

**Effects of Africa's Colonial and Slave Trade History on the Nexus
of Education and Economic Development**

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Dissertation Submitted in Fulfillment of the Requirements for the Degree of
Doctor of Philosophy in Development Finance

**Graduate School of Business Administration of the University of the
Witwatersrand**

Monday, February 24, 2025

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List of Acronyms and Abbreviations

OLS	Ordinary Least Squares
IVs	Instrumental Variables
BVAR	Bayesian Vector Autoregression
CS	Africa's Colonial And Slavery History
SSA	Sub-Saharan Africa
FA	French Africa
BA	British Africa
PA	Portugues Africa
OECD	Organisation For Economic Co-Operation And Development
DHS	Demographic And Health Survey
ACLED	Armed Conflict Location And Event Data
HDI	Human Development Index
HDI INTERVAL	Highest Density Interval Confident Interval
FMI	Financial Market Index
GDP	Gross Domestic Product Per Capita.
GNP	Gross National Product
MCSE	Monte Carlo Standard Errors
CV	Coefficient Of Variation
CHE	Council On Higher Education
IMF	International Monetary Fund
EU	European Union
SAP	Structural Adjustment Programs
TNE	Transnational Higher Education
PRSP	Poverty-Reduction Strategies Program
SANQF	South African Notational Qualifications Framework
NQF	Notational Qualifications Framework
HEIs	Higher Education Institutions
CFA	Communauté Financière Africaine

Abstract

This dissertation investigates two major issues. First, the effect of Africa's history (colonialism, slavery, and slave trade) (CS) on investments in education and the development of educational institutions is ascertained. This is achieved by determining the effect of Africa's CS history on investments in education and examining the role of Africa's CS history in explaining contemporary education. This has been done using instrumental variables. Secondly, the effect of Africa's CS history on the relationship between educational development and economic development is investigated by using Africa's CS history and the ranking of colonial and slavery factors as intervening effects on the relationship between educational development and economic development, as well as on the relationship between investments in education and economic development. Panel data analysis together with time series analysis have been used to address this objective.

First, the causality confidence is improved when railroads and disease prevalence are used as instruments for the European population which addresses any endogeneity concerns going forward. Mostly because the distribution of colonial roads and disease prevalence dictated the location where Europeans settled to inevitably invest and develop. Moreover, the main observation is that precolonial and colonial educational development partly explains the significant differences that intergenerational mobility has had on contemporary development, which is connected to deep evolutionary traits, more specifically to slavery intensity as well as the type and policies of colonisation that was developed.

Second, time series estimates varies similarly by empire on education investments and higher education enrolment, which implies that educational development is still currently highly neocolonial and neoliberal. Similarly, traces of the aftereffects of the severity of slavery and slave trade together with ethnic fractionalization and missions amongst other colonial factors strongly and persistently continue to influence the current relationship between economic and educational development. In more details, findings have established a disconnection between educational and economic development which has been attributed to neocolonialism and neoliberalism as their involvement disrupts the development of higher education institutions and causes it to be regarded as a commodity rather than a public good.

A possible recommendation is that African governments should not allow their higher education institutions to be used as a marketplace for the production of instrumental and academic knowledge which is irrelevant to a nation's development but only beneficial to the global economy. This then can be done by incorporating a nation's development plan in both private and public higher education institution as well as on external funding policies.

In the autoregression results, the development of education is highly disconnected from economic development in regions that were severely affected by slavery, Islam dominancy, European settlers and ethnic fractionalization which can still be largely mapped to colonial violence as caused by slavery and slave trade. Hence, a possible implication for these regions could be for policy makers to consider improving their policies in such a way that they are less repressive because policies that are entirely repressive tend to be counter-productive if development initiatives are not in place to aid in determining the drivers of violence further assisting in improving the education of youth, socio-economic inequalities, including skills by creating community awareness and education programs.

Declaration

This is my original work and has not been presented before for a degree in this or any other University.

By Jason Biketi Nasila

Signature: *Jnasila*

Appreciation

My greatest thanks, above all else, is to my Lord and Saviour Jesus Christ for giving me the grace to embark on these studies. For His love and Mighty hand upon my life that has brought me this far. My Pastors, Apostle JB Makananisa and Prophetess T E Makananisa of Charis Missionary Church, for their constant prayers, encouragement and guidance. It was at the verge of contemplating discontinuing this degree that I received a word of encouragement from my pastor's son, Prophet Andries Semono, that God said I should continue the studies and I would complete them, that gave me and remained the drive to continue till the end.

I would also like to show immense appreciation to my supervisors Prof Kodongo and Prof Ojah for their unwavering guidance, support, great sacrifice and uncompromised standards and expectations throughout this degree. Your selflessness in making time and having the patience to supervise me gave me the necessary nudge to continue even under intense pressure. I have acquired a wealth of knowledge which I hope will be a valuable contribution in this field.

My sincere gratitude also goes out to Prof Joan Ricart-Huguet at Loyola University Maryland, USA, who generously permitted me to use his dataset on colonial investments, which formed the very foundation of all subsequent analysis I was able to perform for this study.

I thank my family for their prayers and support. Most importantly, my wife and angel, Olwetu, the wisdom that God has made her to me and the children with all the efforts and time that you invested to assisting in proof reading and editing my submissions, may God reward your submission and selflessness. Many instances and hurdles along the way have proved this to be a grueling journey but it has all culminated to this wonderful moment by God's grace.

Being awarded the post postgraduate merit bursary and shortly thereafter the Absa financial assistance for employees, indeed provided relief in terms of curbing any financial burden.

For my wife, Oluetu Nasila

Chapter One: Introduction

1.1. Background of the Study

As Africa continues to experience sluggish economic growth and trails the rest of the world in economic development, it is important to recognize the role that African history may have played in this regard. The main focus is on the four identifiable eras in Africa's history: the colonial period (1890s till early 1960s), the scramble for Africa (1860 till 1905), the slave trade period (early 7th century through 19th century) and precolonial political centralization and institutions (Michalopoulos and Papaioannou 2020 and Gakunzi 2018). This section briefly examines debates about each of these historical eras, pointing out their possible effects, as highlighted in the literature, on education and economic development in Africa. These views on the ramifications of these eras' destructive activities on education and, ultimately economic development are used to develop some of the core arguments that inform this study.

The scramble for Africa resulted to the interior of Africa being partitioned by Europeans into special zones, protectorates, colonies, and free trade areas. As a result, some scholars have argued that creating the resulting artificial states by particularly partitioning ethnicities have led to the underdevelopment of Africa (Michalopoulos and Papaioannou 2016; and Amin 1972). For instance, people who belonged to partitioned ethnicities have worse educational outcomes, fewer household assets, and limited access to utilities which is in contrast to those from non-split ethnicities (Michalopoulos and Papaioannou 2016). Michalopoulos and Papaioannou (2020) also suggests that work needs to be done to analyze the impact of colonial artifact formation and colonial borders on political, social, and economic development.

Dowden (2009) linked the partitioning of Africa to certain degrees of discrimination amongst ethnicities and conflicts which contributed to poor educational outcomes for people who especially belonged to partitioned ethnicities. Greater rates of ethnic fractionalization which led to political instability and high rates of patronage were also found amongst ethnic groups which had been affected the most by slave trade.

Africa has also been the victim of slave trade and slavery with the transatlantic slave trade having begun in the early 1500's and continued through the 19th century (Lovejoy 1989). Slaves were traded in exchange for valuables such as horses from the Middle East, and textiles and weapons

from Europe, which became even more important to the West African economy, where Ghana, Mali, and Songhai became influential as a result of Trans-Saharan slave trade. In 14th and early 15th century, a place like Timbuktu in Mali was known to be a commercial and intellectual development center for the trans-Saharan gold and salt trade, and it grew as a center of Islamic culture (Khair 2003 and Medupe 2014). However, due to the invasions that happened in 1468, and in the 16th century respectively, the educational institutions suffered a huge setback as many scholars were exiled and killed. Consequently, there was a significant decline in the education development as well economic activities (see Aime 2009, Benjaminsen et al. 2004, and Huddleston 2009). Later, in 1894, the French invaded the city and partly restored it economically and educationally from the desolate condition.

Earlier, Africans had also been subjected to Arab slavery that started in the early 7th century and continued until the 1960s. As a key component of Africa's history, the duration of the Arab slave trade was more than 13 centuries. However, in Mauritania, slavery was officially banned only in August 2007. Arab raids affected areas consisting of the Horn of Africa, East Africa and Great Lakes regions in the eastern part of the African continent. Zanzibar served for centuries as a hub for these slaves. In West Africa, Arab slave trade affected Niger Valley to the Gulf of Guinea, and slaves captured in these areas were shipped out of Africa using trans-Sahara roads (Gakunzi 2018).

Arab traders eventually settled on the east coast of Africa and promoted trade in beads, porcelain, clothes, glass, copper, African Ivory and slaves between Arabs and Africans, as result of which economic activities and education began to develop. Thereafter, Christian missionaries settled along the east coast of Africa, establishing mission stations, for example in Zanzibar in 1860. Subsequently, in 1868 a second mission station was established in Bagamoyo, and these two stations are believed to have been responsible for the emancipation of slaves, educating people on trade policies and practice, and providing elementary education to children. This contributed to marked increase in economic activities as well as to education development (Salyers 2009).

The form of political centralization of African ethnicities in terms of empires, kingdoms, state like entities before colonialism has also been linked with Africa's poor development as compared to the rest of the developing world. Among other factors contributing to this were the conflicts that existed in some communities between ethnicities following slave trade – ethnic fractionalization (Herbst 2000; and Besley and Reynal-Querol 2014). A positive correlation also has been found

between economic development and heritage of statehood and it accounts for a considerable percentage of cross-country variation in development (Borcan et al., 2018).

However contradictory evidence has been documented by Bleaney and Nishiyama (2002) who show that human capital accounts for 1.2 percent of Africa's annual growth shortfall relative to Asia. Jerven (2011) argues that economic growth could benefit from human capital at a certain threshold as evidenced by results from the World Bank, shown in Figure 1.2 and 1.3. Africa's low GDP per capita can also be partly due to low literacy rates compared to other parts of the world as illustrated in Figure 1.6. Several of these developments continued through the 1980s regardless of the growth failure (see Figure 1.1). Despite the precolonial conditions, significant infrastructure and human capital developments were made.

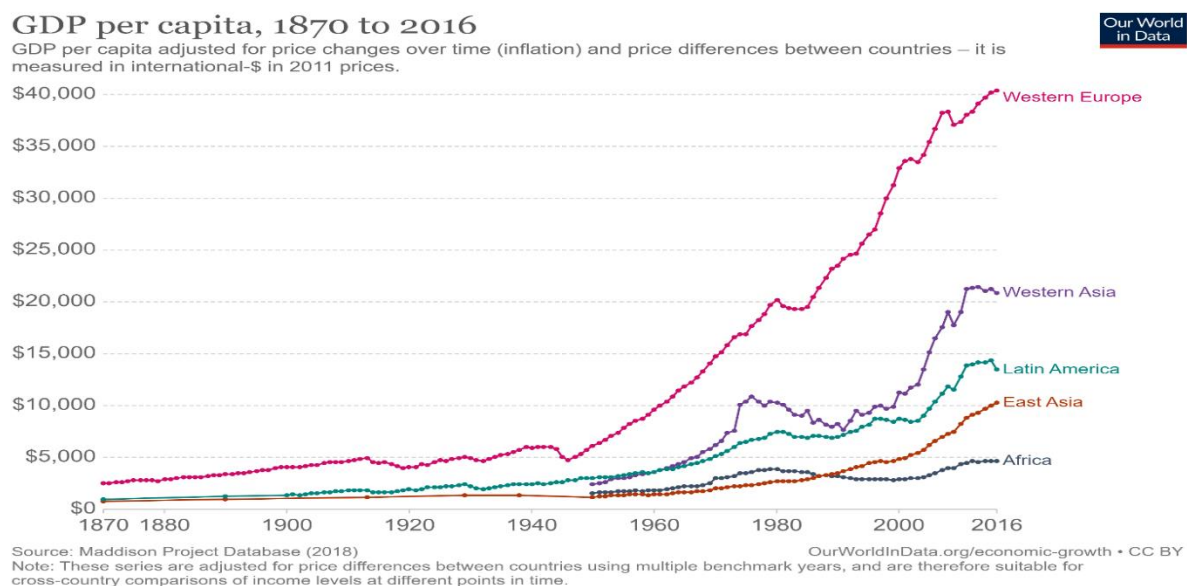


Figure 1. 1: GDP per Capita.
Source: Maddison Project Database (2018).

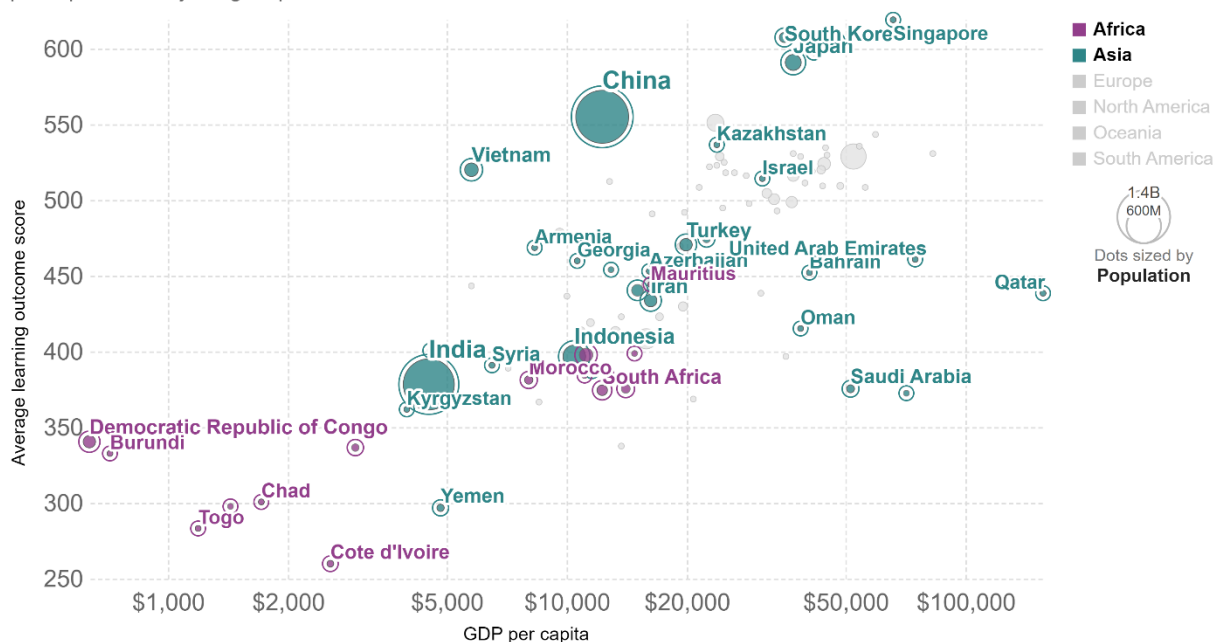
The practice or lack of political authority in African empires, kingdoms, and chiefdoms was also a crucial factor possibly contributing towards educational development. Amongst neighboring ethnic homelands with varying legacies of pre-colonial political institutions, pre-colonial ethnic political centralization and regional development are highly correlated. Pre-colonial political authorities and institutions took part in the provisioning of education and health. However, studies

such as Bandyopadhyay and Green (2016) do not find a link between precolonial political centralization and public goods such as the setup of schools, and therefore, educational development. They argue that these institutions (schools, roads, building infrastructure etc.) were set up during colonial times by the settling British and French even though for a long time, scholars have debated whether it was to Africa's detriment or benefit (Michalopoulos and Papaioannou 2020). Thus, there is room for more precise studies to clearly elaborate and assess the impact of Africa's historical legacies on educational development.

Average learning outcomes vs GDP per capita, 2015

The vertical axis shows average scores across standardized, psychometrically-robust international and regional student achievement tests. To maximize coverage by country, tests have been harmonized and pooled across subjects (math, reading, science) and levels (primary and secondary education). The horizontal axis shows GDP per capita after adjusting for price differences between countries and across time.

Our World in Data



Source: Altinok, Angrist, and Patrinos (2018), Maddison Project Database 2020 (Bolt and van Zanden, 2020)

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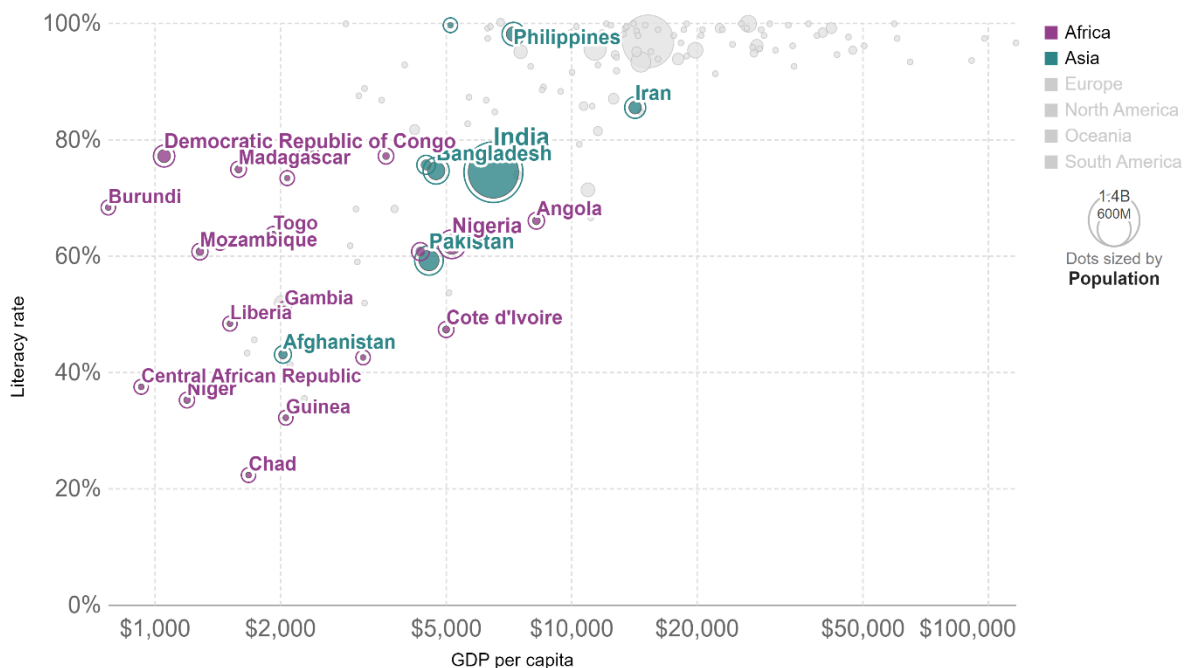
Figure 1. 2: Average learning outcomes vs GDP per capita.

Africa subsequently became a victim of colonization that started in the 1890s until the 1960s (Gakunzi 2018). Some researchers have argued that colonization had notable growth benefits for Africa because, in their views, it facilitated investments in education (building of schools), development of transportation networks, setting up of state institutions, and the eventual

eradication of slavery (Heldring and Robinson 2012). Rodney (1981, 1972) and Austin (2010), amongst other researchers, nevertheless, have a contrasting view, arguing that colonialism is the foundation of the problems Africa is facing in this present time. They argue that colonization led to Africa's reduced levels of human capital, poverty, underperformance of the overall state, with high rates of corruption, authoritarianism, and poor manufacturing sector.

Literacy rate vs. GDP per capita, 2019

Literacy rate of the population aged 15 and above. GDP per capita is measured in constant international-\$. This means it is adjusted for price differences between countries and adjusted for inflation to allow comparisons between countries and over time.



Source: UNESCO (via World Bank), Data compiled from multiple sources by World Bank

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Figure 1. 3: Literacy rate vs. GDP per capita.

Studies (e.g., Acemoglu, Johnson, and Robinson 2005; Michalopoulos and Papaioannou 2020) have also taken the view that colonization had both extractive and investment outcomes. Nonetheless, analyses of the real GDP per capita comparing Africa to Asia and other parts of the developing world (by e.g., Sachs and Warner 1997; and Collins and Nissan 2016) often show that during the colonization era, economic output in Africa and Asia was low relative to other regions (see Figure 1.1), with researchers often linking the slow growth partly to colonialism, and partly

to ethnic and tribal divisions (arguably outcomes of colonialism's divide to conquer policy), and climate and geography, among others (Sachs and Warner 1997). Colonialists may have promoted education development, but their form of education was arguably discriminative because it disregarded the African culture and the forms of education and educational institutions that were hitherto in place (Kay and Nystrom 1971). Kay and Nystrom also expressed contrasting views on the role of colonialism on education in Africa, suggesting that more in-depth studies are required to explain the nuanced relationship between colonialism and education and how this, in turn, may have affected economic development.

In this thesis, work that links economic development and development of education to historical legacies in an African context is consolidated in the literature review to clearly ascertain gaps that warrant the purpose of this study. The flow chart below summarizes the framework of this study.

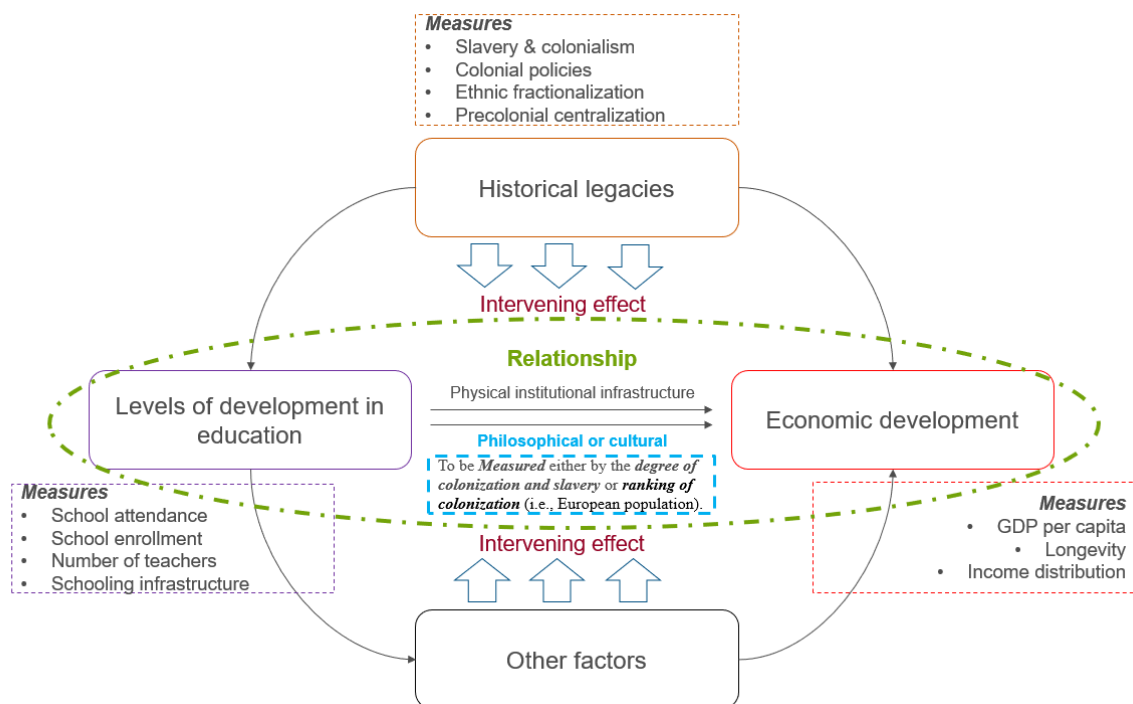


Figure 1. 4: Flow chart of the study.

1.2. The State of Education and Economic Development in Africa

Although still the least economically and institutionally developed region of the world, a lot of improvement has been noted in various spheres in Africa. For example, an increase in the number

of people obtaining education in tertiary institutions, reduction in poverty, increase in urbanization, and improved productivity have been observed with a significant positive change in infrastructure (Pinkovskiy and Sala-i-Martin 2014).

Other key things to note are the reduction in malnutrition, infant mortality, and a decline in civil wars (Young 2012). Politics in Africa are slowly taking a turn for the better (Collier and Gunning 1999), a much-needed improvement contrasting earlier works to explain the so called “African dummy” phenomenon (Easterly and Levine 1997). The dummy derives from observing the variation in growth rates in the world and that of Africa to account for post-colonial economic growth. This dummy was an effort to explain the chronic failure observed on Africa’s economic growth. The existence of such a dummy is as a result of empirical economic growth models that were developed to explain geographical variations in the steady-state growth rate. The readings from the dummy showed a persistently slower steady-state growth rate for African economies as compared to other regions (Jerven 2011).

Jerven (2011) revisits the clarification of the African post-colonial economic performance. In his paper, ‘Deficient public services’ in the African economies does not encapsulate the demand or time aspect of public service delivery (Sender 1999). Collier and Gunning (1999) conceded that the aspect of public service which has received most attention in the empirical literature is education. However, its linkage to growth is unresolved, and despite the slowdown in growth since the mid-1970s that is reflected in the African economies, there have been a significant improvement in human capital development since independence. Given the reverse growth in the 1990s, African regions also experienced a peak in the life expectancy between 2000 and 2014. That resulted in a significant economic growth and also increased the income across the continent, which has been referred to as ‘Africa Rising’, (Salami et al., 2019).

Data from world development Indicators established an almost perfect negative correlation of 98.5% between GDP growth and literacy rates for the period 1970-2000 for Sub-Sahara Africa, implying that literacy has a negative impact on growth rates (see Jerven, 2011). This is in contrast to the direct proportional association that is seen in Figure 1.2 and Figure 1.3 that is illustrated between average learning outcomes, literacy and GDP per capita from the World Bank data. Nevertheless, enrollment and literacy levels have rapidly increased even when growth has not been high. Bennel (2002) on the other hand differs by pointing out that in the midst of economic crisis

and contraction, formal education in Africa has progressed immensely whereas demand for such educated labour has not been entirely met, while Europe and North America education was expanding together with rapid growth in the formal sector.

Sub-Saharan Africa's average annual growth rate in GDP and literacy between 1980 and 2000 as shown in Table 1.1 was one of the lowest in the world, but the situation improved in the period 2000 - 2020, with Africa recording an average of 7.76% and -0.83% growth p.a, respectively. However, Africa's population was the fastest growing during the period 2000 – 2020, which depressed the growth in GDP per capita, as supported by Figure 1.5. These statistics confirm the observation by Easterly and Levine (1997) and Atardi and Saia-Martin (2003) in consensus that Africa's economic growth record was dismal up until the year 2000.

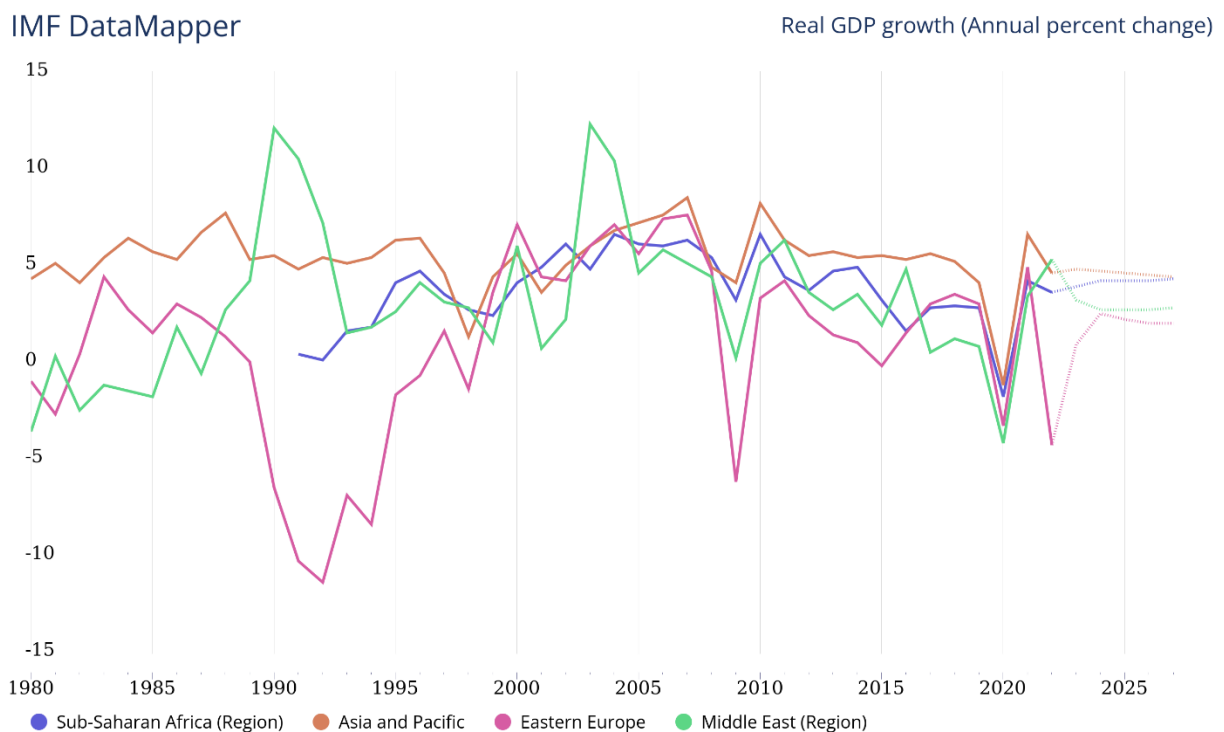
Atardi and Saia-i-Martin (2003) reported that growth in Sub-Saharan Africa (SSA) was particularly high from the beginning of decolonization in the late 1950s and the mid-1970s. Between 1960 and 1975, per capita growth average was between 1.5 percent to 2 percent per year, which was comparable to Asia and other world regions. Arrighi (2002) also noted that when it came to economic performance, Africa was not substantially poorer than South Asia and First World regions until 1975. Further, Sylvester (2005) established that decolonization had a positive impact on growth. He showed that countries that became independent first grew quicker than counties that were still under colonial rule.

Conversely, decolonization posed low school enrollment and high illiteracy rates that resulted in the immediate challenge of a shortage of skilled personnel in administrations which affected key economic sectors. Moreover, developing aid towards education became a focal point of Cold War tensions and rivalry (Wilfred and Bokana 2017). According to World Bank statistics, the average GDP per capita growth rate for East Asia was approximately 4.9 percent, for South Asia 3.6 percent, for the Middle East 1.2 percent, for Latin America 0.5 percent, but for SSA countries -0.6 percent from 1980 to 2000. Additionally, Glewwe, Maiga and Zhend (2014) indicate that SSA countries experienced the lowest economic development and enrollment in higher education during that same period.

Table 1. 1: Average Annual Growth Rates of Literacy, Population, Per capita GDP, and GDP, World Regions, 1980-2020.

		East Asia & Pacific	Europe & Central Asia	Latin America & Caribbean	Middle East & North Africa	North America	South Asia	Sub- Saharan Africa	World
Literacy	1980-2000	-13.35%	-19.29%	-20.41%	-6.43%	0.00%	-27.98%	-16.21%	0.84%
Population	1980-2000	1.78%	1.40%	0.42%	1.90%	2.57%	1.10%	2.25%	2.88%
GDP	1980-2000	6.08%	1.10%	5.73%	2.89%	6.50%	5.83%	2.46%	5.76%
GDP Per Capita	1980-2000	2.87%	1.61%	5.15%	-0.26%	6.28%	5.81%	1.15%	4.07%
Literacy	2000-2020	-2.93%	-0.01%	1.79%	1.39%	0.00%	-0.68%	-0.83%	-4.42%
Population	2000-2020	1.33%	0.72%	0.35%	1.14%	1.98%	0.81%	1.47%	2.87%
GDP	2000-2020	6.15%	5.08%	3.96%	6.42%	3.72%	8.42%	7.67%	4.86%
GDP Per Capita	2000-2020	4.12%	3.77%	4.38%	3.36%	3.22%	6.36%	4.50%	3.62%
Literacy	1980-2020	-8.40%	-9.63%	-9.60%	-2.48%	0.00%	-14.34%	-8.35%	-1.91%
Population	1980-2020	1.55%	1.06%	0.38%	1.52%	2.27%	0.96%	1.86%	2.87%
GDP	1980-2020	6.11%	3.09%	4.84%	4.66%	5.11%	7.13%	5.07%	5.31%
GDP Per Capita	1980-2020	3.50%	2.69%	4.76%	1.55%	4.75%	6.08%	2.82%	3.84%

Source: World Bank (2002)



©IMF, 2022, Source: World Economic Outlook (April 2022)

Figure 1. 5: Real GDP Growth.
Source: IMF Datamapper (2020).

Moreover, in 2016, the SSA economy saw its worst economic performance on record over the previous two decades. According to statistics, the real GDP aggregate for the sub-Saharan African region increased in the first quarter by 1.1 percent, immediately after a corresponding decrease of 1.0 expansion in the third quarter. According to Wilfred and Bokana (2017), since 1993 SSA's economic performance has never been as bad as compared to the precipitous decrease in the 2016 GDP growth rate. Sectors such as mining and agriculture responsible for the extraction of raw materials which also employs a large number of citizens as had been linked to the decline of GDP growth in SSA owing to vulnerability to external shocks.

Furthermore, Wilfred and Bokana (2017) showed that higher education based human capital at the output level appears to be the most significant in relation to SSA economic growth. In support of this, some researchers (Acemoglu, Gallego, and Robinson 2014; Barro 2001; Glaeser, Ponzetto, and Shleifer 2007; and Lipset, 1959) have also argued that economic growth, development, institutional quality, and political engagement are linked to educational achievements as supported by Figure 1.3. Inadequate schooling or higher education clearly explains poor human capital's production performance (Glewwe, Maiga, and Zheng 2014). Bloom (2014) also adds that the level of education and especially higher education attainment of a country's population discloses and reflects the people's knowledge, skills, economic progress, and freedom. It has also been shown in a broad body of research (see Lucas 1988; Shaihani et al. 2011 for a review) that education has a positive influence on human capital in the determination of long-run development. Romer (1990) and Nelson and Phelps (1966), on the theory of economic growth, also suggest that education-centered human capital has an influence on economic development because it functions as an agent of diffusion, innovative technology, and catch-up processes and it is an input in the production process (Lucas 1988). Table 1.2 provides examples of a few other studies that have examined the relationship between Growth and Education.

Table 1. 2: Relationship between Growth and Education.

Study	Country	Findings
Pegkas (2014)	Greece	Higher and secondary education have statistically significant positive effects on the GDP growth, but primary education has no significant impacts on economic growth.
Gemmell (1996)	OECD Countries	While higher and secondary education impact on growth in the developed economies, primary education mostly impact on the less developed nations.
Tallman & Wang (1994)	Taiwan	Higher education appears to have higher positive effects on the economic growth compared with secondary and primary education.
Lin (2006)		All the three: higher, secondary and primary education, exhibit positive effects on growth in the economy
Chi (2008)	China	Higher education has larger and positive effects in China than secondary and primary education has on GDP growth.
McMahon (1998)	Asia	While higher education negatively impacts on growth, secondary and primary levels have statistically significant positive impacts on economic growth.
Abbas (2001)	Sri Lanka and Pakistan	Economic growth of these countries are negatively impacted by primary education, while higher and secondary education exhibit a statistically significant positive effects on the two countries' economic growth.
Villa (2005)	Italy	Education at secondary and higher levels impacts positively on the GDP growth, whereas, result from primary education indicates that it has no significant impacts on growth in Italy
Gyimah, Paddison & Mitiku (2006)	Africa	Conclude that the three education levels are statistically significant with a positive effect flowing from education variables to growth in the African countries per-capita income.
Wilfred and Bokana (2017)		Higher education human capital at the output level appears to be the most significant of all the levels of education.
Jerven (2011)		Established an almost perfect negative correlation of 98.5% between GDP growth and literacy rates for the period 1970-2000

Gyimah-Brempong, Paddison and Mitiku (2006) use data for the 1960-2000 period, from the World Bank, on 34 African countries for their study. They find that all levels of education have a positive and significant effect on growth rate of per capita income for the 34 African countries. They further show that growth elasticity of higher education human capital to be about 0.09, which is twice as large as growth impact of physical capital investment. These findings support results by Gyimah-Brempong (2002) that there is a positive correlation between investment rates, export growth, and education with growth rate of real GDP. This result is consistent with endogenous growth theory which argues that human capital is an important determinant of long-term economic growth (Rosenberg 2004). Concurring with the study done by Nesta that established that 63% of the growth rate could be attributed to innovation, while 37% is linked to capital and labour in the United Kingdom over the 2000-2008 period (Nesta Foundation 2013).

On the other hand, a growing body of research (e.g., Walters, Chisadza, and Clance, 2020; Brown 2000; Cogneau and Moradi 2014; Frankema 2012; Gennaioli and Rainer 2007) examines the effects of historical institutions on contemporary development in Africa. Benavot & Riddle (1988) explained that Africa's gap in education development to colonial periods has also been the reason for low economic development and productivity, owing to colonial rule, with British rule being considered more favorable, agreeing with Brown (2000); Garnier and Schafer (2006); and Grier (1999). This gap has been caused by the low level of colonial investment in basic, secondary and university education (Glaeser et al. 2004; and Easterly and Levine 2016). Illiteracy rate for SSA has been the highest (i.e., 34.7%) as compared to other parts of the world from 2009 to 2019. Illiteracy figures in Table 1.3 are also supported by low literacy rates for Africa as compared to those of other parts of the world as is also seen in Figure 1.6.

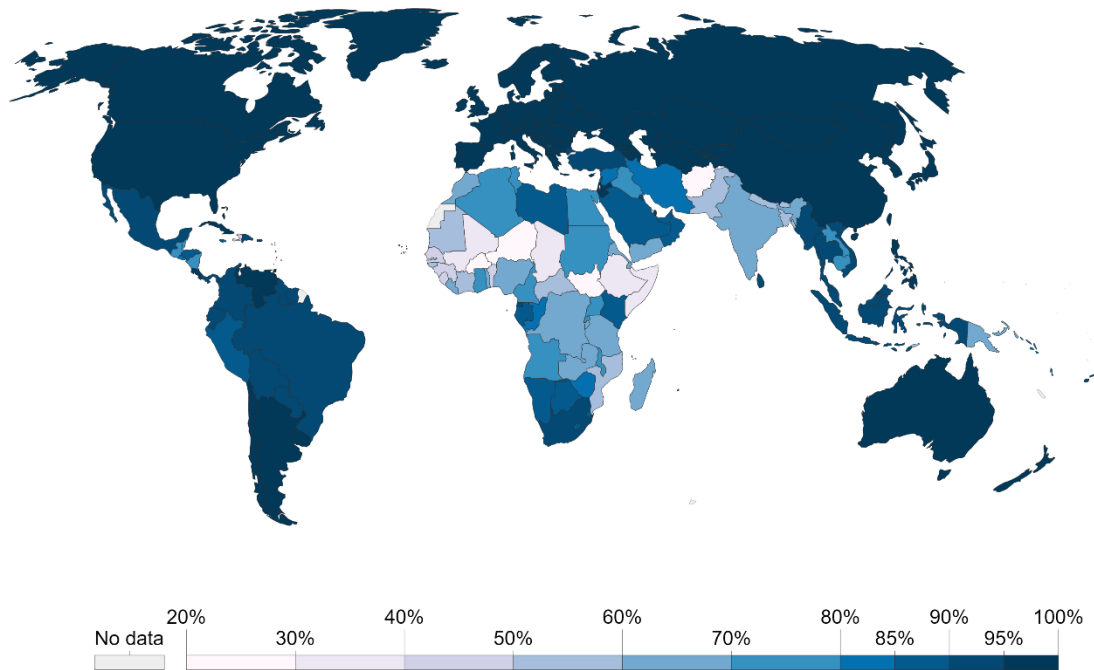
Table 1. 3: Percentage of Illiteracy amongst all Adults (Over 15 years), 2009-2019.

Region					
Sub-Sahara Africa	South Asia	Arab States	Latin America and the Caribbean	East Asia and the Pacific	Europe and Central Asia
34.7	27.1	20.6	6.3	4.2	1.5

Source: Statista.com

Literacy rate by country, 2011

Literacy rate for the entire population, 2011 or latest data from CIA Factbook.



Source: CIA Factbook (2016)

OurWorldInData.org/global-rise-of-education • CC BY

Figure 1. 6: Literacy rate by country.

1.3. Historical Legacies

1.3.1. Partitioning of Africa

The interior of Africa was partitioned by the Europeans into special zones, protectorates, colonies, and free trade areas. Although this was done with very limited geographical knowledge and ethnic landscape, the border design assisted them in colonizing Africa and marking off regions that were rich in minerals (e.g., gold, copper, diamond etc.) and had agricultural potential (e.g., rubber, cocoa etc.). The partitioning has been linked to more harm than good, in the likes of discrimination amongst ethnicities, civil conflict and irredentist demands (Dowden 2009).

As a result, it has been argued by some scholars that creating these artificial states and partitioning ethnicities has led to the underdevelopment of Africa (Michalopoulos and Papaioannou 2016; and Amin 1972). People who belonged to partitioned ethnicities had worse educational outcomes, fewer household assets and limited access to utilities which is in contrast to those from non-split

ethnicities (Michalopoulos and Papaioannou 2016). It has also been noted by Michalopoulos and Papaioannou (2020) that more work needs to be done to analyze the impact of colonial artifact formation and colonial borders on political, social, and economic development.

1.3.2. Slavery and Slave Trade

Amongst some events that have marred Africa's history and thereby contributed in some way or another to its present underdeveloped state, is slavery and slave trade. The earliest of these were during the 600s when Arab Muslims were the main slave traders (Gakunzi 2018). They would sell black Africans as slaves in North Africa. Later, Europeans took over that role, as over the years they became more interested in this practice as a lucrative business. The slaves were captured via different scenarios during raids on villages, in wars amongst tribes, and at time the relatives of those who owed money were also sold. Regardless of whom the slaves were sold to, the common objective was almost always a means of raising the status of the buyer or slaveholder. By acquiring more slaves, in some cultures, one would seem more powerful. The slaves were bought to do menial domestic and labour chores (see Aime 2009; Benjaminsen et al. 2004; and Huddleston 2009).

It is recounted that many Africans were sold and shipped to western countries (Southern United States, Salvador, Guyana, and the Caribbean countries: Dominican Republic, Cuba etc.). The transatlantic slave trade began approximately during the early 1500's and continued through the 19th century, involving about twelve million Africans forcefully shipped out of Africa to serve as slaves (Lovejoy 1989). These slaves were taken to work in the plantations where these countries wanted manual human labor. Slaves were also shipped to India, Middle East, North Africa, and Indochina (i.e., Cambodia, Laos, Myanmar, Thailand, and Vietnam) but to a lesser extent (Salemink 2008). Nunn (2008) did an analysis in which he found a strong negative association between contemporary economic development in Africa and slave trade and evidenced that slave trade had an adverse effect on economic development in the region to which Obiliki (2016) concurred reporting lower literacy rates in such communities. Some studies have also argued that slave trade also continued to present a major negative influence in Africa's economy and political development post-independence. Using mainly shipping records from the TAST Database Eitis et al. (1999) and Nunn (2008) presented a systematic empirical analysis of how the current economic development is impacted by slave trade: initially, the study estimates the numbers of exported

slaves between 1400's through 1900's from some contemporary African countries. Secondly, the study shows the impact of slave trade on per capita incomes of countries in 2000, usually indicating a negative link between slave trade and the economic development.

Another dimension explored about the impact of slave trades in Africa was on population growth arguing that enslavement and shipping of captives depopulated the African continent. In 1850, the African continent is said to have had about 50 million people whereas at that time it was expected to have been approximately 100 million (Manning 1981; Thornton 1980; and Frankema and Jerven 2014). As slave trade depopulated African countries, there were less people to educate and as a result, places which suffered most from slave trade had low economic and educational development as also noted by Lovejoy (1989) that those exported as slaves were mostly males and children which was part of the selection criteria for the purchase of slaves.

Furthermore, Obikili (2013) investigated the impact of the slave trade on literacy in Africa using evidence from the colonial Era data on literacy rates of administrative districts: e.g., the colonial censuses of Nigeria and Ghana from the 1950's, and data on slave exports of different ethnic groups, and validated his findings by using contemporary data on literacy rates from the 2010 Nigerian literacy survey. He found that there was a significantly negative correlation between slave export intensity before the colonial era and literacy rates during the colonial era. He further stated that there were other means (i.e., individuals, families or the local community, particularly through the effect on social capital) by which slave trade negatively influenced factors that affected development other than inter-ethnic group conflict or formal nation-state level institutions. These factors being the nature of the ethnic groups' socio-political institutions in the precolonial era, religion, missionaries, disease environment, and indicators of groups' economic development in the colonial era.

Ethnic fractionalization was found to be at a higher degree in places affected the most by slave trade as locals were recruited. Even African chiefs, kings, and headmen raided villages and towns in order to enslave locals then sell them to European merchants (Besley and Reynal-Querol 2014). This concurs with findings by Law (1989) that showed that it required an outlay of capital to coordinate and equip slave-raids and slave caravans, which was mostly dominated by political and military leaders in African societies.

Most slaves exported during the trans-Atlantic trade out of Western Africa were males, but through the Indian Ocean and Red Sea trades out of Eastern Africa, it was mostly females. Researchers such as Dalton and Leung (2014) have used this to substantiate the higher rates of polygyny in Western Africa as compared to East Africa. Teso (2014) focused more on gender roles, saying that as a result of unbalanced sex ratios owing to the enslavement of men more than women, women were then subjected to more forced labour which thereby changed the role of women in the general society. They became more involved in household decision making and even being more in the frontline in politics.

The different streams that contributed to the enormous supply of slaves within Africa included small scale kidnapping, enslavement of judicial criminals, seizure of insolvent debtors, and sale of domestic slaves. The capture and selling of slaves over four centuries surely depopulated Africa. Nunn and Wantchenkon (2011) hypothesized that the nature in which slaves were captured by neighboring communities would have somewhat led to mistrust amongst ethnicities. As a result, economic and institutional development in any such country plagued with disunity and mistrust amongst its people would be sub-standard with regards to this current world. They tested the hypothesis using Afrobarometer data with measures of trust and number of slaves by ethnic group by Nunn (2008). Slave trades ultimately led to a negative impact to such societies in the precolonial era (e.g., Manning 1990; and Nunn 2008) therefore relating the long-term effect of such slave trades to ethnic groups rather than countries. During that precolonial era, Africa had diverse number of ethnic groups which independently formed societies.

The consequence of slave trades on any given ethnic group would be a crumble in the governance system or more accurately the hierarchy of authority, resulting in a dysfunctional society. Rodney (1972) also argued that slave trade affected societal structures, curbed state development by impeding building of schools, transportation systems etc. Taxation would also be impeded because of lack of state citizenry. The higher degree of ethnic diversity was a result of the violence and insecurity caused by slave traders as argued by Nunn (2008). This was supported by cross country-results by Green (2013) that showed a significant correlation between slavery and ethnic diversity as well as work by Whatley and Gillezeau (2011) that uncovered a significant positive relationship between slave traders and number of ethnic groups across the African continent.

