18)	0.07	(0.44)

Notes. The unit of observation is a 20 km by 20 km grid cell. Columns (1) and (2) present the mean of the corresponding variable. Column (3) presents clustered standard errors for the difference in means clustered at the territory level. Inside and Outside indicate whether a grid cell is inside or outside the former concession area respectively. Columns (4-5) use the average of all optimal bandwidths (120 km for the UMHK, 24km for the RC) as determined using the procedure suggested by Cattaneo et al. (2019). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Double Concession Boundary Geography

UMHK	Within 50 km		Within 100 km	
	DiD coefficient	Std. err.	DiD coefficient	Std. err.
	(1)	(2)	(3)	(4)
Elevation	-18.16	(52.27)	-11.70	(41.95)
Ruggedness	-5.89	(13.59)	-3.56	(10.91)
Rainfall (avg.)	-23.87	(12.41) [*]	-31.82	(10.22) ^{***}
Rainfall (st. dev.)	0.92	(2.26)	2.79	(2.04)
Land suitability	0.06	(0.11)	0.13	(0.10)
Malaria suitability	0.18	(0.67)	0.30	(0.53)

Notes. The unit of observation is a 20 km by 20 km grid cell. Columns (1) and (3) present the Difference-in-Discontinuity coefficients, using the RD coefficients from Table 2 and Table II. This coefficient is interpreted as the effect on the discontinuity of being at the border of the UMHK concession, with the RC concession boundary acting as baseline. Columns (2) and (4) display the corresponding standard errors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix A.3 Concession Contamination

Figure 10 provides additional historical context, showing the obsolete Rhodesia Congo Border Concession (RCBC), which fully contained the smaller Nkana concession. The paper’s analysis focuses exclusively on the Nkana boundary, representing the Rhokana Corporation’s effective sphere of influence. The larger RCBC boundary does not contaminate any findings, as virtually all data clusters used in the Nkana analysis lie entirely within its territory, precluding any confounding effects from the outer border.

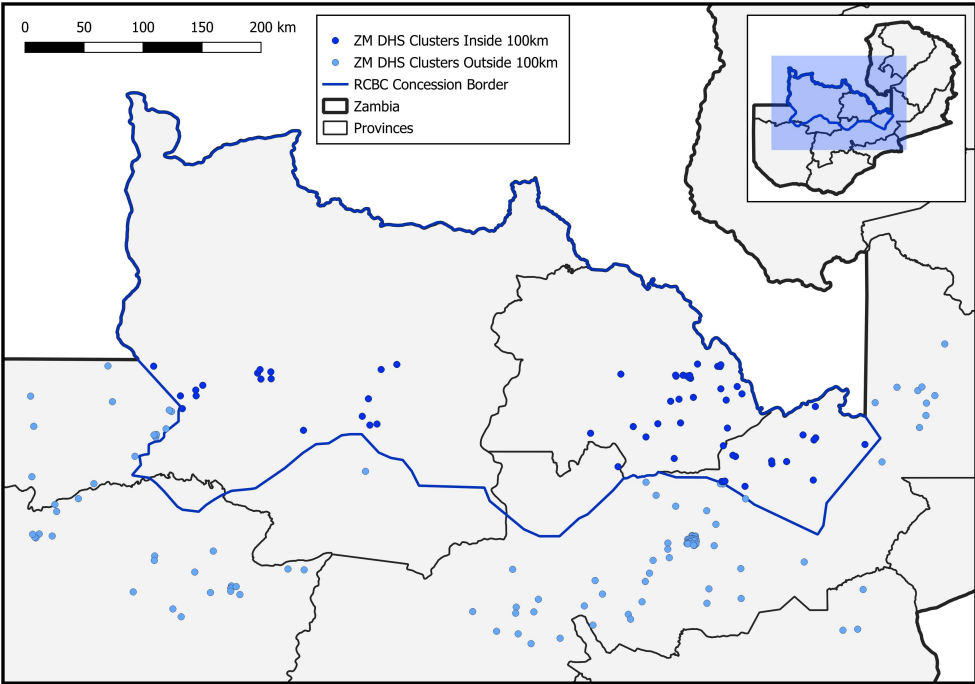


Figure 10: RCBC Concession Boundary and DHS Clusters

Appendix A.4 Full Individual RD Regressions

This appendix section provides the complete regression discontinuity (RD) estimates for outcomes at the individual concession level. The following tables (13 through 16) detail the specific discontinuities found at the borders of the UMHK and RC concessions for agglomeration, development, and gender-related outcomes. These individual estimates are the component results that are synthesized and formally compared in the difference-in-discontinuities analyses in the main body of the paper.