Communities/Societies in Africa that have higher rates of ethnic fractionalization today suffered from higher levels of slave trading.

A lot of slaves were kidnapped or taken during major wars even some being enslaved by relatives and friends (Nunn 2017). This in turn led to more warfare, civil unrest, and political instability within and amongst kingdoms, and this in turn resulted in poor infrastructure, underdeveloped financial systems, contorted foreign exchange markets and low schooling rates (Easterly and Levine 1997). Furthermore, Easterly and Levine (1997) stated that any area affected by the above would not be settled by colonizers/missionaries therefore they would not set up of institutions and locals would be deprived of education assuming these conflicts persisted to the colonial period. Nunn (2008) suggests that any country that has a dysfunctional political system cannot deliver adequate educational services. This also holds for poor countries as the quality of education would not be up to par. Obikili (2016) also suggested that the quality of national institutions has affected today's economic development. This has been an ongoing trend since colonial times where there were lower literacy rates in ethnic groups most affected by slave trade.

Contrary to the above though, some researchers argue that European settlers found it easy to colonize and indirectly rule via local chiefs in regions which had been affected by slave trade. This would be possible nevertheless if these communities were not plagued by conflicts, civil unrest, and the like. As mentioned before, when the Europeans were able to settle successfully in any community, it would promote economic development via construction of institutions: schools, transportation and housing. The locals would then benefit by being educated (Whatley 2012). On the other hand, colonists and slave traders also had adverse effect on the form of education and institutions that pre-existed their arrival. These institutions comprised of traditional schools such as Bogwera and Bojale in Botswana that played a key role in passing knowledge and skills from one generation to the next and universities.

Firstly, as a result of introduction and enforcement of colonialism, traditional schools were disregarded and replaced. Colonists introduced a capitalist system by reinforcing colonial conditions on Africans via the training of individuals for service to the colonial state and promoting the values of the colonial society (Mosweunyane 2013). In the case of universities, the oldest institution in Africa is University of Sankore, founded in the 12th century in Mali, then referred to as Timbuktu. Initially it was known as the Sankore mosque founded in the 989CE by the crudité

Chief judge of Timbuktu, Al-Qadi Aqib ibn Mahmud ibn Umar, and later sponsored to be a leading education center. It constituted of independent schools or colleges which were operated by Islamic scholars (Khair 2003).

Since Mali was colonized by the French, the French colonial government is known to have introduced the French education policy in West Africa and established their own basic education structures (Kusiak 2010). This then resulted in them disregarding educational institutions that were established before the colonial era but rather they supported the construction of several mosques. In French West Africa, in the early 1930s, an endorsement to switch village schools to rural schools was made with the intention to invest in and promote agricultural education and manual trades (e.g., barter system) (Gamble, 2009).

Obikili (2016) using census data from Nigeria and the Gold Coast State colonial era, further found that there is a negative cross-country association between literacy and slave trade. According to his study, places that were affected the most by slave trade had lower literacy rates. The principles of native education emphasized by British Tropical Africa organization were that education “should be adapted to the mentality, aptitudes, occupations and traditions of the various peoples” which were also considered within international and intercolonial bodies. The Achimota College in the Gold Coast for example was amongst the new schools that they established as a succor to meliorate agriculture, native industries, and health (Steiner-Khamsi and Quist 2000; Gamble 2009; and London: H. M. Stationery Office 1925).

Okoye and Pongou (2015) using Demographic and Health Surveys (DHS) data from Nigeria in 2008 to assess the role of slave trade and Christian missions on contemporary literacy, documented a significantly positive association between proximity to the Christian missions and education. Obikili (2013) finds a strong negative association between literacy (as a partly causal element of human capital) and real GDP per capita, literacy and slave trade, as well as adult literacy and various measures of slave intensity. Lucas (1988), Mankiw et al. (1992) and Hall and Jones (1999) also suggest that variations in GDP per worker are as a result of differences in average education.

Despite the growing reports and research when it comes to the impact of slave trade on the economic, political, and social development of Africa, it is believed that more research has to be done in order to really uncover the extent to which slave trade has impacted African development. The suggestion was not to treat these eras in African history independently, as slave trade affected

colonization and therefore the development of such areas (Okoye and Pongou 2015). Combining data from the slave trade era as well as the colonial era would possibly yield more insightful analysis.

1.3.3. Pre-colonialism

The form of political centralization of African ethnicities in terms of empires, kingdoms, state like entities before colonialism has been linked also with Africa's poor development, as compared to the rest of the developing world. Among other factors contributing to this were the conflicts that existed in some communities between ethnicities following slave trade – ethnic fractionalization (Herbst 2000; and Besley and Reynal-Querol 2014). A positive correlation also has been found between economic development and heritage of statehood and it accounts for a considerable percentage of cross-country variation in development (Borcan et al., 2018).

Although more stable political systems before colonialism would have been to the advantage of Africa's development, the challenge also with them is the favoritism (e.g., in terms of land allocations, choosing of leaders etc.) and ethnic patronage that accompanies such ethnic based political institutions (e. g., Posner 2005; Franck and Rainer 2012; De Luca et al. 2015; and Dickens 2018). Ethnic leaders were thought to be more trustworthy by locals than elected politicians and said to be less corrupt (Logan 2011; and Michalopoulos and Papaioannou 2015).

Post-independence, most of these ethnic based institutions persisted as European settlers via indirect rule would strengthen roles played by local chiefs and kings. In such areas, local economic development was inevitable as locals especially the local elite were being educated (Kay and Nystrom 1971). Also, in places where political centralization was more stable, it was shown that status, privileges and wealth often determined distribution of power and authority. Examples of these are: the Bemba, the Zulu, the Ngwato and the Banyankole which contemporarily still maintain strong centralized authority by means of well-established kingships (Michalopoulos and Papaioannou, 2013, 2020). This was shown in studies done by Murdock (1959, 1967) and Fortes and Evans-Pritchard (1940). In the same studies, ethnic groups were classified into those that either lacked (e.g., the Logoli, the Tallensi, the Nuer etc.) or had centralized authority. For those that lacked centralized authority there were no strict divisions in ranks, wealth, status, etc., and Gennaioli and Rainer (2007) also demonstrated those communities, ethnicities or countries

consequently had low educational or literacy rates, low immunization rates and higher infant mortality.

Botswana is one such country that demonstrated a strong political setup which persisted even post-colonization and thereby played a crucial role in its post-independence economic success. Advisory bodies, local administrators were responsible for instructing local chiefs and even the king was subject to checks by the chiefs (Schapera 1970). Sierra Leone on other hand had poor pre-colonial centralization and as a result there was poor governance which in turn contributed massively to their poor economic development even post-independence. They also failed to combat violence, negatively influencing economic development (Acemoglu et al. 2016).

During the colonization era, ancestral homelands that were already divided as states saw higher rates of regional development. Boone (2003) and Herbst (2000) also discuss how the more politically centralized groups because of proper governance created or formed policies that endured the colonial era which contributed significantly to the national building process, thereby enhancing economic growth. Local chiefs, kings, and the like were found to be more accountable, which played a role in post-independence investments in infrastructure, transportation, school setups, etc., in countries such as Rwanda (Jedwab and Storeygard 2017). However, Bandyopadhyay and Green (2016) argued that there was no link between precolonial political centralization and public goods (e.g., roads, schools).

Another interesting association documented was the correlation between bride price (dowry) payment, which is a practice seen in Africa and parts of Asia, and school construction programs. There were higher female enrollment rates in places where bride price was paid and especially if the amount was higher. That is, the bride price was used by the girls' family to educate them, thereby proving to be an important mediating contributor for development policies. Societies where this custom is not much in practice experience lower female enrollment rates (Michalopoulos and Papaioannou 2020). Further work has been recommended to explore how other traditional cultural practices influenced economic growth/ development e.g., inheritance rules, female genital mutilation, patriarchy.

It has also been recommended that further work be done in Africa, especially in terms of using more refined data on infrastructure, school contractions and colonial institutions. Exploring heterogeneity with high quality data with a wider special coverage. Also, studies should be done

to assess how precolonial and colonial features influenced political hierarchies during independence and post-independence.

1.3.4. Colonial Legacies

European colonialism in Africa had a significant impact on the African economy because it stimulated investment in education (e.g., school construction), created transportation infrastructure, allowed the establishment of state institutions, and ushered in the eventual abolition of slavery (Heldring and Robinson 2012). However, Rodney (1981, 1972) and (Austin 2010) amongst other schools of thought argue that colonialism is at the root of the current difficulties in Africa. According to them, colonialism resulted in Africa's lower levels of human capital, poverty, and overall state underperformance, including high rates of corruption, authoritarianism, and inferior manufacturing industries. Taking a different view point, Acemoglu et al. (2005) argues that colonialism had both extractive and investment outcomes.

The French government in 2005 requested that the benefits with regards to colonialism should be emphasized/accentuated through a bill via the French National Assembly. In Africa, however, the French government was asked to pay for “crimes against humanity” (Atiles-Osoria 2018). As the colonists settled in their different territories as they had partitioned African land amongst themselves, the eminent challenge they had was to take over/be in authority over those places since already there was the existing rule via indigenous people chiefs, kings, headmen, etc. The British introduced indirect rule where they ruled the interior headmen and local chiefs. In areas where the French settled, they mostly focused on trying to rule coastal areas and interior with the Europeans and to centralize power and by educating a minority of the local elite.

The setting up of institutions was also something that was key, and it depended mostly on the favorability in ecology of the area, population size, and the presence or absence of endemic diseases. In places where the above were favorable, colonists settled in great numbers, setting up institutions (e.g., education, building infrastructure, etc.). In areas where the opposite was the case, they settled in fewer numbers, setting up institutions for extracting minerals and natural goods (Darwin 2012; and Fieldhouse 1999). As a result, extraction states, also known as gate keeper states, had very little/no development at all. An example is Sierra Leone where the British were indirectly ruling. Post-independence, local chiefs provided public goods, settled disputes, collected

taxes on production and education was positively related to the number of ruling families because of the high levels of political influence (Acemoglu et al. 2014).

There were also areas known as colonial concessions (Congo Free State), which were areas that were rich in mineral resources and agricultural potential and colonizers used to extract both via forced labour. Development of institutions was very minimal in these areas as a result of which housing, access to basic public goods, schooling and health care services was much lower, for instance Anversoise and Anglo Belgian Indian Rubber concessions in northern Congo (e.g., Lowes and Montero 2017).

Furthermore, highlighting more in-depth regarding forced labour systems that colonist employed in Africa particularly in Nigeria, French Africa, and Rwanda-Burundi it shown that forced labor practices came about as a result of numerous factors but mainly due to the scarcity of labour directly associated with low population density. Most colonial administrations resorted to forced labour practices also because of the lack of tax systems which would be present if there were no properly established private property rights in which they also did conscription and kind labour taxation (Gardner, 2012). There was also the finding of the exploitation of precolonial labour tribute systems that had already been in place which colonists modified to form their own forced labour systems. Archibong and Obikili (2018) continue to give an example of the kasanvu tribute system which was indigenous to Uganda where the local people either cultivated cotton or worked without pay on other days and they generated revenue from that as well. They further discuss how in Nigeria during 1920 until 1938 thousands of locals were imprisoned for incompliance to the payment of farm taxes or for petty crimes. The convicts were then used in public work projects as cheap labour.

These forced labour systems undoubtedly provided substantial boosts to local revenues as a result colonial states exercised the practice heavily especially during the pre-World War I period. Other examples were the Equatorial and French West Africa corvée system (prestations) where work without pay for a certain number of days per year was mandated of adult African males. For those who had been working six months or more however minimal pay was provided. Estimations of additional income gained by colonial states from those prestations in addition to the normal budget were about 50 percent (Waijenburg, 2018).

On the other hand, discriminatory forced labour systems that were exerted on people particularly in Rwanda and Burundi by the Belgian colonial administration around 1931 also proved to be detrimental for a number of reasons. Since it was more in favour of the Tutsi than the Hutus, it resulted in mistrust between the two ethnic groups. Consequently, there was a weakening of a widely used precolonial risk-sharing institution that exhibit less trust today and are less likely to use this risk-sharing arrangement. The rift between these two ethnic groups and the differences therefore were also a major contributing factor for ethnic violence and the 1994 genocide that disrupted economic and education activities (Blouin 2013; and Blouin and Mukand 2016).

According to Glaeser et al. (2004) and Easterly and Levine (2016) Africa's poor economic performance and educational gap when compared with other continents is a result of lack of proper/reduced investment efforts in colonial times: i.e., lack of educational investments by colonists, primary and secondary education school construction was low so that even tertiary education had minimal exposure. Northern Africa experienced a rise in formal education especially with the Islamic people around 14th and 15th centuries. In the south of Africa where the Dutch and English settled, they constructed schools around the 17th century e.g., George Schmidt founded Genadendal, the first mission station in South Africa, in 1738.

Missionaries also played a key role in the aspect of education as they would set up schools in order to educate locals especially to be able to read the bible. These missionaries also contributed to the abolition of slavery and for slave trades in African societies. This would ultimately lead to African development together with promoting commerce as per the viewpoint by the work published by Sir Thomas Fowell Buxton "The African Slave trade and its Remedy".

According to Johnson (1967) and Okoye and Pongou (2014) it was observed that missions were mostly set up along coastal areas in places that were affected mostly by slavery because of the lack of transportations especially inland (Jedwab et al. 2018). There were differences however in the way the British and the French administrated their educational policies as these were ruling indirectly and directly respectively. The overall objective was to enhance authority/colonial power in the occupied land. The British worked in hand with missionary schools and mostly had classes taught in indigenous languages which was quite different from the French who developed a centralized education system where the medium of communication and teaching was French

(Frankema 2012; and Cogneau and Moradi 2014). Most of these investments in education occurred post-World War II.

There was an observed difference between those exposed to protestant missions versus catholic. When looking at both, given the fact that these schools were mostly situated by the coast because of the lower disease burden, in a study done by Alesina et al. (2019) the finding was that of a strong within-country positive association between proximity to the protestant missions and literacy. The impact was great also for those born during the colonial era. Catholic mission school exposure was less and according to Nunn (2014) it benefited mostly male and none for females. On the other hand, female education was mostly impacted positively by protestant education.

Protestant missionaries also devised a way to enhance the contemporary literacy and newspaper readership in areas where they were posted. They imported printing presses from places of higher development, and this had a positive impact on literacy overall. The combined data from the 2005 and 2008 Afro-barometer surveys done with around 28 000 people from Beach et al. (1925) was used in a study to determine this by Cagé and Rueda (2016).

As a result of colonialism, Africa became even more linguistically diverse including indigenous languages that already existed. The language diversity became too much and the distance also of these official languages (English, French, Portuguese) from the indigenous languages was great, and thus limited human capital accumulation. Consequently, human capital was limited, leading to lower levels of education post-independence. They showed that lower human development (e.g., health and education) was as a result of linguistic distance from the official language and linguistically diverse countries in Africa that were more likely to adopt the colonial language as the official language. The argument was put forward by Laitin and Ramachandran (2016, 2018).

Taking into consideration the family structure in an African setting, polygamy has long been an African norm and in most parts of Africa it still is today. Nevertheless, the introduction of the missions and thereby Christianity in Africa is somewhat believed to have led to a decrease in this practice. But post-independence there is very little or no correlation found between polygamy and education investments (Fenske 2013). Modern day school/education seems to have less impact on cultural change. Another study carried to understand the role of investments by the colonial state from 1910 to 1928 in French West Africa, with a population of around 12 million, assesses the long term effect of colonial investments on education: higher educational rates associated with the

incorporation of more teachers (i.e., by adding 10 teachers per 100, 000 inhabitants), of which a substantial legacy of colonial human capital investments was exhibited (Huillery 2009).

1.3.5. Case Studies

Several empirical papers have been used in this section to examine the role of colonial and missionary human capital (i.e., education and health) investments in Nigeria, Benin, Togo-Ghana, Cameroon, Ghana and South Africa are discussed below.

Nigeria

As stated earlier, missions settled along the coast, so in Nigeria Southern states mostly benefited more especially those also greatly affected by slave trade. Studies by Okoye and Pongou (2014) show that Northern Nigeria had limited or minimal educational investment as the North was ruled by Islamic Sokoto Caliphate and Borno emirates which did not allow or opposed Christian expansion. Individuals staying close to these missions attained contemporary education. Contemporary schooling was also increased by placing Christian missions per 1000km² of a person's homeland. In terms of gender heterogeneity, females were more impacted and people from all religions benefited if they lived close to schools established by Christian missionaries.

Benin

A study conducted by Wantchékon et al. (2015) on the impact of catholic schools using unique longitudinal data. The comparison is between those with/without schools in the same village and those very 1st students from colonial schools and their descendants. It then showed that: firstly, those who obtained colonial education were considerably more politically active, had better living standards, better social networks. Secondly, the children of such individuals also benefited significantly from their parents' education, as the same pattern of attainment in the same spheres would be observed and thirdly, extended families also benefited. Lastly, in villages where these schools were setup those people's descendants had better outcomes as compared to those without schools.

Togo- Ghana	In a study by Cogneau and Moradi (2014), post-World War II Togo was partitioned between the British and French and it was found that contemporary education continued mostly on the British side (i.e., Ghana) where most of the mission schools were set up. Since the rule was by the French on the side of Togo literacy rates were not as high.
Cameroon	The same findings were obtained after German Cameroon was partitioned post-World War II. The British side had higher literacy rates, but they also dropped after independence. These were findings by a study carried out by Dupraz (2015).
Ghana	According to Michalopoulos and Papaioannou (2018), the development of pre-industrial trade routes, railway construction also played a role in enabling mission schools to move further inland even to the North but there was always the controversy of Christian mission school in Islamic regions which they opposed. But mainly the Ashante ethnic groups benefited the most from missionary education after they allowed them into their regions after 1890. Even here, the mission schools were placed along the coast given the low prevalence of malaria (Burgess et al. 2015).
South Africa	It is distinctly found that 1849 people that hail from districts where Christian missions were built on average had higher educational attainment (Fourie and Swanepoel 2015).

A general observation in Africa on infrastructure development which was mostly in the form of colonial roads and railway tracts to places that were rich in natural resources, agriculture and minerals also played a role in education. People were now able to travel to and from the mission schools via those means thereby increasing literacy rates overall across the continent (Alesina et al. 2019) as a result urbanization was also positively impacted (Jedwab and Moradi 2016).

1.4. Motivation

Most of the few existing relevant literature covering some countries in Africa at different times (e.g., Alesina et al. 2019; Cogneau and Moradi 2014; Dupraz 2015; and others) have focused on the role of history (colonialism and its artefacts, slavery and slave trade, pre-colonial political structure etc.) on education and literacy. However, there is a gap for further work to help understand how the effect of Africa's history on education has impacted country level economic development. This is in line with the research agenda recommended in the recent detailed literature review by Michalopoulos and Papaioannou (2020). The most crucial pre-requisite for any such work would be to get hold of more refined data from Africa on pre-independence investments in institutions and educational infrastructure. Heterogeneity needs to be further explored and high-quality data allowing wider spatial coverage would bring this enablement.

For example, Nunn's (2008) paper on the long term effects of Africa's slave trade focused on the link between economic development and slave trade, and Obikili (2016) further determined the impact of slave trade on literacy with evidence from the colonial era. Hence, the contribution of this study to the ongoing discourse and beyond is to determine the link between development of education through physical infrastructure and cultural or philosophy channels with these eras and the resulting effect on economic development.

Studies that have been done show the link amongst and between some of these eras of time in Africa's history. Precolonial political institutional and cultural traits were almost always in one way or another an influential factor for colonialism and thereby colonial investments (Whatley 2015). The practice of indirect rule is clearly portrayed in recent works by Heldring (2016) and Blouin (2013). Gerring et al. (2011) also showed that more politically centralized and institutionally advanced societies practiced indirect rule. Therefore, African development can be studied from different time periods, in different empirical studies, and with more emphases on within-country variation.

1.5. Purpose of the Study

The purpose of this study is to ascertain whether the relationship between Africa's history and educational development/provision can explain the region's economic development. Furthermore, the study seeks to determine how Africa's History (colonialism, slave trade and slavery etc.) has

impacted on educational development/provision and how this has in turn impacted economic development. The historical events that will be considered to arrive at the expected results include slavery and colonialism. This exercise will be explored in several countries sampled from sub-Saharan Africa.

The findings of this study will lead to a simulation of possible development strategies that will inform Africa's educational development trends on economically under-developed countries.

1.5.1. Research Questions

Below are the research questions of this study.

- | | |
|---|---|
| 1. History & Educational Development | How did Africa's historical legacies (colonial-era, precolonial-era and slavery and slave trade) affect development of institutions and investments in education? |
| 2. Education Development & Economic Development | How is Africa's history (colonialism, slavery, and slave trade) significant to the development of education and Africa's contemporary economic development? |

The above debriefs are directed at determining the effects on the nexus of education development and economic development as a result of Africa's colonial and slave trade history.

1.5.2. Research Objectives

The objectives of the study are as follows:

- Procure better and more refined data on colonial institutions and investments in education, and educational infrastructure, ideally covering all of (sub-Saharan) Africa.
- Ascertain the effect of Africa's history (colonialism, slavery, and slave trade) on investment in education and development of educational institutions.
- Determine the relationship between the effect of Africa's history on development of education and Africa's contemporary economic development.

1.6. Significance of the Study

This study commences by determining whether there is a relationship between Africa's history and the development or provision of education. Furthermore, understanding the impact of Africa's history (colonialism, slave trade and slavery, etc.) on the development or provision of education and how this has impacted economic development. The success of this investigation will ideally also enable us to partly address the research questions raised by Michalopoulos and Papaioannou (2020) regarding obtaining better and more refined data on colonial institutions and investments in education, health, and infrastructure, across all of sub-Saharan Africa. This thesis will also in part explore the opportunity opened by Obikili (2016) regarding the need to examine the sub-national literacy rates in French colonies in places where the states took charge of investments in education. Furthermore, it also forms a basis to explore the long-term effects of the slave trade on locally provided public goods.

1.7. Organization of the Study

In this chapter, the key elements of this study are introduced: namely historical legacies, education development and economic development. Further, a brief background on how history impacted development of education and how this played part in economic development. In chapter 2, a detailed review of literature is conducted to explicate the importance in understanding how Africa's history (colonialism, slave trade and slavery, etc.) has had an impact on development or provision of education and how this in turn has impacted economic development, as to identify the gap in this relevant literature. The methodological paradigm and development of the measures of slavery and slave trade, colonialism, imperialism and government policies, are discussed in chapter 3. Chapters 4 and 5 are self-contained analysis and empirical results reflective of the main objectives of the study. Lastly, chapter 6 concludes.

Chapter Two: Prior Studies

2.1. Introduction

Since the post-independence period there have been significant within-country and cross-country variations in educational attainment across Africa, although literacy rates and average schooling years have been notably lower in comparison to other continents (Barro & Lee, 2013; Alesina, et al., 2019). This observation is supported by data on literacy rates for 2011 documented in the CIA Factbook (see Figure 1.6).

This chapter presents literature from previous studies to support the study objectives.

2.2. Colonial and Slavery History of Investments in Education and Development of Educational Institutions

Africa's notable educational lag has been attributed to a number of factors mostly concentrated during colonial times even though other historical legacies may also have played a role (Walters, et al., 2020). For instance, there was little colonial investments in education, leading to inadequate infrastructure to service basic education (very few classrooms to support primary and secondary school enrollments) and university education being deemphasized for natives (Glaeser, et al., 2004; Easterly and Levine, 2016).

The expansion of Islam in northern Africa as well as the upsurge in commerce aided the influx of formal education into the continent in Northern Africa and the Sahel according to Fourie (2013). By the fourteenth to the fifteenth centuries Timbuktu and amongst other institutions (located in as the latter-day Mali) were prominent educational hubs. There have been a number of documented evidence regarding the existence of educational systems and formal educational institutions in Africa dating far back into the precolonial period (Ajayi, et al., 1996; Assie-Lumumba, 2006; Lulat, 2005). For example, Lulat (2005) mentioned that in 970AD Al-Azhar University was established in Cairo, Egypt and in Morocco Fez the Al-Quarawiyyin University was established in 859AD. In Alexandria as well approximately between 331 and 642AD there was an academy called the Alexandrian Academy or the Universal Museum Library as reported by Ajayi et al. (1996). Additionally, Lange (1987) also made mention of the educational system which was utilized in Ethiopia which produced many scholars including Zera Yacob who was one of the first African philosophers. Their tradition consisted of using an African script called the Ge'ez and could have been considered as a form of formal education.

On the other extreme end of Africa, George Schmidt founded Genadendal which was the first missionary school in South Africa in 1738. That was to be the beginning of the schools the Dutch and English built there during the seventeenth century. In other places, such as Sierra Leone and Mauritius, enrollment rates were surprisingly greater than 20% even before the scramble for Africa and at the beginning of colonial rule. Prior to that, protestant missions had established few missions in Africa (Mantovanelli, 2013a) along the coastal areas due to lack of a transportation network and the high prevalence of malaria (see Jedwab, Meier zu Selhausen, and Moradi 2018), but they moved further inland during the 1850s following the introduction of quinine.

As missionaries started settling all across the African continent, converting Africans to Christianity became at the forefront and literacy rates also surged. That also brought about the abolition of slavery during the mid to late nineteenth century owing to the fact that missions were established in areas most prone to slave trades mostly along the coastal regions (Johnson, 1967; Okoye, & Pongou 2014). The book titled *The African Slave Trade and Its Remedy*, published in 1839, by Sir Thomas Fowell Buxton, popularized suggestions that aided Africa to go into a sustained development path by emphasizing on commerce, investing in education, and converting many to Christianity.

Investments in education in the Northern parts of Africa and some of West Africa were very limited if at all possible as Islamic rule was more dominant. The setting up of schools, development of educational systems and the formation of educational policies was encompassed within a broader vision of directly or indirectly ruling settled communities. That also came about as part of colonial states wanting to minimize costs towards education because human-capital investments were deficient (Acemoglu, Gallego, & Robinson 2014) and the ideologies behind developing centralized public educational systems varied considerably.

Murdock's ethnographic coding of political complexity has played a significant role to enable scholars to understand the how Africa's development history has been influenced by precolonial institutions. Figure 2.1 shows the "Jurisdictional Hierarchy beyond the Local Community Level" which is the updated work (Murdock, 1967) of Murdock's (1959) "*Jurisdictional Hierarchy beyond the Local Community Level*". The number of jurisdictional layers above the local (village) level is represented by five categories. Additionally, George Peter Murdock's Ethnographic Map from the late to the early twentieth centuries was also a significant aid in assembling the spatial

distribution of ethnicities during that period split by national border. The eight uninhabited upon colonization areas are displayed in Figure 2.3 panel A together with 835 ethnic homelands and regions, while panel B zooms Ghana (the Gold Coast). The following studies have made use of the above data sets.

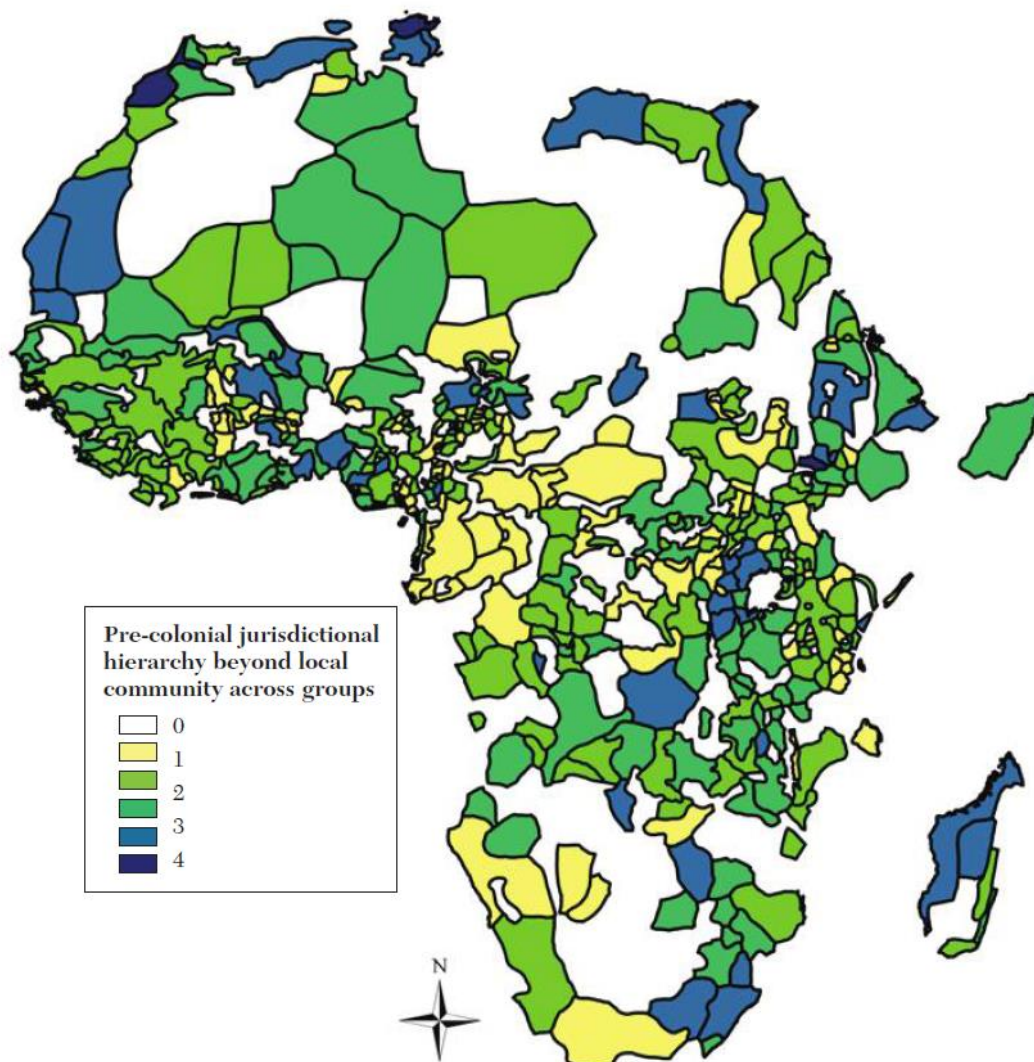


Figure 2. 1: Jurisdictional Hierarchy beyond the Local Community Level (0 indicates societies “lacking any form of centralized political organization.”, 1 is an indication of small chiefdoms, 2 is an indication of large chiefdoms, 3 and 4 is an indication of ethnic groups that were part of large states)

Source: Murdock (1959, 1967)

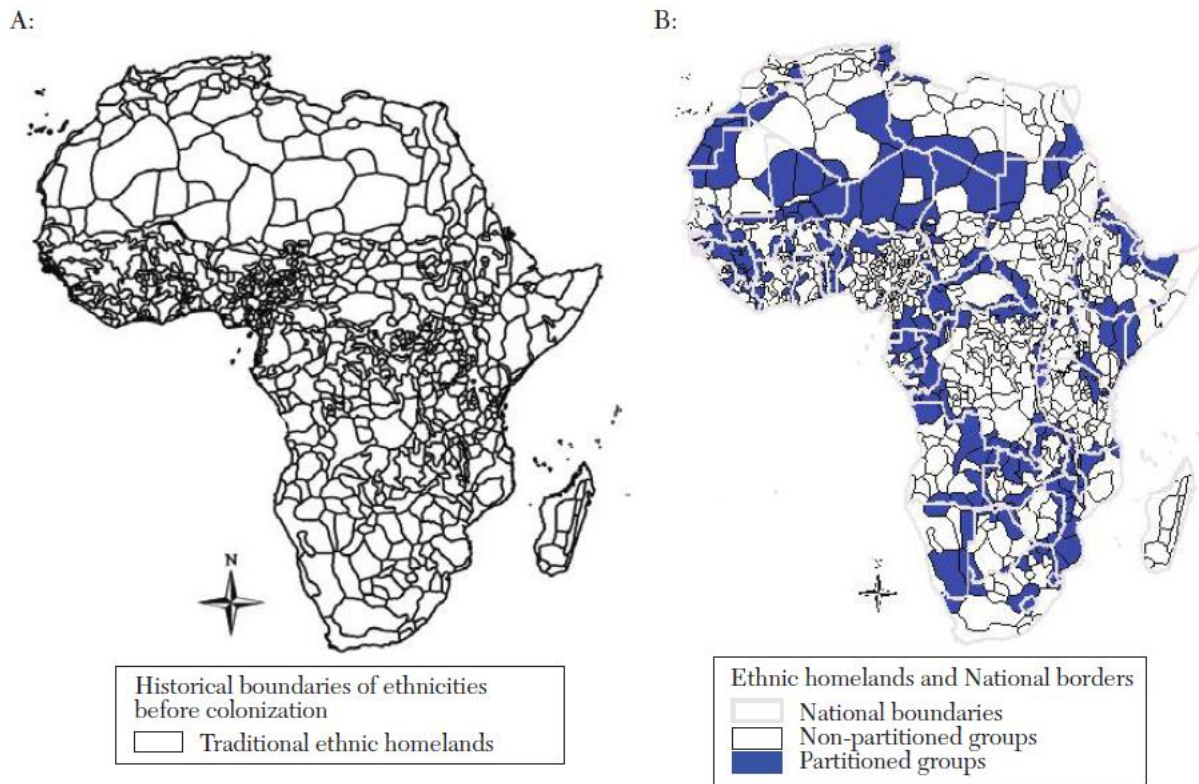


Figure 2. 2: Ethnic homelands.
Source: Michalopoulos & Papaioannou (2020)

For example, according to Okoye & Pongou (2014), the setup and expansion of Christian missions in Nigeria also was a strategic one as they had to mostly settle in the south as the Islamic Sokoto caliphate and Borno Emirate were mostly in charge and ruled north. It was therefore not exactly accessible because of this and so the education system was run by the British administration entirely which resulted in very limited investment setups. They also demonstrated that distance to Timbuktu and distance to the coasts were also vital in determining education outcomes. Placing Christian missions closer to the ethnic homelands increased average contemporary schooling (i.e., enrollments) and therefore leading to higher educational attainments. On account of ethnic homelands, they also reported on the heterogenous pattern describing that females benefited more than males and in fact people of all religions would benefit if they lived closer to a mission school (even Muslims). By using Murdock's ethnographic map and DHS educational data from 2008 which involved 30 000 people and placed Christian missions per 1000km² from their homelands. They found that there was a strong positive link between contemporary schooling and colonial

mission school legacies. This was also done taking into account controls for location and individual, ethnicity specific constraints, proxies of precolonial development (contemporary education correlated negatively with this) and state focused effects.

Similarly, on tracking the settlement of the Christian missionaries along the Gold coast, a notable pattern was observed. Apart from the fact that there was lower malaria prevalence along the coast, the practice of Islam was less in that region as compared to North. Despite being able to move further inland via the construction of railway tracks or routes, it was only after the cold war that they were able to successfully invade then north. Local indigenes also played a key role to that expansion. The Ashante ethnic groups benefited the most from the missions in terms of education, health as they allowed missionaries into their region after 1890 (Michalopoulos, Naghavi, & Praroto 2018; Jedwab, et al. 2018). All the above-mentioned findings were established via digitalized colonial Blue book of Christian missions spanning from 1751-1932.

Ricart-Huguet (2021) conducted a study by using combined novel data sources to understand the origins of colonial investments in former British and French Africa. He shows level of public infrastructure expenditures by district (1910–1939 average) as supported by the map in Figure 2.3. By using the location of pre-colonial trading posts in coastal colonies (X), the location of the first pre-colonial trading post in each colony (+), and the location of natural harbors (anchors) and capes (lighthouses) he shows that colonial investments were very unequally distributed within sixteen British and French African colonies. He further argues that natural harbors and capes led to some places becoming centers of pre-colonial coastal trade, which in turn later increased colonial investments not only in infrastructure but also in health and education. The positive link between early trade and colonial investments can also be explained by ‘agglomeration economies attenuated with distance’ (Rosenthal and Strange 2004). However, he does not find a definite link between colonial investments and natural resources and pre-colonial ethnic characteristics, including pre-colonial political centralization. His findings articulate the significance of pre-colonial trade for long-term development in South Asia and China (Jha, 2013; Jia, 2014) as well as in Africa.

Ricart-Huguet (2021) also makes a contribution to the economic account of the origins of regional and ethnic inequality (Bates, 1974; Robinson, 2014) by reorganizing the ‘ethnic’ distribution of colonial opportunity to underscore its commercial origins. His findings shows that colonialism was

beneficial to some while to others it was not, and these results established a bedrock for the ‘ethnic distribution of colonial opportunity’ by Horowitz (1985). For example, in a country like Uganda, which had the first university in East Africa in 1960, only 1 student was from Kakwa and Lugbara in Northwestern Uganda while 50 percent of the students represented 16 percent of the Baganda population in Central Uganda. That ethnic inequality was also true for labor practices (Cooper 1996), conscription and other domains.

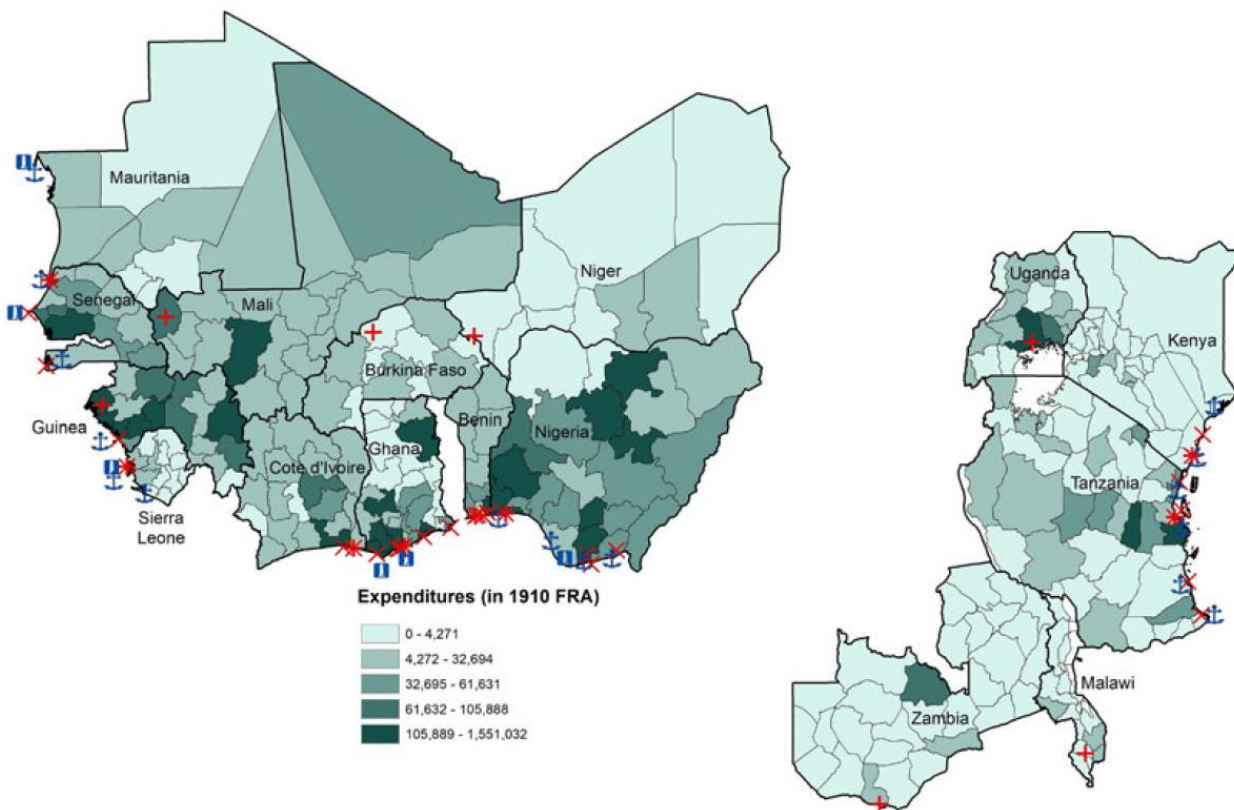


Figure 2. 3: Geography, pre-colonial trade, and public infrastructure expenditures by district (1910–1939).

Source: Ricart-Huguet (2021)

Cogneau and Moradi (2014) and other scholars like Frankema (2012) document that the British colonies formed an educational system centralized around using local indigenous languages for teaching and learning. They also often employed people from the local community to assist in that respect, and they were able to administrate all that through Christian missions to whom they outsourced educational investments. French colonies on the other hand had an educational system

that was centralized on teaching and learning in the French language. The primary reason for that being that they wanted only a few educated elite and as a result local dialects were never taught which was a stark contrast to the British where average education attainment was higher. For example, Berman (1974) reported that 5,360 schools out of 5590 were Christian missionary based whereas the rest were state sponsored. In both British and non-British colonies educational investments began only after the Second World War. Of important note is that Portuguese and Belgian colonies had limited resources so Christian missions played a pivotal role as these colonies most often followed an indirect rule strategy and enrollment rates within these non-British colonies was almost equal between state run schools and missionary schools (Frankema 2012). In British Africa however, school enrollments were mostly generated via missionary schools and were above 90 percent during 1900 and 1938 respectively (Cogneau & Moradi, 2014; Frankema, 2012).

It is also worth mentioning that most of the mission schools were superintended by African converts who were responsible for overseeing the overall functionalities in those schools doing most of the work, and in protestant mission's seven out of eight official staff members were African during 1903 and 1925 respectively. For instance, in Uganda in 1938 only 285 teachers were of European descent in contrast to 8456 African teachers who taught in primary schools (Frankema, 2012). Meier zu Selhausen, van Leeuwen and Weisdorf (2018) also reported on that finding stating that in Uganda in the year 1904, out of 162 missions stations European teachers comprised only 3 percent as approximately 2 500 indigenes taught in missions schools. According to Jedwab, Meier zu Selhausen, and Moradi (2018) there were also six times more missions with African indigenes in the Gold Coast in 1890.

There have also been numerous studies that have been done to survey Christian mission legacies outside Africa. In Brazil, Paraguay and Argentina for example industrial specialization and human capital were associated with the location of the Jesuit missions as the influence of their early investments persisted (Caicedo, 2017) and in Mexico areas in close proximity to Catholic missions recorded higher industrial attainment as opposed to those near Jesuit missions (Waldinger, 2017). Again in India, protestant and Christian missions are associated with contemporary literacy, tertiary education and development (see Mantovanelli, 2013b; Castello-Climent, Chaudhary, & Mukhopadhyay 2015 for details). In further analyses of places that had Christian missions outside

Africa there were rather interesting findings in China where it was demonstrated that there was a rise in literacy rates even though converts to Christianity among the Chinese were few.

In order to examine the legacy of Christian missions on education even more extensively Nunn (2014) utilized 2015 Afrobarometer surveys covering 17 sub-Saharan African countries. The surveys involved approximately 21 000 respondents in which he assessed their living in close proximity to the missions and also assessing different ethnic exposures to Christian missions. He collaborated these surveys with George Murdock's ethnographic Atlas which provides information on the spatial distribution of African ethnicities during colonization times. Together with that he also made use of Roome's (1924) map (depicted in Figure 2.4) on the location of early missions. The resultant findings were that protestant missions impacted female education immensely when compared to males. Catholic missions on the other hand had notable influence on male education in the long term. Census data used by Alesina et al. (2019) involving missions of respondents from 23 African countries in one accord with that demonstrated strong within country positive association between literacy rates and proximity to protestant missions.

On another note, regions that had pre-existing centralized governing systems were also noted to have had less colonial investments. For example, in an analysis done in Nigeria it was found that public goods (e.g. education) were withheld in certain ethnic regions especially to leaders who were not compliant to colonial powers (Archibong, 2019). As a result, Bandyopadhyay and Green (2016) do not detect any link between public goods provision of education and healthcare and pre-colonial ethnic centralization, but indicate that Centralised ethnic regions were found to have sustained vast wealth (i.e. private goods). Hillery (2011) also observed that due to increased hostility of local citizens towards European settlers in French West Africa, there were less colonial investments such as education. On the other hand, regions with less hostility experienced more investments. An inverse relationship was demonstrated therefore between the provision of public goods and centralization.

In an argument put forth by Lowes et al. (2017) however they state that precolonial ethnic centralized societies inevitably meant that there would be more co-operation from the leaders of ethnic groups in question, but at the same time there would be lower tendency for locals to obey national laws they would implement in areas that had more developed precolonial systems. The noncompliance and hostility coupled with the absence of the British colonial administration would

be therefore discourage the supply of schooling institutions as discussed by Müller-Crepon (2020) which was in line with the suggestion made by Frankema (2012) that these colonies must have experienced organized resistance from the centralised ethnic regions. Contrary to this however, Gennaioli and Rainer (2007a) state that local chiefs were more accountable and worked hand in hand very well with European settlers in regions that had strong precolonial centralized systems which in turn aided in increasing the provision of public goods (e.g., education, health, infrastructure). Concurring with this Michalopoulos and Papaioannou (2013) state that regions that had strong centralized systems in place the society ethnic leaders would be more accountable and involved especially in policy implementation.

Nevertheless, existing leaders in centralised ethnic regions together with their ethnic and traditional institutions were recognized by the British colonies and traditional leaders were absorbed in their administrations to enforce institutions in countries like Uganda (Lugard, 1929; Gennaioli & Rainer, 2007a). Eventually, according to Gennaioli and Rainer (2007a) because leaders were in submission to political authority and were held liable in centralised ethnic regions, colonial governments managed to introduce and implement colonial influences, including education policies using an indirect rule. On the other hand, in fragmented regions (i.e., ethnic regions that were without political unity) the British colonies depended less on ethnic authorities but implement colonial governance and used a more direct approach (Müller-Crepon, 2020) by accommodating and cooperating with traditional chiefs who were accountable to the 'distant' colonial administration (Clignet & Foster, 1964). However, in the long run colonial government found it difficult to manage and coordinate these leaders because they were dispersed and pursued self-gain (Gennaioli & Rainer, 2007 a, b). Budgets for native administration were also larger in centralised than in fragmented ethnic regions according to Müller-Crepon (2020) because European administrators were few and colonial rulers were barely involved in those regions. French colonies on the other hand had little consideration for existing ethnic institutions, local ethnic leaders, traditional ethnic boundaries and systems therefore their incorporation of ethnic leaders in their administrations was solely dependent on their loyalty to the French government and their education systems (Bolt & Bezemer, 2009; Crowder, 1964).

That greatly encouraged the influx of the British colonist that started when trading companies began to enter into African territories as they had commercial motivations of being in charge of

the administrative economy and adopting their approaches to each colony which formed part of the initial intention to settle in Africa (Moradi, 2008), thereby promoting economic diffusion and minimizing political interference that had tremendous impact on the operations of individual institutions (Clignet & Foster, 1964). However, African territories that were part of the French empire were more rigid and common law was implemented (Clignet & Foster, 1964; Cogneau & Moradi, 2014). The education systems between the French and British however varied greatly.

Education policies in British institutions accommodated ethnic diversity across societies, yet French institutions did not accommodate the characteristics of the different societies in their education policies (see Brown (2000) for a detailed comparative study on the education policies between British and French institutions). For instance, in British colonial institutions, English was introduced at a later stage and people were taught in their local dialects, whilst the French mandated that the French language be taught from elementary school level. As a result, Benavot and Riddle (1988) and other scholars found great variations in contemporary education outcomes in these two kinds of colonial rule (Bolt & Bezemer, 2009; Brown, 2000; Garnier & Schafer, 2006; Grier, 1999; White, 1996). For example, after World War I, the German colony of Togo was partitioned between the British and French. With the use of quasi-experimental variations from these regions post war, Cogneau and Moradi (2014) were able to deduce that though there were numerous post-independence educational investments in both countries, the Ghanaian side of the border had prominent rise in primary education completion rates as well as contemporary literacy rates. That was also the same for Cameroon for which cohort-based data dating back to the colonial era were utilized. British primary education was found to have been positively affected those born during the colonial era but they seemed to gradually evanesce (Dupraz, 2015).

Both the British and French colonies in German Cameroon also invested heavily in setting up educational institutions which was the driving initiative that played a key role in increasing educational attainment. In areas with British rule it was noted that there was higher primary school completion coupled with more school participation. This was also possible because they had a lot of missionary activity and invested much capital into public schools. French investments also in turn resulted in higher education outcomes as they invested more in education later in colonial times (Dupraz, 2015).

In a more in-depth study Cogneau and Moradi (2014) did an analysis in order to understand the variations in literacy in regions between what is known at present as Ghana and Togo at the partitioning border of the German Togoland between the French and British territories. They performed a border discontinuity analysis using data on recruits to the Ghana colonial army and show insignificant results without any notable results for the North, yet for the Southern regions of Togo and Trans-Volta Togoland they found positive effects of increased education spending and missionary support. They further stressed that more studies need to be done to explore the extent of colonial effects on education outcomes.

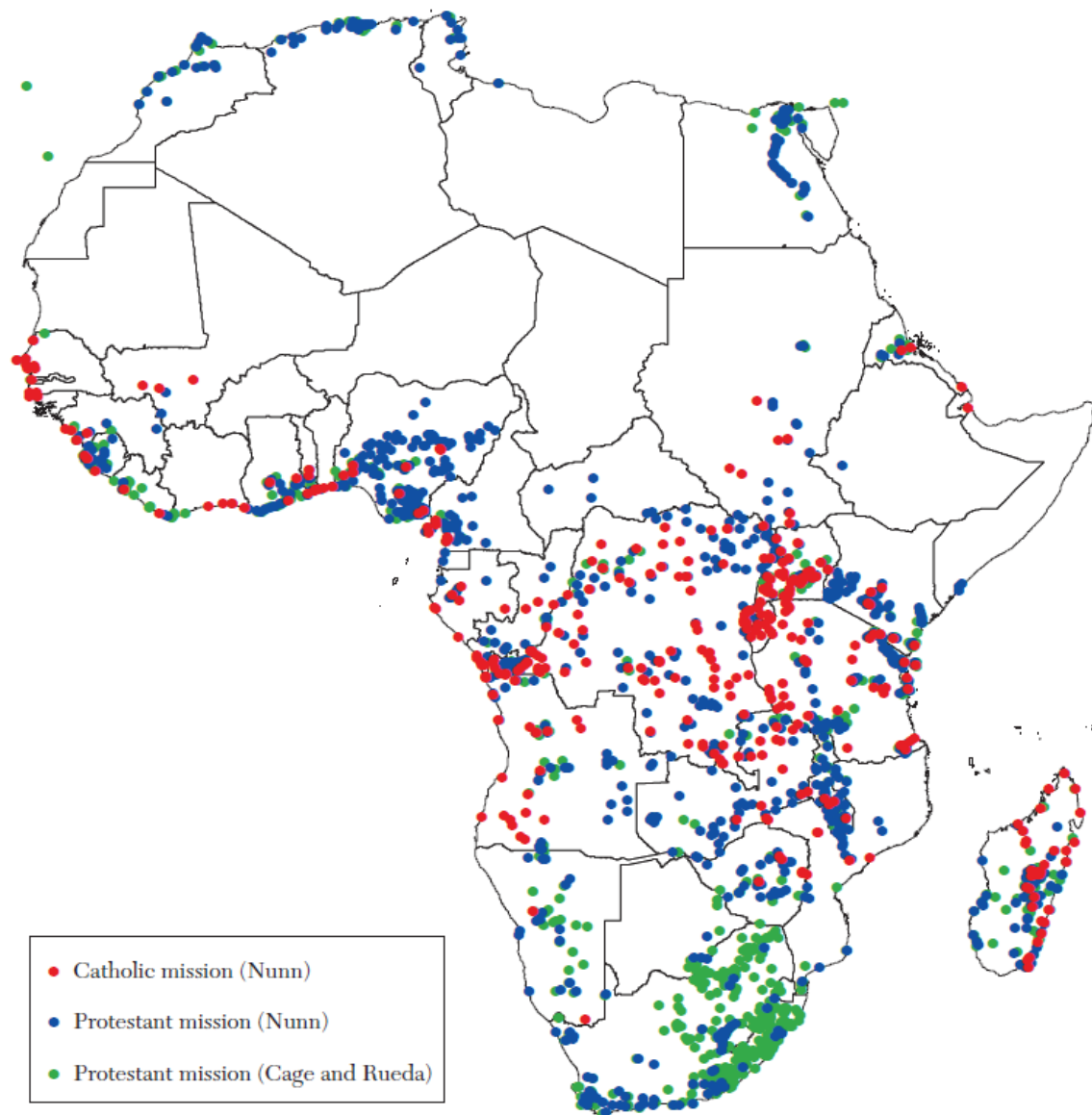


Figure 2. 4: Christian Missions.

Source: Nunn (2010) and Cage and Rueda (2016), and Michalopoulos and Papaioannou (2020).

2.3. The effect of Colonial and Slavery History on education

Numerous crucial factors have had to be considered when evaluating and monitoring the progress of Africa's economic development and growth together with how they contribute as some of the key driving forces as far as Africa agency is concerned (Frankema, 2012). In consonance, Lipset (1959) and other scholars state that economic growth, development, quality of institutions and political participation are linked to educational outcomes (Acemoglu, Gallego, & Robinson, 2014; Barro, 2001; Glaeser, Ponzetto, & Shleifer, 2007). As a consequence, Africa's relative underperformance in terms of economic growth and productivity has also been attributed to its educational gap during the colonial period, owing to the considerable inertia in both the supply and demand for education at that time which did not tally. This relative underperformance as Glaeser et al. (2004) explained, has been partly due to low levels of colonial investments in education, the construction of few basic primary and even fewer secondary schools, and the lack of promotion of universities (Easterly and Levine 2016).

That being said, scholars like Angeles and Elizalde (2017) have linked contemporary development characteristics and increased public goods provision, including schooling with pre-colonial ethnic institutions (Archibong, 2019; Gennaioli & Rainer, 2007; Michalopoulos & Papaioannou, 2013, 2014; Michalopoulos, Putterman, & Weil, 2019). In agreement with this, Bolt and Bezemer (2009) and other scholars have linked the differences in education outcomes to educational, political, and administrative approaches implemented by colonial rulers amongst former colonies (Cogneau & Moradi, 2014; Dupraz, 2015; Frankema, 2012; Huillery, 2009). Benavot and Riddle (1988) and other scholars have also noted that disparities in contemporary education outcomes should be credited to colonial rule, considering the British rule as more favorable (Brown, 2000; Garnier & Schafer, 2006; Grier, 1999).

Walters, Chisadza, and Clance (2020) therefore ascertained the effect of colonial and pre-colonial institutions on contemporary education in Africa using geolocated DHS literacy outcomes for Cameroon, Côte d'Ivoire, Ghana, and Nigeria. They found a positive association between British rule and literacy in centralised ethnic regions and an even stronger positive association in fragmented ethnic regions. That is explained by the association between missionary activity (Cogneau & Moradi, 2014; Frankema, 2012) specifically in centralised ethnic regions and literacy outcomes in their results. Their findings suggested that the positive effect of British rule on

contemporary literacy was dependent on the pre-colonial centralization of ethnic regions. Additionally, as a result they suggested that educational outcomes presently are not only because of colonial or pre-colonial ethnic institutions but due to the contention between colonial and precolonial institutions.

According to a study done by Huillery (2009) during the period between 1910-1928 using an OLS specification demonstrated that educational attainment rose markedly for children between the ages of seven to twelve by 10% due to the deployment of 10 more teachers per 100 000 inhabitants. That was a rather impressive turnout as the average enrollement was between 33 and 34 percent across 98 districts. They saw fewer children suffering from stunted growth also during this period with the addition of more doctors. Regressions from this report indicated that colonial educational investments played a crucial role in the quality of education in the contemporary setting. Better contemporary health institutions were observed in places which had colonial health investments.

Moreover, an analysis of the cape colony missions in South Africa was conducted to examine persistence in education. That was achieved using the data from the 1996 population census together with the 1849 census of missions. It showed that there was higher average educational attainment amongst people from areas that had missions near them. The result was found to be robust to the inclusion of contemporary controls. The introduction, spread and use of the printing press also made a large contribution to literacy rates as reported by Dittmar (2011) and Cagé and Rueda (2016). Making use of Afrobarometer surveys from 2005 and 2008 in contribution with maps from Beach, Fahs, and Bartholomew (1925) in a study that involved approximately 28 000 people, they found no strong association between contemporary literacy and proximity to Christian missions. However, they found that there was a strong positive link between increase in literacy rates and proximity to Christian missions that had a printing press.

Furthermore, the effects of slave trades on education and human capital were also examined using census data from the late colonial era. In that analysis, Obikili (2016) focused on the Gold Coast and Nigeria where he demonstrated that in places that were mostly affected by slave trades literacy rates were significantly lower. That was to also emphasize on the finding of negative country correlation between literacy and slave exports. Taking into account the strong association between GDP and education. In the same vein, using DHS data from Nigeria in 2008, Okoye and Pongou (2015) also came to the same finding that slave exports had a negative impact on literacy and also

that human capital was indirectly promoted or encouraged by slave trades as mentioned by Obikili (2016). Although there were numerous Christian missionary schools close to slave ports which aided in increasing literacy levels, the negative impact of slave trades on education was much more dominant that it seemed to negate the positive impact of Christian missions.

In a paper by Whatley and Gillezeau (2009) to study the impact of the slave trade on African economies they argued that the slave trade had a large and significant impact on African economies and societies. They further show the conditions under which the African response discouraged political development and instead encouraged violence, social hierarchy, and ethnic diversity. In addition, they show evidence in favor of a guns-for-slaves cycle indicating that there may have been a prisoners' dilemma style arms race among small African states that would help explain regional trends in the African response to the slave trade (Gemery and Hogendorn, 1974; Inikori, 2003).

2.4. The effect of education as affected by Colonial and Slavery History on economic development

Different features of colonial educational policies have been examined in literature to determine their impact on modern development in Pan-(Sub-Saharan) Africa in general, while others are focused on specific nations as well as studying the effects of historical institutions on Africa's contemporary development. Brown (2000) together with Cogneau and Moradi (2014) and other scholars have explained that colonial rule and pre-colonial ethnic institutions are interdependent with effects that determine outcomes contemporarily (Frankema, 2012; Gennaioli & Rainer, 2007a). Hence it is crucial to understand this interdependence by considering colonial and pre-colonial institutions, and pre-existing ethnic institutions to explain differences in contemporary development as well as education outcomes.

Over the decades there have been debates on the actual benefits and or disadvantages of colonialism on African development. Some pointing to the fact that European colonization of Africa was for its best interest as a lot of investments were made in education, health and infrastructure, political centralization, railway and roads constructions and the fact that slavery was eventually abolished largely due to the intervention from Christian missions (Heldring & Robinson, 2012). On a more contrasting view however some scholars (e.g., Darwin (2012) and Fieldhouse (1999)) have argued that colonialism resulted in or indirectly led to manufacturing taxes, low human capital levels, authoritarianism, low levels of state capacity and poverty.

Giving evidence through many influential papers in order to support the negative role colonialism played in Africa Darwin (2012) and Fieldhouse (1999) amongst others investigated the extractive institutions that the Europeans setup. Firstly, these extractive communities were setup in regions with less favorable geography and which also had high yellow fever prevalence and malaria. There was very little to no development in such areas or regions as the main objective in setting up in the first place was for the extraction of natural resources (i.e., minerals and agricultural goods). There were very few investments in transportation (setup or construction of railways) and that was so only because they wanted to get the raw goods or resources to the industrializing world. As a result those regions also had limited provision of basic public goods (e. g. health and education). Colonial gate keeper states were also faced with the challenge of not being able to extend their command and power to people in those regions (Cooper, 2002).

Concurring with that there were various interesting findings that were made in a study conducted to examine two rubber concessions in Northern Congo. Contemporary outcomes at the borders of these concessions were examined, namely the Anversoise and Anglo-Belgian India Rubber companies. Lower and Montero (2017) in that study showed that literacy, vaccination rates and schooling were quite low within the concessionary boundaries and living conditions were also not up to par. Furthermore, some researchers have shown how extractive institutions in Africa were associated with empowerment of dictatorial local chiefs, widespread use of forced labor, oppression, extremely high taxation strategies on farmers and mass killings (Rodney, 1981; Bates, 1981; Young, 1994; Dowden, 2009; Mamdani 1996).

The setup of inclusive institutions were in areas with lower population densities, less or no disease (malaria and yellow fever) prevalence and more favorable ecology and geography. Acemoglu, Johnson, and Robinson (2001, 2002, 2005) therefore associated contemporary development in these regions with the setup of those inclusive institutions (i.e., Christian missions with schools and or clinics etc.) and as a result in these regions education, health services and railroad construction was higher. Such areas were for example South Africa, Oceania and North America.

The position and significance of chiefs during the colonial period and post-independence is undeniable. Acemoglu, Reed, and Robinson (2014) made an analysis of the interior of Sierra Leone amongst others in order to truly explore the above statement. They deduce that violence and oppression were a common way of exerting authority by headmen, subordinate chiefs and paramount chiefs. In the Sierra Leone region in particular the chiefs were more liable to colonial administrators, state capacity was characteristically lower and there were a few ruling families. When the ruling chiefs managed to remain in power even post-independence it would mean a few things: the chiefs or families in rule would control land, impose taxes on produced goods, during election they would allocate votes to the candidates they favored, and they settled disputes. Another finding to support contemporary outcomes was that there was a positive relation between the numbers of ruling families and health indicators, education and household assets. The importance of political competition with that therefore cannot be over emphasized as fewer ruling families would hold more authoritarian views (Acemoglu, Reed, & Robinson, 2014).

Futhermore, economic performance was also gauged for countries that had strong precolonial centralization systems and those that lacked them. Using Murdock's jurisdictional hierarchy,

Gennaioli and Rainer (2007b) calculated percentages of the population that were under politically centralized groups. They found that in countries with high scores on the ethnic specific precolonial political centralization proxy, national institution quality was higher. They also stated that in countries such as Sierra Leone and Liberia infant mortality rates and morbidity were higher accompanied with lower educational attainment and immunization rates. The findings would otherwise be improved in countries such as Rwanda, Swaziland, Lesotho and Botswana where there were stronger precolonial centralization systems in place (Gennaioli & Rainer, 2007b). There are more studies done to show the hierarchy of authority in centralized societies and systems of accountability that were in place. Herbst (2000) and Boone (2003) show that there were bureaucratic systems in those centralised regions where hereditary kings and superior Chiefs had local leaders who were in sense reporting to them which allowed for greater accountability and transparency within those centralized societies. Local assemblies were also present for the discussion of new policies. For example, in countries like Zambia projects used to be facilitated by chiefs amongst other public goods provision investments (Baldwin, 2013).

Additionally, a strong conditional cross-country correlation between post-independence investments in construction of infrastructure and especially transport was shown by Jedwab and Storeygard (2017), which concurred with Heldring (2016), who in Rwanda illustrated a positive association between regions' experiences with precolonial kingdoms and pre-genocide public goods (schools, roads). In Bandyopadhyay and Green (2016) interestingly though, no such positive correlation was found between public goods provision and precolonial political centralization in Uganda.

The impact of the printing press with regards to influencing economic development was also assessed in a variety of studies. For example, Afrobarometer survey data from 2005 and 2008 in combination with geocoded historical maps from Beach, Fahs, and Bartholomew (1925) were utilized. The study involved 28 000 respondents and revealed that proximity to Christian missions with a printing press escalated newspaper readership and trust as well as contemporary literacy rates. There was no link found between contemporary health and proximity to colonial era Christian missions. According to Dittmar (2011) there was a link between urbanization to the spreading of the printing press which he substantiated with cross-regional evidence from Europe. Cagé and Rueda (2018) further described increased political activity in regions that had a printing

press. Consequently, as these printing presses were brought into places with high growth potentials or high levels of development a robust correlation between democracy and duration of exposure to Christian missions was found (Woodberry, 2012, Woodberry & Shah, 2004; Gallego & Woodberry, 2010).

2.5. Other factors affecting educational development in Africa

African historical legacies as explained above have directly influenced educational and economic development over the centuries undoubtedly, needless to say there are a number of other key factors that have in one way or another indirectly impacted African development as they are discussed respectively (Michalopoulos & Papaioannou, 2020).

Education in itself has been found to impact economic growth in various ways. Hall and Jones (1999) stating that technological progress within any economy cannot be entirely dependent on education alone. Taking into account the degree of ethnic fractionalization in Africa, education has been found to influence societies by reducing the probability of conflicts between ethnicities especially in more ethnically diverse societies as well as reducing distance amongst them as well. It is quite crucial to account for the above-mentioned factors as they are important for economic growth within ethnically fractionalized countries (Gradstein & Justman, 2002). Many researchers have come to a common consensus that the high levels of ethnic fractionalization and inequality in Africa are major contributing factors for Africa's underdevelopment during the post-independence period which also affected the provision of public goods (i.e., education, health etc.) (Easterly & Levine, 1997; Alesina, et al., 2003; Baldwin & Huber, 2010; Desmet, Ortuño-Ortín, & Wacziarg 2012; Habyarimana, et al., 2009; Michalopoulos, & Papaioannou, 2016).

The impact that civil wars have had in many African countries also cannot be overlooked as at any given time properly functional institutions form a crucial part in growing any economy. Numerous studies have been conducted in order to formally assess the extent to which civil wars have negatively affected growth rate income in certain African countries (Gyimah-Brempong & Traynor, 1999; Barro, 1997; Atardi & Sala-i-Martin, 2003). The Armed Conflict Location & Event Data Project (ACLED) has been a reliable source for data that has become very crucial in the provisioning of the relevant data concerning battles between rebels and militias, riots, foreign intervention, conflicts, violence against civilians and conflicts between non-state actors. A total of 64 650 high conflict areas are illustrated in the map in Figure 2.5. Panel A depicts spatial violence distribution from 1997-2013 in Africa, while Panel B contains an index that describes number of violent events that occurred across ethnic homelands. The following studies have made use of the above conflict data sets.

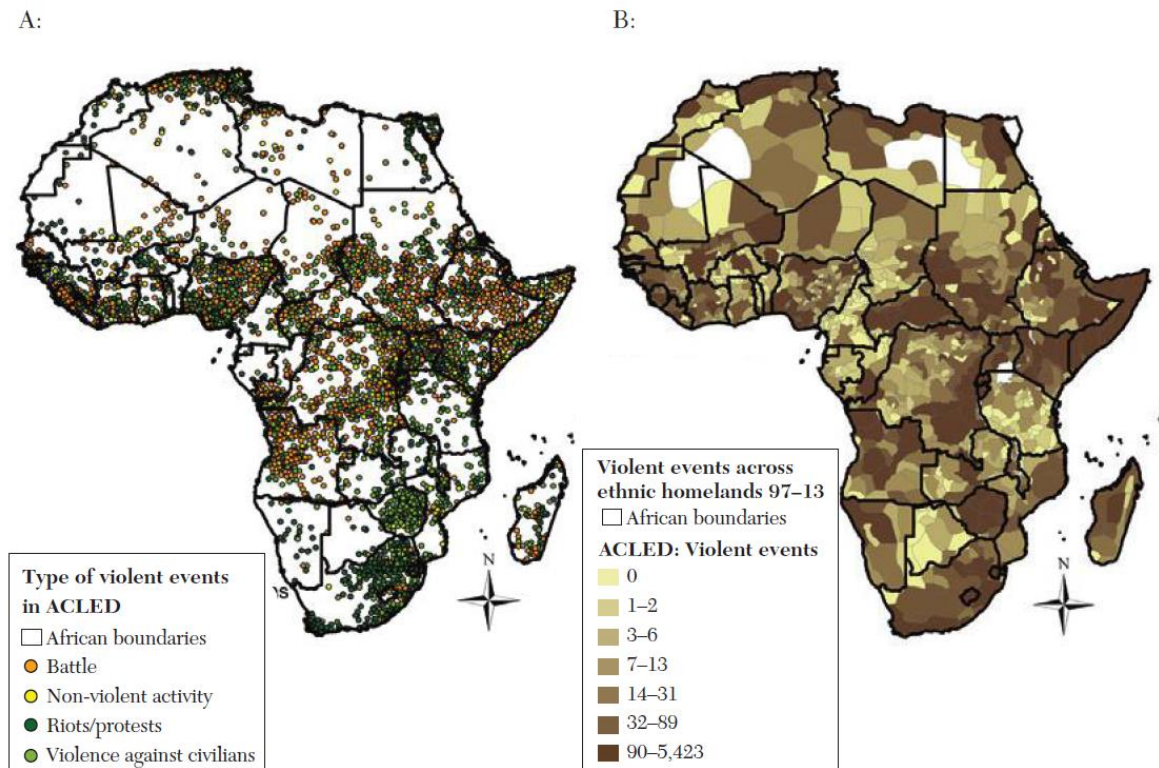


Figure 2. 5: Civil Conflict Incidence across Africa.
Source: Armed Conflict Location and Event Data (ACLED)

Ethnic fractionalization was found to be one of the major influential forces behind civil wars, and moreover, the conflicts tended to have a strong spillover to neighboring countries especially where people from homogenous ethnic groups were residents (Bosker & de Ree, 2014) across those regions. Goemans and Schultz (2017) further state in an analysis they conducted that territorial conflicts were more likely in regions of high ethnic fractionalization even more so among or between politically powerful groups. They concluded that using contemporary ethnic maps, which demonstrated that the ethnic power relations database records indicating how individual nationals were affected as well as the correlates of war project. They also found that on overall in across 102 borders there were 29 disputes. There was also increased tendency for territorial conflicts in regions with poorly demarcated borders, while the likelihood was lessened in places with lakes, water bodies and/or rivers as they provided clear border demarcations. In a cross-border analysis to examine conflicts Englebert, Tarango, and Carter (2002) show that when people of the same

ethnic groups resided on either sides of the borders disputes were more likely. They also mentioned how territorial disputes cross-country were more common in areas with partitioned ethnicities.

Seeing that ethnic fractionalization stemmed from the scramble for Africa, it was therefore imperative to explore in depth as to how that African legacy directly and indirectly affected African development. Consequently, because of the scramble for Africa numerous ethnic groups were split as the process of forming colonies was under way. That was somewhat hugely disadvantaging as people from different cultural, ethnic, and linguistic backgrounds were compelled to be part of the same colonial artifact. That contributed largely to the ethnolinguistic composition of many African countries and was a major causative factor in igniting and perpetuating conflicts. That was mainly because such ethnic differences sank deep into encouraging ethnic discrimination and favoritism and played out most conspicuously in the political arena to incite civil wars (Alesina, Hohmann, Michalopoulos, & Papaioannou, 2018, 2019). They made this finding on the basis that intergenerational mobility in post-independence education had sizable differences with regards to colonial investments. That was motivated by deep evolutionary traits (Ashraf & Galor, 2013), geographic heterogeneity (Michalopoulos, 2012) and ecological features (Cervellati, Chiovelli, & Esposito 2019). Robinson (2001, 2002) and Chua (2003) also further discuss on how ethnic inequality has negatively impacted political development in Africa as well as across the developing world.

Even though the immense positive impact colonialism has had in Africa is certainly undeniable, it did however lead to other factors which were found to be detrimental to educational outcomes and inevitably economic development in most African countries, one such being linguistic policy. Some studies were done as a result to evaluate how colonial educational policies impacted contemporary development while some researchers focused more on individual countries and others took a more Pan-African approach. Some of the data used did not reflect the full picture, and for example some maps like Roome's (1924) (illustrated in figure 5) did not capture all missionary stations where Africans did their main health provisions, educational and religion studies (Jedwab, Meier zu Selhausen, & Moradi, 2018). In a novel hypothesis put forward by Laitin and Ramachandran (2016) which assessed the link between contemporary human development and colonial languages, they mentioned that African countries adopted a colonial language as an official language when linguistic diversity was much. Consequently, this would then lower human

development (i.e., education, health). Therefore, using a global sample, they were able to link low levels of education and health to linguistic distance of the official language to indigenous languages. They did that using within-Africa cross-county narratives and regressions in order to substantiate their argument. In addition to that they also performed an analysis involving Cameroon and Ethiopia which showed how student performances were negatively affected when European languages were used in African schools (Laitin, Ramachandran, & Walter, 2019; Ramachandran, 2017).

The internal hierarchies and bureaucratic systems within ethnic regions themselves and kingdoms were vital influential factors in how social and economic activities played out to yielding desired economic development across Africa. Moscona, Nunn and Robinson (2017a, b) reported that segmentary lineage ethnicities operated along matrilineal or patrilineal lines and moreover social and economic activities would center around that particular family and that conflicts were more likely in segmentary lineage ethnicities which was mostly due to general mistrust amongst individuals. But in overall the children from matrilineal kinship systems were on average more healthier and educated but less co-operative (Lowes, 2018).

For instance, an analysis of indigenes from central and northern Benin was done using a unique longitudinal data set. The data assisted in tracking and identifying the earliest mission school students and their descendants. That was of course in comparison to those who did not receive formal education as reported in a study by Wantchékon et al. (2015). The analysis demonstrated how people who received formal education were more politically inclined and active within the society and were less likely to work in or venture into agriculture. They were more socially linked and even took part in election as candidates and had higher and better living standards, and their children also followed suit in that pattern with good living standards and better social networks. The benefits would go on to impact extended families as more people would have a chance of getting educated which as a result lead to a better livelihood. On the other hand, those who did not get any formal education together with their descendants had poor outcomes (Wantchékon, et al., 2015). However, in a study done across 107 Madagascan districts to determine long term impacts of mission schools and colonial settlement, very little to insignificant statistical correlations were observed between missionary schools and contemporary well-being (Weitzke, 2015).

Some traditional cultural practices or customs have been shown to influence economic development to a certain level. One of which being the payment of bride price by the groom to the family of the bride. The practice was and is still prevalent in most of Sub-Saharan Africa and in parts of Asia. In a study done by Ashraf et al. (2020) involving Zambia and Indonesia in comparison they show that school construction programs and female enrollment would markedly increase in areas or regions where the bride price tradition was practiced as the parents of the bride would be able to invest in their girl's education when such funds are available. Consequently, there would be higher female enrollment within those ethnic groups and the amount of the bride price received would directly translate to the level of educational attainment. That is, the higher the bride price the greater the educational attainment at marriage. Within ethnic groups that did not have that tradition however there was no notable increase in education for girls especially following the construction of schools. These findings therefore illustrated the importance of traditional cultural practices as mediating factors for development policies.

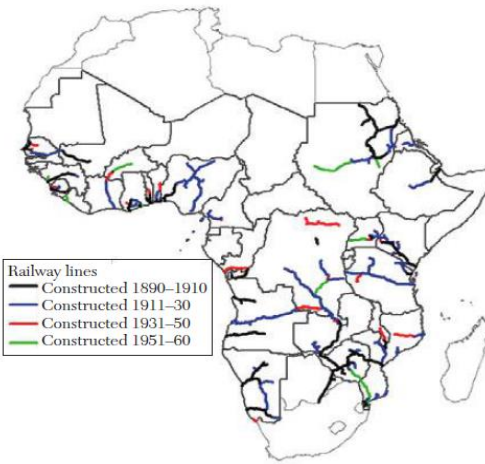
Another area that was assessed was the association of colonial state investments in education and Christian missions on polygyny. In an analysis done by Fenske (2013), he found that educational expansion in Kenya, Sierra Leone, Zimbabwe, and Nigeria had not reduced polygyny. Therefore, he found no significant association between polygamy and post-independence educational investments. Different findings however were noted in the study done in Malawi which showed higher educational attainments, lower rates of polygyny and higher female marriage age in relation to close proximity to the Livingstone mission (Kudo, 2017). Areas that had more Christian missions and received more teachers are noted to have had lower rates of polygamy rates today. The presence of health clinics within Christian missions or lack of them was also assessed. The overall idea was that health clinics provided the necessary health education in order for local people living around or in close proximity to the Christian missions to have safe sexual behavior. Mantovanelli (2013a) further stated in support of this saying the missions helped to curb the spread of HIV by shaping peoples beliefs and morals. Therefore, HIV prevalence decreased by 2 percent of a standard deviation with every 1 standard deviation increase in the proximity to health clinic. Of course, this was true for Christian missions with health clinics. Cagé and Rueda (2018) reported that in places that had missions that lacked health clinics there was more HIV prevalence which increase by 1-1.5 standard deviation with every 1 standard deviation increase in proximity to a Christian mission.

Safer sexual behavior was adopted by the populations living near health clinics being run by missions. That might have also helped in preventing the spread of HIV (Mantoavelli, 2013a). In agreement with this, Cagé and Rueda (2017) also found lower HIV prevalence in areas close to mission hospitals and clinics as health education was given regarding safer sexual practices e.g., condom use and or abstinence. HIV prevalence would then be much higher in regions that had Christian missions without health clinics. They were able to establish that using DAS data, which demonstrated that HIV prevalence increased by 1 to 1.5 percentage of standard deviation when proximity to a mission had a one standard deviation increase.

However, large scale mistrust in the use of modern medicine in many parts of Africa can also be explained by the types of medical campaigns that used to take place during colonial times. One such campaign was one embarked and examined by Lowes and Montero (2018). The campaign included these countries: Cameroon, Democratic Republic of Congo (DRC), Chad, Central African Republic (CAR), and Gabon which focused on combating syphilis, sleeping sickness caused by tsetse fly and malaria. They tracked the extent of the campaign reach outs between the years 1921-1956 using archived data which they mapped out. The campaign had very little to no good outcome to say the least and their overall benefit was highly questionable as it resulted in numerous adverse effects including blindness, gangrene and even death. That then in the long run resulted in less uptake of health services in areas which were affected and general mistrust of medicine (Dupas & Miguel, 2017). For example, World Bank health projects were less effective in places where those campaigns had occurred.

On another note, the construction of railroads in Africa during colonial times also played a major role in encouraging development in those respective areas or regions according to scholars and policy makers. There were definite distinct patterns in the distribution of these rail roads which were evidenced by Jedwab and Moradi (2016). The data focused on most of Sub-Saharan Africa, excluding South Africa, in which they used the data to map out railroad distribution. This is illustrated in Figure 2.6, panels A and B, which showed that, firstly rail roads were connected to ports to the interior as Europeans were extracting minerals and crops. They did not connect them to the main cities, for example in Mozambique there were only 3 main rail lines and 2 subordinated ones as supported by Figure 2.7, panel B. Secondly as investments were insufficient during colonial times there were therefore less railway lines.

A:



B:

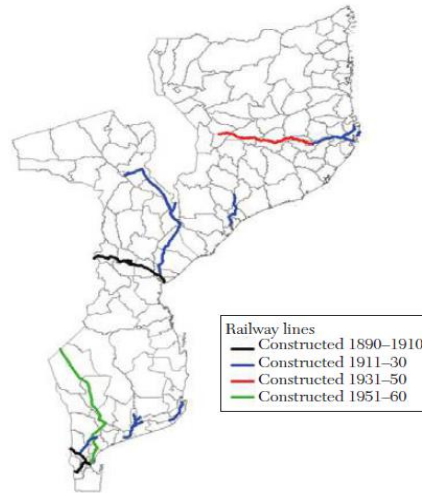
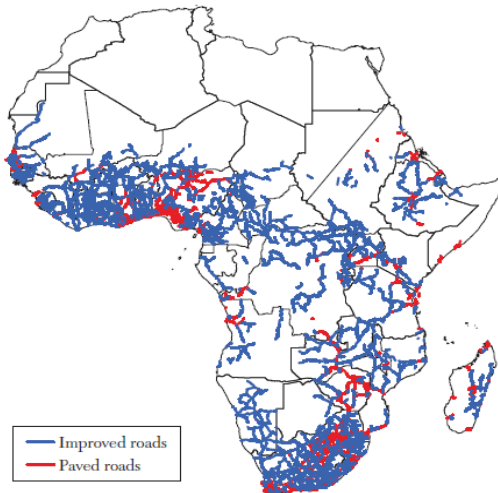


Figure 2. 6: Colonial Railroads.

Source: Michalopoulos and Papaioannou (2020)

A:



B:

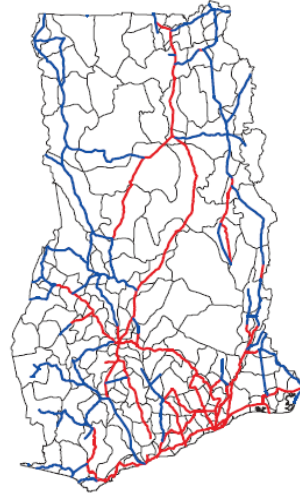


Figure 2. 7: Roads.

Source: Michalopoulos and Papaioannou (2020)

Furthermore, another analysis was done in Nigeria where the overall impact of railroad was examined. The study was performed with individuals who lived closer to areas with colonial roads. Using data from the DHS Okoye, Pongou and Yokossi (2017) were able to deduce that the overall livelihood would be influenced a positive way once people lived near a railroad. They had more

access to public goods (i.e., health, education etc.) which then resulted to high levels of literacy and education attainment in those regions. The probability of these individuals taking more professional careers was higher. In the same vein there have been similar findings in ongoing work by Alesina et al. (2019). They demonstrated that intergeneration mobility in education was linked to colonial railroads and also found a very strong robust and persistent positive link between educational attainment and colonial railroads. That was achieved using consensus data from across 23 African countries. Furthermore, Jedwab and Moradi (2016) stated that the surge in urbanization post-independence in the sample of 39 Sub-Saharan countries he worked on was as a result of colonial rail roads.

2.6. Status Quo in Africa

An analysis of the annual average growth rates of populations, per capita GDP and GDP was done for various world regions spanning from 1820-2010 by Wesley and Peterson (2017). They achieved this using data made available by the Maddison Project (2013) for per capita GDP growth and the World Economic (2016) and US Census Bureau (2016) for population. The findings demonstrated that during the period between 1820-1913 when much of the world was developing and had growing per capita GDP, Africa had low average annual growth rates even though not the lowest in that period. Later on, however between 1913-2010 Africa average annual rates per capita were at the lowest (0.83) even though there was a slight improvement while other world counterparts were experiencing significantly higher growth, for example western Europe at 1.85 and Asia 2.28. This minute increase in Africa's GDP per capita was as a result of a fast-growing population during that period despite experiencing an average of 3% growth p.a.

A number of scholars have had differing views, interpretations and opinions regarding the effects that the different legacies have had on Africa's economic growth. Sylwester (2005) for example, argued that countries that experienced independence first in Africa tended to show more rapid growth than those that were still under colonial rule and as a result suggested that decolonization had a positive impact on growth. Other writers in likes of Artadi & Sala-i-Martin (2003) also contributing to the fact that from the beginning of decolonization during the 1950s till the mid-1970s, Sub-Saharan Africa experienced high growth rates. The growth rates were comparable to other world regions such as Asia, recording 1.5 to 2 percent growth per year. Arrighi (2002) further suggested that it was not until 1975 that Africa showed a marked economic underperformance. Nevertheless, decolonization has also been associated with some negative impacts with low school enrollments and high illiteracy rates being at the top of the list. The lack of formally educated and trained personnel went in to affect key economic sectors.

During the period from 1980 to 2000, Glewwe et al. (2014) stated that SSA countries experienced the lowest higher education enrollments as well as the lowest economic development. According to World Bank statistics Africa had average GDP per capita growth of -0.6 percent during this same period while it was 4.9 percent for East Asia, South Asia had 3.6 percent, the Middle East 1.2 percent while Latin America was at 0.5 percent.

The Sub-Sahara economy suffered the worst economic performance in 2016 over 20 years since 1993 more or less when the real GDP aggregate increased by 1.1 percent in the first quarter which was followed shortly afterwards by a corresponding decrease of 1.0 in the third quarter (Olamosu & Andy, 2015). The effects of external shocks on the agricultural and mining sectors of the economy also played a role in that decline in GDP growth as a large number of citizens were employed in these sectors.

In the discussion of the essence of adequate schooling and attainment of higher education as an important driving factor for increased human capital, some writers have made contributions in support of this. Firstly Lucas (1988) stated that when human capital was driven by formerly educated individuals it would influence economic development in the following ways. Playing an input role in the production process, innovative technology also rises, and it acts as an agent of diffusion, corresponding with Nelson & Phelps (1966) and Romer (1990). Therefore, poor human capital production performance could be directly linked to inadequate schooling or lack of higher education (Glewwe, et al., 2014). Additionally economic development, growth, political engagement and institutional quality are also positively associated to educational achievements (Acemoglu, et al., 2014; Barro, 2001; Glaeser, et al., 2007; Lipset, 1959).

In the determination of long term development, the positive influence of education towards human capital cannot be over emphasized (Lucas, 1988; Shaihani, et al., 2011). Bloom (2014) further stated that the level of education and higher education attainment of a country's population reflects the people's skills, knowledge, freedom and economic progress. Wilfred and Bokana (2017) then stating how higher education human capital at the output level seemed most significant to SSA economic growth.

Additionally, Rosenberg (2004) made mention of endogenous growth which stipulated that human capital is a significant factor in determining long-term economic growth. In a more precise context Gyimah-Brempong, et al. (2006) found, using World Bank data over the period 1960-2000 from 34 African countries, that growth rates per capita income in African countries was positively influenced by all levels of education. In the study they also show how growth elasticity for higher education human capital was 0.09 which was double the value for the growth impact of physical capital involvement. The overall findings in their study were in agreement with a study in the same vein done by the Nesta Foundation (2013) in the United Kingdom from 2000-2008 which

evidenced that 37% of growth rates linked to capital and labour while 63% could be attributed to innovation. Consequently, some researchers such as Benavot & Riddle (1988) have stated that Africa's educational gap was due to few education investments from colonial times resulting in low productivity. Also, the low colonial investments during the colonial era in basic secondary and university education are said to be one of the reasons for the relatively low educational outcomes in Africa with illiteracy rates being the highest (34.7%) in the world between 2009 and 2019 compared to other world counterparts (Easterly & Levine, 2016; Glaeser, et al., 2004).

2.7. Concluding Remarks

Although there are still a lot of questions on the real extent to which colonial education investments and Christian missions really impacted Africa's way of life, social systems and overall literacy rates, it's quite clear that they have played a tremendous role in increasing educational attainment in Africa. Taking into account that colonial setups and location preferred and did not occur randomly, there is still more room to examine the influence of precolonial events on colonialism, slave trades, scramble for Africa and precolonial political centralization (Fourie & Swanepoel 2015; Jedwab, et al. 2018) as these events did not occur independently of one another. Therefore, due to the above, more in-depth studies with more refined data on colonial institutions and investments in education, health, and infrastructure, ideally covering all of (sub- Saharan) Africa could possibly give more enlightenment in that regard.

Hanushek, and Kimko (2000) suggested that schooling quality across the missions could also be assessed as well as differences between education types and outcomes. Higher education quality has been observed to have a strong association with economic growth. Jedwab et al. (2018) have also made the recommendation of delving more into the archives in order to retrieve more complete data and digitization of scattered sources. This step would assist in eliminating some error in variable bias and give a more in-depth analytical overviews of educational spread.

That would also allow for differences between areas which had Protestant missions as opposed to Roman Catholic missions to be more clarified which would be a rather interesting analysis as these groups had different ideologies (Caccedo, 2017; Waldinger, 2017). Eaton and Kortum (2002) also recommended integrating quantitative models of international trade with some "reduced-form" estimates. This, together with connecting patterns of individual specialization and colonial policies, could otherwise explain Africa's low export share in skill intensive sectors.

It would also be of benefit to quantify the legacy of colonial education policies using more colony specific studies, for example doing more in-depth analysis to examine the real impact of Islamic education institutions, social and political development and literacy. This study will be a contribution to the ongoing studies (e. g. Michalopoulos & Papaioannou, 2020; Ricart-Huguet, 2021; Walters, Chisadza, and Clance, 2020) that are attempting to fill this significant research gap.

Chapter Three: Econometric Models and Estimation Methods

3.1. Introduction

Colony-level accounts, although important, cannot fully explain variations in colonial investments within a colony or country. There are large disparities across colonies in the way that colonialists (British, French, Belgian, and Portuguese) and missions invested in educational, and other infrastructure. Economic and political developments were influenced by colonial investments, although little is known about the magnitude and dispersion of these investments (Huillery, 2009). Colonies with more European settlers established better institutions that may have possibly facilitated long-term economic development (Acemoglu Johnson and Robinson, 2001). Scholars have focused on colonial institutions to explain the inequalities between colonial and long-term development (Lange 2004; and Mahoney 2010).

Econometric models and estimation methods used to investigate the objectives of this study that will contribute to the ongoing discourse on colonial investments and institutions are presented in this chapter.

3.2. The Effect of Africa's History on Investment in Education and Development of Educational Institutions

3.2.1. Econometric Model

To ascertain the effect of Africa's history (colonialism, slavery, and slave trade) on investments in education and development of educational institutions, this objective will be modelled in two parts using instrumental variables (IVs). In the first part, the effect of Africa's history on investments in education will be determined, and secondly, also to determine the effect of Africa's history (colonialism, slavery, and slave trade) on the development of educational institutions. We first specify, following Walters et al. (2020) and Ricart-Huguet (2021), the empirical models to be used in examining the role of colonial history on investment in education:

Firstly, the linear models below are used to justify the use of IVs on colonial education and investments:

$$\begin{aligned}\log(E_{ijd}) &= \mu_0 + \mu_1 Y_{ijd} + \mu_2 I_{ijd} + \mu_3 \text{districtFE}_{ijd} + \mu_4 \text{yearFE}_{ijd} + \mu_{5k} X_{ijd} + \eta_{jd} + \epsilon_{ijd} \\ \log(Y_{ijd}) &= \beta_0 + \beta_1 \log(E_{ijd})^I + \beta_3 I_{ij} + \beta_4 \text{districtFE}_{ijd} + \beta_{5k} X_{ij} + \eta_{jd} + \epsilon_{ijd}\end{aligned}\quad (3.1a)$$

where E_{ijd} is the size of the European population and Y_{ijd} is a vector that includes the number of students and teachers including investments in education from district i in colony j (1905–1956 average) on either cross sectional or panel data d . I denotes either railroads or disease prevalence, X is the controlling factor which is made of socioeconomic characteristics (ethnic diversity, Islam prevalence, pre-colonial trading post, and pre-colonial political centralization) and the size of the African population and.

Secondly, the linear model below is considered when explaining diffusion patterns of colonial investments in education and educational development

$$\{\log(X_{ijt}) = \beta_0 + \beta_1 \text{Distance}_{ijt} + \beta_2 AP_{ijt} + \beta_3 E_{ijt} + \eta_j + \epsilon_{ijt}\quad (3.1b)$$

where E_{ijt} is the European population, AP_{ijt} is the African population, X_{ijt} is a vector that includes educational and infrastructure investments including educational institutions and the civil administration, and the factors from which diffusion pattern will be examined, Distance_{ijt} is either distance between district capital and the nearest precolonial trade post, distance between district capital i and the coast in colony j (1905-1956 average) or is the distance from the first British/French precolonial school.

Thirdly, the linear model below is used to examine investment distribution patterns on colonial educational institutions:

$$\{\log(Y_{ijt}) = \beta_0 + \beta_1 E_{ijt} + \beta_{2k} I_{ijt} + \eta_j + \epsilon_{ijt}\quad (3.1c)$$

Where Y_{ijt} is a vector that includes infrastructure investments in education, E_{ijt} is the European population, I_{ijt} are the education and economic institutions in the coast and capital for district i in colony j (1905-1956 average).

Lastly, the linear model below is used to understand development patterns of colonial educational institutions:

$$\begin{cases} \log(I_{ijt}) = \beta_0 + \beta_1 E_{ijt} + \beta_2 A_{ijt} + \beta_3 \text{state} + \beta_{4k} Y_{ijt} + \beta_5 \text{ethnicity}_{ijt} \\ + \beta_6 \text{murdock}_{ijt} + \eta_j + \epsilon_{ijt} \end{cases} \quad (3.1d)$$

Where I_{ijt} is a vector that includes the educational institutions, Y_{ijt} is a vector that includes development in education, E_{ijt} is the European population, A_{ijt} is the African population, ethnicity_{ijt} is ethnic fractionalization and murdock_{ijt} is precolonial centralization in the coast for district i in colony j (1905-1956 average).

Infrastructure investments in education and other institutions will take into consideration the amount of infrastructure investments and expenditure towards human capital within each district, which will be used as a proxy and will be obtained from colonial investment data by Huillery (2009) and McAlexander and Ricart-Huguet (2022) for French West Africa under the colonial office covering eight colonies that includes detailed information on demographics, education, health, infrastructure investments and other activities.

Development of educational institutions will be proxied by the number of colonial staff per institution, while intensity of agriculture as Ricart-Huguet (2022) which account of the degree at which agriculture was practiced will be the proxy for agriculture within each district using data by Huillery (2009) and McAlexander and Ricart-Huguet (2022).

The effects of Africa's history on investment in infrastructure and development of educational institutions will be accounted for by Europeans, colonial state administration and governance, pre-colonial centralization, ethnic fractionalization, and African population.

Following Acemoglu, Johnson, and Robinson (2002) the log of population will be used as a proxy for colonial development from the data by Huillery (2009) and McAlexander and Ricart-Huguet (2022).¹

¹ The use of log of population to proxy development is also routed in an observation during the 1960s that ethnic regions and countries with higher populations appeared to have higher levels of education and are contemporarily more developed.