A key finding of this paper, detailed in the Tables 13 through 16, is the consistent lack of statistically significant discontinuities at the Rhokana Corporation (RC) boundary. This "null effect" across development, gender, and agglomeration outcomes warrants careful interpretation.

Given the RC's documented extractive policies (its reliance on seasonal contracts, active discouragement of permanent family settlement, and enforcement of a rigid "colour bar") one might have expected to find persistent negative developmental effects, similar to other extractive institutions in the literature.

However, the "null" finding is a comparative result. It signifies that the region inside the RC concession is not measurably different from the region just outside it. This implies that the baseline colonial framework in the rest of Northern Rhodesia was itself sufficiently non-developmental that the RC's corporate model did not constitute a comparatively worse regime. This interpretation strengthens the paper's central Diff-in-Disc finding: the observed divergence is not driven by a negative RC legacy, but by a positive and unique institutional legacy created by the UMHK's Labour Stabilization Programs.

Appendix A.5 Alternative Specifications

The paper's baseline findings demonstrate considerable robustness, holding firm against several alternative specifications of the regression discontinuity (RD) design. A primary check

Table 13: UMHK Concession and Agglomeration

	(1)	(2)	(3)	(4)
Panel A: Urbanization	Nightlights		Built-up surface	
UMHK	9.428***	9.479***	0.662***	0.654***
	(3.990)	(3.939)	(4.584)	(4.609)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	9,660	10,738	9,772	10,738
Clusters	26 28	33 28	27 28	33 28
Bandwidth	152.09	200.00	156.72	200.00
Mean dep. var.	4.354	3.917	0.304	0.277
Std. dev. dep. var.	6.929	6.701	0.369	0.363
Panel B: Utilities	Electricity		Water	
UMHK	0.751***	0.741***	0.667***	0.656***
	(4.326)	(4.435)	(3.506)	(3.232)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	9,772	10,738	9,174	10,738
Clusters	27 28	33 28	27 28	33 28
Bandwidth	160.08	200.00	132.49	200.00
Mean dep. var.	0.334	0.304	0.439	0.389
Std. dev. dep. var.	0.472	0.460	0.496	0.488

Notes. Standard errors are clustered at the DHS cluster level. All regressions include a local linear specification estimated separately on each side of the concession boundary and use a triangular kernel. Optimal bandwidths are chosen using the MSE-minimizing procedure suggested by Cattaneo et al. (2019) and are reported in km. Regressions control for sex, age, age squared, and survey year. Nightlights measures the luminosity of an area during the nighttime hours as measured by the Visible Infrared Imaging Radiometer Suite (VIIRS) (ICF, 2014). Built-up surface is an index ranging from 0.00 (extremely rural) to 1.00 (extremely urban), obtained from the Global Human Settlement Layer (GHSL) project. Electricity and water are indicator variables equal to 1 if the household respectively has access to electricity or piped water (into the dwelling, yard, the neighbour's dwelling, or a public tap) and 0 otherwise. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

involves substituting the baseline local linear polynomial with a local quadratic polynomial to ensure the results are not driven by the specific functional form. Table 17 confirms that the positive and statistically significant discontinuities in wealth, education, and health at the former UMHK boundary persist under the quadratic model. Similarly, Table 18 shows that the null effects observed at the RC boundary also hold, with no significant discontinuities emerging. Furthermore, the results are stable across different bandwidth selection procedures. The main analysis consistently presents findings using both an optimal bandwidth calculated via a Mean Squared Error minimizing procedure and a wider, fixed bandwidth. The consistency of the results across these different bandwidths demonstrates that the findings are not an artifact of a specific sample size around the cut-off.