Additionally, for investment diffusion across ethnic regions a code will be included to account for coastal versus hinterland regions and an additional code will be included to do a cross country comparison for colonies that are landlocked versus coastal. Similar to Huillery (2009), the geodesic distance² will also be adopted to account for investment diffusion from each district capital to the closest precolonial trading posts and the coast.

Investments, development and education outcomes differed in regions that were dominated by missions compared to Islam (Okoye & Pongou (2014). Hence a variable to control for religion will be included, where Islam will be measured as a dummy variable taking the value of 1 for ethnic regions that were dominated by Islam and 0 otherwise.

Since disease prevalence influenced where missions established their stations, malarial and tsetse fly prevalence proxies from data by Huillery (2009) and McAlexander and Ricart-Huguet (2022) will be used to determine the effect that disease prevalence had on investments and development of educational institutions.

² The length in terms of the number of edges of the shortest path between two vertices is referred as the geodesic distance (Han, et al., 2012).

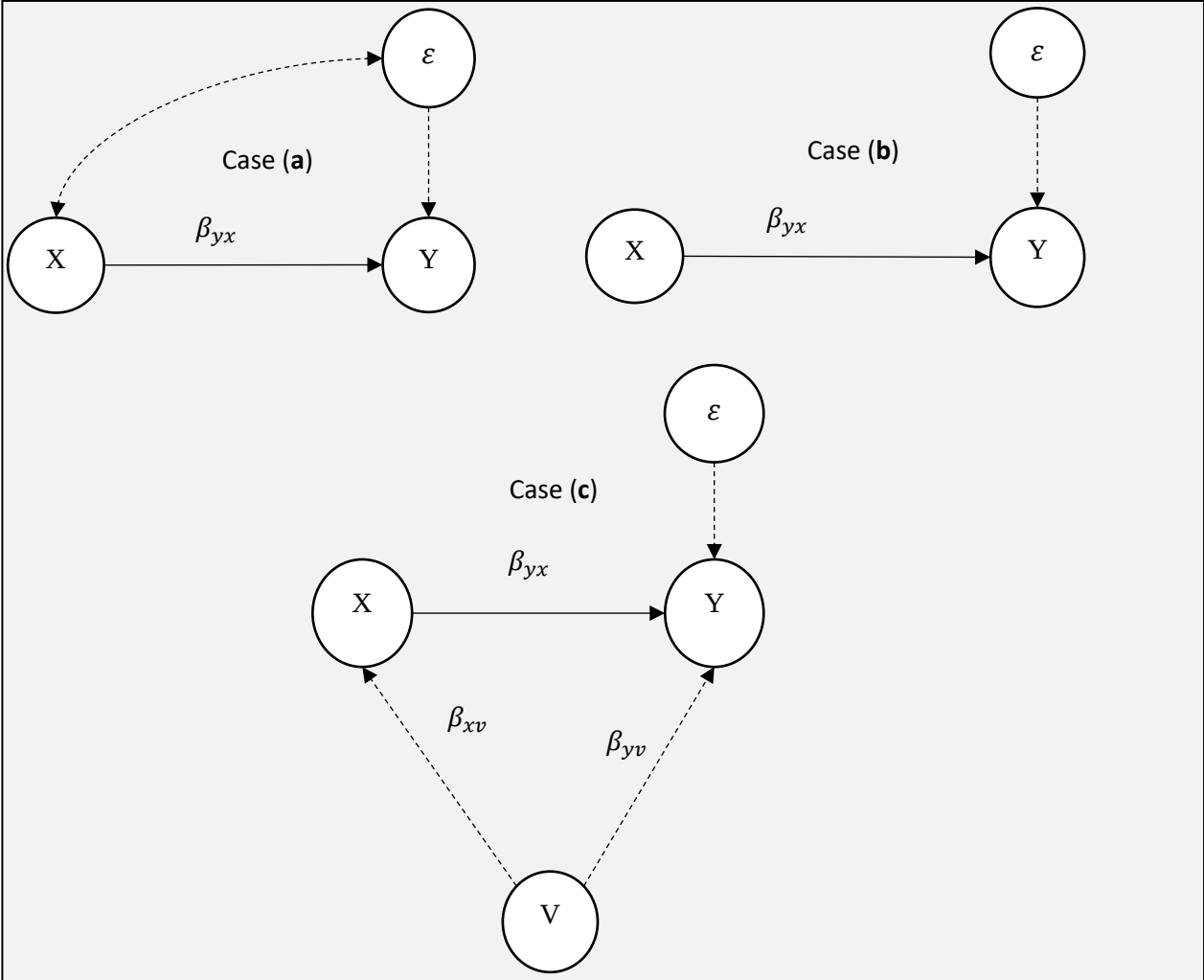


Figure 3. 1: Causal relationships using observational data with a case (a) biased, case (b) unbiased, and case (c) omitted variables.

The demonstration of causal inference in observational studies for both biased and unbiased estimates is depicted by case (a) in Figure 3.1. Correlation between predictor variable X and unobservable variables results in an error term (ε) that makes estimates biased. Unbiased estimates of causal effects are only possible when the predictor variable is not in correlation with other unobservable factors, as depicted by case (b) in Figure 3.1. For instance, considering the effect of Africa's colonial and slavery history on investments in education, the estimate of causal effects can be problematic because of other factors correlated with both Africa's colonial and slavery (X) history and investment in education (Y) that would then inevitably make unbiased estimate of the

relationship between X and Y impossible. Including unobservable covariates that are correlated with the predictor to a biased statistical regression model leads to unbiased estimates, which are obtained in a population under the condition that covariates are uncorrelated with residuals (i.e., error term). Ordinary least squares (OLS) is unbiased only when predictors and residuals are uncorrelated in the population. Appending a set of convening covariates such as ethnic centralization, population, colonial rule, the presence of missionaries and effect of scramble of Africa to equation 3.1a and 3.1b might result in the estimation of the unbiased causal relationship. In order to get unbiased estimates on this empirical specification, it is necessary to include all the relevant variables. When the selection process is associated with the independent variable, there is an endogenous bias in the data. Because of this, the estimates will be skewed if any variables are excluded, which is otherwise referred to as omitted variables bias as depicted by case (c) in Figure 3.1, which is as a result of selection or self-selection problems in many cases (Wooldridge 2010, and Heckman 1979).

Due to the lack of all the essential covariates to model the interactions between variables of interest effectively using OLS, the IVs approach proves to be a beneficial substitute. For instance, IVs attempt to estimate causal effects by first determining which of the covariates are instrumental (Pokropek 2016). Gyimah-Brempong (2002) amongst other scholars in a paper uses panel data from African countries and a dynamic panel estimator to investigate the effects of corruption on economic growth and income distribution. He compared IVs estimates to OLS estimates that provide a very poor and inconsistent fit for the growth equation. Although the IV estimates are of the right signs and some estimates are significantly different from zero, the absolute magnitude of the IV estimates are low and they are less precisely estimated compared to their OLS counterparts.

Consider a causal relationship between X and Y , if a covariate Z affects the outcome variable Y only through its effect on the predictor variable X and is not linked to Y but linked to the predictor (X) and it should not be directly or indirectly causally inferred by X , Y or the error term ε then Z is referred as an instrumental variable. Therefore, Z and X must be highly correlated and Z can only be related to Y through X (Pearl 2000; Maydeu-Olivares, Shi and Rosseel 2019). As a result, multiple IVs and/or causal paths can be used to estimate the relationship between X and Y .

Consider the case with a single dependent variable y , given that N denotes the sample size, n_x being the number of predictors $\mathbf{x}$, and n_z the number of instrumental variables $\mathbf{z}$, leading to $n_x +$

$n_z + 1$ variables. The IV model is basically y on $\mathbf{x}$ on $\mathbf{z}$ with correlated errors between y and $\mathbf{x}$. All variables are also assumed to be mean centered so that there is no mean structure (all means and intercepts are zero) for description purposes (Maydeu-Olivares, Shi and Rosseel 2019). Letting $\mathbf{w}' = (y, \mathbf{x}', \mathbf{z}')$, the matrix form of an IV model can be expressed as

$$\begin{aligned}\boldsymbol{\omega} &= \boldsymbol{\beta}\mathbf{w} + \boldsymbol{\varepsilon} \\ &= (\mathbf{I} - \boldsymbol{\beta})^{-1}\boldsymbol{\varepsilon}\end{aligned}\tag{3.2}$$

The covariance matrix of the error term $\boldsymbol{\varepsilon}$ can be denoted by $\boldsymbol{\Psi}$. In keeping with the partitioning of $\boldsymbol{\omega}$, $\boldsymbol{\beta}$ and $\boldsymbol{\Psi}$ can be partitioned as follows

$$\begin{aligned}\boldsymbol{\beta} &= \begin{pmatrix} 0 & \boldsymbol{\beta}_{yx} & 0 \\ 0 & 0 & \boldsymbol{\beta}_{xz} \\ 0 & 0 & 0 \end{pmatrix}, \\ \boldsymbol{\Psi} &= \begin{pmatrix} \boldsymbol{\Psi}_{yy} & & \\ \boldsymbol{\Psi}_{xy} & \boldsymbol{\Psi}_{xx} & \\ 0 & 0 & \boldsymbol{\Psi}_{zz} \end{pmatrix},\end{aligned}\tag{3.3}$$

There are no exclusion constraints (parameters set to zero) in a standard IVs model in any of the submatrices in 3.3. Inferring $\boldsymbol{\Sigma}_0 = (\mathbf{I} - \boldsymbol{\beta})^{-1} \boldsymbol{\Psi} (\mathbf{I} - \boldsymbol{\beta})^{-\text{v}}$ as the covariance structure, $\boldsymbol{\Sigma}_0$ can be partitioned in line with the partitioning of $\boldsymbol{\omega}$ as

$$\boldsymbol{\Sigma}_0 = \begin{pmatrix} \boldsymbol{\sigma}_{yy} & & \\ \boldsymbol{\sigma}_{xy} & \boldsymbol{\Sigma}_{xx} & \\ \boldsymbol{\sigma}_{zy} & \boldsymbol{\Sigma}_{zx} & \boldsymbol{\Sigma}_{zz} \end{pmatrix}\tag{3.4}$$

There must be at least one or more instrumental variables than predictors in the model for a model to be tested. The model cannot be tested with the chi-square statistic if $n_z = n_x$ (exactly identified with 0 degrees of freedom). The target model must include as many instrumental variables, $\mathbf{z}$, as there are (endogenous) predictors, $n_z \geq n_x$, for it to be estimable (Bollen 1989).

In the IVR model, there are no exclusion constraints (parameters set to zero) in any of the submatrices in (3.3): the assumption that every $\mathbf{x}$ predicts y , every $\mathbf{x}$ is determined by every $\mathbf{z}$, all $\mathbf{x}$ and y errors are correlated³, all $\mathbf{x}$ errors are correlated, and $\mathbf{z}$ errors are correlated.

Additionally, the three most popular sources of potential research instruments as categorized by Murnane and Willett (2010) are variables that describe ethnic-country regions' proximity to relevant institutions; institutional rules and geographic characteristics; and deviations from cohort trends. Hence, the IVs technique will be used in this study by instrumenting, Z_{rpc} and W_{rpc} , distance to the national border, geodesic distance, border distance, distance to railway roads as proximity to relevant institutions, and colonial rules and ethnic region centralization as institutional rules, and linguistic distance as a possible deviation from cohort trend.

For example, Ricart-Huguet (2021) in his paper on the origins of colonial investments in former British and French Africa, uses a two-stage least squares (2SLS) model and instruments pre-colonial trade with natural harbors and capes. He observed an increase in confidence in the causality of his results which also concur with Jha (2013) and Gaikwad (2014) who also found natural harbors to be instrumental. On another paper Nunn (2008) also used Afrobarometer survey data to determine the relationship between the number of slaves exported and per capita income in 2000. He found that the link was causal by making use of a two-stage least-squares regression and instrumenting historic distance from the coast. Table 3.1 provides examples of instruments that have been used in studies that analyzed several issues connected with Africa's colonial, slavery history, education, and economic development.

³ This study considers the case where $\mathbf{z}$ may also include binary variables by estimating y and $\mathbf{x}$ conditional on $\mathbf{z}$ as described in econometric literature, and not modeling of y , $\mathbf{x}$, and $\mathbf{z}$ jointly as described in the SEM literature (Maydeu-Olivares, Shi and Rosseel 2019).

Table 3. 1: IVs in studies connected with Africa’s colonial and slavery history, education, and economic development.

Study	Outcome variable(s)	Explanatory variable	Instrumental variable
Gyimah-Brempong et al. (2006)	Real GDP per capita	Higher education	Primary and secondary education
Nunn (2008)	Per capita GDP in 2000	Number of slaves exported from a country	Sailing distance from each country to the nearest location of demand for slave trades
Ricart-Huguet (2021)	Colonial Investments	Natural harbor or cape	Pre-colonial trade with natural harbors and capes: Distance from post and Distance from the coast
Rouse (1995)	Educational attainment	Community colleges	Distance to school
Neal (1997)	Achievement test scores	Catholic school	Distance to school
Dee (2004)	Civic participation	College	Distance to college

Several tests will be conducted to establish whether there is endogeneity and then IVs will be used depending on the strength of the instruments. Firstly, the Durbin–Wu–Hausman (DWH) test or the augmented regression test for endogeneity will be used to justify for the use of instrumental variables for this study. An elaborate causal relationship of four cases of the validity of instruments in a causal relationship description can be found in Appendix I. Secondly, the relevance of the instruments identified will be assessed using Stock-Yogo critical values and Kleibergen-Paap F-statistic in relation to their strengths. However, statistical theories are used to draw causal inferences based on large samples because large sampling variability may occur in finite samples and/or make estimates to be biased. A substantial amount of research in the econometrics literature examines the factors that influence the performance of estimators for correctly defined IV models, to determine whether instrumental variables are 'weak' predictors of X. These studies (see Bound, Jaeger, and Baker 1995; Staiger and Stock 1997; and Stock and Yogo 2005 for more details) have concentrated on the effect of the strength of the relationship between X and Z by comparing the

effectiveness of the two-stage least squares (2SLS) to the Maximum likelihood (ML) estimator. The F statistic as derived by Staiger and Stock (1997) in equation 3.5 is used to determine whether the instruments are considered strong or weak based on the strength of the relationship between $\mathbf{x}$ and $\mathbf{z}$, R_{xz}^2 , and sample size (N) for a single predictor ($\mathbf{x}$) model. The F statistic can be written as

$$F = \frac{R_{xz}^2}{1 - R_{xz}^2} * \frac{N - p_z - 1}{p_z} \quad (3.5)$$

An instrument is considered to be strong and reliable (Stock, Wright and Yogo 2002) if F is at least 10 as shown by Stock and Yogo (2005). Yet, the F statistics can no longer be sufficient when there are multiple predictors X (e.g., Sanderson and Windmeijer 2016). The strength of the instruments when there are multiple predictors X is evaluated by calculating the minimum eigenvalue of the Cragg and Donald (1993) statistic under normality assumptions (for more details read Maydeu-Olivares, Shi and Fairchild (2018)).

According to Hahn and Hausman (2002), an increased bias in the estimated IVs coefficients is caused by weak identification. To check whether the instruments are orthogonal to the error distribution of the dependent variable or if the model is correctly specified, the Hansen J statistic will be used to test for over-identifying restrictions (Hansen 1982). That is, is $E(\mathbf{z}'\mathbf{u}) = 0$ for $y = \mathbf{x}\beta + u$ correct?

$$H_0: E(\mathbf{z}'\mathbf{u}) = 0 \quad (\text{The model is correctly specified})$$

$$H_1: E(\mathbf{z}'\mathbf{u}) \neq 0 \quad (\text{The model is not correctly specified})$$

The section that follows provides a brief description of the method that will be used to estimate parameters for the IVs in this study.

3.2.2. Estimation Method

The IVs parameter estimation in a relationship between the predictor and the outcome is similar to classical regression analysis using the OLS estimator but is restricted by the variation of the exogenous instrument. OLS parameter estimation in a relationship uses the covariance between the predictor and the outcomes, $\beta_{XY} = \sigma_{XY}/\sigma_X^2$, where σ_{XY} is the covariance between the predictor and the outcome, and σ_X^2 is the variance of the predictor that under the condition of a valid instrument it might be interpreted in terms of causality. β_{XY} , denotes the relationship between X

and Y as demonstrated graphically by the Venn diagram in the parameter development on the left side in case (a) of Figure 3.2.

Conversely, IVs estimation in a relationship uses the covariance between the predictor and the outcomes, $\beta_{XY} = \sigma_{XY|Z} / \sigma_{X|Z}^2$, where $\sigma_{XY|Z}$ is the ratio of the shared part of variance bounded by the variation of the instrument, and $\sigma_{X|Z}^2$ variance of the predictor that is shared with an instrument. β_{XY} , under IVs as illustrated graphically by the Venn diagram on the right side of Figure 3.2 in case (b) is constructed only from the instrument that is identified to be exogenous and the part of the variation that is common to the variables of interest.

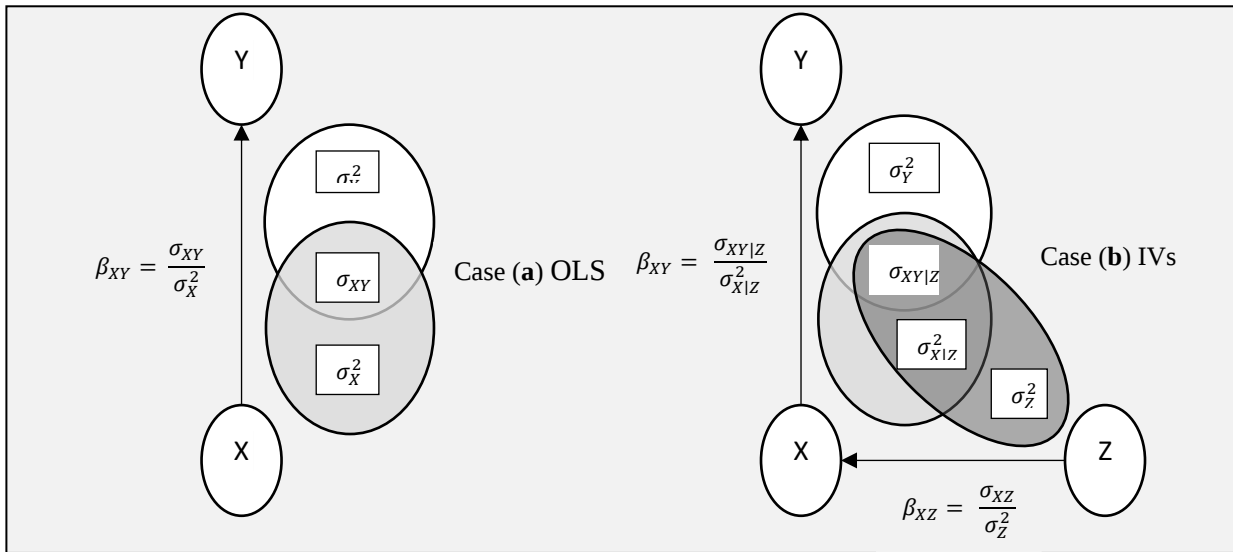


Figure 3. 2: Venn diagrams demonstrating the OLS and IVs approaches used to estimate causal relationships between two variables (Murnane and Willett 2010; and Pokropek 2016).

Theoretically, two-stage least squares (2SLS), limited-information maximum likelihood (LIML), generalized method of moments (GMM), continuous updating estimator (CUE), g-estimation of structural mean models (SMM) and the Bayesian approach (BA) are the most commonly used for IVs parameter estimation (Kleibergen and Zivot 2003; and Burgess, Small and Thompson 2017). Furthermore, Maydeu-Olivares, Shi and Rosseel (2019) provide fully worked out examples of how to estimate the IVR model using both 2SLS regression and LIML and they find out that asymptotically, these estimators are unbiased when the sample size is very large, leading to

unbiased estimates. Additionally, they also discovered that differences between 2SLS and LIML are small and favor 2SLS in small samples (N is less or equal to 100), however, the LIML is preferred to 2SLS if the instruments are weak, (Maydeu-Olivares, Shi and Rosseel 2019). Moreover, regression estimates are skewed in the face of missing data or other validity risks. Fitting the IVs model instead yields unbiased results in large samples. Improved coverage is frequently obtained regardless of any form of misspecification on the IVs model, especially when the sample size is 500 or higher.

On account of the recommendations made by Maydeu-Olivares, Shi and Rosseel (2019) that differences between 2SLS and LIML are small and favor 2SLS in finite samples (N is less or equal to 100), with the finite sample bias for the CUE and LIML (Burgess et al. 2017), the OLS estimator will be the main estimation method that will be used for parameter estimation and the 2SLS will be used if the endogeneity test is positive and there are strong instruments (Burgess et al. 2017). Table 3.2 provides a summary of the consistency and efficiency of estimation methods used for IVs to motivate for selecting 2SLS.

The appellation of the 2SLS estimator is derived by the fact that OLS regressions can be used in two steps to obtain one stage point estimates of a 2SLS. Operationally, estimates for the IVs regression are not obtained by the OLS regressions because this procedure results in biased estimation of standard errors. Because causal effects in the IVs regressions are estimated using a smaller portion of the variation only the exogenous part of the variation identified by the instrument is used to determine the accuracy of the estimators than in OLS. The 2SLS estimator with the assumption that $\mathbf{y}$, $\mathbf{X}$ and $\mathbf{Z}$ are mean centered can be expressed as follows:

$$\hat{\beta}_{yx} = (\hat{\mathbf{X}}'\hat{\mathbf{X}})^{-1}\hat{\mathbf{X}}'\mathbf{y}$$

Where $\hat{\mathbf{X}} = \hat{\mathbf{Z}}(\hat{\mathbf{Z}}'\hat{\mathbf{Z}})^{-1}\hat{\mathbf{Z}}'\mathbf{X}$ and $\hat{\mathbf{X}}$ is the matrix containing predicted values from the first stage regression $\mathbf{x}$ on $\mathbf{z}$ given that $\mathbf{y}$ is a $\mathbf{N} \times 1$, $\mathbf{X}$ is a $\mathbf{N} \times \mathbf{n}_x$, and $\mathbf{Z}$ is a $\mathbf{N} \times \mathbf{n}_z$ are matrices containing the responses to dependent variables, predictors, and instrumental variables. The residual for the $\mathbf{y}$ on $\mathbf{z}$ regression is;

$$\hat{\epsilon}_y = \mathbf{y} - \mathbf{X}\hat{\beta}_{yx}$$

Standard errors for the 2SLS under normality assumptions for parameter estimates can be obtained as the squared root of the diagonal elements of (Maydeu-Olivares, Rosseel and Shi, 2018)

$$\text{var}(\hat{\beta}_{yz}) = \hat{Y}_{yy}(\mathbf{X}'\mathbf{Z}(\mathbf{Z}'\mathbf{Z})^{-1}\mathbf{Z}'\mathbf{X})^{-1}, \hat{Y}_{yy} = N^{-1}\hat{\boldsymbol{\varepsilon}}_y'\hat{\boldsymbol{\varepsilon}}_y$$

Table 3. 2: Instrumental variable estimation methods, (Burgess et al. 2017; Maydeu-Olivares et al. 2019).

Method	Consistency	Efficiency
2SLS	Consistent estimates are obtained even when the first-stage model is mis-specified when the outcome is continuous. However, point estimates are correct in estimation of the causal effect in two stages when the outcome is non-continuous, but the standard error is not correct.	Efficient, but biased with weak instruments. Robust to misspecification in the first-stage model and flexible to incorporate different exposure outcome models.
LIML	Consistent especially with weak instruments as the median of the distribution of the estimator is close to unbiased even with weak instruments. However, the disadvantage of the estimates is that they do not have defined moments for any number of instruments.	Asymptotically efficient and less
BA	Frequentist properties of inference (such as coverage levels) obtained from the Bayesian approach are more robust with weak instruments. Additionally, valid inferences can be obtained that are not based on asymptotic results under the modelling assumptions, but rather on the posterior distribution of the causal parameter.	biased provided that the parametric assumptions hold.
GMM	Intended as a more flexible form of 2SLS to handle problems of heteroscedasticity of error distributions and non-linearity in the two-stage structural equations	
CUE	Similar to the LIML estimator in terms of confidence intervals and finite sample bias. If the residuals defined under the CUE and LIML are homoscedastic then the estimator are equivalent. However, homoscedasticity assumptions are not made under the CUE estimator. Moreover, the CUE and two-step GMM estimators have the same asymptotic distribution	Unique estimates are not guaranteed in finite samples. Less efficient, less stringent assumptions.
SMM	Similar to the GMM, the estimating equations are not guaranteed to have a unique solution with multiple IVs. However, the resembling two-step method outlined for the GMM results to efficient estimates.	

The squared root of the diagonal elements of $\text{var}(\hat{\beta}_{yz})$ below gives heteroscedastic consistent standard errors under ADF assumptions

$$\text{var}(\hat{\beta}_{yz}) = \mathbf{G}\mathbf{\Omega}\mathbf{G}', \mathbf{G} = (\mathbf{X}'\hat{\mathbf{X}})^{-1}\mathbf{X}'\mathbf{Z}(\mathbf{Z}'\mathbf{Z})^{-1}$$

where

$$\hat{\mathbf{\Omega}}_{\text{ADF}} = N^{-1}\hat{\mathbf{\epsilon}}_y^2\mathbf{z}_i'\mathbf{z}_i = N^{-1}\mathbf{Z}'\text{diag}(\hat{\mathbf{\epsilon}}_y^2)\mathbf{Z}$$

Under normality

$$\hat{\mathbf{\Omega}}_{\text{NT}} = N^{-1}\hat{\mathbf{Y}}_{yy}\mathbf{Z}'\mathbf{Z}$$

The Sargan's (1958) test statistic, T_{NT} , below can be used under normality to assess the goodness of fit of the model

$$T_{\text{NT}} = \frac{\hat{\mathbf{\epsilon}}_y'\mathbf{Z}(\mathbf{Z}'\mathbf{Z})^{-1}\mathbf{Z}'\hat{\mathbf{\epsilon}}_y}{\hat{\mathbf{\epsilon}}_y'\hat{\mathbf{\epsilon}}_y}$$

Under ADF assumptions, the goodness of fit of the model can be assessed using

$$T_{\text{ADF}} = N^{-1}\hat{\mathbf{\epsilon}}_y'\mathbf{Z}\hat{\mathbf{\Omega}}_{\text{ADF}}^{-1}\mathbf{Z}'\hat{\mathbf{\epsilon}}_y$$

According to Kleibergen and Zivot (2003) regarding interpretation of IVs estimates, IVs estimates do not provide the expected average treatment effect (ATE) of the condition but estimates the local average treatment effect (LATE) on those affected by the instrument (Angrist and Krueger 2001). Moreover, the validity of IV estimates for the entire population depend on whether the effects estimated using IVs might be heterogeneous or homogenous. If the effects are assumed to be homogenous, estimates could be generalized and the LATE equals ATE, otherwise estimates cannot be generalized.

3.3. The Effect of Africa's Colonial and Slavery History on the Contemporary Relationship between Educational and Economic Development

This section briefly describes and explains the applied econometric method that has been used to address this objective: – the Bayesian vector autoregression (BVAR). This model is highly

recommended by Eaton and Kortum (2002), in which they proposed integrating quantitative models of international trade with some “reduced form” estimates. Also, an additional hierarchically global parameter is introduced on the BVAR model that Bańbura et al. (2010) and Zungu et al. (2022) and others have used which further allows for economic relationships of interest to be examined across countries. More details on how the BVAR has been implemented are covered in sub-sections 3.3.1 and 3.3.2.

3.3.1. Bayesian Vector Autoregression

Consider the reduced form of VAR, which consists of a set of $\mathbf{K}$ endogenous variables $\mathbf{y}_t = (y_{1t}, y_{2t}, \dots, y_{Kt})$. Including p lags of the endogenous variables, the VAR(p) model as proposed by Lütkepohl (2017) may be defined as:

$$\mathbf{y}_t = \mathbf{A}_0 + \mathbf{A}_1\mathbf{y}_{t-1} + \dots + \mathbf{A}_p\mathbf{y}_{t-p} + \mathbf{u}_t \quad (3.7)$$

where $\mathbf{A}_i (i = 1, \dots, p)$ are $(K \times K)$ coefficient matrices, and $\mathbf{u}_t$ is a K -dimensional white noise process with a time-varying positive definite covariance matrix, $E(\mathbf{u}_t\mathbf{u}_t') = \Sigma_{\mathbf{u}}$, such that $E(\mathbf{u}_t) = 0$.

For this study, the matrix notation in a BVAR setting is,

$$\begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_T = v + A_1 \begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_{T-1} + A_2 \begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_{T-2} \dots + A_3 \begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_{T-3} + \mathbf{u}_t \quad (3.8)$$

where ED denotes economic development, EE stands for educational development, IE is investments in education, $\mathbf{A}_i$ are (3×3) coefficient matrices for $i = 1, \dots, p$ and $\mathbf{u}_t$ is a 3-dimensional white noise process with a time-varying positive definite covariance matrix. There are $3 + 3^2p$ coefficients to be estimated and they increase quadratically with the number of included endogenous variables and linearly in the lag order. Thus, leading to a dense parametrization that might introduce the curse of dimensionality which could be triggered by higher dimensional models due to the inaccuracies that could be caused by structural inferences and out-of-sample forecasting.

The Bayesian approach is advantaged in addressing this short coming, such that, it imposes an additional prior structure on the VAR model which effectively mitigates against the curse of dimensionality and enables for the estimation of large models (Doan et al., 1984; Bańbura et al.,

2010). According to Koop (2013), these models have the unique ability to improve accuracy for out-of-sample prediction as well as the reduction of the residual by enabling the models to perform beyond their capability. De Mol et al. (2008) have covered the details of this type of approach that forces the model to be parsimonious and is related to frequentist regularization approaches which were originally proposed by Hoerl and Kennard (1970) and Tibshirani (1996). Also, the capability that the Bayesian framework introduces on the VAR creates an enablement for layers of uncertainty to be addressed by hierarchically modelling economic relationships, a broader scope of economic issues to be covered, including the allowance that it makes for the data to be further enriched by involving prior information (Gelman et al., 2013).

3.3.2. Prior Selection and Specification

The subject on properly informing prior belief has grown to be a critical multivariate topic which has received much attention. For instance, uninformative or informative priors need to be considered in place of flat priors, because since flat priors do not primarily impose any form of belief, they in turn perform poorly (Stein 1956) and also yield estimators that are inadmissible. The work by Litterman (1980) was one of the initial attempts to address this shortcoming, in which priors and hyperparameters were specified such that the model maximizes out-of-sample forecasting performance over a pre-sample, while the parameterization of the model by Del-Negro et al. (2007) was focused on using values that maximized the marginal likelihood function. Bańbura et al. (2010) controls for overfitting by using a decision criterion based on the in-sample fit.

The best source for prior information is economic theory, however, it is deficient in many ways more specifically towards high-dimensional models. Villani (2009) recognizes this recommendation in his work by reformulating the model by introducing priors on a steady state which made it easier for economists to understand. Later, Giannone et al. (2015) propose a data-based approach which treats prior hyperparameters as additional estimable parameters and allocates them a hyperprior individually. The formulation invokes Bayes's law as follows:

$$p(\boldsymbol{\gamma}|\boldsymbol{y}) \propto p(\boldsymbol{y}|\boldsymbol{\theta}, \boldsymbol{\gamma})p(\boldsymbol{\theta}|\boldsymbol{\gamma})p(\boldsymbol{\gamma}) \quad (3.9)$$

$$p(\boldsymbol{y}|\boldsymbol{\gamma}) = \int p(\boldsymbol{y}|\boldsymbol{\theta}, \boldsymbol{\gamma})p(\boldsymbol{\theta}|\boldsymbol{\gamma})d\boldsymbol{\theta} \quad (3.10)$$

where $\mathbf{y} = \left(\begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_4, \dots, \begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_T \right)^T$, $\boldsymbol{\theta}$ denotes the autoregressive and variance parameters of the VAR model and $\boldsymbol{\gamma}$ represents the set of hyperparameters, while ED, EE and IE are as previously described. Consequently, Equations 3.9 and 3.10 can be expressed explicitly as Equation 3.11 and 3.12 below, respectively.

$$p(\boldsymbol{\gamma} | \left(\begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_4, \dots, \begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_T \right)^T) \propto p\left(\left(\begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_4, \dots, \begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_T \right)^T | \boldsymbol{\theta}, \boldsymbol{\gamma}\right) p(\boldsymbol{\theta} | \boldsymbol{\gamma}) p(\boldsymbol{\gamma}) \quad (3.11)$$

$$p\left(\left(\begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_4, \dots, \begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_T \right)^T \middle| \boldsymbol{\gamma}\right) = \int p\left(\left(\begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_4, \dots, \begin{bmatrix} \text{ED} \\ \text{EE} \\ \text{IE} \end{bmatrix}_T \right)^T | \boldsymbol{\theta}, \boldsymbol{\gamma}\right) p(\boldsymbol{\theta} | \boldsymbol{\gamma}) d\boldsymbol{\theta} \quad (3.12)$$

The marginal likelihood (ML) that is in Equation 3.10 is the density of the data as a function of the hyperparameter $p(\boldsymbol{\gamma} | \mathbf{y})$ and is obtained by marginalizing Equation 3.9 with respect to $\boldsymbol{\theta}$. Therefore, the ML is marginal and conditional with regards to $\boldsymbol{\theta}$ and $\boldsymbol{\gamma}$, respectively. The exploring of the full posterior hyperparameter space in the Bayesian hierarchical approach is then performed by the ML with taking into consideration the uncertainty surrounding them, which the ML does using an empirical Bayes method only when an appropriate frequentist interpretation is present then the ML assumes the role of a decision criterion of the selection of the hyperparameter. This results in more robust and accurate impulse response functions and forecasts than factor models which have been extensively adopted in applied research by scholars like Baumeister and Kilian (2016) and others (Nelson, Pinter, and Theodoridis 2018; Altavilla, Boucinha and Peydró 2018; Miranda-Agrippino and Rey 2020; Altavilla, Parigi, and Nicoletti 2019).

The work by Giannone et al. (2015) has further added to the normal-inverse-Wishart (NIW) family, that has focused mainly on conjugate prior distributions. By “conjugate” is meant that the prior is made more efficient as the ML is in a closed form. The most commonly used priors are from the

NIW family, which are: the steady-state prior (Villani 2009), the Normal-Gamma prior (Griffin and Brown 2010; Huber and Feldkircher 2019), and the Dirichlet-Laplace prior (Bhattacharya et al., 2015). More recent work by Carriero et al., (2016) and other has been more focused on addressing heteroskedastic error structures (Kastner and Frühwirth-Schnatter 2014; Clark 2011). Accounting for the heteroskedastic component further improves model performance but not for conjugate priors as this might complicate inferences. Hence, the model in Equation 3.7 is addressed within the NIW framework by letting $\mathbf{A} = [\mathbf{a}_0, \mathbf{A}_1, \dots, \mathbf{A}_p]^T$ and $\boldsymbol{\beta} = \text{vec}(\mathbf{A})$. This leads to the conjugate prior in Equation (3.13):

$$\boldsymbol{\beta}|\boldsymbol{\Sigma} \sim \mathcal{N}(\mathbf{b}, \boldsymbol{\Sigma} \otimes \boldsymbol{\Omega}) \quad (3.13)$$

$$\boldsymbol{\Sigma} \sim \text{IW}(\boldsymbol{\psi}, \mathbf{d})$$

where $\mathbf{b}, \boldsymbol{\Omega}, \boldsymbol{\psi}, \mathbf{d}$ are function of the lower -dimensional vector of hyperparameter $\boldsymbol{\gamma}$. The Minnesota (Litterman 1980) prior which is amongst the three prior that the work by Giannone et al. (2015) has covered imposes a random walk processes hypothesis on all individual variables. This prior specification causes the Minnesota prior to be parsimonious and more efficient in forecasts of macroeconomic time series (Kilian and Lütkepohl 2017) that has made it to be used as a benchmark for model performance evaluation. Thus, characterizing the prior distribution by the below moments.

$$\mathbb{E}[(\mathbf{A}_s)_{ij}|\boldsymbol{\Sigma}] = \begin{cases} 1 & \text{if } i = j \text{ and } s = 1 \\ 0 & \text{otherwise.} \end{cases}$$

$$\text{cov}[(\mathbf{A}_s)_{ij}, (\mathbf{A}_r)_{kl}|\boldsymbol{\Sigma}] = \begin{cases} \lambda^2 \frac{1}{s^\alpha} \frac{\Sigma_{ik}}{\psi_j/(d - M - 1)} & \text{if } l = j \text{ and } r = s \\ 0 & \text{otherwise.} \end{cases}$$

where λ is the hyperparameter and its role is to weight the importance of the data relative to the data which can be referred to as controlling the tightness of the prior. As λ approaches 0 the posterior also approached the prior, whereas when λ approaches ∞ , the distribution of the posterior becomes the same as that of the prior. The prior variance is controlled by α , while ψ_j which is the j^{th} variable of $\boldsymbol{\psi}$ controls the standard deviation on the lags of all independent variables.

According to Giannone et al. (2015), Minnesota prior can be further improved by making an attempt to “reduce the importance of the deterministic component implied by VAR models estimated conditioning on the initial observations” by introducing additional priors. This is referred to as the expectation of future observation which is based on the initial condition as well as estimated coefficients. An example of such an additional prior is the sum-of-coefficients prior, which has a restriction that assumes that no-change forecast is optimal at the start of a time series. An artificial dummy-observation can be added on top of the data matrix as a way of incorporating the sum-of-coefficients prior.

$$\mathbf{y}^+_{M \times M} = \text{diag}\left(\frac{\bar{\mathbf{y}}}{\mu}\right),$$

$$\mathbf{x}^+_{M \times (1 + M_p)} = [0, \mathbf{y}^+, \dots, \mathbf{y}^+],$$

where $\bar{\mathbf{y}}$ is a $M \times 1$ vector of averages over the first p lag order observations of each variable; μ as the hyperparameter controls the prior variance. As prior mirrors uninformative when μ approaches ∞ , while when μ approaches 0, the form of the model ends up with as many unit roots as variables with no cointegration. The latter case demands for cointegration relationships to be introduced on the data and the single-unit-root prior (Sims 1993; Sims and Zha 1998) is most suitable in addressing this shortcoming. The prior introduces cointegration by either drawing the variables towards the presence of at least a single unit root or towards their unconditional mean. Its associated dummy observations are as follows:

$$\mathbf{y}^{++}_{1 \times M} = \frac{\bar{\mathbf{y}}^T}{\delta},$$

$$\mathbf{x}^{++}_{M \times (1 + M_p)} = \left[\frac{1}{\delta}, \mathbf{y}^{++}, \dots, \mathbf{y}^{++}\right],$$

where $\bar{\mathbf{y}}$ denotes the same as before; δ as key hyperparameter controls the prior variance. Note that the approach that has been used to implement sum-of-coefficients and single-unit-root priors is generic to all priors that belong to the NIW family in Equation 3.11. The fitting of the

hierarchical approach to prior selection as well as the estimation of VAR models in levels, are the two unique roles of the two mentioned dummy-observation priors.

Moreover, the breakpoint method (Ravnik & Zilic, 2011) is the most common method for checking the robustness of VAR models where the series is divided into two parts. Hence, the BVAR will be compared to the classical VAR together with the breakpoint for robustness, where the series will be divided into two equal samples where the first subsample covers the period from 1960 to 1989 and the second subsample from 1990 to 2021.

3.4. Data Description and Measurement

Extensive colonial investment data will be obtained from Huillery (2009) for French West Africa and from Ricart-Huguet (2021) for British colonies under the colonial office covering sixteen colonies that very often includes detailed information on demographics, education, health, infrastructure investments and other activities as supported by the summary in Tables 3.3 and 3.4. From French West Africa Huillery (2009) collected the original French records for multiple years in the 1910–1939 period for Benin (formerly Dahomey), Burkina Faso (Upper Volta), Cote d’Ivoire, Mali (French Soudan), Niger, Mauritania, Senegal, and Guinea. On the other hand, from British colonies, Ricart-Huguet (2021) collected British colonial records for 1915, 1920, 1927, 1928 and 1938 for Ghana (Gold Coast), Kenya, Malawi (Nyasaland), Nigeria, Sierra Leone, Tanzania (Tanganyika), Uganda and Zambia (Northern Rhodesia).

Table 3. 3: Summary of light density together with colonial factors and educational data for the period 1905 to 1956.

	Population		Light Density	Expenditure	Malaria	TsetseFactor	Students	Rail in KM
	Europeans	African						
Minimum		1,000.00						
Maximum	7,164.00	3,040,604.00	50.69	1,551,032.00	4.00	3.29	13,764.00	590.11
Range	7,164.00	3,039,604.00	50.69	1,551,032.00	4.00	3.29	13,764.00	590.11
Sum	53,847.00	51,807,972.53	336.65	14,556,099.47	900.89	358.36	247,284.64	13,163.30
Median	32.00	93,134.50	0.07	6,209.73	3.00	0.85	184.50	
Mean	178.89	166,051.19	1.08	46,654.16	2.89	1.15	858.63	42.19
Variance	327,154.09	73,829,631,806.10	24.21	21,164,990,220.91	0.65	1.02	3,866,246.29	5,517.68
Standard deviation	571.97	271,716.09	4.92	145,481.92	0.81	1.01	1,966.28	74.28

Table 3. 4: Averaged Severity of Colonial and slavery factor by colony for the period 1905 to 1956.

Colcode	Country	Population of Europeans	Slavery	Ethnic groups	Ethnic Fractionalization	Islam	Centralization	Hostility	Missions	Colonial Length	Number of Colonizers
BEN	Benin		3.68	3.82	0.39	0.64	3.40	1.57	18		3.68
BFA	Burkina Faso	10	3.43	6.64	0.61	2.00	2.79	0.97		10	3.43
CIV	Cote d'Ivoire	69	3.45	5.68	0.46	0.63	2.12	1.01	202	69	3.45
GHA	Ghana	146	2.66	3.86	0.36	0.43	2.61	0.00	415	146	2.66
GIN	Guinea	74	3.32	3.78	0.38	1.00	2.20	1.56	487	74	3.32
KEN	Kenya	537	1.62	4.09	0.38	0.55	1.89	0.00	334	537	1.62
MLI	Mali	82	3.70	4.20	0.51	2.00	2.46	1.12		82	3.70
MRT	Mauritania	21	4.00	4.67	0.50	2.00	3.11	1.31	6	21	4.00
MWI	Malawi	59	3.25	2.60	0.30	0.00	2.50	0.00	328	59	3.25
NER	Niger	15	3.58	5.10	0.56	2.00	2.69	1.94		15	3.58
NGA	Nigeria	184	3.33	11.00	0.62	0.83	2.44	0.00	194	184	3.33
SEN	Senegal	354	3.91	2.79	0.31	1.71	2.45	0.00		354	3.91
SLE	Sierra Leone	75	3.38	3.29	0.36	0.86	2.51	0.00	994	75	3.38
TZA	Tanzania	214	2.68	5.71	0.44	0.17	2.00	0.00	377	214	2.68
UGA	Uganda	133	2.71	5.07	0.40	0.00	2.79	0.00	197	133	2.71
ZMB	Zambia	397	2.88	4.60	0.48	0.00	2.71	0.00	427	397	2.88

By making use of an Army Map service of 1941, Ricart-Huguet (2021) further identified districts that had railroads and he also georeferenced colonial investments by making the most of detailed colonial maps with district boundaries. The homogeneous institutional structure within ministry of the colonies in Paris and the colonial office in London was an advantage for Ricart-Huguet (2021) to replicate the data collection process from Huillery (2009). Furthermore, as administrators reported to the ministry of the colonies in Paris and the colonial office in London, administration for record-keeping processes were identical within each empire. Contrastingly, for the majority of west and east Africa it did not take until the 19th century for them to be integrated into the British and French empires which was otherwise to French Algeria and British Southern Africa.

On a related note, according to Cooper (2005), and Frankema and Jerven (2014), record keeping during colonial times was not without its challenges in part due to the lack of accuracy with regards to population censuses. Administrators were in most part known to make use of educated guesses as a means of cancelling out inaccuracies or filling in the gaps. At times data on health, education and infrastructure would be organized under colonial settings and in other instances it would be collected by a certain town or district. In light of this, Ricart-Huguet (2021) has argued that there is no evidence of possible systematic error owing to the fact that these French and British records might have measurement error. Additionally, he collected multiple sources that provided information about the economic, characteristic, physical, and geography per district as an attempt to explain colonial investments.

A similar exercise to that of Huillery (2009) and Ricart-Huguet (2021) will be adopted to collect data on colonial institutions and investments in education, health, and infrastructure for non-British colonies. In addition to the data presented by Huillery (2009) and Ricart-Huguet (2021) for the French and British colonies for the 1910-1939 period, more refined data on colonial institutions and investments in education, health, and infrastructure, ideally covering all of (sub- Saharan) Africa dating back to the slave trade period with possible sources being Cagé and Rueda (2016, 2018) for missionary data, Trans-Atlantic Slave Trade and intra-American slave trade databases and other possible sources.

Ricart-Huguet's (2021) approach to determine investment diffusion will be adopted by using pre-colonial precolonial schools per colony, pre-colonial trading post in each colony, coastal or inland

as well as determining the geodesic distance from each district capital to the closest trading posts to different district capital respectively. Another adaptation will be to account for the practice of Islam in those areas for which an ordinal variable for high, medium and low will be used. This will be with the assistance of Kuhne (1927) world map, and Hubert's (1922) map on early West Africa together with the United States geological services (USGS 1921). The first two maps were especially crucial as they were on natural resources. Since great quantities of natural resources would have encouraged economic development and infrastructure investments. Frankema (2012) and other scholars have also noted that economic development was also influenced by agriculture where the soil quality, sustainability of soil for agriculture and elevation also played key roles on outcomes through effects on technological diffusion, slave trade, colonial reach and public infrastructure provision (Gennaioli, La Porta, Lopez De Silanes, & Shleifer, 2014; Michalopoulos, 2012; Nunn & Puga, 2012). The effect of presence of natural resources and practice of agriculture on levels of investments will be determined.

In the same vein, elevation also has been found to play a key role in its effects on colonial investments. Worth mentioning here would be the high prevalence of malaria at lower elevations. The map by Lysenko and Semashko (1968) for 1990 and tsetse fly data from the Food and Agriculture Organization by Alsan (2015) will be used to control for malaria prevalence because places with disease prevalence, since colonial investments would have been lower. Cage and Rueda (2016) and other scholars also concur with this by stating that malaria prone areas were affected negatively in their socio-economic (Gallup & Sachs, 2001), economic, and educational outcomes as well as historic mission settlement setups (Frankema, 2012; Jedwab, Selhausen, & Moradi, 2019).

Apart from that, pre-colonial ethnic institutions will be measured using ethnic institution data from George Peter Murdock's Ethnographic Atlas (Murdock, 1969) and geolocated literacy data from the Demographic and Health Surveys (DHS) (ICF, 2017). By considering chiefly hierarchy and political complexity of ethnic regions in line with Gennaioli and Rainer (2007 a, b) to quantify the degree of political centralization as a measure of pre-colonial ethnic institutions. Moreover, proxies of pre-colonial political institutions and development that can influence investments, including intensity of agriculture, settlement patterns, and the size of local communities and level of political centralization will be obtained from pre-colonial ethnic group characteristics from data

by Murdock's (1959). Additionally, pre-colonial ethnic characteristics from Huillery (2009) for French districts and Ricart-Huguet (2021) for British districts on whether the district was located in a pre-colonial kingdom or in an acephalous society will be included (Encyclopedia Britannica 2020; Olson 1996).

The previous discussion opens an opportunity to split ethnic regions by colonial country borders as well as the different colonial influences contemporarily for the colonies of interest for this study by accounting at an ethnic-country region level. Furthermore, with data available from Michalopoulos and Papaioannou (2013), additional ethnic-country region demographic, location and geographic characteristics will be included. As a proxy for development in regions where there were no data, the log of population by ethnic regions will be used to measure development as used by Acemoglu, Johnson, and Robinson (2002). Furthermore, in 1960 ethnic regions and countries with higher populations presumably had higher levels of education and are contemporarily more developed. According to Michalopoulos and Papaioannou (2014) colonial rules were highly visible in capital ethnic region within which cities are located and thought of as a national institution. Compared to other regions, regions where capital cities were located tend to be more developed with higher economic activity. On the other hand, this study will also control for distance to the national border, border distance, as Michalopoulos and Papaioannou (2016) have also associated low development with regions closer to national borders.

For post-independence analysis, growth measurement data from 1960 until present on countries will be used as supported by the summary in Table 3.5. In addition to the data available from World Bank, Afrobarometer and other sources with more refined data on growth measurement, ideally covering all of (sub- Saharan) Africa dating back to the slave trade period with possible sources being the Maddison Project Database, McLeary (2018) and other possible sources.

Table 3. 5: Post-independence statistics on sample data for 17 African and 5 non-African countries for 1960-2021 period from TheGlobalEconomy.com and FD Index Database.

	GDP per capita	Industrialization Index	Financial Market Index	Educational Enrollment	Educational Investments	Human development index
Mean	1,705.00	22.00	0.12	0.42	0.12	0.46
Standard Error	63.00	2.31	0.01	0.01	-	0.01
Median	1,462.00	13.19	0.10	0.38	0.11	0.42
Standard Deviation	434.00	16.03	0.04	0.10	0.02	0.08
Sample Variance	188,434.00	256.83	-	0.01	-	0.01
Kurtosis	(1.00)	(0.72)	(1.81)	(0.83)	(0.61)	(1.23)
Skewness	1.00	0.98	0.15	0.51	0.81	0.58
Range	1,247.00	46.63	0.12	0.36	0.06	0.24
Minimum	1,305.00	8.24	0.07	0.24	0.10	0.36
Maximum	2,552.00	54.87	0.19	0.60	0.15	0.60
Sum	81,859.00	1,055.95	5.67	20.29	5.77	21.91
Count	48.00	48.00	48.00	48.00	48.00	48.00
Confidence Level(95.0%)	126.00	4.65	0.01	0.03	-	0.02

Where there are missing data values, the stochastic regression imputation (Enders 2010) will be used. This method is preferred to impute missing data primarily because it is considered as an improvement of regression imputation as it adds a random error terms from the residual of the regression model distribution to the predicted value (Behzadian, et al., 2008). For all analysis, sampling weights will be used and standard errors will be computed and one plausible will be used in all analysis. However, estimates that do not contain between-imputation variance occur when only one plausible value is used (Rutkowski et al. 2010). It is an adequate example despite leading to underestimation of standard errors, yet imputation techniques are not yet well developed with regards to IV estimation.

Chapter Four: Educational Development in Africa: Do Precolonial and Colonial Eras Matter?

4.1. Introduction

Summary statistics, findings from empirical estimations, and the supporting interpretations of the analysis are presented in this chapter for the first research objective. The results are compared to similar studies conducted elsewhere to support the inferences that are drawn in conclusion.

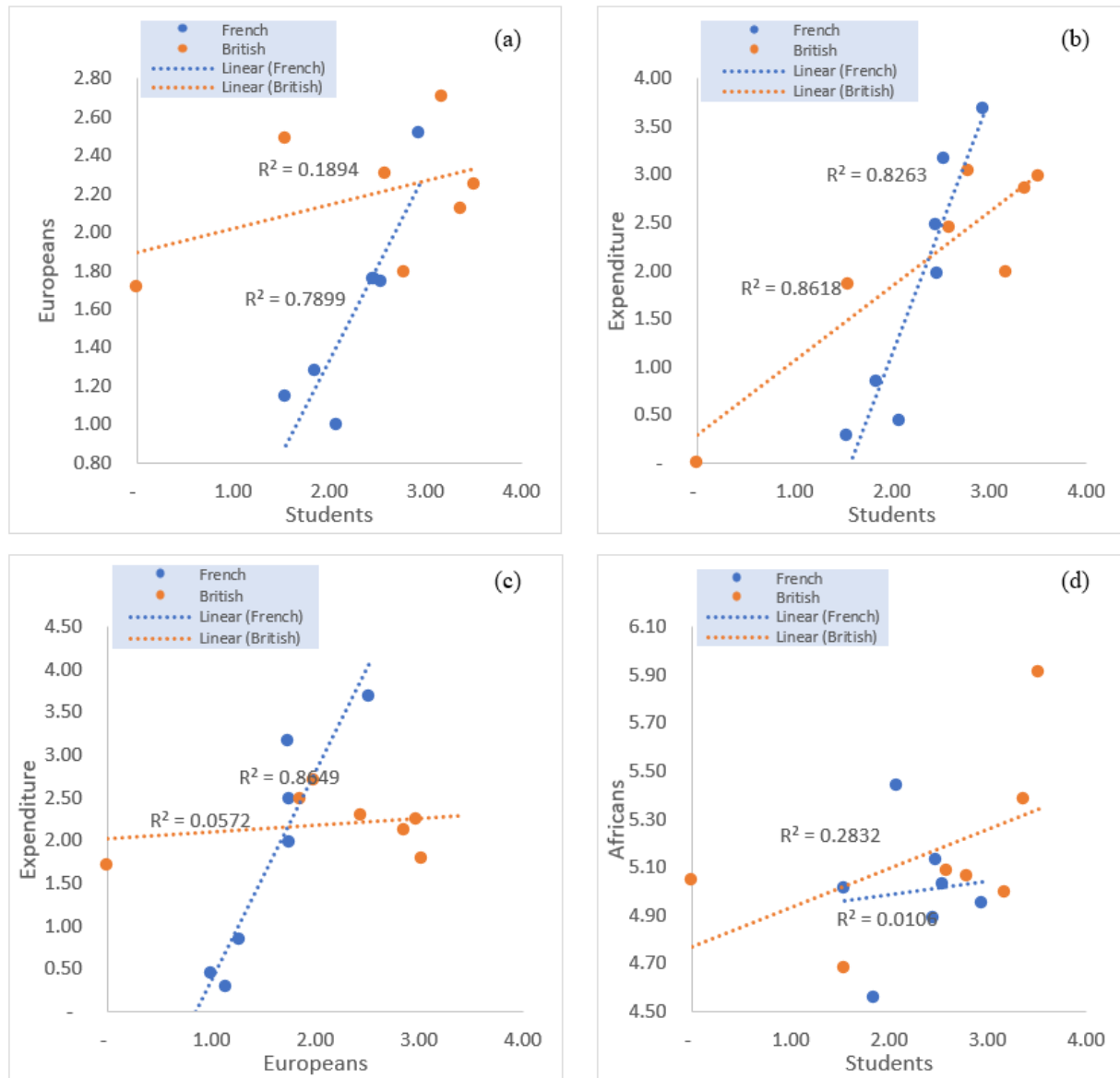
4.2. Descriptive analysis

In this section some descriptive statistics are presented as a prelude to the main empirical analysis to provide a detailed appreciation of the data and to speak to the basic relationships. Infrastructure investments in education equals the sum of public education expenditures on infrastructure, measured as aggregated infrastructure expenditures multiplied by total number of students divide by population. Such expenditures as supported by Table 4.1 in a district-year were 51, 240.38 FRA and 44,085.89 FRA on average for the period 1905 to 1956 in French francs for French and British colonies, respectively. On average the population of Europeans is in favor of British Africa, while educational investments in term of infrastructure are the highest for French Africa. This coupled with the highest average number of students that is observed in British Africa, triggers a need for cross empire relationships of these variables to be further explored. Figure 4.1 shows that the population of Europeans is more positively correlated with the number of students as well as with expenditure in education for French colonies, while the number of students is more correlated with expenditure and the African population for British colonies. For example, in Figure 4.1 (b), schooling infrastructure as proxied by the number of students and expenditure investments are correlated at $\tilde{\rho} = 0.92$ and $\tilde{\rho} = 0.90$ for the British and French, respectively. However, the overall impact of colonial educational development is more positively correlated with the African population in British colonies than in French with a correlation of 0.52 and 0.10, respectively, as seen in Figure 4.1 (d). Thus, indicating that applying an empire control on colonial educational investments and development is a good starting point to explain difference in relation to the European population.

Table 4. 1: Summary of colonial investments, population, prevalence, and educational data for the period 1905 till 1956.

	Infrastructure Expenditure	Population		Light Density	Index		No. of Students	
		European	African		Malaria	Tsetse		
Number of Observations	112.00	101.00	112.00	112.00	112.00	112.00	103.00	French Africa
Minimum	-	-	1,000.00	-	-	-	8.00	
Maximum	1,150,341.00	2,154.00	540,805.50	50.69	4.00	3.29	3,724.94	
Range	1,150,341.00	2,154.00	539,805.50	50.69	4.00	3.29	3,716.94	
Sum	5,738,922.47	8,248.00	12,575,937.53	138.91	310.75	145.83	36,922.64	
Median	12,112.36	16.00	77,648.50	0.05	3.00	1.50	213.83	
Mean	51,240.38	81.66	112,285.16	1.24	2.77	1.30	358.47	
Varariance	17,046,435,076.98	62,659.57	8,636,555,324.07	44.95	0.90	1.38	242,126.21	
Standard deviation	130,562.00	250.32	92,933.07	6.70	0.95	1.17	492.06	
Coefficient of variation	2.55	3.07	0.83	5.41	0.34	0.90	1.37	
Number of Observations	200.00	200.00	200.00	200.00	200.00	200.00	185.00	British Africa
Minimum	-	-	4,300.00	-	-	0.00	-	
Maximum	1,551,032.00	7,164.00	3,040,604.00	25.75	4.00	3.15	13,764.00	
Range	1,551,032.00	7,164.00	3,036,304.00	25.75	4.00	3.15	13,764.00	
Sum	8,817,177.00	45,599.00	39,232,035.00	197.75	590.14	212.53	210,362.00	
Median	2,833.50	46.00	111,106.50	0.09	3.00	0.75	149.00	
Mean	44,085.89	228.00	196,160.18	0.99	2.95	1.06	1,137.09	
Varariance	23,550,164,403.79	454,488.72	108,026,530,568.13	12.75	0.50	0.81	5,678,285.17	
Standard deviation	153,460.63	674.16	328,673.90	3.57	0.71	0.90	2,382.92	
Coefficient of variation	3.48	2.96	1.68	3.61	0.24	0.85	2.10	

Figure 4. 1 Relationship between logged mean number of students and education expenditure; European population and students; European population and expenditure.



Similar with the colonial and slavery factors that are in Table 4.2, results also vary significantly on average across the British and French Africa with factors like slavery, Islam dominance, precolonial centralization that were mostly disruptive to colonial educational development (Rodney 1972; McAlexander & Ricart-Huguet 2022; Okoye and Pongou 2014; Nunn 2008) being the highest for the latter empire. However, the distance to precolonial schools and railroads that contributed towards development (Michalopoulos and Papaioannou 2018; Alesina et al. 2019; Jedwab and Moradi 2016) are highest for British Africa. Moreover, malaria and tsetse fly

prevalence are not biased towards a single empire which then shows colonial ecology as a general factor within and or across empires which disadvantaged colonial education development.

It can then be concluded based on the observations that the discussed descriptive analysis inadequately ascertains the effect that Africa's colonial and slavery history had on investment in education and development of educational institutions, which then motivates for the adoption of a suitable econometric model that can fully address the research questions that are linked to this objective. Instrumental variables (IVs) together with ordinary least squares (OLS) have been used in the sections that follow as supplements that further enrich the discussed descriptive outcomes.

Table 4. 2: Summary of the mean severity of colonial and slavery artifacts for the period 1905 till 1956.

	Slavery Intensity	Ethnic Group Count	Ethnic Fractionalization	Islam	Precolonial Centralization	Distance to First Precolonial School	Distance to railroad, in KM	
Number of Observations	112.00	112.00	112.00	112.00	112.00	112.00	112.00	French Africa
Minimum	0.84	1.00	-	-	1.00	-	-	
Maximum	3.00	12.00	0.87	2.00	4.00	1,271.55	194.67	
Range	2.16	11.00	0.87	2.00	3.00	1,271.55	194.67	
Sum	294.36	507.00	51.22	161.00	286.38	39,531.84	3,379.73	
Median	2.90	4.00	0.48	2.00	2.39	323.06	-	
Mean	2.63	4.53	0.46	1.44	2.56	352.96	30.18	
Varariance	0.30	4.88	0.04	0.59	0.44	65,280.88	3,009.10	
Standard deviation	0.55	2.21	0.21	0.77	0.66	255.50	54.86	
Coefficient of variation	0.21	0.49	0.46	0.53	0.26	0.72	1.82	
Number of Observations	200.00	200.00	200.00	200.00	200.00	200.00	200.00	British Africa
Minimum	-	1.00	-	-	0.04	-	-	
Maximum	3.00	35.00	0.94	2.00	4.00	1,204.79	590.11	
Range	3.00	34.00	0.94	2.00	3.96	1,204.79	590.11	
Sum	348.31	1,040.00	85.47	69.00	471.47	84,304.92	9,783.57	
Median	2.00	4.00	0.47	-	2.38	373.45	1.90	
Mean	1.74	5.20	0.43	0.35	2.36	421.52	48.92	
Varariance	0.82	18.37	0.06	0.44	0.67	87,056.58	6,817.94	
Standard deviation	0.90	4.29	0.25	0.66	0.82	295.05	82.57	
Coefficient of variation	0.52	0.82	0.57	1.92	0.35	0.70	1.69	

4.3. Possible endogeneity

As the European population and missions were the main colonial schooling mechanisms, the population of Europeans (labelled, “Europeans” in the subsequent discussions and reporting) have been used as the main factor together with all the other additional factors which may have played a role in enabling Europeans to invest towards colonial education are included as controls in the specifications that will be used to address the first objective. Moreover, some of the controls to be used in the empirical specifications could be potential instruments in the colonial schooling regression as they determined the location (Mantovanelli, 2013 a, b, Jedwab, Meier zu Selhausen, and Moradi 2018) where Europeans settled as well as dictated which regions received investments and where educational institutions were set up. Some of these controls such as railroads and disease prevalence, which could be correlated with Europeans, may introduce endogeneity if treated as ordinary explanatory variables; as such, they are treated as instruments for the European population and not just explanations for colonial schooling as also supported by literature (Burgess et al. 2015 and Mantovanelli, 2013 a,b have details on disease prevalence and Jedwab and Moradi 2016 on railroads).

Hence, the first-stage effect of railroads and disease prevalence on Europeans is considered as well as the reduced form effect on investments in education and educational development.

The linear models below are considered:

$$\begin{aligned}\log(E_{ijd}) &= \mu_0 + \mu_1 Y_{ijd} + \mu_2 I_{ijd} + \mu_3 \text{districtFE}_{ijd} + \mu_4 \text{yearFE}_{ijd} + \mu_{5k} X_{ijd} + \eta_{jd} + \epsilon_{ijd} \\ \log(Y_{ijd}) &= \beta_0 + \beta_1 \log(E_{ijd})^I + \beta_3 I_{ij} + \beta_4 \text{districtFE}_{ijd} + \beta_{5k} X_{ij} + \eta_{jd} + \epsilon_{ijd}\end{aligned}\quad (4.1)$$

where E_{ijd} is the size of the European population and Y_{ijd} is a vector that includes infrastructure investments in education together with the number of students and teachers from district i in colony j (1905–1956 average) on either cross sectional or panel data d . I denotes either railroads or disease prevalence, X is the controlling factor which is made of the African population and socioeconomic characteristics (ethnic diversity, Islam prevalence, pre-colonial trading post, and pre-colonial political centralization).

The endogeneity test starts with results in Table A.1.1, where an OLS regression is estimated with railroads and the European population as explanations for educational investments followed by a

2SLS regression with railroads as an instrument for the European population together with the African population, disease prevalence, ethnic fractionalization, Islam dominance and precolonial schooling as social and educational features which help with restricting the regressions to be estimated only in regions that were precolonially and colonially educational. Looking at the OLS regression (model 1), it can be seen that the effects of railroad, European population and the first schools that were precolonially built by colonists are positive and significant at 1%, 0.1% and 1%, respectively. Thus, a 1-, 0.1- and 1-point increase, growth and spread in railroad, European population and precolonial schools, respectively, results in 20, 67 and 385 points increase in educational investments. However, when the European population in the educational investments regression as in model 2 is instrumented by railroads, the causality confidence of the growth of the European population increases by 59 points including significant and positive estimates for the presence of Islam at the 1% level that leads to 61-point increase in investments. Thus, the use of instrumental variables is also further justified by the Angrist-Pischke first-stage F-statistic is 85 and above the Stock and Yogo convention of 10 for weak instruments.

Also, model's 3 and 4 are causal and verify the discussed results by estimating a first stage effect of railroads on the European population as well as an OLS reduced form for the effect of railroads on educational investments. With all precolonial and colonial educational features retained, a 1% increase in the kilometers of railroads increases both the European population and educational investments by 28% and 45%, respectively. Moreover, a 5 and 1 point spread in the first precolonial schools that were established by colonists results in 188 and 441 points increase in the European population and investments in education, respectively. However, the effect of the presence of Islam is negative and significant at the 0.1% level causing a 59 points drop in the European population.

A similar interpretation is true even when estimates are considered for French (Table A.1.2) and British Africa (Table A.1.3) except that the causality confidence when the European population is instrumented by railroads is much higher for French than British Africa by 54 points. Additionally, precolonial schooling control effects remain the same elsewhere for British Africa except towards the European population, while in French Africa it is significant and positive only towards the European population. The impact of the presence of Islam on an empire level becomes insignificant towards the European population and is significant in the OLS model's (1 and 4) and

negative. A 1- and 5-point increase in the spread of Islam leads to 396- and 369-point decline in investments in education in French Africa, respectively, whereas in British Africa investments drop by 66 and 92 points when a 1 point spread of Islam is observed. Also, malaria prevalence effects are significant and positive in French Africa at the 5% and 1% level leading to 55- and 92-point decline in investments in the OLS (model 1) and 2SLS (model 2), respectively, while the European population declines by 143 points when malaria prevalence increases by a 0.1 point. An increase in tsetse fly prevalence by 1- and 5-point leads to 39, 40 and 37 points increase in investments in model 1 (OLS), 2 (2SLS), and 4 (OLS reduced) in British Africa, while in French Africa more tsetse fly prevalence by 5 points increase investments by 13 points. Moreover, the effects of the initial precolonial schools that were specifically not built by colonist is significant and negative in French Africa at the 1, 0.1 and 5% level in model's 1 (OLS), 2(2SLS) and 4 (reduced OLS), respectively. Thus, a 1, 0.1 and 5 points spread in precolonial schools that were not specifically built by the French colonist leads to 460, 700 and 389 points drop in investments, respectively. The effect of any growth in the African population is positive and significant only for British Africa in the OLS model's (1 and 4) at the 1% and 0.1% level, further showing 44 and 61 points increase in educational investments when the Africa population grows by a 1 and 0.1 point, respectively.

Additionally, control variable estimates in the investments regression show that strong Islam centralization was in part responsible for the regions that experienced few to no European settlers and empire level results also show that more colonial spread of Islam negatively interfered with educational investments with the French Africa case being more severe. Also, high disease prevalence further reduces the European population in French Africa consequently disadvantaging regions that were susceptible to high malaria prevalence. These results possibly explain the observed interruption caused by precolonial schools that were not specifically established by colonist in French Africa. However, results also seem to suggest that British Africa was more favored towards investments in education than French Africa and this can be further supported by the fact that as the British collaborated with missions which inevitably explains the variations. On the other hand, the French used a more centralized education system and were not open to work with missions. That, coupled with strong Islam centralization that also refrained from collaborating with missions led these regions to being highly deficient. As a result, the impact of the British

education system is also visible in the African population as estimates show that any growth in the African population encourages educational investments levels.

Educational development estimates in Table A.1.4 further supports the endogeneity results that have been previously discussed. Indeed, an evaluation of models 1-4 confirms that the construction of more colonial railroads remains positive and significant at 1% as well as instrumental towards the growth of the European population. However, the increase in the causality confidence is highest for British Africa. In other words, these results show that regions that were privileged with the construction of railroads inevitably received the most educational investments coupled with well-developed education institutions. However, in this regression amongst the controls, disease prevalence as well as Islam centralization does not impede educational development, however, the only disruption that is evident towards both the European population and number of students is caused by high levels of ethnic fractionalization. Therefore, a 5-point increase in ethnic fractionalization results in a 11 and 25 point drop in the European population and number of students, respectively. These results concur with the findings in Turkey by Oyvat and Tekgüç (2019), showing that regions that were exposed to high ethnic fractionalization levels experienced few to no European settlers inevitably making them deficient towards educational development and investments.

On that note, the first stage results in models 1 to 3 strongly suggest that railroads directly affected the choice of region where Europeans settled which then indirectly influenced investments towards education as well as educational development (reduced-form Models 4). As is seen from the estimates, railroads increase the likelihood of having more investments towards education as well as the expansion of colonial schools. This then shows that colonial railroads are more than just an explanation because they are instrumental to European settlement patterns which in turn determined colonial educational development and investments that were done towards education. These finding identifies colonial educational development together with investments which were made in education as an additional area that either influenced or was influenced by colonial railroads to the one's (i.e., the location of primary commodity production, urban development and mining and military developments) which Jedwab and Moradi (2016) including Roessler et al. (2016) have mentioned. These findings are also true even when within colony (i.e., Tables A.1.3,

A.1.4, A.1.5 and A.1.6) effects are estimated with effects being more favorable for French colonies than British towards investments in education but inverse is the case for students.

Jedwab and Moradi (2016) and other scholars have analyzed the distribution of colonial railroads in relation to development and have shown that colonial railroads played a major role in development during the colonial era. Also, from a sample of 39 Sub-Saharan African countries, they were able to show that the within country urbanization variation post-independence was in favor mostly of countries that had more colonial railroads. On the other hand, with consensus data from across 23 African countries, Alesina et al. (2019) uncovered a significant relationship between colonial railroads and educational attainment which is strong, positive, persistent and robust, further showing an association between colonial railroads and the intergenerational mobility in education.

Second, disease prevalence (i.e., malaria and tsetse fly) could also be instrumental for the European population in the IV regression rather than explanatory variables in the educational development regressions. Therefore, high malaria prevalence coupled with lack of transportation networks was a huge set back which hindered protestant missions from setting up their stations and schools inland up until quinine was introduced during the 1850's and transportation networks began to be established (Jedwab, Meier zu Selhausen, and Moradi 2018). As a result of the mentioned disadvantages, most mission stations and schools were at the coast, and there was also notable variance between protestant and catholic attendees which is also supported by the strong within - country positive relationship between literacy and proximity to protestant missions which was evidenced by Alesina et al. (2019).

Hence, combining the literature evidenced that shows that disease prevalence also had a significant influenced on the settlement patterns of missions with endogeneity validity tests can be a good guide to determine whether disease prevalence can also be used as more than just an explanation for colonial educational development.

On that note, endogeneity results for disease prevalence are represented by Table A.1.7 and A.1.8 for tsetse fly and malaria, respectively. Just like with railroads, an educational development OLS regression is first performed followed by a 2SLS educational development regression that instruments the growth of the European population with disease prevalence, thereafter the first

stage regression on the European population, and lastly a reduced reform OLS on the number of teachers.

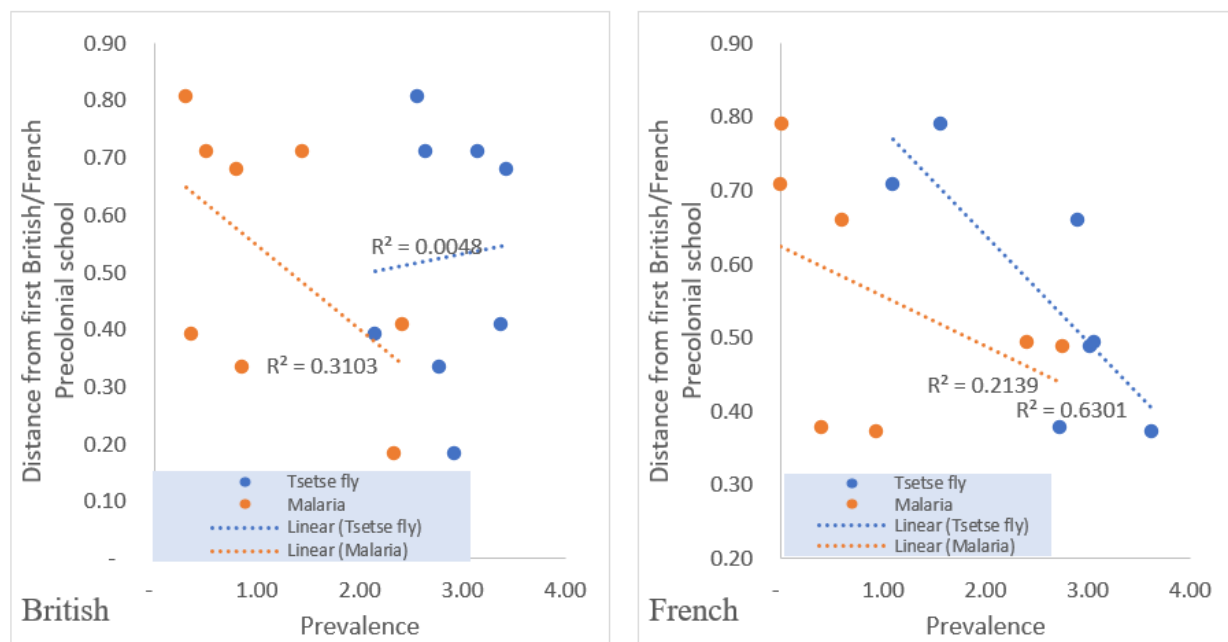
The effect of tsetse fly and the European population in model 1 is significant at 5 and 0.1% level, respectively, and directionally inverse with the latter as positive. Therefore, a 0.1-point growth in the population of Europeans leads to a 12-point increase in the number of teachers, while a 8 point decrease in the number of teachers is observed when tsetse fly becomes more prevalent by 5 point. Moreover, instrumenting the population of Europeans by tsetse fly as in model 2 even further increases the causality confidence of the effects of the European population on the number of teachers by 12 points. Also, as the F-statistic by Angrist-Pischke is above the Stock and Yogo convention of 10 for weak instruments, tsetse fly is then verified as a negative and a valid instrument. The instrumental validity results are even further ascertained by the first stage (model 3) and reduced form (model 4) as they are causal, the effect of tsetse fly on both the European population and number of teachers is negative and significant at 1 % level, respectively. Consequently, a 1-point increase in tsetse fly prevalence results in a 137- and 27-point decline in the European population and number of teachers, respectively.

The endogeneity test that follows assumes malaria as an instrument for the European population and the resulting estimates lead to similar conclusions as those of tsetse fly. The interpretation of model's 1-4 in Table A.1.8 further validates the discussed findings on tsetse fly, as it can be seen that malaria is also a valid instrument for the European population, which is evident by the observed increase in the causal confidence by 6 points that is seen on the change of impact that any growth in the European population has on the number of teachers in the OLS (model 1) as compared to the 2SLS (model 2). This then coupled with the weak instrument F-statistic that is above Stock and Yogo criteria of 10 or more also validates malaria as a good instrument.

Also, the causal confidence increase that is observed when the European population is instrumented is highest for tsetse fly and it can therefore be deduced that during the colonial era, tsetse fly was more detrimental towards the development of educational institutions than malaria. This implies that regions that were exposed to high tsetse fly prevalence were the least educationally developed due to few to no teachers that were posted to these regions. This is also supported by Jedwab, Meier zu Selhausen, and Moradi (2018) who found that from the 1850's following the introduction of quinine malaria became more manageable and hence the expansion

and functionality of the missions and colonial administration was less hindered. However, tsetse fly prevalence still proved to be a hinderance towards European settlement and therefore the establishment of state and educational institutions even after the 1950's. For instance, according to Lowes and Montero (2018), all medical efforts that were made in the period 1921 till 1956 in Gabon, Chad, Cameroon, Democratic Republic of Congo (DRC) and Central African Republic (CAR) to control sleeping sickness caused blindness, gangrene and death including other adverse effects rather than cubing against its spread. Hence, findings show that regions that had high prevalence of malaria compared to tsetse fly were more favored as supported by Figure 4.2 that shows that tsetse fly is more inversely related to teachers than malaria especially for French colonies.

Figure 4. 2 Relationship between disease prevalence and distance from first British/ French precolonial school.



Estimates of the control variables in Table A.1.7 show that the effect of a 1-point growth in the African population results in 11-, 8- and 10-point increases in the number of teachers in model's 1 (OLS), 2 (2SLS) and 5 (Reduced OLS), respectively. Furthermore, a 1-point expansion of the civil administration leads to 46-, 36-, and 45-point respective increase in the number of teachers in model's 1 (OLS), 2 (2SLS) and 5 (Reduced OLS) including an increase of 86 points in the growth of the European population. The impact of the spread of precolonial trading post also produces similar effects at the significant as the civil administration but at much higher magnitudes, while the effects of hostility events are significant only towards the European population and positive.

Other than that, a 0.1- and 1-point increase in ethnic fractionalization reduces both the European population and number of teachers by 114 and 18 points, respectively. Also, increased precolonial centralization by 5- and 0.1-point results in an 11 and 37-point separate increase in the European population and number of teachers in model's 1 and 2, respectively. However, in model's 3 and 4 the opposite effect is observed that declines the European population and the number of teachers by 221 and 15 points when regions become more precolonially centralized by 0.1 and 1 point, respectively.

These results once again clearly show high ethnic fractionalization partly causes educational development disruption which can be attributed to high slavery and scramble for Africa. Also, precolonial centralization negatively interfered with educational development, hindering Europeans from settling in regions that had strong precolonial centralization. However, strong precolonial centralization is not an obstruction towards the increase in teachers and the growth of the European population in all regions, mostly those where the civil administration together with precolonial trade were well established.

All the discussed observations and findings for control variables that are in Table A.1. 7 for all models are directionally the same as those that are in Table A.1. 7 at the same level of significance across all models with some slight variations in the actual magnitudes of impact, further confirming the noted disruptive effects of high ethnic fractionalization and strong precolonial centralization towards the European population as well as educational development and investments.

These results explain the variance in the distribution of the European population, education infrastructure investments and the number of school students with results being favorable for areas that had a railroad and or with low prevalence of tsetse fly and malaria. Hence, railroads and disease prevalence will be used as instruments for the European population in order to understand investments in education between the British and French colonies. Going forward, the effects of colonialism and slavery factors are estimated using ordinary least squares (OLS) models in comparison to the second stage of the 2SLS or instrumental variable (IV) models.

4.4. Colonial and slavery factors as explanations for investments in education and educational development

This section focuses on the effects which precolonial and colonial factors had on investments in education and educational development.

The linear model below is considered:

$$\log(X_{ijd}) = \beta_0 + \beta_{1k}\text{slavery}_{ijd} + \beta_{2k}\text{colonial}_{ijd} + \beta_3 A_{ijd} + \beta_4 E_{ijd}^I + \beta_{5k}\text{Firstschools}_{ijd} + \eta_j + \epsilon_{ijd} \quad (4.2)$$

where E_{ijd} is the size of the European population, A_{ijd} is the size of the African population, X_{ijk} is a vector that includes education investments as well as educational development (i.e., number of students or teachers), $\text{Firstschools}_{ijd}$ are the first schools that were built by either the missions and or by French or British colonialists, η_j are the fixed controls, slavery_{ijk} are the intensity or types of slavery and colonial_{ijk} are the colonial factors (ethnic fractionalization, ethnic count, Islam prevalence, malaria index, tsetse fly factor, centralization and other secondary education institutions such as agriculture, health and precolonial trade) in district i and colony j estimated on either cross section or panel data d with I as the instrument.

The impact of precolonial schooling on investments in education and educational development cannot be omitted since the first precolonial schools, which were established by missions and colonialists at the coast (Mantovanelli, 2013 a, b), served as an emergence point for colonial investments in education and educational development. In this regard, “first precolonial schools” refers to the first schools that were built during the precolonial era by either missions or colonialists, while “first British/French precolonial schools” are those that were built specifically by colonialists. These variables assume the value of 1 if the first precolonial school was constructed within the given region or 0 otherwise.

Moreover, according to Jedwab et al. (2018) the absence of transportation networks and high malaria prevalence (Alesina et al., 2019) restrained missions from moving further inland which made coastal areas the initial point where protestant missions established their stations and also set up their first schools (Mantovanelli, 2013a, b). Hence, the models could suffer from two related

concerns: spatial dependence and the fact that the first precolonial schools were constructed along the coast. Therefore, the effects of the initial precolonial schools will be examined with regional restriction which will only be on coastal colonies as that captures the most effects of the first precolonial schools that were built.

Table 4. 3 Cross section estimates showing second stage effects of precolonial schooling on infrastructure investments in education.

	Cross empire				French				British			
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
European population, logged	0.67 *** (0.13)	1.35 *** (0.34)	0.61 *** (0.13)	1.35 *** (0.34)	0.57 ** (0.19)	1.66 ** (0.60)	0.44 * (0.18)	1.66 ** (0.62)	1.05 *** (0.15)	1.61 *** (0.41)	1.01 *** (0.15)	1.61 *** (0.41)
African population, logged	0.33 (0.19)	0.14 (0.22)	0.39 * (0.18)	0.17 (0.22)	0.61 (0.35)	0.38 (0.46)	0.87 ** (0.33)	0.63 (0.46)	0.55 ** (0.20)	0.45 * (0.22)	0.57 ** (0.20)	0.46 * (0.22)
First precolonial school	2.39 * (1.03)	1.51 (1.18)			-0.43 (1.48)	-2.59 (2.15)			3.71 ** (1.17)	3.20 * (1.28)		
First British/French precolonial school			4.16 *** (1.01)	2.96 * (1.21)			4.02 ** (1.36)	1.96 (2.09)			3.80 ** (1.19)	2.83 * (1.40)
N	200	200	200	200	60	60	60	60	140	140	140	140
R ²	0.18	0.17	0.23	0.20	0.19	0.17	0.30	0.20	0.37	0.36	0.37	0.35

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Table 4. 4 Cross section estimates showing second stage effects of precolonial schooling on students.

	Cross empire				French				British			
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
European population, logged	0.46 *** (0.10)	0.87 ** (0.27)	0.42 *** (0.10)	0.85 ** (0.27)	0.36 *** (0.05)	0.46 ** (0.15)	0.33 *** (0.06)	0.47 ** (0.15)	0.71 *** (0.13)	1.22 *** (0.37)	0.69 *** (0.13)	1.22 *** (0.37)
African population, logged	0.87 *** (0.16)	0.74 *** (0.18)	0.90 *** (0.16)	0.76 *** (0.18)	0.09 (0.13)	0.04 (0.15)	0.17 (0.14)	0.08 (0.18)	1.09 *** (0.18)	1.00 *** (0.20)	1.10 *** (0.18)	1.00 *** (0.20)
First precolonial school	2.21 ** (0.85)	1.87 * (0.91)			-0.22 (0.46)	-0.31 (0.50)			2.64 * (1.05)	2.18 (1.15)		
First British/French precolonial school			2.28 ** (0.81)	1.58 (0.94)			0.45 (0.41)	0.14 (0.55)			2.28 * (1.07)	1.43 (1.25)
N	191	191	191	191	51	51	51	51	140	140	140	140
R ²	0.27	0.24	0.27	0.24	0.50	0.50	0.51	0.50	0.39	0.36	0.38	0.35

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

On that note, when considering the estimates in Table 4.3 and 4.4, it can be observed that when the European and African populations are used as the main factors, cross colony estimates towards colonial students are only significant at 5% and positive for the presence of the first precolonial school and not for those that were specifically constructed by colonialists. When within colony estimates are considered, the effect of both the first precolonial schools that were built by colonists and or missions remain significant for the British colonies, while for French colonies, all precolonial schooling effects are insignificant.

On the other hand, the cross impact of precolonial schools on investments in education is positive and significant at 5% and 1% for regions where the first precolonial schools and first British/French precolonial school were constructed, respectively. These results show that coastal regions where European and missions constructed their first schools received more investments in education compared to other regions, another explanation could be that these specific regions that were privileged with the first precolonial schools had already adopted the colonial and mission education systems and policies which gave them the advantage as compared to other regions that still had strong precolonial centralization. When within colony estimates are considered, causal estimates for British colonies remain significant on the effects of precolonial schooling on all regressions, while for French colonies only the effects of the first precolonial schools that were constructed by the colonists remain significant towards investments that were made in education.

These estimates that are mostly favorable for the British than French colonies can be explained by the differences in the way the British and French administrated their education policies as these were ruling indirectly and directly, respectively. The British introduced indirect rule where they ruled the interior headmen and local chiefs. In areas where the French settled, they mostly focused on trying to rule coastal areas and interior with the Europeans and to centralize power by educating a few indigenes.

The British, in contrast, worked hand-in-hand with missionary schools and mostly had classes taught in indigenous languages which was quite different from the French who developed a centralized education system where the medium of communication and teaching was French (Frankema 2012; Cogneau and Moradi 2014). Hence, the impact of precolonial schooling which is mostly in favor of the British colonies may be closely linked to the type of colonial rule and the

education policies and systems that were put in place. That then shows that the type of education policies that were introduced by the French limited investments in education and also restricted educational development which might have contributed to less collaboration between the French and precolonial administration leading to precolonial schools that were not set up by the French to receive little to no investments in education. These French results are also a complement to the British findings by Okoye and Pongou (2014), in which they suggested that in places where institutions were set up via missions and the British Europeans, the overall impact and development towards precolonial schooling was much more significant as they accommodated the local indigenous culture.

Table 4. 5 Cross empire cross section estimates showing second stage effects of precolonial centralization, ethnicity and Islam on students.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Slavery		Ethnicity		Disease		Islam		Murdock		Institutions	
European population, logged	0.69 *** (0.08)	0.95 *** (0.17)	0.58 *** (0.08)	0.80 *** (0.16)	0.63 *** (0.08)	0.88 *** (0.16)	0.68 *** (0.08)	0.95 *** (0.17)	0.62 *** (0.08)	0.87 *** (0.16)	0.29 *** (0.08)	0.68 *** (0.18)
African population, logged	0.97 *** (0.13)	0.87 *** (0.15)	1.21 *** (0.13)	1.15 *** (0.14)	1.04 *** (0.14)	0.95 *** (0.15)	1.01 *** (0.13)	0.92 *** (0.14)	1.08 *** (0.13)	1.01 *** (0.14)	0.84 *** (0.12)	0.83 *** (0.13)
Indigenous slavery, logged	0.42 (0.34)	0.47 (0.34)										
Types of Slavery, logged	0.31 * (0.16)	0.45 * (0.18)										
Ethnic count, logged			-0.09 * (0.04)	-0.09 * (0.04)								
Ethnic fractionalization			-0.23 * (0.10)	-0.18 (0.10)								
Malaria index					0.25 (0.49)	0.51 (0.52)						
Tsetse fly factor					0.02 (0.05)	0.00 (0.06)						
Islam prevalence							0.35 * (0.16)	0.52 ** (0.19)				
Centralization									-0.12 (0.17)	-0.08 (0.18)		
Agriculture											0.00 (0.12)	0.07 (0.13)
Health											0.77 *** (0.11)	0.53 *** (0.15)
Precolonial trade indicator											1.29 ** (0.47)	1.11 * (0.50)
Districts (N)	277	277	277	277	277	277	277	277	277	277	277	277
R ²	0.38	0.37	0.40	0.39	0.37	0.36	0.38	0.37	0.37	0.36	0.50	0.47
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

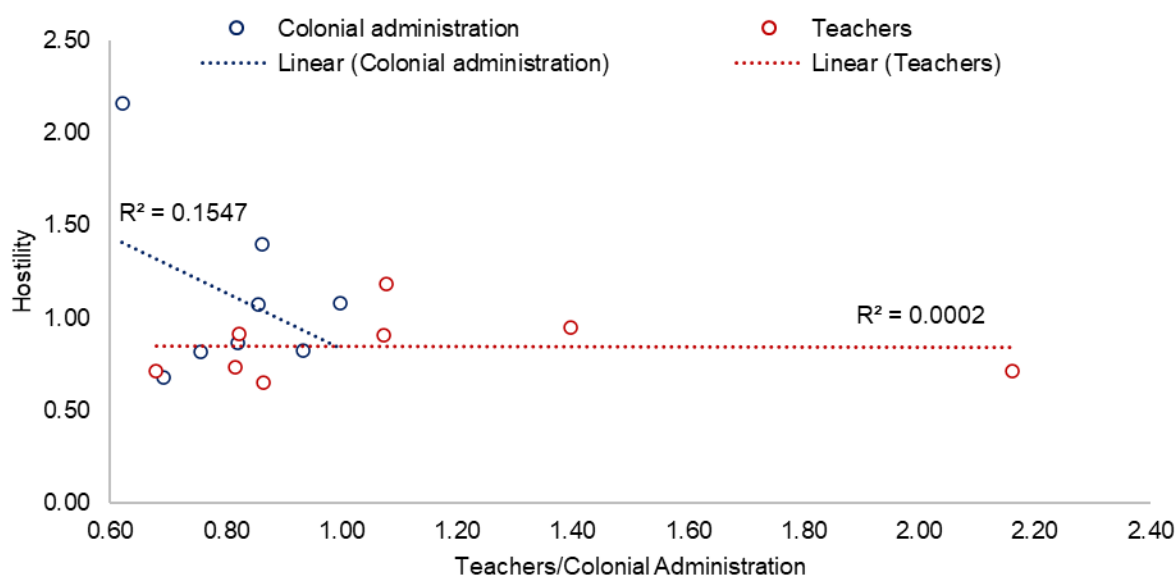
All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Moreover, cross colony estimates in model's 9 of Tables 4.5 and 4.8 show that the impact of precolonial centralization across colonies as proxied by the level of jurisdictional hierarchy beyond the local community level (i.e., where 0 indicates societies "lacking any form of centralized political organization.", 1 is an indication of small chiefdoms, 2 is an indication of large chiefdoms, 3 and 4 is an indication of ethnic groups that were part of large states) for both investments in education and educational development are insignificant. However, when within colony effects of precolonial centralization are estimated, results become significant on the investments in education regression, while on the student's regression estimates remain insignificant. On that note, model's 9 in Tables 4.7 and 4.8 show an inverse influence of precolonial centralization on investments in education significant at 1% and 5% in French and British colonies, respectively, with the latter being positive. For French colonies it shows that a 1% increase in the degree of precolonial centralization decreases investments in education by 127 % points, whereas for the British an inverse impact is observed which shows a 5% increase in the level of precolonial centralization leads to an increase in investments in education by 50% points. These results imply that there was a positive collaboration between the British colonies with regions that were more precolonially centralized, while in the French colonies the inverse is observed. Additionally, in French colonies there was less co-operation from local leaders in regions where there were good precolonial systems which then discouraged indigenes from following the laws and systems that colonialists implemented (Moscona, Nunn and Robinson 2017a, b) which in part explains the negative impact on investments and setups in education. However, the more positive collaboration that is observed in British colonies means that the strong precolonial and bureaucratic systems served as a point of collaboration which allowed for greater responsibility and transparency (Herbst 2000; Boone 2003; Michalopoulos and Papaioannou 2013; Gennaioli and Rainer 2007 a, b) which increases investments in education as well as setup of schools. This then shows that the lack of collaboration between the colonial administration and precolonial centralization systems could have been a form of limitation mostly in the French colonies toward the setup of educational institutions due to the French governance that was territorial and more focused on trying to rule coastal areas and interior with the Europeans and to centralize power and by restricting investments in education and slowing the rate at which the number of both teachers and students were growing (Atilés-Osoria 2018). This then shows that this type of French colonial governance limited intergeneration

mobility in education as there were also even few colonial railroads that were constructed as compared to the British colonies and therefore hindered educational and economic development. This form of territorial governance coupled with other factors explains the education development inequality that mostly favor of British colonies.

Hostility and the resistance which Europeans also encountered played a role in discouraging their settlement, state formation and public investments (McAlexander & Ricart-Huguet 2022) which were the determinants of educational setups and development partly explaining uneven colonial and post-colonial development. However, hostility does not directly explain colonial education because its effects are insignificant in all regressions as seen in model's 1 of Tables 4.11 and 4.12, which could imply that hostility and resistance were mostly aimed at directly discouraging colonial state formation rather than the education systems. These hostile events were good towards the French colonies because the French colonial state and their education system was one integral part as they were focused on only educating the elites as opposed to the British administration that made use of missions to setup schools that were inclusive of the indigenous people and their culture. Therefore, it could mean that hostility and resistance impeded the development of education less than state formation as supported by the more inverse relationship between hostility and colonial administration than the number of teachers in Figure 4.3 below. Therefore, since the administration of investments and education set ups by missions to indigenous with the British colonies were highly dependent on the strength of the colonial state as well as the fact that hostility impeded state formation (McAlexander & Ricart-Huguet 2022), educational development would have been inevitably negatively impacted in the British colonies and but not for those whose education system was integrated with their administration as they restricted locals from being educated like the French.

Figure 4. 3 Logged association between hostility and colonial administration as well as with the number of teachers for the French colonies.