Table 14: RC Concession and Economic Development

	(1)	(2)	(3)	(4)
Panel A: Asset Wealth	Wealth index		Log(wealth score)	
RC	-0.144	0.325	-0.212	3.300
	(-0.411)	(1.142)	(-0.069)	(1.336)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	11,228	14,203	11,464	14,203
Clusters	35 58	59 58	37 58	59 58
Bandwidth	44.11	100.00	44.86	100.00
Mean dep. var.	3.947	3.644	4.792	2.468
Std. dev. dep. var.	1.155	1.296	10.233	10.963
Panel B: Education	Years of education		Literacy	
RC	0.009	0.423	-0.039	0.041
	(0.017)	(0.898)	(-0.731)	(0.921)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	11,416	14,134	4,498	5,512
Clusters	37 58	59 58	34 58	59 58
Bandwidth	49.07	100.00	40.44	100.00
Mean dep. var.	5.424	4.987	0.857	0.825
Std. dev. dep. var.	4.617	4.519	0.350	0.380
Panel C: Health	Woman ht./age pctl.		Child ht./age pctl.	
RC	1.210	1.169	3.873	4.058
	(0.426)	(0.449)	(1.095)	(1.319)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	2,678	2,933	1,658	2,078
Clusters	48 58	59 58	41 58	59 58
Bandwidth	83.87	100.00	58.35	100.00
Mean dep. var.	29.295	28.590	26.411	26.211
Std. dev. dep. var.	25.580	25.456	33.336	33.583

Notes. Standard errors are clustered at the DHS cluster level. All regressions include a local linear specification estimated separately on each side of the concession boundary and use a triangular kernel. Optimal bandwidths are chosen using the MSE-minimizing procedure suggested by Cattaneo et al. (2019) and are reported in km. Regressions control for sex, age, age squared, and survey year. Literacy is an indicator variable equal to 0 if the respondent cannot read at all and 1 otherwise. Wealth score is an index generated by the DHS using the principal 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 score. Respondent ht./age pctl. is measured for a subset of female respondents and divides each respondent's height by her age and finds her percentile in the entire sample. Similarly, Child ht./age pctl. was asked to a subset of children and divides each child's height by his or her age and finds his or her percentile in the entire sample. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15: RC Concession and Gender Outcomes

	(1)	(2)	(3)	(4)
Panel A: Contraception	Modern use		Modern knowledge	
RC	0.094	0.130	0.002	0.002
	(0.575)	(0.870)	(0.089)	(0.100)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	1,849	2,039	1,683	2,039
Clusters	26 29	32 29	22 29	32 29
Bandwidth	160.49	200.00	123.28	200.00
Mean dep. var.	0.059	0.053	0.858	0.840
Std. dev. dep. var.	0.236	0.225	0.349	0.367
Panel B: Domestic Violence	General		Refusing Sex	
RC	-0.035	-0.127**	-0.066	-0.134**
	(-0.576)	(-2.529)	(-0.983)	(-2.541)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	1,432	1,852	1,560	1,898
Clusters	19 29	32 29	21 29	32 29
Bandwidth	110.74	200.00	118.64	200.00
Mean dep. var.	0.461	0.465	0.475	0.489
Std. dev. dep. var.	0.358	0.361	0.500	0.500
Panel C: Income & expenses	Remuneration		Daily purchases	
RC	-0.091	0.202	-0.082	-0.003
	(-0.510)	(1.266)	(-1.202)	(-0.053)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	1,024	1,407	602	666
Clusters	19 29	32 29	6 13	8 13
Bandwidth	106.31	200.00	117.65	200.00
Mean dep. var.	2.243	2.195	0.910	0.929
Std. dev. dep. var.	0.951	0.945	0.855	0.865

Notes. Standard errors are clustered at the DHS cluster level. All regressions include a local linear specification estimated separately on each side of the concession boundary and use a triangular kernel. Optimal bandwidths are chosen using the MSE-minimizing procedure suggested by Cattaneo et al. (2019) and are reported in km. Regressions control for age, age squared, and survey year. Modern use is an indicator variable equal to 1 if the respondent does use modern contraception methods and 0 otherwise. Similarly, modern knowledge is an indicator variable equal to 1 if the respondent does know of modern contraception methods and 0 otherwise. General is an aggregated index based on the 5 DHS questions on different domestic violence justifications. Refusing sex is an indicator variable of one of these five questions, reported directly. Remuneration is a 1 to 4 categorical variable where 1 is unremunerated work and 4 is fully cash-based remunerated work. Household purchases is an aggregated 1 to 4 categorical variable representing women's degree of final say in daily purchases and large purchases, ranging from no say to full say. t statistics in parentheses.

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

Table 16: RC Concession and Agglomeration

	(1)	(2)	(3)	(4)
Panel A: Urbanization	Nightlights		Built-up surface	
RC	0.430	1.867	-0.208*	-0.070
	(0.232)	(1.072)	(-1.750)	(-0.701)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	11,090	14,203	11,464	14,203
Clusters	37 58	59 58	39 58	59 58
Bandwidth	42.14	100.00	45.44	100.00
Mean dep. var.	6.230	4.884	0.353	0.286
Std. dev. dep. var.	6.215	6.053	0.311	0.311
Panel B: Utilities	Electricity		Water	
RC	-0.074	0.055	-0.043	0.094
	(-0.478)	(0.430)	(-0.318)	(0.800)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	11,442	14,163	2,403	2,893
Clusters	41 58	59 58	41 58	59 58
Bandwidth	48.33	100.00	47.31	100.00
Mean dep. var.	0.465	0.387	0.541	0.460
Std. dev. dep. var.	0.499	0.487	0.498	0.498

Notes. Standard errors are clustered at the DHS cluster level. All regressions include a local linear specification estimated separately on each side of the concession boundary and use a triangular kernel. Optimal bandwidths are chosen using the MSE-minimizing procedure suggested by Cattaneo et al. (2019) and are reported in km. Regressions control for sex, age, age squared, and survey year. Nightlights measures the luminosity of an area during the nighttime hours as measured by the Visible Infrared Imaging Radiometer Suite (VIIRS) (ICF, 2014). Built-up surface is an index ranging from 0.00 (extremely rural) to 1.00 (extremely urban), obtained from the Global Human Settlement Layer (GHSL) project. Electricity and water are indicator variables equal to 1 if the household respectively has access to electricity or piped water (into the dwelling, yard, the neighbour's dwelling, or a public tap) and 0 otherwise. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 17: Quadratic UMHK Concession and Economic Development

	(1)	(2)	(3)	(4)
Panel A: Asset Wealth	Wealth index		Log(wealth score)	
UMHK	1.624*** (2.810)	1.632*** (3.507)	15.146*** (3.078)	14.805*** (3.775)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	8,522	10,738	8,522	10,738
Clusters	19 29	32 29	19 29	32 29
Bandwidth	113.56	200.00	115.32	200.00
Mean dep. var.	3.713	3.396	2.730	0.484
Std. dev. dep. var.	1.449	1.525	10.943	11.154
Panel B: Education	Years of education		Literacy	
UMHK	1.946*** (3.225)	2.050*** (4.089)	0.265*** (2.727)	0.311*** (3.825)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	8,493	10,704	2,324	3,025
Clusters	19 29	32 29	18 29	32 29
Bandwidth	112.02	200.00	105.52	200.00
Mean dep. var.	4.176	3.908	0.738	0.684
Std. dev. dep. var.	4.497	4.369	0.440	0.465
Panel C: Health	Woman ht./age pctl.		Child ht./age pctl.	
UMHK	11.561** (2.087)	13.482*** (3.101)	10.173 (1.633)	10.433** (2.041)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	789	1,022	867	1,062
Clusters	18 29	32 29	22 29	32 29
Bandwidth	104.16	200.00	119.85	200.00
Mean dep. var.	25.125	22.528	28.368	27.833
Std. dev. dep. var.	26.293	25.431	35.622	35.603

Notes. Standard errors are clustered at the DHS cluster level. All regressions include a local quadratic specification estimated separately on each side of the concession boundary and use a triangular kernel. Optimal bandwidths are chosen using the MSE-minimizing procedure suggested by Cattaneo et al. (2019) and are reported in km. Regressions control for sex, age, age squared, and survey year. Literacy is an indicator variable equal to 0 if the respondent cannot read at all and 1 otherwise. Wealth score is an index generated by the DHS using the principal 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 score. Respondent ht./age pctl. is measured for a subset of female respondents and divides each respondent's height by her age and finds her percentile in the entire sample. Similarly, Child ht./age pctl. was asked to a subset of children and divides each child's height by his or her age and finds his or her percentile in the entire sample. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 18: Quadratic RC Concession and Economic Development