On the other hand, the French panel and cross-sectional effect of Islam in model 7 of Table 4.9 and model 4 of Tables 4.11 on investments in education and number of teachers is negative and significant at 1%, respectively. Thus, a 1-point increase in the presence of Islam results in a 1.34- and 0.15-point decrease in investments in education, and number of teachers, respectively. That then shows that areas in French colonies that had the presence of Islam experienced less investments which resulted to little or no institutional setups in these areas. Similar findings for French colonies are also observed when Islam is considered as an explanation for number of students using cross sectional data as shown in model 7 of Table 4.6. Therefore, since the main objective of setting up institutions by the Europeans was part of a broader vision to directly or indirectly rule the communities where they had settled, it then proved to be challenging to infiltrate in regions where Islamic precolonial centralization was highly dominant. Therefore, for example it can be observed that some parts of West Africa and most of Northern Africa where Islam is highly practiced, investments in education were limited (Acemoglu, Gallego, and Robinson 2014) as their education systems centered around the Islamic culture. Due to the fact that institutions within these regions were centered around the Islamic culture and the Arabic language, collaboration with colonialists and missions was hindered. As a result, the missions whom colonists used for the education administration function (Frankema 2012; Cogneau and Moradi

2014) were not able to settle in these regions. The effect of Islam seemed to have mostly impacted French colonies more than the British which is still related to the level of collaboration that shows that the French colonial government was less collaborative as compared to the British and missions. Hence, the inverse impact of Islam can also be explained with the fact that both the Islam and French had similar territorial objective. As a result, there was little to no collaboration between these two administrations which was different with the British who had an economic interest with an open-door policy.

The baseline and robust French Africa effects of ethnic fractionalization⁴ in model's 2 of Tables 4.11 and 4.12 on the number of teachers is negative and significant at 1%. Also, high levels of ethnic fractionalization have been attributed to slave trade which resulted in violence and insecurity (Nunn 2008), discouraging political development, and promoted social hierarchy (Whatley and Gillezeau, 2009, 2011; Rodney, 1972). Additionally, Green (2013) and uncovered a significant positive relationship between slave traders and ethnic diversity⁵ which is also complimented by the positive association between slave traders and number of ethnic groups that Whatley and Gillezeau (2011) showed across the African continent. Hence, the mentioned effects of ethnic fractionalization can also partly account of the impact that slave trade, ethnic diversity and scramble for Africa had towards colonial educational development and investments. From this perspective, results show that a 1-point increase in the degree of ethnic fractionalization results in a 0.78- and 0.34-point decline in investments in education and numbers of teachers, respectively. With respect to the cross-colony response of the number students to the ethnic fractionalization and number of ethnic groups effects as seen in model's 2 of Tables 4.5 to 4.7, a 5% increase in the level of ethnic fractionalization or diversity drops the numbers of students on average by 0.09 and 0.23 points, respectively. However, when the same investments regressions are considered for within colony effects, all ethnicity effects become insignificant for French colonies, while for British colonies only the effects of ethnic diversity towards students remains negative and significant at 5%. Therefore, it can be deduced from the above results that increased ethnic diversity as well as high levels of ethnic fractionalization hindered educational development as well as investments that were made towards education. Which concurs with Oyvat and Tekgüç

⁴ Ethnic fractionalization deals with the number, sizes, socioeconomic distribution, and geographical location of distinct cultural groups, usually in a state or some otherwise delineated territory.

⁵ Ethnic Diversity is the existence of people from a variety of cultural and diverse backgrounds within a single area.

(2019) who present results for a case study in Turkey where they show that although ethnic fractionalization does not directly hinder investments in education, it reduces school enrollment rates. However, ethnic effects seem to have been colonially specific with increased levels of ethnic fractionalization disrupting both investments and educational development mostly in French colonies, while any increase in ethnic diversity was disadvantageous mostly in the British colonies. Figure 4.4 also shows a significant positive relationship between ethnic diversity and fractionalization which means an increase in one causes the other to also to increase, while both are disruptive towards educational development as supported by the significant negative correlation in Figure 4.5 between number of students and ethnic fractionalization as well as with ethnic diversity which strongly points towards slavery even as supported by the inverse association between slavery intensity and number of students in Figure 4.6. From the rankings of slavery intensity, Islam dominance, size of the European population, hostility towards Europeans, precolonial centralization and ethnic fractionalization in relation to the spread of the number of students and investments in education per colony as shown in Figures 4.7 and 4.8, it can be seen that slavery was more severe in British than French colonies as a result there are less schools which inevitably depressed enrolments. This could be due to the fact that the British colonies abused the trust that they were given by the chiefs or local leaders and used it as a port to further increase their slavery exports by offering bribes to the chiefs (Obikili 2016) in exchange for locals which then severely fractionalized these regions as a more positive association is strongly visible between slavery and ethnic fraction. Also, it can be seen for Nigeria, Zambia, Burkina Faso and Mali which lowers the student ratio. Another observation is that these hostile events seemed to have been the main impediment towards investments in education, for example in Figure 4.8, it can be seen that colonies that were least hostile like Nigeria received the most investment as opposed to Niger. This finding is even further backed up by the level of precolonial centralization in French colonies where regions that were highly centralized were also highly disadvantaged. The size of the European population does not significantly discriminate on colonial education across regions and the reason is that the European population is inclusive of both colonists and missions whose contribution was inverse. Moreover, high Islam dominance leads to lower enrolment and investments which is certain when you compare Nigeria and Mali.

Figure 4. 4 Association between ethnic diversity (neg) and ethnic fractionalization (elf).

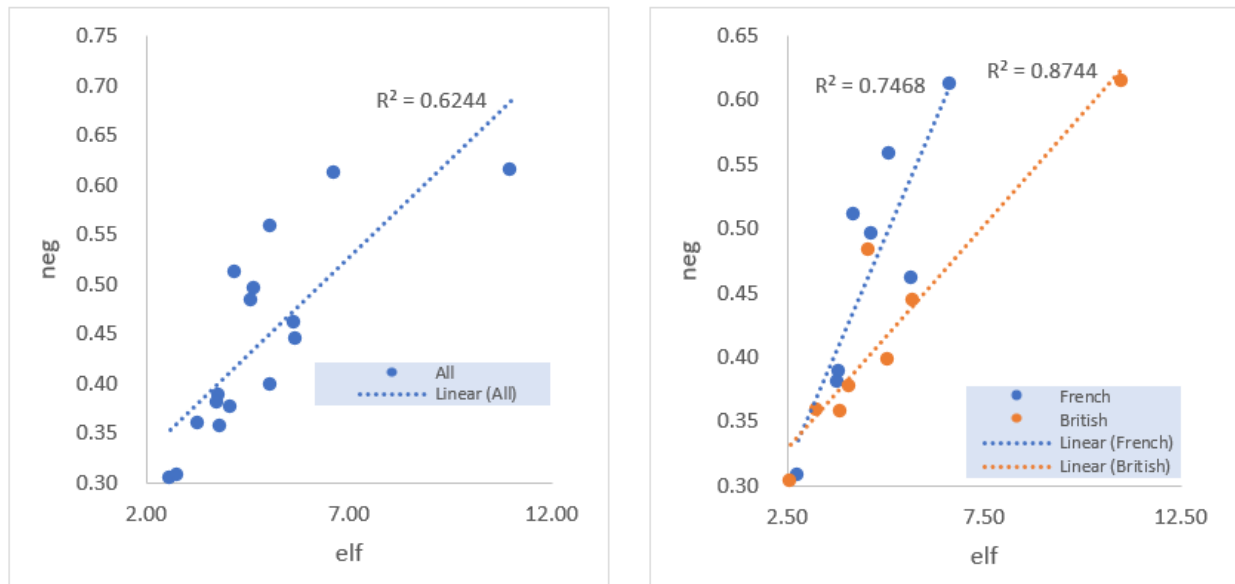


Figure 4. 5 Relationship between ethnicity (i.e., neg and elf) and the logged number of students.

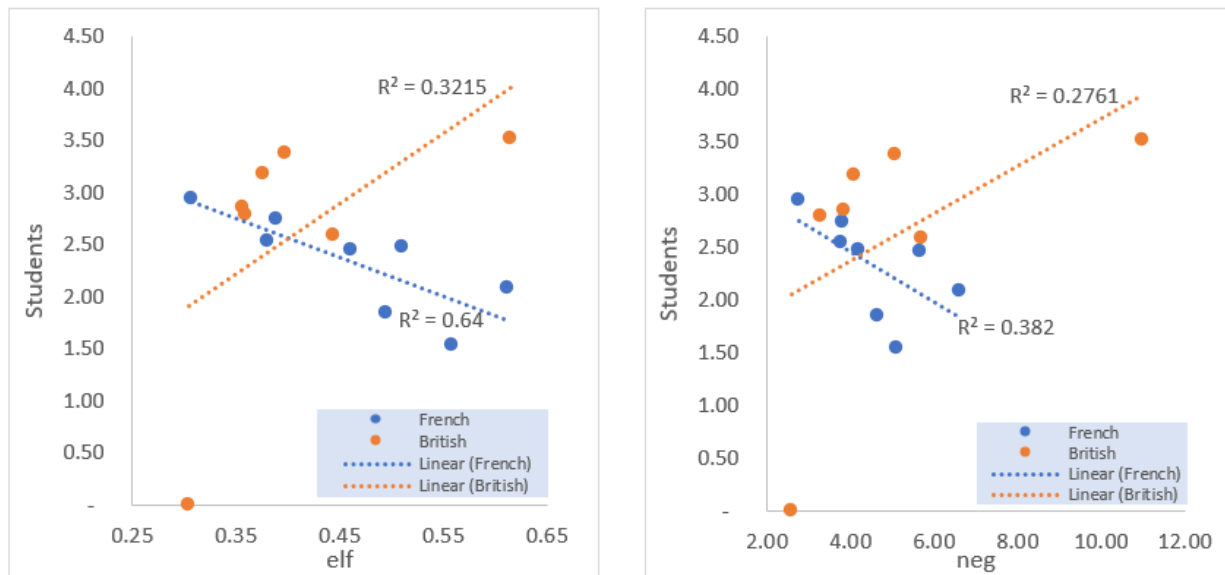


Figure 4. 6 Relationship between number of students and slavery intensity across 16 French and British colonies.

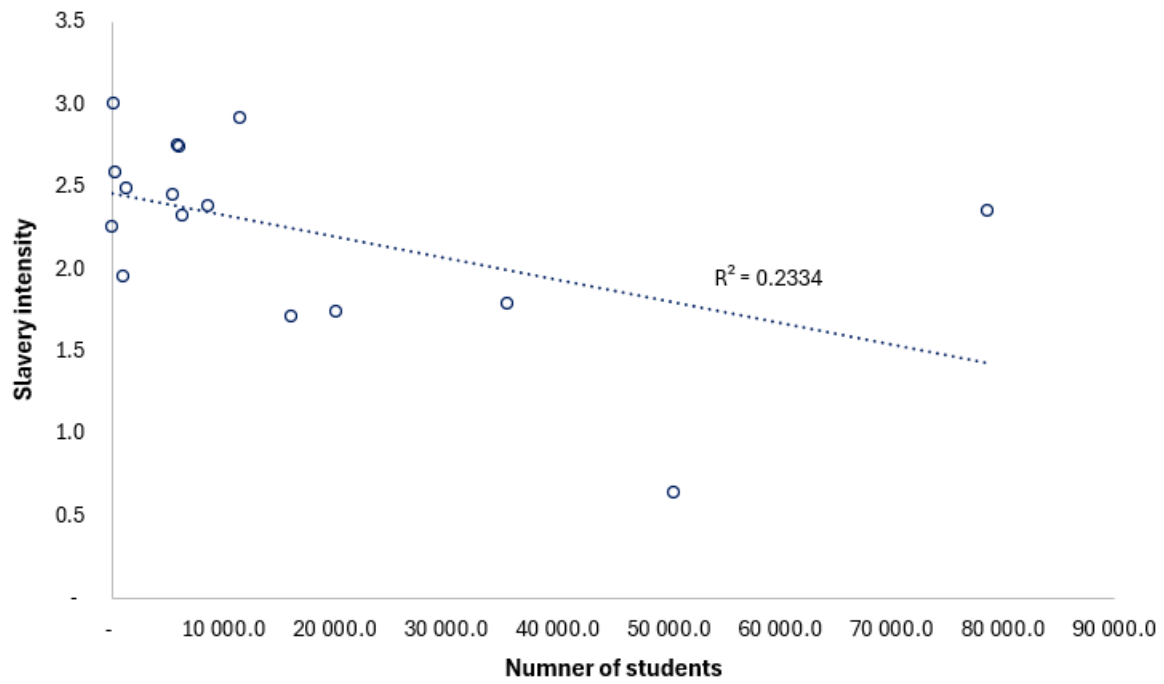


Figure 4. 7: Slavery intensity, Islam dominance, size of European, hostility, precolonial centralization and ethnic fractionalization rankings within the spread of the number of students.

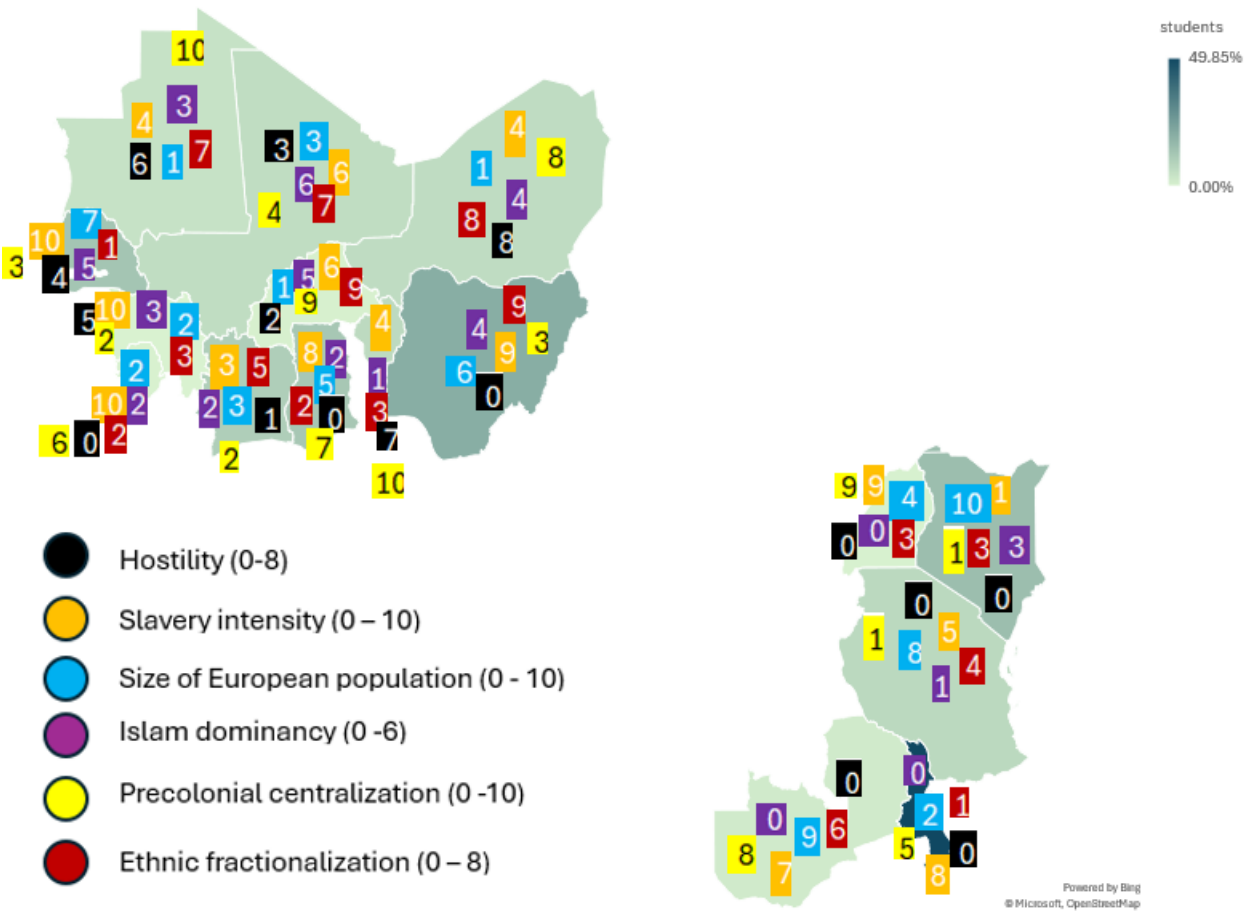
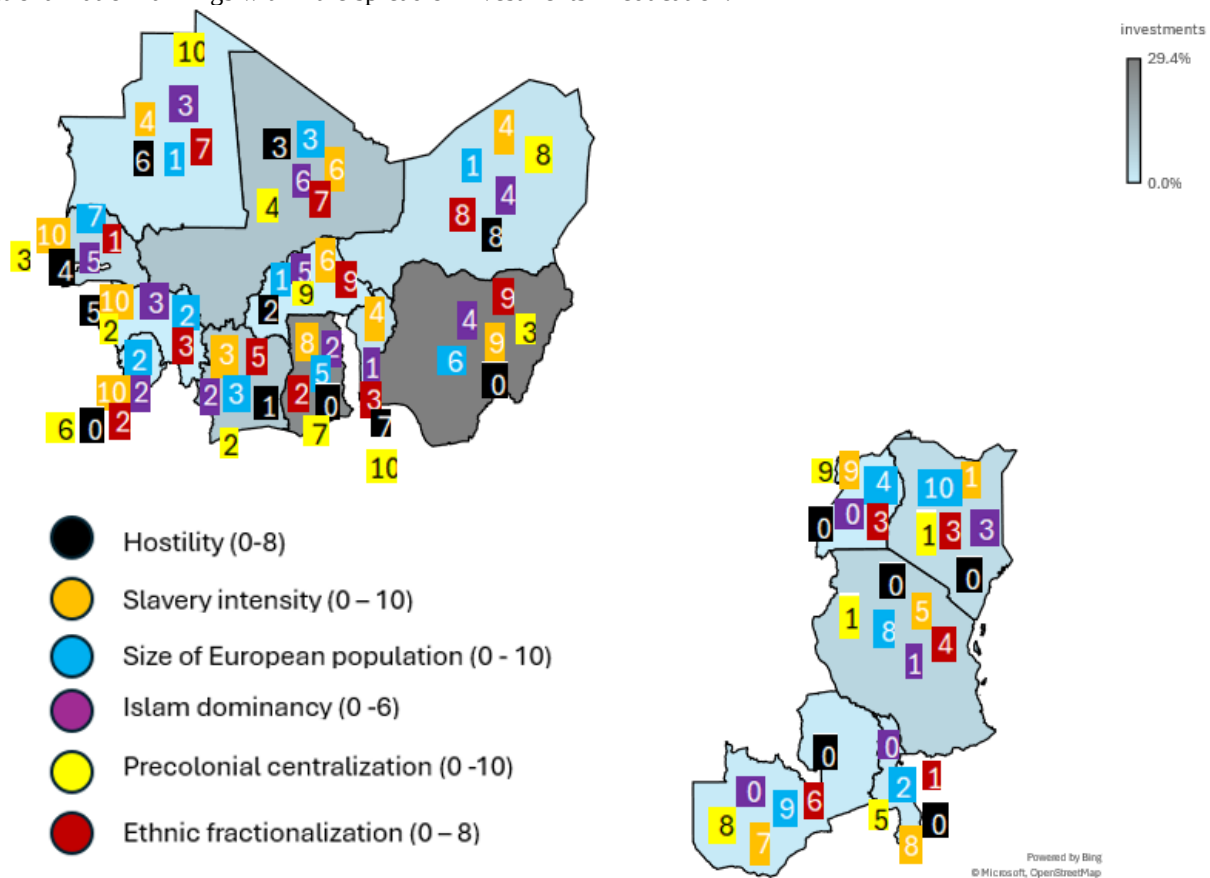


Figure 4. 8: Slavery intensity, Islam dominance, size of European, hostility, precolonial centralization and ethnic fractionalization rankings within the spread of investments in education.



Also, when the effects of other institutions on investments and numbers of students are considered, model 6 in Table 4.5 shows that the impact of precolonial trade and health on students is positive significant at 0.1% and 1%, respectively, except for agriculture. Thus, a 0.1 and 1 -point development in health and pre-colonial trade results in a 1.29- and 0.77-point expansion of colonial development in education, respectively. When within colony effects are estimated, institutional effects remain the same for British colonies, while health effects become insignificant for the French colonies, but then agriculture and precolonial trade effects are inversely significant at 0.1% and 5% with the latter being positive, respectively.

On the other hand, the effects of all institutions towards investments in education in Table 4.8 are significant at 1%, 0.1% and 1% for precolonial trade, health, and agriculture, respectively, with the latter being negative. In other words, these results show that regions that had health and or

precolonial trade also had more developed schools, while opposite was the case in regions where agriculture was mostly practiced. Moreover, within colony estimates in Tables 4.9 and 4.10 shows that the effects of institutions in French colonies remain significant for agriculture at 0.1% and negative, whereas for British colonies only the effects of precolonial trade and health are positive and significant at 0.1%, respectively. Therefore, these results further uncover yet another angle from which colonial policies (i.e., mostly towards education) that were implemented by colonists can be examined, with French colony effects of other institutions towards education development showing a negative association which is mostly from agriculture. However, in the case of British colonies the association of institutions with education is positive which shows that schools developed more significantly in British colonies because their open policies allowed for other institutions to depend on schools which does not appear to be the case for French colonies. For instance, the fact that colonialist in French West Africa only started to assist in the development of agriculture and manual trade (e.g., barter system) in the 1930's (Gamble, 2009) confirms the observed disassociation between agriculture and educational development.

Table 4. 6 French cross section estimates showing second stage effects of precolonial centralization, ethnicity, and Islam on students.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Slavery		Ethnicity		Disease		Islam		Murdock		Institutions	
European population, logged	0.47 *** (0.06)	0.63 *** (0.13)	0.44 *** (0.06)	0.69 *** (0.16)	0.53 *** (0.06)	0.66 *** (0.12)	0.43 *** (0.06)	0.72 *** (0.15)	0.47 *** (0.06)	0.72 *** (0.15)	0.40 *** (0.08)	1.04 * (0.43)
African population, logged	0.16 (0.11)	0.14 (0.11)	0.25 * (0.11)	0.20 (0.12)	-0.04 (0.11)	-0.08 (0.11)	0.25 * (0.11)	0.19 (0.13)	0.20 (0.11)	0.17 (0.12)	0.22 * (0.10)	0.34 * (0.15)
Indigenous slavery, logged	0.62 ** (0.22)	0.59 * (0.23)										
Types of Slavery, logged	0.16 (0.16)	0.19 (0.17)										
Ethnic count, logged			-0.05 (0.04)	-0.04 (0.05)								
Ethnic fractionalization			-0.18 (0.10)	-0.11 (0.11)								
Malaria index					1.22 *** (0.28)	1.34 *** (0.31)						
Tsetse fly factor					-0.00 (0.02)	-0.00 (0.02)						
Islam prevalence							-0.36 ** (0.13)	-0.20 (0.16)				
Centralization									-0.30 (0.16)	-0.27 (0.18)		
Agriculture											-0.48 *** (0.08)	-0.43 *** (0.11)
Health											-0.02 (0.14)	-0.85 (0.57)
Precolonial trade indicator											0.92 * (0.36)	0.81 (0.49)
Districts (N)	92	92	92	92	92	92	92	92	92	92	92	92
R ²	0.46	0.46	0.45	0.44	0.56	0.55	0.46	0.43	0.43	0.42	0.64	0.52
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Table 4. 7 British cross section estimates showing second stage effects of precolonial centralization, ethnicity, and Islam on students.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Slavery		Ethnicity		Disease		Islam		Murdock		Institutions	
European population, logged	0.89 *** (0.10)	1.14 *** (0.23)	0.83 *** (0.10)	1.07 *** (0.21)	0.89 *** (0.10)	1.18 *** (0.21)	0.85 *** (0.10)	1.14 *** (0.21)	0.87 *** (0.10)	1.15 *** (0.21)	0.57 *** (0.11)	1.03 *** (0.26)
African population, logged	1.28 *** (0.16)	1.18 *** (0.19)	1.47 *** (0.16)	1.39 *** (0.17)	1.22 *** (0.16)	1.12 *** (0.17)	1.36 *** (0.16)	1.26 *** (0.17)	1.32 *** (0.15)	1.24 *** (0.17)	1.09 *** (0.15)	1.10 *** (0.16)
Indigenous slavery, logged	0.97 * (0.47)	1.13 * (0.49)										
Types of Slavery, logged	-0.33 (0.21)	-0.25 (0.23)										
Ethnic count, logged			-0.09 * (0.04)	-0.09 * (0.04)								
Ethnic fractionalization			-0.22 (0.11)	-0.18 (0.12)								
Malaria index					0.18 (0.63)	0.46 (0.67)						
Tsetse fly factor					0.44 *** (0.13)	0.44 *** (0.13)						
Islam prevalence							-0.29 (0.25)	-0.16 (0.27)				
Centralization									-0.07 (0.20)	-0.02 (0.20)		
Agriculture											0.12 (0.16)	0.16 (0.17)
Health											0.55 *** (0.14)	0.24 (0.21)
Precolonial trade indicator											1.49 * (0.60)	1.47 * (0.62)
Districts (N)	185	185	185	185	185	185	185	185	185	185	185	185
R ²	0.52	0.51	0.53	0.52	0.54	0.53	0.51	0.50	0.50	0.49	0.57	0.54
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Table 4. 8 Cross empire cross section estimates showing second stage effects of precolonial centralization, ethnicity, and Islam on infrastructure investments in education

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Slavery		Ethnicity		Disease		Islam		Murdock		Institutions	
European population, logged	0.91 *** (0.09)	1.36 *** (0.20)	0.77 *** (0.09)	1.20 *** (0.19)	0.80 *** (0.09)	1.21 *** (0.19)	0.83 *** (0.09)	1.31 *** (0.21)	0.80 *** (0.09)	1.25 *** (0.19)	0.34 *** (0.09)	0.99 *** (0.22)
African population, logged	0.15 (0.14)	-0.00 (0.16)	0.39 ** (0.15)	0.26 (0.16)	0.22 (0.15)	0.09 (0.16)	0.30 * (0.14)	0.15 (0.16)	0.31 * (0.14)	0.19 (0.15)	0.09 (0.13)	0.05 (0.14)
Indigenous slavery, logged	0.94 * (0.37)	1.06 ** (0.38)										
Types of Slavery, logged	0.55 ** (0.17)	0.76 *** (0.20)										
Ethnic count, logged			-0.05 (0.04)	-0.05 (0.04)								
Ethnic fractionalization			-0.15 (0.10)	-0.08 (0.10)								
Malaria index					0.55 (0.33)	0.74 * (0.35)						
Tsetse fly factor					0.05 (0.06)	0.02 (0.06)						
Islam prevalence							0.18 (0.17)	0.45 * (0.21)				
Centralization									0.20 (0.19)	0.28 (0.21)		
Agriculture											-0.36 ** (0.13)	-0.24 (0.15)
Health											1.00 *** (0.12)	0.61 *** (0.18)
Precolonial trade indicator											1.70 ** (0.54)	1.33 * (0.59)
Districts (N)	301	301	301	301	301	301	301	301	301	301	301	301
R ²	0.29	0.29	0.25	0.24	0.25	0.25	0.24	0.23	0.24	0.23	0.43	0.37
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Table 4. 9 French cross section estimates showing second stage effects of precolonial centralization, ethnicity, and Islam on infrastructure investments in education.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Slavery		Ethnicity		Disease		Islam		Murdock		Institutions	
European population, logged	0.80 *** (0.15)	1.84 *** (0.40)	0.74 *** (0.14)	1.82 *** (0.43)	0.90 *** (0.14)	1.72 *** (0.35)	0.72 *** (0.14)	1.92 *** (0.42)	0.85 *** (0.14)	1.88 *** (0.40)	0.47 * (0.20)	3.57 * (1.74)
African population, logged	-0.09 (0.23)	-0.07 (0.28)	0.16 (0.22)	0.09 (0.28)	-0.34 (0.23)	-0.40 (0.27)	0.09 (0.21)	0.05 (0.28)	-0.07 (0.22)	-0.07 (0.27)	-0.29 (0.23)	0.59 (0.65)
Indigenous slavery, logged	1.53 ** (0.54)	1.15 (0.68)										
Types of Slavery, logged	-0.18 (0.40)	-0.02 (0.49)										
Ethnic count, logged			-0.09 (0.10)	-0.04 (0.13)								
Ethnic fractionalization			-0.78 *** (0.23)	-0.53 (0.30)								
Malaria index					0.85 ** (0.32)	1.09 ** (0.38)						
Tsetse fly factor					0.12 * (0.05)	0.11 (0.06)						
Islam prevalence							-1.34 *** (0.29)	-0.82 * (0.42)				
Centralization									-1.27 *** (0.35)	-1.27 ** (0.44)		
Agriculture											-1.08 *** (0.20)	-0.91 * (0.38)
Health											0.58 (0.38)	-3.56 (2.37)
Precolonial trade indicator											0.83 (0.95)	-0.48 (1.90)
Districts (N)	101	101	101	101	101	101	101	101	101	101	101	101
R ²	0.30	0.28	0.36	0.30	0.39	0.36	0.38	0.31	0.33	0.31	0.46	0.20
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Table 4. 10 British cross section estimates showing second stage effects of precolonial centralization, ethnicity and Islam on infrastructure investments in education

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Slavery		Ethnicity		Disease		Islam		Murdock		Institutions	
European population, logged	1.07 *** (0.11)	1.39 *** (0.25)	0.96 *** (0.11)	1.27 *** (0.23)	1.00 *** (0.11)	1.34 *** (0.24)	0.94 *** (0.11)	1.27 *** (0.24)	1.01 *** (0.11)	1.31 *** (0.23)	0.57 *** (0.12)	1.13 *** (0.29)
African population, logged	0.36 * (0.17)	0.22 (0.20)	0.57 *** (0.17)	0.47 * (0.19)	0.39 * (0.16)	0.27 (0.18)	0.59 *** (0.16)	0.47 * (0.19)	0.49 ** (0.16)	0.39 * (0.18)	0.29 (0.15)	0.28 (0.16)
Indigenous slavery, logged	1.28 ** (0.47)	1.54 ** (0.51)										
Types of Slavery, logged	0.05 (0.22)	0.14 (0.23)										
Ethnic count, logged			-0.03 (0.04)	-0.03 (0.04)								
Ethnic fractionalization			-0.08 (0.10)	-0.04 (0.10)								
Malaria index					0.75 (0.64)	1.00 (0.67)						
Tsetse fly factor					0.42 ** (0.14)	0.41 ** (0.14)						
Islam prevalence							-0.52 (0.26)	-0.39 (0.28)				
Centralization									0.50 * (0.21)	0.57 ** (0.22)		
Agriculture											-0.12 (0.17)	-0.06 (0.18)
Health											0.71 *** (0.14)	0.35 (0.23)
Precolonial trade indicator											2.11 *** (0.62)	2.10 ** (0.66)
Districts (N)	200	200	200	200	200	200	200	200	200	200	200	200
R ²	0.39	0.39	0.36	0.36	0.40	0.39	0.37	0.37	0.38	0.37	0.49	0.45
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Table 4. 11 OLS French panel estimates showing the effects of precolonial centralization, ethnicity, and Islam on teachers while instrumenting the European population with tsetse fly.

	(1)	(2)	(3)	(4)	(5)	(6)
	Hostility	Ethnicity	Murdock	Islam	Slavery	Institution
European population, logged	0.14 *** (0.01)	0.14 *** (0.01)	0.15 *** (0.01)	0.15 *** (0.01)	0.15 *** (0.01)	0.06 *** (0.01)
African population, logged	-0.00 (0.01)	0.02 (0.01)	0.01 (0.01)	0.02 (0.01)	-0.00 (0.01)	0.05 *** (0.01)
Civil Admiration, logged	0.51 *** (0.02)	0.50 *** (0.02)	0.50 *** (0.02)	0.47 *** (0.02)	0.50 *** (0.02)	0.30 *** (0.02)
Hostility toward Europeans, logged	-0.00 (0.01)					
Ethnic fractionalization, logged		-0.34 *** (0.06)				
Precolonial centralization, logged			0.40 *** (0.04)			
Presence of Islam				-0.15 *** (0.02)		
Indigenous slavery					0.36 *** (0.04)	
Military staff, logged						0.05 *** (0.01)
Intensity of Agriculture, logged						0.21 *** (0.04)
Pre-colonial trading post						0.73 *** (0.04)
Health staff, logged						0.38 *** (0.01)
N	3118	3118	3118	3118	3118	3118
R ²	0.37	0.38	0.39	0.39	0.39	0.59
Years FE	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 4. 12 Robust French panel estimates showing the effects of precolonial centralization, ethnicity, and Islam on teachers while instrumenting the European population with malaria (M) and tsetse fly(T), respectively.

	(1)		(2)		(3)		(4)		(5)		(6)	
	Hostility		Ethnicity		Murdock		Islam		Slavery		Institutions	
	IV _M	IV _T	IV _M	IV _T	IV _M	IV _T	IV _M	IV _T	IV _M	IV _T	IV _M	IV _T
European population, logged	0.11 *** (0.02)	0.31 *** (0.04)	0.12 *** (0.02)	0.33 *** (0.04)	0.09 *** (0.02)	0.17 *** (0.02)	0.17 *** (0.02)	0.45 *** (0.05)	0.09 *** (0.02)	0.22 *** (0.03)	0.10 *** (0.02)	0.30 *** (0.04)
African population, logged	-0.01 (0.01)	0.02 (0.02)	0.01 (0.01)	0.04 * (0.02)	-0.00 (0.01)	0.01 (0.01)	0.03 * (0.01)	0.07 *** (0.02)	-0.01 (0.01)	0.01 (0.01)	0.06 *** (0.01)	0.07 *** (0.01)
Civil Admiration, logged	0.53 *** (0.02)	0.36 *** (0.04)	0.51 *** (0.02)	0.34 *** (0.04)	0.55 *** (0.02)	0.48 *** (0.03)	0.45 *** (0.02)	0.21 *** (0.05)	0.54 *** (0.02)	0.44 *** (0.03)	0.28 *** (0.02)	0.18 *** (0.03)
Hostility toward Europeans, logged	0.00 (0.01)	-0.01 (0.01)										
Ethnic fractionalization, logged			-0.35 *** (0.06)	-0.25 *** (0.06)								
Precolonial centralization, logged					0.33 *** (0.05)	0.42 *** (0.05)						
Presence of Islam							-0.15 *** (0.02)	-0.20 *** (0.02)				
Indigenous slavery									0.33 *** (0.04)	0.40 *** (0.04)		
Military staff, logged											0.05 *** (0.01)	0.09 *** (0.01)
Intensity of Agriculture, logged											0.16 *** (0.05)	-0.06 (0.07)
Pre-colonial trading post											0.74 *** (0.04)	0.76 *** (0.05)
Health staff, logged											0.35 *** (0.02)	0.19 *** (0.04)
N	3118	3118	3118	3118	3118	3118	3118	3118	3118	3118	3118	3118
R ²	0.37	0.32	0.38	0.32	0.38	0.39	0.39	0.29	0.38	0.38	0.59	0.47
Years FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

4.5. Colonial schooling diffusion apart from precolonial and colonial factors

The expansion of the colonial administration was restricted due to limited investments, revenue, manpower and precolonial systems (Young 1994). Agglomeration economies in developed countries consider distance in addition to the precolonial and colonial factors to understand development (Rosenthal and Strange 2004). Hence, the diffusion patterns of infrastructure investments in education and colonial educational development from within the French and British colonies may aid in further understanding spatial inequality (Bates 1974) and ‘ethnic distribution of colonial opportunity’ (Horowitz 1985).

Taking into consideration the mentioned, the relevance of colonial development hubs to infrastructure investments in education is examined in order to understand the extent to which the mentioned factor diffused from the colonial development hubs (i.e., coast, British or French school, and precolonial trade). Diffusion is examined from colonial development hubs from the British or French School, precolonial trade post and the coast.

The linear model below is considered:

$$\log(X_{ijt}) = \beta_0 + \beta_{2k} \text{distance}_{ijd} + \beta_3 A_{ijd} + \beta_4 E_{ijd} + \eta_j + \epsilon_{ijd} \quad (4.3)$$

where E_{ijd} is the size of European population, A_{ijd} is the size of the African population, X_{ijt} is a vector that includes education investments, educational development, and the factors from which diffusion pattern will be examined. distance_{ijd} is distance from the various colonial hubs which includes distance from the first British/French precolonial school and coast as well as distance between district capital and the nearest precolonial trade post in district i and colony j on either cross section or panel data d .

Table 4. 13 Cross section estimates showing diffusion of investments in education (I) and expansion of schools (S) for 16 African countries.

	I				S			
	(1)		(2)		(3)		(4)	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
European population, logged	0.73 *** (0.16)	2.01 *** (0.53)	0.62 *** (0.15)	1.80 *** (0.53)	0.43 *** (0.06)	0.68 *** (0.18)	0.36 *** (0.06)	0.51 ** (0.16)
African population, logged	-0.15 (0.23)	0.00 (0.31)	0.17 (0.22)	0.05 (0.28)	0.12 (0.11)	0.12 (0.12)	0.25 * (0.09)	0.22 * (0.10)
Distance from First British/French School, in 100 km	-0.00 * (0.00)	0.00 (0.00)			-0.00 * (0.00)	-0.00 (0.00)		
Distance from the coast, in 100 km			-0.00 *** (0.00)	-0.00 (0.00)			-0.00 *** (0.00)	-0.00 *** (0.00)
District (N)	101	101	101	101	92	92	92	92
R ²	0.29	0.24	0.37	0.28	0.44	0.42	0.57	0.55
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

The OLS cross-section results that are in Table 4.13 are on the cross-colony impact of distance from the coast and first British or French precolonial school on colonial investments in education. In the set of regressions, a subset of key contemporaneous economic variables that exert a large influence on colonial investments and diffusion patterns are used as controls. These variables are European and African populations as these are the main factors that determined the establishments and diffusion of the European and mission administrations (Burgess et al. 2015; Salyers 2009; Johnson 1967; Okoye and Pongou 2014).

The effect of both the distance from the coast and the first British or French precolonial school is negative and significant at 0.1% and 5%, respectively. Therefore, the negative effect of distance shows that infrastructure investments in education decline as the distance from the first British/French precolonial school as well as when the distance from the coast increases. These results show that European settlers, and distance are associated with high investments and educational development since increasing distance either from the coast or from the first British or French precolonial schools significantly reduces investments. When the regressions are estimated for within colony effects, the impacts remain the same for both the French and the British colonies as shown in Tables 4.14 and 4.15, respectively. The French panel estimates in Table 4.16 also further confirm that as the distance from the first British or French trading post or coast increases both the number of teachers and investments in education declines significantly.

Table 4. 14 French cross section estimates showing diffusion of investments in education (I) and expansion of schools (S).

	I				S			
	(1)		(2)		(3)		(4)	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
European population, logged	0.73 *** (0.16)	2.01 *** (0.53)	0.36 *** (0.06)	0.51 ** (0.16)	0.73 *** (0.16)	2.01 *** (0.53)	0.36 *** (0.06)	0.51 ** (0.16)
African population, logged	-0.15 (0.23)	0.00 (0.31)	0.25 * (0.09)	0.22 * (0.10)	-0.15 (0.23)	0.00 (0.31)	0.25 * (0.09)	0.22 * (0.10)
Distance from First British/French School, in 100 km	-0.00 * (0.00)	0.00 (0.00)			-0.00 * (0.00)	0.00 (0.00)		
Distance from the coast, in 100 km			-0.00 *** (0.00)	-0.00 *** (0.00)			-0.00 *** (0.00)	-0.00 *** (0.00)
District (N)	101	101	92	92	101	101	92	92
R ²	0.29	0.24	0.57	0.55	0.29	0.24	0.57	0.55
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Table 4. 15 British cross section estimates showing diffusion of investments in education (I) and expansion of schools (S).

	I				S			
	(1)		(2)		(3)		(4)	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
European population, logged	0.96 *** (0.10)	1.24 *** (0.23)	0.83 *** (0.10)	1.06 *** (0.21)	0.96 *** (0.10)	1.24 *** (0.23)	0.83 *** (0.10)	1.06 *** (0.21)
African population, logged	0.51 ** (0.16)	0.43 * (0.17)	1.29 *** (0.15)	1.23 *** (0.16)	0.51 ** (0.16)	0.43 * (0.17)	1.29 *** (0.15)	1.23 *** (0.16)
Distance from First British/French School, in 100 km	-0.00 *** (0.00)	-0.00 ** (0.00)			-0.00 *** (0.00)	-0.00 ** (0.00)		
Distance from the coast, in 100 km			-0.00 ** (0.00)	-0.00 ** (0.00)			-0.00 ** (0.00)	-0.00 ** (0.00)
District (N)	200	200	185	185	200	200	185	185
R ²	0.40	0.39	0.53	0.52	0.40	0.39	0.53	0.52
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Table 4. 16 French Panel estimates showing diffusion of teachers with tsetse fly (T) and malaria (M) as instruments, respectively.

	OLS	Teachers	
		IV _T	IV _M
European population, logged	0.14 *** (0.01)	0.15 *** (0.02)	0.34 *** (0.03)
African population, logged	0.01 (0.01)	0.01 (0.01)	0.03 (0.02)
Civil administration, logged	0.46 *** (0.02)	0.45 *** (0.02)	0.30 *** (0.03)
Distance from First British/French trading post, in 100 km	-0.02 *** (0.01)	-0.02 *** (0.01)	-0.03 *** (0.01)
Distance from the coast, in 100 km	-0.01 * (0.00)	-0.01 * (0.00)	-0.00 (0.01)
District (N)	3118	3118	3118
R ²	0.38	0.38	0.32
Year FE	Yes	Yes	Yes
District FE	Yes	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

These estimates show that the limited diffusion we observe presently is partly a function of the coastal, first British, or French schools and trade posts. European settlers amongst other channels can be an explanation for the reduction in investments and the number of students that is observed when the distance from either the coast, first British or French school or trade post increases. These findings also concur with Okoye and Pongou (2014) who also demonstrated that distance to Timbuktu and distance to the coasts were also vital in determining educational outcomes. Furthermore, Hall and Jones (1999) have also showed that by taking into account the degree of ethnic fractionalization in Africa, education has been found to influence societies by reducing the probability of conflicts between ethnicities especially in more ethnically diverse societies as well as reducing distance amongst them. The same conclusions for the effect of distance on investments in education also hold for the impact of distance towards the number of teachers as well as students.

To confirm the OLS discussed results, the European population are instrumented with railroads in the cross-sectional estimates, while malaria and tsetse fly in the panels estimate are used as instruments for Europeans. All distance effects are consistent with OLS and significant as well as the causal confidence of Europeans improves significantly in both the investments and student's regressions which then shows that the IV estimates verify the OLS estimates which also serves as a check for robustness.

4.6. Examining the role of colonial schooling, colonialism, and slavery in explaining contemporary development

This section presents results that are focused at explaining the role that colonial education, colonialism and slavery history have played towards the current spatial development imbalance across Africa. Specifically, this section presents findings which show that slavery and colonialism together with their artifacts are in part explanations for the disparities observed in contemporary development.

The linear model below is considered:

$$\log(\text{current}_{ij}) = \beta_0 + \beta_{1k}\text{schooling}_{ij} + \beta_{1k}\text{slavery}_{ij} + \beta_{2k}\text{colonial}_{ij} + \beta_4 E_{ij}^{\text{rail}} + \eta_j + \epsilon_{ij} \quad (4.4)$$

Where schooling_{ij} is colonial investments in education and number of students, E_{ij} is the size of the European population, current_{ij} represents contemporary development as proxied by nightlights, educational attainment, living conditions, and international business or investors aid, slavery_{ij} are the slavery factors (i.e., slavery intensity and types) and colonial_{ijk} are the colonial factors (i.e., ethnic fractionalization, number of ethnic groups, precolonial centralization, disease prevalence and Islam dominancy) in district i and colony j (1905-1956 average).

Table 4. 17 French impact of colonialism and slavery artifacts on current development, proxied by average nightlights (1992-2012, logged).

	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	Schooling		Ethnicity		Slavery		Ethnic count		Kingdom		Disease		Islam	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Schooling Investments, logged	0.01 (0.09)	0.05 (0.13)	-0.04 (0.10)	-0.05 (0.14)	-0.01 (0.10)	-0.03 (0.12)	0.01 (0.10)	-0.02 (0.13)	0.01 (0.10)	-0.01 (0.13)	-0.01 (0.10)	0.00 (0.11)	-0.20 * (0.09)	-0.27 * (0.13)
Students, logged	0.06 (0.21)	0.17 (0.34)	0.22 (0.22)	0.18 (0.35)	0.26 (0.21)	0.20 (0.31)	0.24 (0.21)	0.15 (0.34)	0.24 (0.22)	0.19 (0.31)	0.06 (0.25)	0.21 (0.47)	0.23 (0.18)	0.05 (0.28)
European population, logged	0.41 ***	0.16	0.45 ***	0.52	0.42 ***	0.53	0.42 ***	0.59	0.43 ***	0.51	0.56 ***	0.38	0.49 ***	0.84 *
Distance from First British/French School	(0.11) -0.00 *** (0.00)	(0.56) -0.00 *** (0.00)	(0.12)	(0.55)	(0.12)	(0.43)	(0.12)	(0.51)	(0.12)	(0.44)	(0.13)	(0.48)	(0.10)	(0.41)
Ethnic fractionalization			-0.28 * (0.14)	-0.28 * (0.14)										
Former presence of slavery					-0.73 * (0.34)	-0.68 (0.40)								
Type of slavery					0.10 (0.24)	0.13 (0.27)							0.72 ** (0.23)	0.86 ** (0.29)
Number of ethnic groups							0.43 (0.33)	0.44 (0.34)						
Indicator of a precolonial kingdom									-0.05 (0.26)	-0.06 (0.28)				
Malaria index (colonial)											0.14 (0.48)	-0.10 (0.78)		
Tsetse fly index (colonial)											0.10 ** (0.04)	0.10 ** (0.04)		
Presence of Islam 1913													-1.16 *** (0.19)	-1.23 *** (0.22)
N	92	92	92	92	92	92	92	92	92	92	92	92	92	92
R ²	0.41	0.38	0.34	0.34	0.38	0.37	0.39	0.38	0.39	0.39	0.39	0.38	0.57	0.54
European population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ethnic fractionalization	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Slavery	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Table 4. 18 British impact of colonialism and slavery artifacts on current development, proxied by average nightlights (1992-2012, logged) for British colonies.