	(1)	(2)	(3)	(4)
Panel A: Asset Wealth	Wealth index		Log(wealth score)	
RC	-0.144	0.325	-0.212	3.300
	(-0.411)	(1.142)	(-0.069)	(1.336)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	11,228	14,203	11,464	14,203
Clusters	35 58	59 58	37 58	59 58
Bandwidth	44.11	100.00	44.86	100.00
Mean dep. var.	3.947	3.644	4.792	2.468
Std. dev. dep. var.	1.155	1.296	10.233	10.963
Panel B: Education	Years of education		Literacy	
RC	0.009	0.423	-0.039	0.041
	(0.017)	(0.898)	(-0.731)	(0.921)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	11,416	14,134	4,498	5,512
Clusters	37 58	59 58	34 58	59 58
Bandwidth	49.07	100.00	40.44	100.00
Mean dep. var.	5.424	4.987	0.857	0.825
Std. dev. dep. var.	4.617	4.519	0.350	0.380
Panel C: Health	Woman ht./age pctl.		Child ht./age pctl.	
RC	1.210	1.169	3.873	4.058
	(0.426)	(0.449)	(1.095)	(1.319)
Bandwidth choice	Optimal	Wide	Optimal	Wide
Observations	2,678	2,933	1,658	2,078
Clusters	48 58	59 58	41 58	59 58
Bandwidth	83.87	100.00	58.35	100.00
Mean dep. var.	29.295	28.590	26.411	26.211
Std. dev. dep. var.	25.580	25.456	33.336	33.583

Notes. Standard errors are clustered at the DHS cluster level. All regressions include a local quadratic specification estimated separately on each side of the concession boundary and use a triangular kernel. Optimal bandwidths are chosen using the MSE-minimizing procedure suggested by Cattaneo et al. (2019) and are reported in km. Regressions control for sex, age, age squared, and survey year. Literacy is an indicator variable equal to 0 if the respondent cannot read at all and 1 otherwise. Wealth score is an index generated by the DHS using the principal 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 score. Respondent ht./age pctl. is measured for a subset of female respondents and divides each respondent's height by her age and finds her percentile in the entire sample. Similarly, Child ht./age pctl. was asked to a subset of children and divides each child's height by his or her age and finds his or her percentile in the entire sample. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix A.6 Transportation Infrastructure

One potential explanation for persistent differences in development is colonial-era transportation infrastructure. Railways and roads were often central to colonial economic strategies (Storeygard, 2016; Jedwab and Moradi, 2016; Donaldson, 2018), though their impacts on long-run development vary depending on local context.

Both the UMHK and RC concessions relied on rail infrastructure to export minerals, but neither region maintained strong domestic connectivity after independence. The Benguela Railway, a key route for UMHK mineral exports via Angola, was later destroyed during the Angolan Civil War (Figure 11). Road infrastructure deteriorated significantly in the DRC – illustrated by the common notion that “a journey that took one hour in the colonial period now takes a full day” (Van Reybrouck, 2010).

Table 19 compares changes in road networks over time. Column (1) shows that the former UMHK area experienced a sharper deterioration than its surroundings. In contrast, column (2) shows modest improvements in the RC area’s roads. Yet this is not reflected in current differences in development outcomes.

These patterns are consistent with previous findings that colonial “mine-to-port” infrastructure often failed to generate broad-based local development (Bonfatti and Poelhekke, 2017), and therefore may not account for the long-run divergence. Instead, they reinforce the interpretation that labour policies and urbanization – rather than extractive transport routes – are the primary mechanisms of persistence in this setting.



Figure 11: Map of the Benguela Railway

Table 19: Concessions and Infrastructure Development

	(1)	(2)
	Road network in 2010	Road network in 2020
UMHK	-3.851** (-2.283)	
RC		7.119* (1.668)
Road network in 1968	0.812*** (14.786)	1.122*** (10.992)
Observations	832	154

Notes. The unit of observation is a 20 km by 20 km grid cell. Column (1) reports cross-sectional results for the UMHK region (DRC), and Column (2) reports cross-sectional results for the RC region (Zambia). The dependent variable is the length of roads (km) in each grid cell, measured in 2010 for the DRC and 2020 for Zambia due to differences in data availability. Both models control for the road network in 1968. The concession coefficients capture the relative change in infrastructure over a comparable post-colonial period. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$