	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	Schooling		Ethnicity		Slavery		Ethnic count		Kingdom		Disease		Islam	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV		
Schooling Investments, logged	0.19 *** (0.05)	0.11 (0.07)	0.20 *** (0.05)	0.12 (0.07)	0.20 *** (0.05)	0.10 (0.07)	0.19 *** (0.05)	0.12 (0.07)	0.18 *** (0.05)	0.10 (0.07)	0.20 *** (0.05)	0.12 (0.07)	0.20 *** (0.05)	0.12 (0.07)
Students, logged	0.10 * (0.05)	0.04 (0.06)	0.10 * (0.05)	0.05 (0.06)	0.10 * (0.05)	0.04 (0.06)	0.11 * (0.05)	0.06 (0.06)	0.10 * (0.05)	0.05 (0.06)	0.10 (0.05)	0.03 (0.07)	0.08 (0.05)	0.02 (0.06)
European population, logged	0.31 *** (0.07)	0.70 ** (0.23)	0.29 *** (0.07)	0.67 ** (0.22)	0.29 *** (0.08)	0.72 ** (0.25)	0.27 *** (0.07)	0.65 ** (0.23)	0.29 *** (0.07)	0.66 ** (0.23)	0.31 *** (0.08)	0.71 ** (0.25)	0.30 *** (0.08)	0.69 ** (0.24)
Distance from First British/French School	-0.00 (0.00)	-0.00 * (0.00)												
Ethnic fractionalization			-0.15 * (0.07)	-0.14 * (0.07)										
Former presence of slavery					0.08 (0.28)	0.43 (0.36)								
Type of slavery					-0.02 (0.13)	0.06 (0.14)								
Number of ethnic groups							-0.71 *** (0.15)	-0.66 *** (0.17)	-0.75 *** (0.16)	-0.72 *** (0.17)				
Indicator of a precolonial kingdom									0.53 * (0.25)	0.64 * (0.27)				
Malaria index (colonial)											-0.24 (0.38)	0.09 (0.45)		
Tsetse fly index (colonial)											0.13 (0.08)	0.19 * (0.10)		
Presence of Islam 1913													0.18 (0.15)	0.20 (0.16)
N	185	185	185	185	185	185	185	185	185	185	185	185	185	185
R ²	0.49	0.44	0.50	0.45	0.50	0.44	0.55	0.50	0.56	0.52	0.49	0.44	0.51	0.46
European population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ethnic fractionalization	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Slavery	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Table 4. 19 Cross empire impact of colonialism and slavery artifacts on current development, proxied by average nightlights (1992-2012, logged).

	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	Schooling		Ethnicity		Slavery		Ethnic count		Kingdom		Disease		Islam	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV		
Schooling Investments, logged	0.11 *	0.07	0.12 **	0.08	0.12 **	0.07	0.11 **	0.07	0.11 **	0.06	0.12 **	0.10 *	0.10 *	0.05
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.06)	(0.04)	(0.05)	(0.04)	(0.06)	(0.04)	(0.05)	(0.04)	(0.05)
Students, logged	0.10 *	0.08	0.11 **	0.09	0.12 **	0.08	0.12 **	0.10 *	0.12 **	0.09	0.11 *	0.09	0.13 **	0.09
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
European population, logged	0.42 ***	0.62 ***	0.39 ***	0.60 ***	0.38 ***	0.64 ***	0.38 ***	0.59 ***	0.38 ***	0.63 ***	0.40 ***	0.56 ***	0.35 ***	0.64 ***
	(0.05)	(0.14)	(0.05)	(0.14)	(0.06)	(0.17)	(0.06)	(0.14)	(0.06)	(0.16)	(0.05)	(0.14)	(0.06)	(0.17)
Distance from First British/French School, in 100 km	-0.00 **	-0.00 ***												
	(0.00)	(0.00)												
Ethnic fractionalization			-0.17 **	-0.16 *										
			(0.06)	(0.06)										
Former presence of slavery					-0.10	-0.01								
					(0.21)	(0.22)								
Type of slavery					-0.03	0.12								
					(0.10)	(0.14)								
Number of ethnic groups							-0.46 **	-0.44 **						
							(0.14)	(0.15)						
Indicator of a kingdom									0.17	0.24				
									(0.18)	(0.19)				
Malaria index (colonial)														
Tsetse fly index (colonial)											0.11 ***	0.10 **		
											(0.03)	(0.03)		
Presence of Islam 1913													-0.28 **	-0.19
													(0.11)	(0.12)
N	277	277	277	277	277	277	277	277	277	277	277	277	277	277
R ²	0.45	0.43	0.45	0.43	0.45	0.42	0.47	0.45	0.47	0.45	0.46	0.45	0.46	0.44
European population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ethnic fractionalization	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Slavery	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Tables 4.17 (French), 4.18 (British) and 4.19 (cross colony) present both baseline and robust results when infrastructure investments towards education and schooling students are used as the main mechanism. In the set of regressions, the effect of the main mechanisms in consideration towards economic development are controlled using a subset of key colonial and slavery variables that had a large influence on colonial schooling and investments. These variables are the European population, ethnic fractionalization, slavery, precolonial centralization, disease prevalence and Islam dominance.

Model's 1 in the estimates in the mentioned Tables represents results for the impact that precolonial schooling infrastructure and investments have on the current development. It can be observed that an increase in both investments and number of students influences economic development (i.e., as proxied by nightlights) positively at 0.1% and 5% level, respectively, with a predictive power of 31% for the British colonies with similar cross empire results, while estimates for French colonies are not significant. Specifically, increasing infrastructure investments and number of students by 0.1 and 5 points increases economic development by 21, and 10 points, respectively.

Thus, in model's 2, the effect of ethnic fractionalization on economic development is examined. In model's 3, the impact of slavery is determined. Model's 4 assesses the role of precolonial centralization as proxied by the precolonial jurisdictional hierarchy beyond the local community level where 0 indicates societies "lacking any form of centralized political organization, 1 is an indication of small chiefdoms, 2 is an indication of large chiefdoms, 3 and 4 are indicates ethnic groups that were part of large states.

In model's 5, disease prevalence control is applied in order to account for the impact that colonial ecology has had on post-colonial development since high malaria prevalence coupled with the absence of transportation networks hindered both the colonial administration from expanding beyond the coast as well as missions from setting up mission stations and schools inland up till quinine was introduced during the 1850s (Mantovanelli, 2013 a, b; Jedwab, Meier zu Selhausen, and Moradi 2018).

Finally, given that Islam dominance had negative and significantly influenced colonial education development and investments which consequently affected colonial development, in model 6, the effect of Islam dominance is considered in order to assess the impact that the colonial history of

Islam has had in current development mostly in countries such as Nigeria where the control that Islamic Sokoto caliphate and Borno Emirate hindered investments and setups of educational institutions from spreading from the south to the north (Okoye & Pongou 2014).

The impact of colonial schooling remains positive and significant at 0.1% level for British colonies and across empires even when the cumulative causal estimates (i.e., from model's 2-6) are considered which are as a result of the mentioned controls. This with the European population as the development mechanism confirms the effects of increased investments in education and number of students from the colonial period currently still explains economic development mostly in the British colonies. This compliments the findings by Asngar, Nkoa and Zambo (2022) in which they showed that European settler sedentarisation rate had a positive impact on financial markets. Also, these results inversely confirm the theory developed by Acemoglu et al. (2001) that settler mortality has a negative impact on the economic progress of settlements. Also, estimates show that the current development, mostly in French colonies is still highly dependent on the distance from the first precolonial schools that were established by colonists. Hence, showing that distance together with European settlers is still sufficiently associated with post-colonial development.

Indeed, estimates suggest that the influence of colonial education policies in the former colonies still persist even after leaving the colonial yoke which is linked to colonial types and rule. This is because education policies in British institutions accommodated ethnic diversity across societies, yet French institutions did not accommodate the characteristics of the different societies in their education policies (see Brown (2000) for a detailed comparative study on the education policies between British and French institutions). This is also supported by the inverse effects of colonial schooling investments that are seen when the main variables of interest (i.e., colonial schooling and investments) are controlled for Islam dominance for both French and British colonies with the latter being positive. For instance, in the British colonial institutions, the English language was introduced at a later stage and people were taught in their local dialects, while the French mandated that the French language be taught from elementary school. Consequently, the effect of colonial language policies towards contemporary education is further tested by coding the colonial language policy as dummy variables taking the value of 1 for African colonies that were either under the British or French empire, and 0 otherwise. The effect of an indication of the French

education policy in the first state regression in Table 4.22 is negative and significant at the 1 % level. Thus, a 1-point adoption of the French colonial language results in a 47-point decrease in educational attainment. Moreover, the second stage regression that includes both the French colonial language indication as well as an interaction between educational attainment and the French colonial language is estimated, the effects are insignificant towards all three contemporary development measures. It can be seen that any indication of the French education policy leads to a reduction in educational attainment. However, the observed negative impact does not directly or indirectly interfere with economic development through educational attainment. Hence, these results indicate that the French colonial language policy has posed a huge educational development set back in regions that were colonized by the French empire, whereas the opposite is observed when the impact of the British colonial language policy is assessed as supported by estimates in Tables 4.22 and A.1.9, respectively. The effect of the British colonial language is positive and significant at the 1% level. Therefore, a 1-point implementation of the British colonial language policy which accommodated local dialects in their education policies results in a 47-point increase in educational attainment. These observations further show that the effects of ethnic-based colonial education language that was implemented by the British in collaboration with missions as more developmental than the French colonial language policy in which the French mandated the use of the French language without accommodating social ethnic structures. However, there is no evidence of any direct or indirect impact of colonial language towards economic development through educational development except through other channels as broadly discussed. As a result, these results add to findings of Benavot and Riddle (1988) and other scholars who found great variations in contemporary education outcomes in these two kinds of colonial rule (Bolt & Bezemer, 2009; Brown, 2000; Garnier & Schafer, 2006; Grier, 1999; White, 1996).

Table 4. 20: First and Second Stage effects of Precolonial schooling on Contemporary development.

	First Stage	Second Stage		
	Educational Attainment	Night light	International business/investors	Present living conditions
European population, logged	0.03 (0.03)	0.26 ** (0.09)	(0.02) (0.04)	0.04 * (0.01)
Education investments, logged	0.03 (0.03)	0.10 (0.07)	(0.01) (0.03)	(0.01) (0.01)
Students, logged	(0.01) (0.02)	0.15 * (0.06)	(0.02) (0.03)	0.03 ** (0.01)
Distance to Catholic mission	0.04 (0.06)	(0.03) (0.16)	0.05 (0.08)	0.02 (0.03)
Distance to Protestant mission	-0.08 * (0.04)	0.47 (0.31)	0.12 (0.15)	0.08 (0.05)
First British/French Precolonial Schools	1.22 *** (0.35)	2.91 (2.93)	0.25 (1.45)	0.14 (0.49)
First Precolonial Schools	-1.07 * (0.42)	(18.98) (13.00)	12.76 * (6.43)	0.57 (2.15)
Distance from first British/French precolonial school, in 100km	0.00 * 0.00	0.00 0.00	0.00 0.00	0.00 0.00
Educational attainment		3.52 ** (1.30)	(0.11) (0.64)	0.34 (0.21)
Education*First British/French Precolonial Schools		(1.40) (1.13)	0.03 (0.56)	(0.11) (0.19)
Education*First Precolonial Schools		13.90 (9.55)	-10.26 * (4.72)	(0.41) (1.58)
Education *Distance to protestant missions		-0.57 * (0.24)	(0.06) (0.12)	(0.05) (0.04)
Nobs	119	119	119	119
r-squared	0.24	0.61	0.29	0.31
Slavery	Yes	Yes	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

With respect to colonial and precolonial schooling in Table 4.20, results show that, a 5% increase in the distance to protestant missions as well as any indication of a precolonial school decreases educational attainment on average by 8 and 107 points, respectively. However, an indication of a precolonial school that was specifically established by colonist is positive and significant at the 0.1% level, which shows that a 1-point establishment of a precolonial school by colonist leads to a 122-point increase in educational attainment. These results show favorable effects from the presence of and distance to the initial precolonial schools that were established by colonist towards educational attainment, while any increase in the distance to protestant missions including an indication of the first precolonial schools leads to an educational disruption.

Furthermore, an interaction between educational attainment with protestant missions, precolonial schools that were either setup by colonists or not is included in the second stage economic development regression as significant nexus has been established. The second stage effect of an interaction term between educational attainment with precolonial schools and distance to protestant missions towards industrialization and international business or investors aid, respectively, is negative and significant at the 5% level. Thus, a 5-point negative influence that either precolonial schooling or distance to protestant missions has had on educational attainment, indirectly results in a 1026- and 57-point decline in urbanization and international businesses or investors assistance. However, the effects of an interaction term between educational attainment and first precolonial schools that were set up by colonists is insignificant. Interestingly, as observed, the interaction between educational attainment with precolonial schools and distance to protestant missions produces unfavorable significant results toward international businesses or investors aid and urbanization, respectively. This demonstrates that the negative interference that is observed presently towards economic development can be partly attributed to the effects that protestant missions and precolonial schools have had on contemporary education, while the influence of precolonial schools that were established by colonists on educational attainment is partly responsible for the stability. Thus, indicating that there has been an indirect protestant mission disruption towards urbanization through their impact on educational enrollment, whereas the reluctance from international businesses or investors to help African colonies is partly due to the negative effect that precolonial education has had on educational attainment.

Other notable results are the growth in the European population and increase in the number of colonial students which increases both urbanization and human development levels, while the presence of a non-colonist precolonial schools increases aid from international businesses or investors. However, when a control on coastal colonies is applied on the results, the discussed indirect precolonial and protestant disruptions towards contemporary development become insignificant apart from the increased predictive power that is observed on all other variables as they remain significant as supported by the estimates that are in Table 4.21.

Table 4. 21: First and Second Stage effects of Precolonial schooling on Contemporary development on Coastal Colonies.

	First Stage	Second Stage		
	Educational Attainment	Night light	International business/investors	Present living conditions
European population, logged	0.03 (0.04)	0.31 * (0.12)	-0.10 * (0.05)	0.05 * (0.02)
Education investment, logged	0.02 (0.03)	0.02 (0.09)	0.01 (0.04)	(0.01) 0.004 **
Students, logged	0.02 (0.03)	0.19 * (0.08)	(0.06) (0.03)	0.04 * (0.01)
Distance to Catholic mission	0.04 (0.06)	0.01 (0.21)	(0.05) (0.09)	0.02 (0.03)
Distance to Protestant mission	(0.06) (0.05)	1.04 * (0.49)	0.06 (0.21)	0.11 (0.08)
First British/French Precolonial Schools	1.23 *** (0.36)	1.52 (3.32)	0.19 (1.41)	(0.03) (0.53)
First Precolonial Schools	-1.17 * (0.46)	(14.88) (15.97)	7.51 (6.79)	1.67 (2.53)
Distance from first British/French precolonial school, in 100km	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
Educational attainment		5.53 ** (1.90)	(0.02) (0.81)	0.42 (0.30)
Education*First British/French Precolonial Schools		(0.97) (1.29)	0.01 (0.55)	(0.04) (0.20)
Education*First Precolonial Schools		11.34 (11.61)	(6.54) (4.93)	(1.25) (1.84)
Education *Distance to protestant missions		-1.01 * (0.39)	(0.05) (0.17)	(0.07) (0.06)
Nobs	88	88	88	88
r-squared	0.28	0.6	0.36	0.38

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Moving over to the other variables, it can be observed that ethnic fractionalization, which captures the after effect of the scramble for Africa as well as slavery (Nunn, 2008; Green 2013; Whatley and Gillezeau 2009, 2011), is negative and significant by 5 points for both empires when regressed together but by 1 point independently. These estimates show that contemporary development levels of countries that were severely affected by the scramble with or without slavery and ended with high levels of ethnic fractionalization are less developed today on average by 28, 15 and 17 points than those countries that were less impacted in the French, British and across empires, respectively. This can be attributed to the fact that ethnic fractionalization contributed largely to the ethnolinguistic composition of many African countries and was a major negative causative factor in igniting and perpetuating conflicts. This then significantly disadvantaged post-colonial development due to increased number of civil wars (Alesina, Hohmann, Michalopoulos, & Papaioannou 2019) that was caused by ethnic discrimination which resulted from ethnic differences that immensely encouraged ethnic discrimination and favoritism by polluting the political arena. Additionally, as the scramble came with a lot of disruption which times was accompanied by violence and death of key African leaders. Violence resulted in population decline which may have influenced the development trajectory. Another interesting angle to look at is the negative post-colonial influence of colonizers. For example, in many African countries, post-independence also came with political instability involving coups and assassinations of popular African leaders. Therefore, a test is performed by including two dummy variables taking the value of 1 for countries where history has recorded excessive colonial and post-independence violence and 0 elsewhere. According to the record by the World Council of Churches (2024), excessive colonial massacres during the colonial era took place in Bennin, Kenya, Malawi, Nigeria, Senegal, Tanzania and Zimbabwe within French and British Africa. On the other hand, political instability involving coups and assassinations of popular African leaders have been mostly observed in Sierra Leon, Cote d'Ivoire, Senegal, Mali, Niger, Mauritania, Nigeria and Equatorial Guinea within French and British Africa (Annan, 2014). Thus, the impact of the presence of colonial violence in Table 4.22 is negative and significant towards night lights and the present living conditions at the 0.1% and 5% level, respectively. Therefore, implying that a 0.1- and 5-point increase in the number of colonial violence reduces urbanization and human development levels by 134 and 12 points, respectively. This then means that the effect of colonial violence has mostly negatively interfered with urbanization levels as well as the present living conditions, whereas post-colonial

violence do not cause any form of disruption towards contemporary development in the current regression. This shows that the disruptions that have been observed during the post-colonial period towards urbanization and human development have been partly linked to colonial violence which must have been triggered by ethnic fractionalization, slavery, the Scramble as well as other colonial and precolonial factors (Rodney, 1972) that seem to have introduced ethnic conflicts and tribal divisions (Sachs and Warner 1997).

Table 4. 22: First and second stage effects of Islam dominancy, colonial language policy, post-independence violence and neo-colonialism on contemporary development for French Africa.

	First Stage	Second Stage		
	Educational Attainment	Night light	International business/investors	Present living conditions
European population, logged	0.01 (0.03)	0.36 *** (0.08)	(0.04) (0.04)	0.05 ** (0.01)
Education investment, logged	0.00 (0.02)	(0.01) (0.06)	0.01 (0.04)	-0.03 ** (0.01)
Students, logged	0.00 (0.02)	0.23 *** (0.05)	(0.03) (0.03)	0.03 ** (0.01)
Presence of Islam	-0.14 * (0.07)	0.49 (0.60)	0.39 (0.33)	0.04 (0.11)
Ethic fractionalization	(0.04) (0.03)	(0.05) (0.08)	0.09 * (0.04)	0.00 (0.01)
Former presence of slavery	(0.03) (0.12)	-0.79 ** (0.30)	0.22 (0.16)	0.05 (0.05)
Type of slavery	(0.01) (0.06)	(0.13) (0.15)	-0.17 * (0.08)	0.03 (0.03)
French colonial language policy	-0.47 ** (0.16)	1.54 (1.06)	(0.02) (0.59)	0.14 (0.20)
Colonial violence	0.03 (0.11)	-1.34 *** (0.28)	0.10 (0.15)	-1.12 * (0.05)
Post – independence violence	0.37 * (0.16)	2.03 *** (0.42)	(0.28) (0.23)	0.27 *** (0.08)
Educational attainment		0.48 (1.09)	0.31 (0.60)	0.20 (0.20)
Education attainment*Islam		(0.22) (0.50)	(0.29) (0.28)	(0.06) (0.09)
Education attainment*British language		(0.05) (0.93)	(0.46) (0.51)	(0.12) (0.17)
Nobs	119	119	119	119
r-squared	0.37	0.71	0.33	0.37

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001;

** p < 0.01; * p < 0.05.

The precolonial data by Cage and Rueda (2016) for the period 1792 till 1901 combined with colonial data by Ricart-Huguet's (2021) further allows for change of Africa's development trajectory to be tested against the scramble for Africa, colonial, slave trade period as well as the period before the scramble. Hence, this test is performed by coding the colonial period, slavery, scramble for Africa, and the period prior to the scramble as a dummy variable taking the value of 1 for the period that African countries experienced each of the mentioned historical legacies, respectively, and 0 otherwise. It can be seen in Table A.1.10 that with the variables that successfully mapped, cross colony estimates do not strongly discriminate across the different eras for an obvious ruling to be made. The effect of population density on urbanization before and during the scramble as well as during the slave trade and colonial period is positive and significant at the 0.1% level. Furthermore, a 0.1-point increase in population density results in a 89, 23, 1019, and 30 point increase in urbanization levels across the mentioned legacies, respectively. The influence of the distance to precolonial schools is positive and significant but only during the slave trade period at the 1% level, further showing that a 1-point increase of the distance to a precolonial school inevitably leads to an increase in industrialization levels. Moreover, the effect of slavery is significant and inverse before and during the scramble at the 1% and 0.1% level, respectively. Thus, indicating that a 1-point increase in the intensity of slavery reduced urbanization by 89 points, whereas during the scramble urbanization increases by 11 points when slavery rates increase by 0.1 point. Ecology effects as proxied by malaria are negative and significant before the scramble and during the colonial period at the 0.1% and 5% level, respectively. Furthermore, in the mentioned legacies industrialization levels drop by 12 and 84 points when malaria prevalence increases by 0.1 and 5 points, respectively.

However, any growth in the population increases development in all eras, while an increase in slavery intensity produces inverse outcomes during and before the scramble with the latter being negative. Also, during the slave trade period any increase on the distance from either precolonial school or coast inversely influences development with the latter being negative. Moreover, ecology effects as proxied by malaria prevalence is significant and negative during the colonial period and before the scramble, showing that any increase in malaria prevalence reduces development at 0.1% and 5% level before and after the scramble, respectively.

In the French Africa results, slavery effects are insignificant while colonial population and ecological effects in Table A.1.11 are similar to the discussed overall results. However, any increase in the distance from a precolonial school drops development levels during the scramble and slave trade periods, while during the scramble increasing the distance from the coast does not lead to a decline in development. As for British Africa estimates in Table A.1.12, population effects are consistent with the overall outcomes as well as with those of French Africa, however all other effects are completely different mostly when compared to French Africa. Increasing the distance from either the coast or railroad for the slave trade period reduces development at the 0.1% and 5% level, respectively, with increase in malaria prevalence also having the same effect before the scramble. Slavery intensity effects produce inverse effects before and during the scramble with the latter being positive even though during the slave trade period the effects are consistent with those before the scramble.

A notable result from the discussed estimates is the negative effects of malaria prevalence that seems to have re-emerged after the scramble as they were before the scramble with the even impact further increasing by 201 and 72 points in the overall and French Africa results, respectively. This re-emergence of the disruption development of malaria could imply that the colonial era and the scramble interrupted precolonial medical institutions. Also, the fact that the effects of population density are the highest for the colonial period could mean that prior to this period precolonial remuneration was low possibly due to high slavery exports, of which might have been cabbed by the eventual abolition of slavery (Heldring and Robinson 2012).

Slavery intensity in model 3 is also negatively associated with night lights but only and significantly for French colonies, which means that regions that were severely impacted by slave trade and were already fractionalized are contemporarily the most underdeveloped on average by 73 points than those countries that were fractionalized but less impacted by slavery. Moreover, a crumble in the governance systems and lack of any form of jurisdiction resulted in a dysfunctional society lacking even taxation systems (Rodney 1972) as the impact of slave trade on these ethnic groups thus making them highly fractionalized (Nunn 2008). For example, Whatley and Gillezeau (2011) showed a significant positive relationship between the number of ethnic groups and slave traders with cross country results from Green (2013) demonstrating a significant positive association between ethnic diversity and slavery. More specifically, slave trade hindered state

development by disrupting the construction of schools as well as transportation networks, therefore negatively affecting social and political structures which ended up inciting civil wars (Nunn 2008). Regions in Africa also that have higher rates of ethnic fractionalization today also suffered from higher levels of slave trading which in turn left these regions with numerous ethnic groups which became a hinderance towards their post-colonial economic progress as supported by the inverse relationship between number of ethnic groups and contemporary development across empire and within British estimates.

Also, the effect of slavery intensity and types of slavery in Table 4.22 is negative and significant at the 1% and 5% level, respectively. Moreover, a 79-point drop is observed in urbanization levels when slavery intensity levels increase by 1 point, while aid from international businesses or investors declines by 17 points due to a 5-point increase in the types of slavery. This further shows that high slavery rates negatively interfere with both urbanization and aid from international businesses or investors. Hence, showing that the post-colonial effects of increased slavery intensity and types of slavery has been partly responsible for contemporary economic underdevelopment.

Kingdom in model's 4 is a proxy for precolonial centralization which indicates regions that had a kingdom at the end of the nineteenth to account for regions that were centralized while the rest are treated as fragmented. Post-colonial development within and across empires estimates are only significant for the British colonies and positive at 5% level, showing that regions that were precolonially centralized within the British colonies are contemporary more developed than those that were fragmented. These results contradict from a development angle the literacy findings by Walters, Chisadza and Clance (2020) who showed that the effect of British rule on contemporary literacy depends on the pre-colonial centralisation of the ethnic region. They further showed that in fragmented ethnic regions, British rule is associated with favourable effects on literacy. In centralised ethnic regions, their positive effects are mitigated as opposed to estimates in Table 4. 19 which shows that regions that were more pre-colonially centralized are associated with favorable effects on development.

On a related note, as centralized African administrations were disrupted by either slavery, violence or colonialism (Rodney 1981, 1972; Austin 2010), it would be beneficial to establish the trajectory post-colonialism and then address the effect of the colonial disruption. Hence, to perform this test, precolonial development is proxied by precolonial centralization, trade and schools, and

consequently the effects of slavery, colonial education and colonialism towards these measures are determined as supported by the estimates in Table 4.23

Table 4. 23: Effects of Colonial Education, Ethnic Fractionalization, Slavery, Neo-colonialism, Islam and Missions on Precolonial Centralization, Trade and Schools.

	Precolonial Centralization			Precolonial Trade			Precolonial Schools		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
European population, logged	(0.06)			(0.01)			(0.01)		
	(0.05)			(0.02)			(0.01)		
Students, logged	-0.11 *		-0.13 **	0.00		(0.01)	0.00		0.00
	(0.04)		(0.04)	(0.01)		(0.01)	(0.01)		(0.01)
Education investments, logged	0.10 *		0.07	0.06 ***		0.04 ***	0.01		0.00
	(0.04)		(0.04)	(0.01)		(0.01)	(0.01)		(0.01)
French Education policy	(0.31)			0.01			(0.04)		
	(0.24)			(0.08)			(0.05)		
Ethnic Fractionalization		(0.04)			-0.05***			-0.04***	
		(0.04)			(0.01)			(0.01)	
Former presence of slavery		(0.02)			(0.01)			(0.01)	
		(0.18)			(0.6)			(0.05)	
Type of slavery		0.15			0.06			0.01	
		(0.09)			(0.03)			(0.02)	
Colonial violence		-0.43 **			0.00			(0.01)	
		(0.14)			(0.05)			(0.04)	
Presence of Islam 1913		-0.24 **			0.03			0.02	
		(0.09)			(0.03)			(0.02)	
Distance to a catholic mission			(0.09)			(0.01)			(0.02)
			(0.09)			(0.03)			(0.02)
Distance to a protestant mission			(0.01)			-0.08***			(0.02)
			(0.06)			(0.02)			(0.01)
Nobs	119	128	119	119	128	119	119	128	119
r-squared	0.29	0.25	0.24	0.33	0.17	0.34	0.06	0.12	0.09

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Therefore, it can be observed that the impact of the number of colonial students, colonial violence as well as Islam centralization is negative and significant at the 5% level, which shows a 5-point increase in either the number of colonial students, colonial violence including spread in Islam centralization reduces precolonial centralization by 13, 43 and 24 points, respectively. However, the effect of educational investments is positive and significant at the 5% level, further showing that a 5-point increase in colonial educational investments increases the degree of precolonial centralization by 10 points. Thus, showing that colonial education, colonial violence and Islam centralization disrupted the further centralization of more ethnic groups, while the effects of colonial educational investments advanced centralization of precolonial ethnic groups.

Moreover, the response of precolonial trade on colonial education investment effects is also positive and significant at the 0.1% level, while the opposite impact is caused by both ethnic fractionalization as well as distance to protestant missions at the same level of significance. Therefore, a 0.1-point increase in educational investments leads to a 6-point expansion of precolonial trade, however, a 5- and 8-point decline is observed when ethnic fractionalization levels as well as the distance to a protestant mission increases by a 0.1 point. These results indicate a disruption of precolonial trade that is caused by any increase in either the distance to protestant missions or ethnic fractionalization levels, whereas colonial educational investment effects are directly proportional to precolonial trade as well as favorable. Ethnic fractionalization effects are also negative and significant towards precolonial schools at the 0.1% level, which further shows that a 0.1-point increase in ethnic fractionalization levels results in a reduction of the spread of precolonial schooling by 4 points. Thus, showing a disruption of precolonial schooling which can partly be attributed to increased ethnic fractionalization levels that was mainly caused by the Scramble effect, high slavery including more diverse ethnic groups (Nunn, 2008). Further implying that colonial education, ethnic fractionalization, scramble for Africa, colonial violence and protestant missions in part contributed towards the disruption of all precolonial development levels.

Model's 6 shows the influence of colonial ecology variables (i.e., malaria and tsetse fly). Malaria index is insignificant, while tsetse fly prevalence is significant and positive. The positive effects of tsetse fly towards night lights could possibly imply that disease prevalence is no longer a major development hindrance now due to the fact that current policies are government dependent as

compared to during colonial times when colonist were the main policy administrators and they mostly favored regions that were less disease prevalent, as tsetse fly was a setback in the 1950's (Lowes and Montero; 2018), while malaria became less detrimental after 1850s following the introduction of quinine which allowed missions to move further inland (Jedwab, Meier zu Selhausen, and Moradi 2018).

Regarding Islam dominancy which is proxied by the level of Islam presence in 1913, estimates are significant and negative at 0.1% and 1% level for French colonies and across empires, respectively. Thus, a 0.1- and 1-point increase in the presence of Islam results in 116 and 28 points decrease in contemporary development levels in French colonies and across all colonies, respectively. Hence, findings show there is still a post-colonial aftereffect of the colonial disassociation (Okoye & Pongou 2014) that was between the British administration (i.e., colonist and mission) and Islam rule, suggesting that the low levels of development observed in regions that were predominantly Islam during the colonial era are still behind possibly due to the low levels of colonial investments and few institution setups that they received. That implies that the mentioned colonial disassociation is still relevant in explaining development even today. Additionally, by further including types of slavery on the Islam regression, it can also be observed that in regions where there was Islam dominancy the highest types of slavery that were practiced are significant at 1% level and positively associated with contemporary development only within the French colonies.

The influence of the presence of Islam is negative and significant at the 5% level, also showing that a 1 point spread in Islam centralization results in a 14-point decline in educational attainment as supported by the estimates in Table 4.22. This indicates that the effects of colonial Islam centralization towards educational attainments have been negative even though the observed disruption does not indirectly interfere with economic development through education because when an interaction term between Islam and educational attainment is included in the development regression, results are insignificant. Hence, results show that the effects of Islam centralization partly explain the current educational underdevelopment. However, these adverse effects have not negatively influenced economic development through education in any way as these effects are independent as it can be seen in Table A.1.9.

In essence, all of the discussed findings show that post-independence development has been largely impacted by intergenerational mobility especially towards colonial investments in

education and educational development. Ecological features (Cervellati, Chiovelli, & Esposito 2019), geographic heterogeneity (Michalopoulos, 2012) and deep evolutionary traits (Ashraf & Galor, 2013) somewhat dictated the strength of the colonial administrations that were formed and the extent to which colonial investments in education were made.

Moreover, other unexplained second stage estimates in Table 4.22 are as follows: the impact that an increase in colonial educational investment and ethnic fractionalization towards living conditions and international investors is negative and positive, respectively.

4.7. Concluding Remarks

The history of the development of educational institutions together with investments that were made toward education is an important factor which explains the development variations that we observe presently. Therefore, this study is focused on explaining the sizeable difference in infrastructure investments in education and development of educational institutions in relation to precolonial and colonial factors in French and British colonies as well as across colonies. The district level panel data by Huillery (2009) including the cross-sectional data by Ricart-Huguet (2021) together with precolonial panel data by Cagé and Rueda (2016) increases comparability by accounting for colony-level factors, while instrumenting the European population with railroads and disease prevalence increases confidence in the causality of the results in both the investment and development in education regressions. These findings are a contribution in the studies that have and are still being conducted to explain contemporary development from a colonial and precolonial perspective which have mostly focused on the effects of colonial and precolonial patterns.

Contemporary findings in general show that intergenerational mobility in post-independence development has had significant differences with regards to colonial educational development and investments, development of education and precolonial schooling which is motivated by deep evolutionary traits (Ashraf & Galor, 2013), geographic heterogeneity (Michalopoulos, 2012) and ecological features (Cervellati, Chiovelli, & Esposito 2019).

Prior to that, hostility events that the Europeans encountered played a role in discouraging European settlement, state formation and public investments (McAlexander & Ricart-Huguet, 2022) which were the determinants of educational setups and development that partly explain the

uneven colonial and post-colonial development. However, hostility does not directly explain colonial education because its effects are insignificant in all regressions which could imply that these hostile events and resistance were mostly directed at discouraging state formation and consequently colonial policies of which education was a part. Therefore, this implies that hostility impeded development of education through its negative impact on the European population, as its negative effects indirectly discouraged missions who depended on the colonial administration to setup schools in communities as they were the main drivers of educational development mostly in the case of the British and the French colonies as supported by the illustrated inverse relationship between hostility with either the colonial administration or the number of teachers.

On that note, the impact of precolonial schooling is mostly in favor of the British colonies and the reason may be closely linked to the type of colonial rule, the education policies and systems that were more open and accommodated precolonial social and cultural systems. As estimates show that an indication of the French colonial language is associated with educational attainment disruption, while the effects of the British colonial language policy are favorable. However, there is no evidence of a colonial language policy's direct disruption of economic development or indirectly through educational attainment. Thus, showing that the French introduced education policies that were closed which limited investments and also restricted educational development further promoting the incoherence between the French and precolonial administration as well as impeding non-French precolonial schools from receiving investments and being further developed. Estimates also show that colonial education was highly dependent on the distance from either the coast or first precolonial school that were established by either the British or French or trading posts, showing that distance together with European settlers are associated with high educational investments and development.

Moreover, findings also show that regions that had strong precolonial centralization did indeed receive public investments but due to high chieftain resistance (McAlexander & Ricart-Huguet, 2022) and other impeding factors, the European administration functionality was disadvantaged and consequently colonial schooling as there were intense indigenous bureaucratic systems that were dependent on segmentary lineage practices which made all education and economic activities to be centered around the ruling family (Lowes and Montero, 2018; Moscona, Nunn and Robinson 2017a, b), and this is mostly true for French colonies. Relatedly, a precolonial schooling disruption

is also observed which is linked to increased ethnic fractionalization levels mainly attributed to the Scramble effect and high slavery including high ethnic diversity (Nunn, 2008). This is further verified by the estimates which show that the effects of increased slavery intensity and types of slavery results in low urbanization and human development levels.

Also, an indirect protestant mission disruption towards urbanization through their impact on educational enrollment is detected, whereas the reluctance from international businesses or investors to help African colonies is partly due to the negative effect that precolonial education has had on educational attainment. Results also shows a contemporary urbanization and human development disruption that is caused by colonial violence is still related to high ethnic fractionalization, slavery including the Scramble effect as well as other colonial and precolonial factors (Rodney, 1972) that seem to have introduced ethnic conflicts and tribal divisions (Sachs and Warner 1997). Thus, demonstrating that colonial education, ethnic fractionalization, scramble for Africa, colonial violence and protestant missions in part contributed towards the disruption of precolonial development. However, a coastal control on the results leads to insignificant indirect effects of precolonial and protestant missions disruptions towards contemporary development, apart from the increased predictive power that is observed on all other variables as they remain significant. That would be an indication that these interferences were less in colonies that were located at the coast.

Also, a test of the impact of the period before, during and after the scramble reveals a re-emergence of the malaria prevalence disruption towards development, which indicates that the colonial era and the Scramble for Africa interrupted precolonial medical institutions. Additionally, the effects of population density that are highest for the colonial period could mean that prior to this period colonial remuneration was low possibly due to high slavery exports, of which was cabbed by the eventual abolition of slavery (Heldring and Robinson 2012).

Estimates also show that regions that were predominantly Islam were more disassociated with the French colonial administration than British colonies with the reason being that both Islam and the French administration had a territorial objective which was coupled with a closed-door policy, while the British mostly had an economic interest with policies that accommodated precolonial social and cultural structures. This is also justified by the effects of colonial Islam centralization which partly explain current educational underdevelopment. However, these adverse effects do

not negatively influence economic development through education in any way as these effects are independent.

Other than that, a disassociation is also observed between colonial schooling and other institutions which is mostly true for the French colonies and most significant from the agriculture effects. Thus, implying that education policies that were implemented by the French disadvantaged other institutions and made them less dependent on colonial education, while the British education policies encourage a positive association between colonial schooling and other institutions.

Lastly, findings also show that colonial education was also greatly disadvantaged due to ethnic fractionalization which is good way to also account for the after effect of both the scramble for Africa and slave trade because the effect of the latter intensified the rate at which ethnic groups were being fractionalized (Nunn, 2008). However, ethnicity effects seem to have been colonial specific with increased levels of ethnic fractionalization disrupting both investments and educational development mostly in French colonies, while any increase in the number of ethnic groups was disadvantageous mostly in the British colonies as also demonstrated by their relationship.

Chapter Five: Does Africa's Colonial and Slavery History Explain the Contemporary Relationship between Economic Development and Educational Development?

5.1. Introduction

The previous chapter has established that intergenerational mobility in post-independence development has had significant differences with regards to colonial educational development and investments, development of education and precolonial schooling which is motivated by deep evolutionary traits (Ashraf & Galor, 2013), geographic heterogeneity (Michalopoulos, 2012) and ecological features (Cervellati, Chiovelli, & Esposito 2019). The key questions that arise from these findings are:

- i. Has the post-colonial after-effect of different colonial rules on the relationship between educational development and economic development been different?
- ii. Can slavery and slave trade explain the contemporary relationship between educational development and economic development?

This would be because the relationship between education development and economic development has been mostly examined in relation to post-colonial factors and mostly excluding the role that Africa's colonial and slavery history might have played. Thus, the results in this chapter are an attempt to determine whether Africa's colonial and slavey history have affected the link between economic development and development of education.

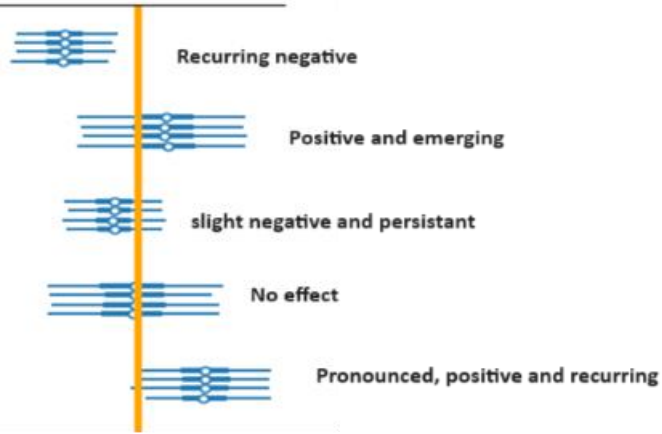
The exploration of this dynamic relationship considers the methodological recommendation by Eaton and Kortum (2002), in which they proposed integrating quantitative models of international trade with some "reduced form" estimates. Following the mentioned recommendation, the Bayesian type of vector autoregression models is chosen and preferred due to its ability to overcome the shortcomings that are in the classical type which are: the loss of degrees of freedom, low data quality and when more than one lag is required as well as providing coefficient estimates that are not biased even when the variables contain unit roots. Also, the dynamic capability of the BVAR allows for the economic relationship of interest to be examined across and within groups. Thus, the BVAR estimates a posterior distribution, which is the combination of the likelihood

distribution (i.e., information contained in the data) and the hierarchical prior (i.e., expert information based on either literature and/or the distribution of the data). Moreover, the posterior is estimated by the BVAR with both the prior and likelihood sharing the same family of distribution, normal.

On that note, the selection of the BVAR is motivated for this study as the focus is on Africa with the majority of countries being either low or medium income. That, coupled with insufficient time series data would make the BVAR suitable as it can inform the estimation of the main parameters by its simulation feature including its ability to borrow information from other homogenous countries or empires to further inform the simulation process. Table 5.1 is a guide of how results (the various types of figures) are obtained; and most importantly, how the figures are interpreted.

Table 5. 1: Summarized guide of the key BVAR outputs together with the way they are obtained and their respective interpretation.

Figure	Example	How figures are	
		Obtained	Interpreted
Trace and density plots of all hierarchically treated hyperparameters and the ML.	Figure A.1.2	By plotting the convergence of the MCMC algorithm, which is essential for its stability. By default, the method provides trace and density plots of the ML and the hierarchically treated hyperparameters	The trace and density plots are visually inspected and what is of interest is whether the key hyperparameters have converged as well as whether the chains (on the right) seem to be adequately exploring the posterior. Thus, as long as there are no glaring outliers (i.e., meaning the distribution of the rank plots are similar and approximately symmetrical) that can be recognized on the trace and density plots then convergence is achieved (Kuschnig & Vashold, 2019).
The Prior and Posterior Correlation Estimates.	Figures A.1.3 & A.1.4	Plot the learned prior and posterior distribution for the correlation parameter	This is the primary test of goodness of fit which is used to verify an insignificant residual. The prior is expected to resemble a uniform distribution, while normal for the posterior. Looking at Figure A.1.3, a uniform distribution is apparent, whereas a symmetrical distribution on the posterior in Figure A.1.4 is evident over the correlation amongst GDP per capita, enrollment and investments.
Either the plot of observed data KDE overlaid on posterior predictive KDEs or the summary statistics.	Figure A.1.7	Plot the observed data (kernel density estimation) KDE overlaid on posterior predictive KDEs.	These plots are important for checking model adequacy, by ensuring the predicted distribution (i.e., posterior) recovers the observed data. Here, the resemblance of the posterior distributions or time series is inspected against the plot of the observed data. If they roughly follow the same distribution or the residual is not significant on the timeseries then the posterior is well parametrized, otherwise not.
Model fits for each country to ensure that the predictive distribution can recover the observed data	Figure A.1.5	Plot the posterior and observed data overtime.	

Either the Plot of intercept of parameters for each empire/country and economic measure or the summary statistics.	Figure A.1.6 or Table 5.11	Summary of the intercept parameters by empire together with their respective convergence diagnostic parameters.	The most important aspect of the interpretation of the intercept of parameters is that the mean should be less than the standard deviation of the samples themselves which then would indicate that plenty of samples have been taken
Educational development response to GDP per capita.	Figure A.1.9	Plot the cross-variance of GDP per capita on the first lag of investments in education.	Below is an example of how actual Bayesian shocks are interpreted. 
Robustness check or the summary statistics	Figure 5.33 and 5.34	Plot the alpha parameter estimates of the BVAR against the classical VAR estimates	These results can be interpreted by ensuring similar magnitudes in the estimates for the alpha terms for both equations and a clear relationship between the first lagged GDP per capita numbers and investments in education along with a very similar covariance structure (Table 5.13 {VAR} and Figure A.1.4 {BVAR}).

5.2. Preliminary Analysis

This section contains preliminary exploratory analysis for the data that have been used on the main colonial types and powers (i.e., French Africa, British Africa, Liberia & Ethiopia, South Africa, Portuguese Africa, Egypt, and Belgian Africa) that Africa experienced including French Indochina, Thailand and Burma that are used to test whether outcomes are Africa specific. Tables 5.2 and 5.3 present summaries of the descriptive statistics for each of the mentioned empires for GDP per capita, education enrollment, educational investments, industrialization, and human development for the period 1960 to 2021 procured from TheGlobalEconomy.com; as well as financial market index (FMI) for the period 1960 to 2020 from the Financial Development Index Database.

Taking human development index (HDI) as the first and most representative of all measures from Table 5.2, it can be seen that on average the highest human development levels are observed in French Indochina followed by Portuguese Africa with the lowest British Africa. The observed Portuguese African human development levels coupled with the high coefficient of variation (CV) for HDI shows that shows instability in human capital development levels of education, standard of living, and life expectancy. Also, in support of the HDI statistics, it can be observed that, on average, the Belgian Africa's economy shows the highest growth, whereas the lowest is seen in Thailand and Burma. Also, the greatest and least deviation in growth is observed in countries that were never colonized (i.e., Liberia & Ethiopia) and French Africa, respectively.

Table 5. 2 Summary descriptive statistics of development measures.

									Jarque-Bera	
	Empire	Mean	Max	Min	Std Dev	Skew	Kurtosis	CV	LM-Stat	P-value
Δreal GDP	French Africa	(0.039)	3.886	(3.318)	1.485	0.124	3.348	133.263	0.456	0.796
	British Africa	0.001	3.811	(3.609)	1.461	(0.163)	3.649	136.181	1.319	0.517
	Liberia & Ethiopia	(0.004)	12.353	(10.883)	4.453	0.366	4.299	145.988	4.627	0.099
	French Indochina	(0.005)	20.355	(15.855)	4.262	1.074	13.459	199.017	285.026	-
	South Africa	(0.063)	2.740	(3.930)	1.598	(0.428)	2.876	131.453	1.866	0.393
	Portuguese Africa	0.077	11.375	(13.470)	3.784	(0.241)	6.164	143.769	20.488	0.000
	Egypt	(0.029)	5.860	(3.330)	1.687	0.739	4.652	137.591	12.279	0.002
	Belgian Africa	0.247	16.025	(11.820)	3.733	0.881	8.399	152.785	80.646	-
	Thailand	(0.177)	6.045	(6.640)	2.215	(0.283)	4.225	141.065	4.557	0.102
Financial markets index	Burma	(0.177)	6.405	(12.330)	2.504	(1.524)	11.531	160.295	201.743	-
	French Africa	0.000	0.006	(0.008)	0.002	(0.691)	12.767	164.208	243.243	-
	British Africa	0.000	0.009	(0.008)	0.003	0.279	5.410	151.335	15.303	0.000
	Liberia & Ethiopia	(0.000)	0.020	(0.020)	0.010	0.039	4.041	187.513	2.270	0.321
	French Indochina	(0.000)	0.043	(0.040)	0.014	0.026	5.843	156.813	20.218	0.000
	South Africa	0.008	0.081	(0.034)	0.021	1.214	5.342	148.958	28.456	0.000
	Portuguese Africa	0.000	0.013	(0.010)	0.005	0.218	3.155	131.123	0.429	0.807
	Egypt	0.008	0.121	(0.083)	0.036	0.927	5.545	157.083	24.784	0.000
	Belgian Africa	(0.000)	0.001	(0.001)	0.000	(0.611)	5.725	138.578	22.294	0.000
Industrialization index	Thailand	0.004	0.125	(0.110)	0.042	0.334	3.789	136.597	2.671	0.263
	Burma	0.000	0.000	(0.000)	0.000	0.552	3.256	134.205	3.155	0.206
	French Africa	7.359	46.231	(16.918)	9.811	1.513	8.396	109.211	95.658	-
	British Africa	3.817	70.609	(42.722)	19.463	0.678	5.330	143.775	18.158	0.000
	Liberia & Ethiopia	6.789	218.976	(182.096)	46.392	0.450	15.179	183.733	310.711	-
	French Indochina	8.597	180.255	(166.844)	41.919	(0.011)	11.878	165.755	197.032	-
	South Africa	5.720	35.371	(21.302)	10.692	0.339	3.387	114.017	1.526	0.466
	Portuguese Africa	(1.512)	353.926	(404.752)	86.706	(0.727)	16.554	219.180	371.634	-
	Egypt	6.601	30.962	(70.683)	14.229	(2.895)	16.181	119.845	518.131	-
Human development index	Belgian Africa	2.105	87.547	(102.272)	27.155	(0.995)	7.700	150.615	65.112	0.000
	Thailand	9.588	24.436	(24.646)	8.703	(1.229)	5.599	76.881	31.992	0.000
	Burma	6.012	64.514	(64.514)	31.084	(0.473)	2.846	122.784	2.256	0.324
	French Africa	0.003	0.012	(0.015)	0.005	(1.228)	4.920	104.114	24.286	0.000
	British Africa	0.003	0.010	(0.005)	0.004	0.126	2.174	104.746	1.866	0.393
	Liberia & Ethiopia	0.002	0.038	(0.043)	0.018	(0.527)	3.244	129.880	2.442	0.295
	French Indochina	0.004	0.069	(0.067)	0.017	(0.428)	10.803	149.667	154.059	-
	South Africa	0.002	0.032	(0.025)	0.012	(0.020)	3.916	134.484	2.101	0.350
	Portuguese Africa	0.004	0.058	(0.075)	0.019	(1.173)	10.198	164.637	114.631	-
Human development index	Egypt	0.001	0.056	(0.056)	0.022	(0.443)	5.470	167.870	17.214	0.000
	Belgian Africa	0.003	0.056	(0.025)	0.015	0.731	4.657	136.012	12.213	0.002
	Thailand	0.001	0.047	(0.047)	0.021	(0.666)	4.178	145.634	7.906	0.019
	Burma	0.004	0.025	(0.025)	0.010	(1.188)	3.925	101.906	15.980	0.000

Note: Please note that Mean, Max and Min is the average, maximum and minimum observed values, respectively; Std Dev stands for the standard deviation; CV represents the coefficient of variation, Skew is skewness, Kurt denotes the kurtosis; and Jarque-Bera is the Jarque and Bera (1987) normality test.

									Jarque-Bera	
	Empire	Mean	Max	Min	Std Dev	Skew	Kurtosis	CV	LM-Stat	P-value
Areal GDP	French Africa	(0.039)	3.886	(3.318)	1.485	0.124	3.348	133.263	0.456	0.796
	British Africa	0.001	3.811	(3.609)	1.461	(0.163)	3.649	136.181	1.319	0.517
	Liberia & Ethiopia	(0.004)	12.353	(10.883)	4.453	0.366	4.299	145.988	4.627	0.099
	South Africa	(0.063)	2.740	(3.930)	1.598	(0.428)	2.876	131.453	1.866	0.393
	Portuguese Africa	0.077	11.375	(13.470)	3.784	(0.241)	6.164	143.769	20.488	0.000
	Egypt	(0.029)	5.860	(3.330)	1.687	0.739	4.652	137.591	12.279	0.002
	Belgian Africa	0.247	16.025	(11.820)	3.733	0.881	8.399	152.785	80.646	-
Financial markets	French Africa	0.000	0.006	(0.008)	0.002	(0.691)	12.767	164.208	243.243	-
	British Africa	0.000	0.009	(0.008)	0.003	0.279	5.410	151.335	15.303	0.000
	Liberia & Ethiopia	(0.000)	0.020	(0.020)	0.010	0.039	4.041	187.513	2.270	0.321
	South Africa	0.008	0.081	(0.034)	0.021	1.214	5.342	148.958	28.456	0.000
	Portuguese Africa	0.000	0.013	(0.010)	0.005	0.218	3.155	131.123	0.429	0.807
	Egypt	0.008	0.121	(0.083)	0.036	0.927	5.545	157.083	24.784	0.000
	Belgian Africa	(0.000)	0.001	(0.001)	0.000	(0.611)	5.725	138.578	22.294	0.000
Industrialization	French Africa	7.359	46.231	(16.918)	9.811	1.513	8.396	109.211	95.658	-
	British Africa	3.817	70.609	(42.722)	19.463	0.678	5.330	143.775	18.158	0.000
	Liberia & Ethiopia	6.789	218.976	(182.096)	46.392	0.450	15.179	183.733	310.711	-
	South Africa	5.720	35.371	(21.302)	10.692	0.339	3.387	114.017	1.526	0.466
	Portuguese Africa	(1.512)	353.926	(404.752)	86.706	(0.727)	16.554	219.180	371.634	-
	Egypt	6.601	30.962	(70.683)	14.229	(2.895)	16.181	119.845	518.131	-
	Belgian Africa	2.105	87.547	(102.272)	27.155	(0.995)	7.700	150.615	65.112	0.000
Human	French Africa	0.003	0.012	(0.015)	0.005	(1.228)	4.920	104.114	24.286	0.000
	British Africa	0.003	0.010	(0.005)	0.004	0.126	2.174	104.746	1.866	0.393
	Liberia & Ethiopia	0.002	0.038	(0.043)	0.018	(0.527)	3.244	129.880	2.442	0.295
	South Africa	0.002	0.032	(0.025)	0.012	(0.020)	3.916	134.484	2.101	0.350
	Portuguese Africa	0.004	0.058	(0.075)	0.019	(1.173)	10.198	164.637	114.631	-
	Egypt	0.001	0.056	(0.056)	0.022	(0.443)	5.470	167.870	17.214	0.000
	Belgian Africa	0.003	0.056	(0.025)	0.015	0.731	4.657	136.012	12.213	0.002

Note: Please note that Mean, Max and Min is the average, maximum and minimum observed values, respectively; Std Dev stands for the standard deviation; CV represents the coefficient of variation, Skew is skewness, Kurt denotes the kurtosis; and Jarque-Bera is the Jarque and Bera (1987) normality test.

Table 5. 3 Summary descriptive statistics of educational development measures.

									Jarque-Bera	
	Country	Mean	Max	Min	Std Dev	Skew	Kurtosis	cv	LM-stat	p-value
Education enrollment (%)	French Africa	0.004	0.014	(0.009)	0.005	(0.147)	2.562	94.168	0.694	0.707
	British Africa	0.004	0.044	(0.043)	0.011	(0.464)	8.175	134.029	69.104	0.000
	Liberia & Ethiopia	0.001	0.159	(0.186)	0.056	(0.421)	5.980	162.900	19.978	0.000
	French Indochina	0.000	0.097	(0.107)	0.041	(0.322)	4.217	159.711	4.741	0.093
	South Africa	0.003	0.072	(0.062)	0.020	0.177	5.510	141.304	16.063	0.000
	Portuguese Africa	0.004	0.140	(0.074)	0.038	0.747	5.007	134.471	12.523	0.002
	Egypt	0.006	0.022	(0.012)	0.007	(0.262)	2.729	92.158	0.869	0.648
	Belgian Africa	0.002	0.059	(0.040)	0.017	0.315	4.768	134.75	8.807	0.012
	Thailand	0.009	0.052	(0.020)	0.015	0.687	3.715	115.211	5.997	0.050
	Burma	0.003	0.041	(0.036)	0.020	(0.009)	2.767	143.177	0.134	0.935
Education investments (%)	French Africa	(0.000)	0.016	(0.012)	0.006	0.212	3.019	124.203	0.449	0.799
	British Africa	0.001	0.017	(0.024)	0.009	(0.429)	2.814	125.434	1.929	0.381
	Liberia & Ethiopia	0.001	0.020	(0.017)	0.009	0.099	2.707	127.480	0.259	0.878
	French Indochina	0.001	0.041	(0.027)	0.012	0.356	4.036	140.692	3.949	0.139
	South Africa	0.000	0.008	(0.010)	0.003	(0.387)	4.907	156.781	10.592	0.005
	Portuguese Africa	0.001	0.045	(0.042)	0.014	0.039	5.299	139.937	10.583	0.005
	Egypt	0.000	0.022	(0.020)	0.011	0.038	2.807	140.606	0.107	0.948
	Belgian Africa	(0.001)	0.049	(0.049)	0.025	0.082	2.129	116.918	1.966	0.374
	Thailand	(0.002)	0.045	(0.061)	0.021	(0.251)	3.321	126.480	0.888	0.641
	Burma	0.000	0.039	(0.039)	0.015	0.162	3.426	136.141	0.703	0.704

Note: Please note that all abbreviation that have been used share the same descriptions as those that are in Table 5.1.

Taking human development index (HDI) as the first and most representative of all measures from Table 5.2, it can be seen that on average the highest human development levels are observed in French Indochina followed by Portuguese Africa with the lowest British Africa. The observed Portuguese African human development levels coupled with the high CV for HDI shows that shows instability in human capital development levels of education, standard of living, and life expectancy. Also, in support of the HDI statistics, it can be observed that, on average, the French Indochina's economy shows the highest growth followed by Belgian Africa, whereas the lowest is seen in French Africa. Also, the greatest and least deviation in growth is observed in countries that were never colonized (i.e., Liberia & Ethiopia) and French Africa, respectively.

The most consistent growth is observed in South Africa as also supported with the stability that can be justified by both the low CV and standard deviation. A similar observation can be broadly made with regards to the financial markets and industrialization except for the instability as supported by the high CV which is as expected mostly for financial development. Furthermore, on average, higher education enrollment favors Thailand, whereas expenditure in education is shared

by British Africa, Liberia & Ethiopia, French Indochina and Portuguese Africa. The normality test is approximately in favour of most of the time series that have just been discussed even before being detrended. The original (solid lines) and transformed (dotted lines) trends for all development measures that have just been described are presented in Figure 5.1 and 5.2 below in a standardized form.

There is visibly an unstable trend for industrialization and human development index compared to economic growth, financial markets development, investments in education and enrollment in education for most colonies except for Ethiopia and Liberia where all development trends are mostly unstable. A notable observation from Figure 5.1 is that both economic and educational development share an almost similar trend, which is mostly in favour of the former and latter for the first and second half of the period, respectively. As approximately the periods 1999 and 2000 appear to be the point of symmetry where most development trajectories across all colonies suddenly change, this change could be largely due to changes in the partnership agreements, as the year 2000 marked the end of the Lomé Conventions I, II and III which spanned from 1975–2000 thereafter the Cotonou Agreement in 2000. This is mostly true for African colonies that were never colonized as well as South Africa, French Indochina, Burma, Thailand and Egypt, while inverse is the case for Burma, Thailand and Egypt. On the other hand, British Africa shows a more consistent positive relationship throughout the entire period for all development trends except for the drop seen at the end of financial markets and economic growth trend. Also, Burma and Belgian Africa seem to be the two empires that are the most unstable in all aspects of their developments. Additionally, Belgian Africa appears to be the most underdeveloped in most of its indicators apart from the notable increments observed since 1995.

On a different note, in order to improve normality, variables in the data are transformed with the technique that resembles that of Kuschnig and Vashold (2019) which illustrates dummy priors. Also, by taking into consideration that the model is estimated for approximately 63 observations, it can be concluded that the sample size is technically sufficient to estimate a BVAR model (Zungu, Makhoba, & Greyling, 2022). This also accounts for using yearly data as opposed to the usual use of quarterly data that scholars like Heppke-Falk, Tenhofen and Wolf (2006) have used in their analyses, because there are no quarterly or monthly data available for post-colonial economic development.

Additionally, since the frequency of the data is yearly, it does not eliminate discretionary colonial impact (Blanchard and Perotti, 1999; 39 and Perotti, 2002) of Africa's history on the link between educational development and economic development. However, the yearly frequency of post-colonial development data (GDP per capita, school enrollment, spending in education, financial markets index, human development index and industrialization) that has been used is much more dynamic as compared to other development measures. Multiple imputations together with data preparation is performed using R studio, while all the modeling is done in python.

Figure 5. 1 Standardized values of all the time series for the selected economic (solid line) and educational (dotted line) development measures for the first group.

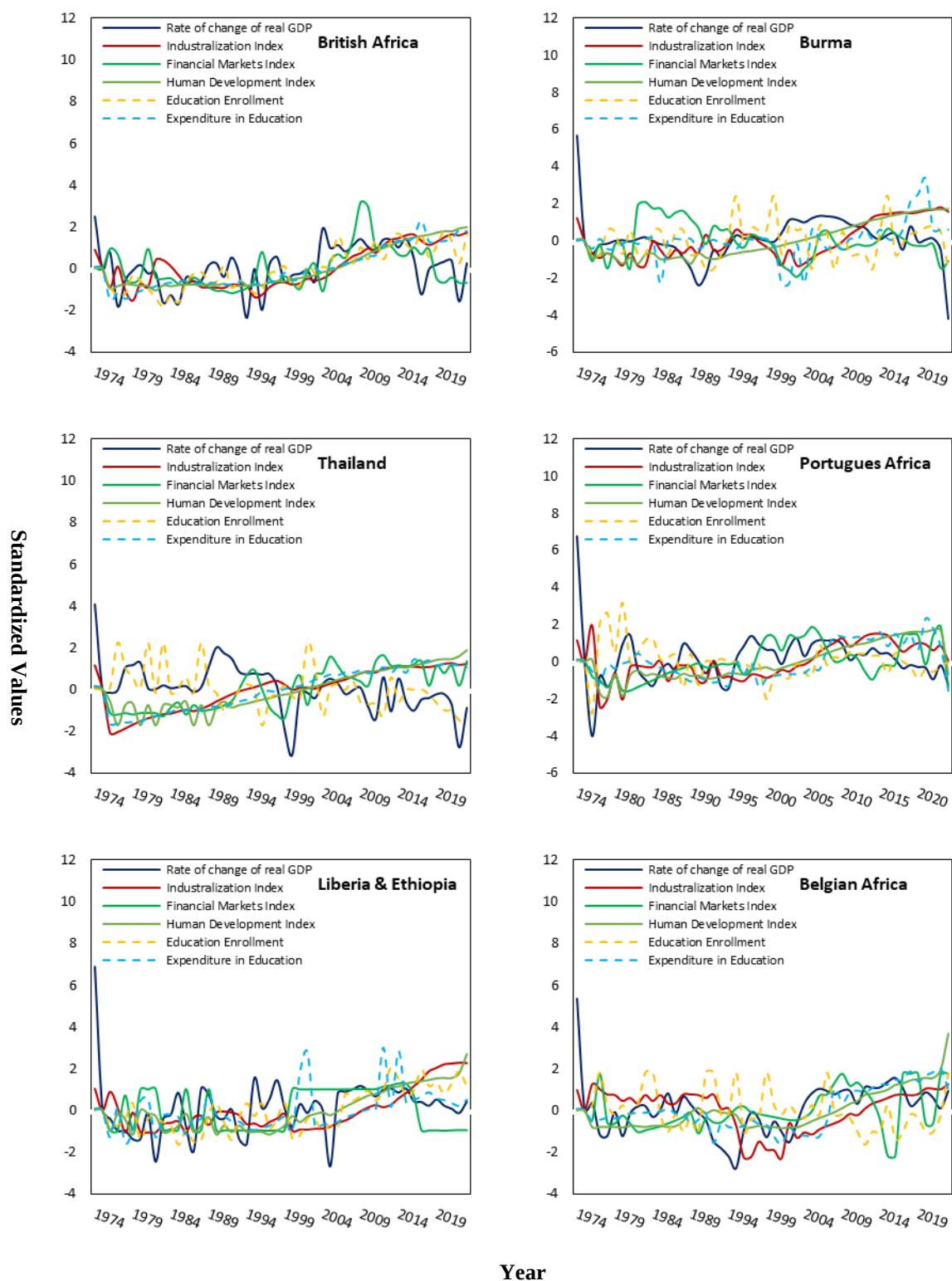
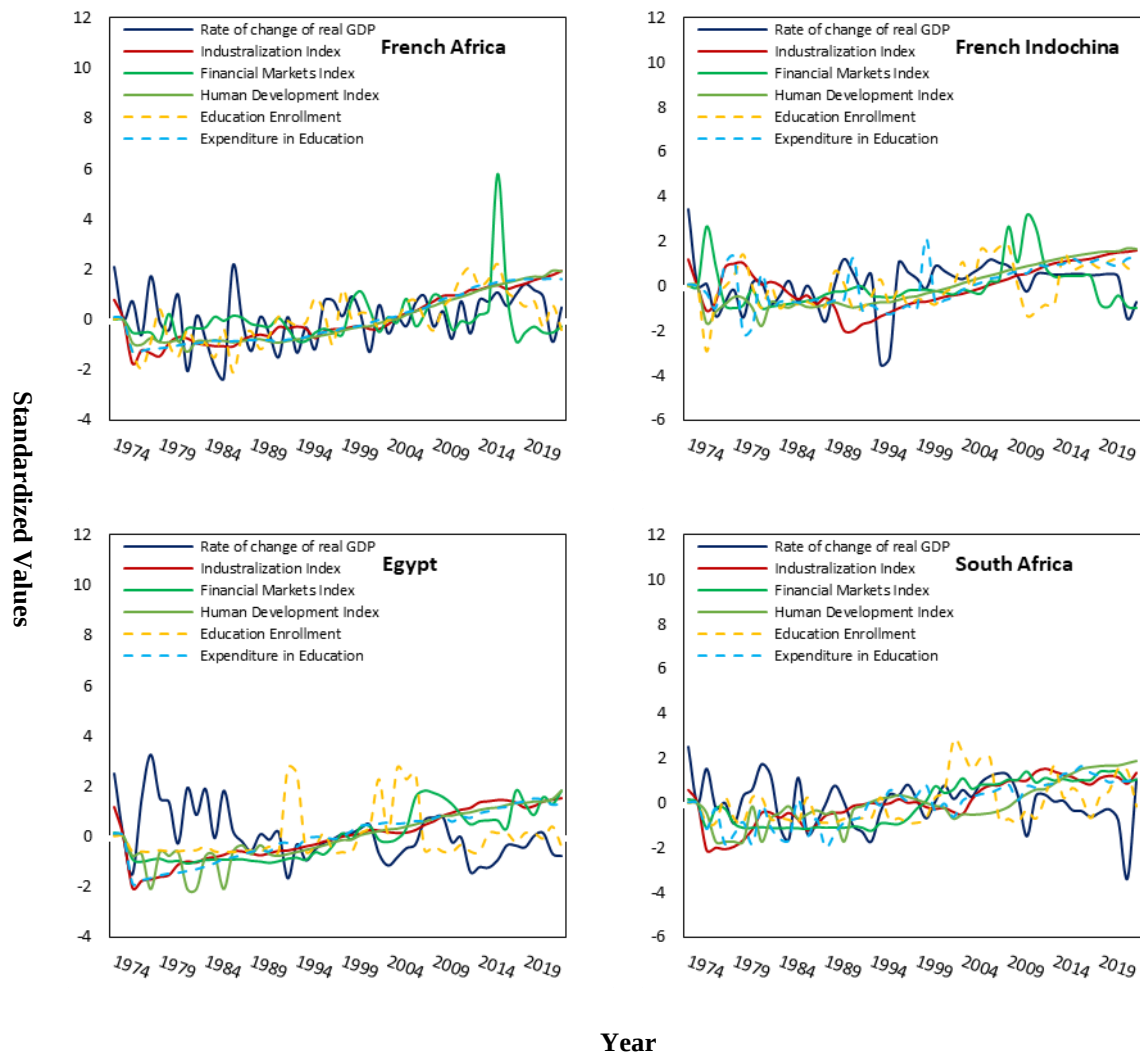


Figure 5. 2 Standardized values of all the time series for the selected economic (solid line) and educational (dotted line) development measures for the second group.



Also, the testing of the effect of colonialism and slavery artifacts is made possible by the datasets from Ricart-Huguet (2021) and Huillery (2009) for the period 1905 to 1956 on 16 colonies. Moreover, Table 5.4 presents the averages of the mentioned factors by colony. Consequently, these averages are used to develop the colonial and slavery clusters (i.e., 1 and 2 stand for least and most, respectively) that are seen in Table 5.5 which is then used together with colonial empires as controls when modelling the relationships of interest.

Table 5. 4: Mean Severity of Colonial and slavery artifacts by colony.

Colcode	Country	Europeans	Slavery	Ethnic groups	Ethnic fractionalization	Islam	centralization	Hostility	Missions	Colonial length	No. of colonizers
BEN	Benin		3.68	3.82	0.39	0.64	3.40	1.57	18		3.68
BFA	Burkina Faso	10	3.43	6.64	0.61	2.00	2.79	0.97		10	3.43
CIV	Cote d'Ivoire	69	3.45	5.68	0.46	0.63	2.12	1.01	202	69	3.45
GHA	Ghana	146	2.66	3.86	0.36	0.43	2.61	0.00	415	146	2.66
GIN	Guinea	74	3.32	3.78	0.38	1.00	2.20	1.56	487	74	3.32
KEN	Kenya	537	1.62	4.09	0.38	0.55	1.89	0.00	334	537	1.62
MLI	Mali	82	3.70	4.20	0.51	2.00	2.46	1.12		82	3.70
MRT	Mauritania	21	4.00	4.67	0.50	2.00	3.11	1.31	6	21	4.00
MWI	Malawi	59	3.25	2.60	0.30	0.00	2.50	0.00	328	59	3.25
NER	Niger	15	3.58	5.10	0.56	2.00	2.69	1.94		15	3.58
NGA	Nigeria	184	3.33	11.00	0.62	0.83	2.44	0.00	194	184	3.33
SEN	Senegal	354	3.91	2.79	0.31	1.71	2.45	0.00		354	3.91
SLE	Sierra Leone	75	3.38	3.29	0.36	0.86	2.51	0.00	994	75	3.38
TZA	Tanzania	214	2.68	5.71	0.44	0.17	2.00	0.00	377	214	2.68
UGA	Uganda	133	2.71	5.07	0.40	0.00	2.79	0.00	197	133	2.71
ZMB	Zambia	397	2.88	4.60	0.48	0.00	2.71	0.00	427	397	2.88

Table 5. 5: Control matrix showing clustered severity of colonial and slavery measures (1905 to 1956).

Colcode	Country	Europeans	Slavery	Ethnic groups	Ethnic fractionalization	Islam	Centralization	Hostility	Missions	Colonial length	No. of colonizers
BEN	Benin	1.00	2.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00
BFA	Burkina Faso	1.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00
CIV	Cote d'Ivoire	1.00	2.00	2.00	2.00	1.00	1.00	2.00	2.00	2.00	1.00
GHA	Ghana	2.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	2.00
GIN	Guinea	1.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	1.00	2.00
KEN	Kenya	2.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
MLI	Mali	2.00	2.00	1.00	2.00	2.00	1.00	2.00	1.00	1.00	1.00
MRT	Mauritania	1.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00
MWI	Malawi	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00
NER	Niger	1.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	2.00
NGA	Nigeria	2.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00
SEN	Senegal	2.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	2.00	2.00
SLE	Sierra Leone	1.00	2.00	1.00	1.00	2.00	2.00	1.00	2.00	2.00	1.00
TZA	Tanzania	2.00	1.00	2.00	2.00	1.00	1.00	1.00	2.00	2.00	2.00
UGA	Uganda	2.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	2.00
ZMB	Zambia	2.00	1.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	2.00

5.3. Panel Data Analysis (Stationarity, Cointegration and Causality)

Before implementing any timeseries model on the data, it is crucial to make sure that the data satisfies all stationary, cointegration and causality conditions to guarantee efficiency of estimators (Lau, Ng, Cheah, & Choong, 2019). As a result of extensive time series investigation, several tests have been proposed and used by scholars like Pesaran (2015) that when appropriately implemented, time series estimators would be most accurate. Moreover, in order to overcome inefficiency in this study, the unit roots, cointegration and causality tests are performed, respectively.

Firstly, several panel unit root tests are conducted and based on the outcome all the necessary level of transformations and differencing as required are implemented on the data until stationarity is achieved where possible. The unit root tests that have been used are: (1) Levin, Lin, and Chu “LLC” (2002); (2) Im, Pesaran, and Shin “IPS” (2003); (3) several Fisher-type tests (i.e., Maddala and Wu (1999); P test proposed by Choi (2001); inverse normal test (Choi (2001)); and the logit test (Choi (2001))).

The considered tests assume that all cross sections in

$$\Delta y_{i,t} = \alpha_i + \rho y_{i,t-1} + \sum_{k=1}^n \phi_k y_{i,t-k} + \delta_i t + \theta_t + u_{i,t}$$

consist of similar panel unit roots process with $H_0: \rho < 1$ as the null hypothesis which assumes that the Y time series is stationary and $H_A: \rho < 1$ as the alternative which assumes the series is nonstationary. On that note, Tables 5.6 and 5.7 below contain the panel unit root test results for all the selected tests. From the unit root outcome, it can be observed for Africa that percentage differences in time series of GDP per capita as well as the second differenced of industrialization, financial markets index, investments in education, education enrollment and human development index all show a panel unit root and are stationary. However, economic growth, financial market index and education enrollment have a panel unit and are also stationary when they are either differenced or not. Likewise, the integration order of the timeseries for Africa are the same as for the non-African countries. Nevertheless, due to the fact that the main focus of interest is on the

dynamics of the objective as opposed to parameter estimation, variables in levels are used in this study even though some of the variables do not have unit roots (Perotti, 2002; de Castro and de Cos, 2006; and Heppke-Falk, Tenhofen and Wolf, 2006). Consequently, because of the presence of white noise on both economic growth and industrialization index after differencing, economic growth as well as industrialization are modeled on logged terms and not on the detrended series. On that note, a test to check cointegration is then performed as required, as there is more than one series integrated of the same order based on the panel unit test results. Hence, the cointegration test is considered for all other variables apart from GDP per capita.

Table 5. 6: Panel unit root tests of both economic and educational development measures results on yearly data for the period 1976 till 2022 for African countries.

			Hadri	Im	Levinlin	Madwu	Pm	Invnormal	Logit
Areal GDP	O	P. value	0.000	0.006	0.135	0.010	0.002	0.004	0.006
		Stat	17.873	(2.529)	(1.101)	29.046	2.844	(2.632)	(2.664)
	T	P. value	0.991	0.000	0.000	0.000	-	0.000	0.000
		Stat	(2.373)	(19.971)	(16.937)	430.815	78.771	(19.301)	(46.084)
	O	P. value	-	1.000	1.000	0.998	0.978	1.000	1.000
		Stat	44.138	4.954	6.193	3.339	(2.015)	5.033	6.682
induindex	O	P. value	0.983	0.000	0.000	0.000	-	0.000	0.000
		Stat	(2.127)	(14.835)	(10.500)	287.490	51.685	(14.959)	(30.747)
	T	P. value	-	0.018	0.134	0.002	0.000	0.016	0.005
		Stat	30.304	(2.108)	(1.106)	33.641	3.712	(2.153)	(2.688)
	O	P. value	0.969	0.000	0.000	0.000	-	0.000	0.000
		Stat	(1.870)	(19.766)	(17.805)	416.992	76.158	(19.086)	(44.606)
fmiindex	O	P. value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Stat	29.388	(3.767)	(3.465)	47.458	6.323	(4.009)	(4.667)
	T	P. value	0.979	0.000	0.000	0.000	-	0.000	0.000
		Stat	(2.025)	(19.515)	(17.329)	417.403	76.236	(18.765)	(44.650)
	O	P. value	-	0.647	0.023	0.355	0.400	0.680	0.658
		Stat	55.766	0.378	(1.988)	15.340	0.253	0.469	0.411
Investment	O	P. value	0.972	0.000	0.000	0.000	-	0.000	0.000
		Stat	(1.906)	(20.499)	(18.611)	438.345	80.194	(19.637)	(46.890)
	T	P. value	-	1.000	0.992	1.000	0.993	1.000	1.000
		Stat	58.043	4.715	2.415	1.060	(2.445)	4.862	5.450
	O	P. value	0.994	0.000	0.000	0.000	-	0.000	0.000
		Stat	(2.491)	(23.495)	(21.476)	540.921	99.579	(22.128)	(57.862)
HDI	O	P. value	-	1.000	0.992	1.000	0.993	1.000	1.000
		Stat	58.043	4.715	2.415	1.060	(2.445)	4.862	5.450
	T	P. value	0.994	0.000	0.000	0.000	-	0.000	0.000
		Stat	(2.491)	(23.495)	(21.476)	540.921	99.579	(22.128)	(57.862)

*, ** and *** indicate the rejection of non-stationarity by the null hypothesis at the 1 percent, 5 percent, and 10 percent levels, respectively.

Please not that O and T is the original and transformed data, respectively.

Table 5. 7: Panel unit root tests of both economic and educational development measures results on yearly data for the period 1976 till 2022 for French Indochina, Thailand and Burma.

			Hadri	Im	Levinlin	Madwu	Pm	Invnormal	Logit
Areal GDP	O	P. value	0.000	0.019	0.655	0.002	0.000	0.013	0.005
		Stat	8.752	(2.085)	0.398	21.315	4.421	(2.229)	(2.859)
	T	P. value	0.957	0.000	0.000	0.000	-	0.000	0.000
		Stat	(1.721)	(16.392)	(15.337)	254.365	71.697	(15.157)	(42.799)
induindex	O	P. value	0.000	0.999	0.992	0.999	0.949	0.999	0.998
		Stat	33.489	2.969	2.388	0.349	(1.631)	3.034	3.280
	T	P. value	0.807	0.000	0.000	0.000	-	0.000	0.000
		Stat	(0.867)	(12.339)	(11.006)	165.373	46.007	(12.145)	(27.825)
fmiindex	O	P. value	0.000	0.196	0.115	0.296	0.356	0.202	0.216
		Stat	20.214	(0.856)	(1.201)	7.278	0.369	(0.833)	(0.802)
	T	P. value	0.892	0.000	0.000	0.000	0.000	0.000	0.000
		Stat	(1.236)	(10.360)	(6.098)	129.752	35.724	(10.605)	(21.832)
Enrollment	O	P. value	0.000	0.000	0.001	0.000	0.000	0.000	0.000
		Stat	3.539	(3.350)	(3.214)	27.811	6.296	(3.565)	(4.524)
	T	P. value	0.958	0.000	0.946	0.000	0.000	0.000	0.000
		Stat	(1.723)	(10.296)	1.604	130.890	36.053	(10.659)	(22.023)
Investment	O	P. value	0.000	0.819	0.097	0.866	0.842	0.867	0.859
		Stat	32.746	0.913	(1.299)	2.520	(1.005)	1.113	1.109
	T	P. value	0.938	0.000	0.000	0.000	-	0.000	0.000
		Stat	(1.539)	(12.202)	(4.528)	167.421	46.598	(12.216)	(28.170)
HDI	O	P. value	-	1.000	1.000	1.000	0.958	1.000	1.000
		Stat	48.237	5.920	4.470	0.004	(1.731)	5.788	7.888
	T	P. value	0.946	0.000	0.000	0.000	-	0.000	0.000
		Stat	(1.611)	(13.265)	(3.466)	193.997	54.270	(13.146)	(32.641)

*, ** and *** indicate the rejection of non-stationarity by the null hypothesis at the 1 percent, 5 percent, and 10 percent levels, respectively.

Please not that O and T is the original and transformed data, respectively.

Moreover, Table 5.8 contains cointegration results obtained among series that are integrated of the same order. According to the cointegration test even as has been used by Pfaff (2008), the first ($r = 0$), second ($r \leq 1$), third ($r \leq 2$) and fourth ($r \leq 3$) hypothesis tests for the presence of cointegration. Since the test statistic for all the four tests exceeds the 1% level significantly, the null hypothesis of no cointegration is then rejected. Usually when the null hypothesis in the Johansen-Procedure is not rejected at any other rank except when $rank = 0$ then it implies that the data is cointegrated, otherwise it is not cointegrated. Thus, looking at the outcome of the trace tests, results indicate that there are multiple cointegrated relationships in both the African and non-African settings.

Table 5. 8 Johansen-Procedure.

		Test	10pct	5pct	1pct
Africa	r less or equal to 4	16.85	6.5	8.18	11.65
	r less or equal to 3	37.08	15.66	17.95	23.52
	r less or equal to 2	62.31	28.71	31.52	37.22
	r less or equal to 1	93.16	45.23	48.28	55.43
	r equal to 0	143.85	66.49	70.6	78.87
French Indochina, Thailand & Burma	r less or equal to 4	11.29	6.5	8.18	11.65
	r less or equal to 3	27.99	15.66	17.95	23.52
	r less or equal to 2	49.46	28.71	31.52	37.22
	r less or equal to 1	88.69	45.23	48.28	55.43
	r equal 0	156.71	66.49	70.6	78.87

Also, it is important that the causality relationship amongst the variables of interest be explored before prematurely adopting an econometric model as a preliminary motivation for the use of a time series model. Moreover, the Granger causality test is fitted on the VAR model with the below specification:

$$\begin{pmatrix} y_t \\ x_t \end{pmatrix} = \begin{pmatrix} v_y \\ v_x \end{pmatrix} + \begin{pmatrix} \alpha_{11,1} & \alpha_{12,1} \\ \alpha_{11,1} & \alpha_{12,1} \end{pmatrix} \begin{pmatrix} y_{t-1} \\ x_{t-1} \end{pmatrix} + \dots + \begin{pmatrix} \alpha_{11,p} & \alpha_{12,p} \\ \alpha_{11,p} & \alpha_{12,p} \end{pmatrix} \begin{pmatrix} y_{t-p} \\ x_{t-p} \end{pmatrix} + \begin{pmatrix} u_y \\ u_x \end{pmatrix}$$

and used to test the null hypothesis: $H_0: \alpha_{12,i} = 0$ for $i = 1, \dots, p$ which assumes that x does not Granger cause y , which means that the lag coefficients of x are insignificant. Likewise, in order to perform causality test in the opposite direction the same walt test also has to be performed to check whether $H_0: \alpha_{11,i} = 0$ for $i = 1, \dots, p$ is true.

Tables 5.9 represent Granger causality results for Africa and non-Africa (French Indochina, Thailand, and Burma). Results show that for Africa a unidirectional Granger causality exists from investments in education to economic growth. The other results further show that there is unidirectional causality from industrialization index to both human development and financial market development as well as human development to financial markets. Also, the test does not reveal causation in any direction between economic growth with any other development measures except towards investments in education.

Granger results for non-African regions show that, first, there is unidirectional causality from financial markets to economic growth, investments in education to economic growth, education enrollment to industrialization, human development to investments in education and

industrialization to investments in education. Nevertheless, no causation is detected in any other variable or direction.

It can therefore be concluded, based on preliminary causal analysis which has used Granger causality tests, that this method is inadequate and is not reliable for explaining the dynamic interactions between variables. On that note, this form of dynamic relationships that exist between covariates that relate to one another are commonly modelled by vector autoregressive (VAR) models (Sims, 1972). As for this study, the hierarchical Bayesian Vector Autoregression (BVAR) model is what is used to explore the relationship between the variables of interest.

Table 5. 9 Granger-Causality Results.

Dependent variable	Independent variable						
	Δ Real GDP	INDUS	FMI	HDI	ENROL	INV	
Δ Real GDP	-	0.135	1.288	0.753	1.645	0.200	Africa
		0.874	0.284	0.476	0.203	0.820	
INDUS	0.750	-	5.711	4.182	0.144	0.361	
	0.478		0.006**	0.021**	0.866	0.698	
FMI	1.167	0.096	-	0.559	0.742	0.835	
	0.319	0.908		0.575	0.481	0.439	
HDI	1.064	0.003	4.390	-	0.613	0.296	
	0.353	0.997	0.017**		0.545	0.745	
ENROL	0.339	1.478	0.303	1.203	-	0.454	
	0.714	0.237	0.740	0.309		0.638	
INV	3.777	0.213	1.267	1.449	0.057	-	
	0.029**	0.809	0.290	0.244	0.944		
Δ Real GDP	-	1.383	0.146	0.127	0.162	0.148	Not-Africa
		0.260	0.865	0.881	0.851	0.863	
INDUS	1.817	-	0.753	1.395	1.993	2.126	
	0.173		0.476	0.257	0.146	0.130*	
FMI	5.160	0.224	-	0.803	0.356	0.100	
	0.009***	0.800		0.453	0.702	0.905	
HDI	0.512	0.167	0.868	-	0.066	11.977	
	0.602	0.847	0.426		0.936	0.000***	
ENROL	0.875	2.020	0.341	1.892	-	0.293	
	0.423	0.143*	0.713	0.161		0.747	
INV	3.413	0.127	1.019	1.075	0.936	-	
	0.040**	0.881	0.368	0.349	0.399		

Note: H_0 of ‘no Granger causality’ between dependent and independent variable. Chi-squared statistics and P-values in parentheses for Africa and non-African countries (French Indochina, Thailand and Burma). *, **, and *** denote significance at 10%, 5% and 1% respectively.

5.4. Examining Outputs of the Bayesian VAR

The importance of understanding precolonial and colonial ethnic institutions cannot be overemphasized, as they are interdependent with effects determining contemporary outcomes (Brown 2000; Cogneau and Moradi 2014; Frankema, 2012; Gennaioli & Rainer, 2007 a, b; Walters et al., 2020). The hierarchical BVAR model has been adopted to determine the effect of Africa's colonial and slavery history on the relationship between educational development and economic development using PyMC, a probabilistic programming library for Python that allows users to build Bayesian models with a simple Python API and fit them using Markov Chains Monte Carlo (MCMC) methods. Hierarchical BVAR are advantaged compared to the classical vector autoregression models especially when using low data quality as well as when more than one lag is required in the model (Zungu et al., 2022). Also, the additional hierarchical capability allows for economic relationships of interest to be examined across and within groups. Hence, the prior feature of a BVAR overcomes the mentioned setback that exist in the traditional VARs by allowing for the prior to be configured in a way that the observed data is further enriched by resampling the data based on the prior distribution (Koop, 2013).

Given the dynamics of the BVAR model, it is necessary to begin by parameterizing the model such that convergence of the MCMC is guaranteed (see the demonstration for South Africa that is in Figure A.1.8). On that note, in the first place the hyperparameters for the hierarchical priors are initially selected as shown in Table 5.10.

Table 5. 10: Hyperparameter for the hierarchical prior.

Parameters	Initial parameters	Distribution	Description
P	$\alpha = 2, \beta = 2$	Beta	Parameter rho determines the share of impact each country's data contributes to the estimation of the covariance relationship among the economic variables
$\hat{\alpha}_{location}$	$\mu: 0, \sigma^2: 0.1$	Gaussian	Controls the overall prior variance of all VAR coefficients
$\hat{\alpha}_{scale}$	$\mu: 3, \sigma^2: 0.5$	Inverse Gamma	
$\hat{\beta}_{location}$	$\mu: 0, \sigma^2: 0.1$	Gaussian	Controls the tightness of the variances of the coefficients of lagged variables other than the dependent variable in each equation
$\hat{\beta}_{scale}$	$\mu: 3, \sigma^2: 0.5$	Inverse Gamma	
Ω_{global}	$n = n_{eqs}, \eta = 1.0, sd_dist = pm. Exponential. dist(1)$	Exponential	Global covariance matrix

Besides their weak ability to deal with low data quality from mostly low- and medium-income countries, classical VAR models also experience loss of degrees of freedom when too many lags are included, which makes them over-parameterized. The prior selection feature in BVAR overcomes the discussed weakness because of the MCMC which resamples the observed data using a class of algorithms for sampling from a specified prior distribution (Zungu et al., 2022). On that note, all parameters have been treated hierarchically because the objective is to model multiple countries including the country-level relationship between economic and educational development. The construction of the hierarchical prior is then completed by setting the initial distribution parameters as is reflected in Table 5.10. To be precise, an inverse-Gamma distribution is assumed for the scale parameters (i.e., $\hat{\alpha}_{scale}$ and $\hat{\beta}_{scale}$) and location parameters (i.e., $\hat{\alpha}_{location}$

and $\hat{\beta}_{location}$), which follow the Gaussian distribution; while the impact share parameter ρ assumes a *Beta* distribution. The parameter ρ measures the marginal impact that each country's data contributes to the estimated covariance from the modelled link between economic and educational development. Hence, the presence of a share parameter in the model additionally allows country estimates to be shifted away from the hierarchical mean by not hierarchically centering the parametrization of the key likelihood for each country that is under consideration. This has been achieved by making the global covariance to be country specific by applying the below adjustment in the model.

$$\Sigma_{country} = \rho * \Omega_{prior} + (1 + \rho) * \text{noise_chole}_{likelihood}$$

where ρ accounts of the marginal country-share impact, while both the parameters Ω_{prior} and $\text{noise_chole}_{likelihood}$ obtain the Cholesky factor for the prior and likelihood distribution, respectively. Also, two more parameters z_alpha_scale and z_beta_scale are included in the model which aid when making other additional country-specific adjustments.

As the MCMC is the sampling engine that is being used by the BVAR, the initial number of iterations need to be capped as a guarantee of early convergence and in this case the number of samples to be drawn has been set at 2 000 while the number of iterations to tune is 1 000 because the tuning samples are drawn in addition to the number of draws that have been specified.

It's worth noting, when interpreting the impulses from GDP per capita, expenditure in education, financial markets, human development, and industrialization, that these impulses are not caused by any of the other variables in the model, because the impulses are derived from residuals of the BVAR equation. Moreover, section 5.5 presents cross- and within-empire results for French Africa, British Africa, Ethiopia and Liberia, South Africa, Portuguese Africa, Egypt, and Belgian Congo as the main colonial empires in Africa including French Indochina, Burma, and Thailand as test cases.

Figure A.1.2 in the appendix presents plots of the density and trace of the maximum likelihood for the hierarchically treated hyperparameters. The figure shows that there are no visible outliers on the model as most of the rank plots of all chains look similar, indicating a good mixture of chains,

which then implies that all chains seem to be parameterizing the posterior correctly (Vehtari et al., 2021). Also, by graphically inspecting the mentioned plots, it can be observed on the estimated BVAR, that the hyperparameters converge as supported by the density (on the left) and trace (on the right) plots.

Furthermore, a flat uniform prior is apparent in the case of South Africa from the correlation matrix that is shown in Figure A.1.3 between the time series that is generated from the prior specification. Also, the learned posterior distribution for the correlation parameters between the time series that is implied by the posterior specification can be examined by using the correlation matrix. Figure A.1.4 confirms that a symmetrical distribution posterior has been allowed over the correlation amongst GDP per capita, enrollment and investments.

Next, the model fit for each empire is plotted in Figure A.1.5 as a way to ensure that the posterior predictive distribution is recovering the observed data. The observation made is that the mode seems to have reasonably recovered most of the observed data (*dots*) for GDP per capita, enrollment and investments when compared to the posterior prediction (*straight line*). The discussed model fit results combined with the focus of interest which is mainly on the dynamics of the objective as opposed to parameter estimation, as also was the same with Ravník & Žilić (2011), guarantees the use of the BVAR in this study.

Now, looking at the posterior distribution of the intercept parameter for each empire in Table 5.11 or Figure A.1.6, the Monte Carlo standard errors (MCSE) of the mean is less than the standard deviation of the samples themselves (that is the `mcse_mean` column is much less than the `sd` column), thus indicating plenty of samples have been taken.

Table 5. 11: Intercept Parameters for each empire and Economic Measure (1981-2021).

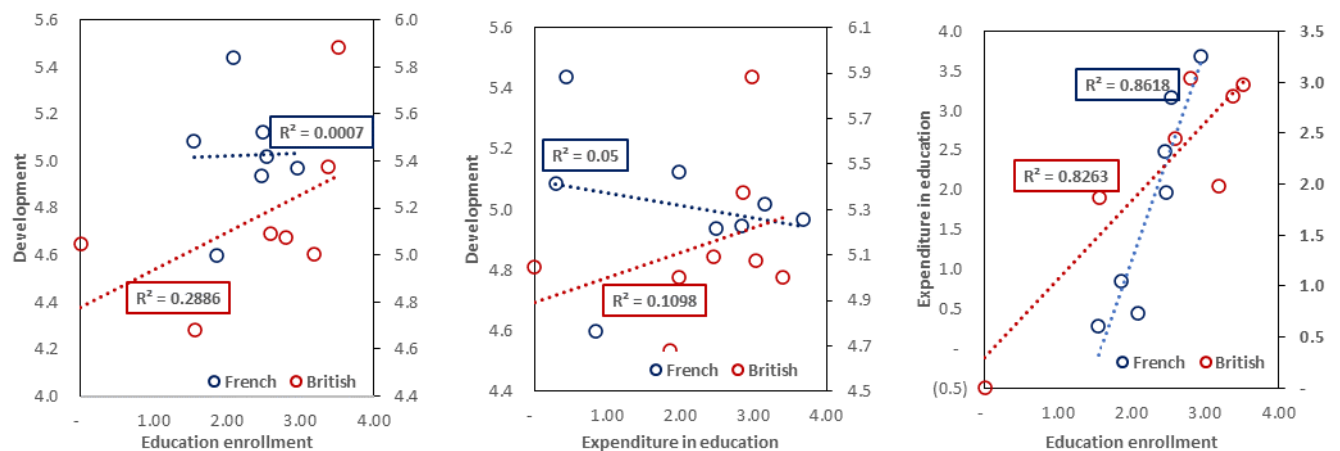
	Mean	Sd	hdi_3%	hdi_97%	mcse_mean	mcse_sd	ess_bulk	ess_tail	r_hat
FA [G]	0.026	0.072	-0.078	0.154	0.01	0.007	201	60	1.03
FA [I]	0.04	0.049	-0.047	0.144	0.002	0.002	397	463	1.02
FA [E]	0.049	0.054	-0.039	0.169	0.003	0.003	379	310	1.02
BA [G]	0.028	0.04	-0.054	0.096	0.002	0.001	419	757	1
BA [I]	0.036	0.043	-0.052	0.114	0.002	0.001	460	754	1.01
BA [G]	0.041	0.041	-0.043	0.119	0.002	0.001	416	505	1.01
L & E [G]	0.044	0.047	-0.044	0.139	0.003	0.002	308	559	1.02
L & E [I]	0.023	0.042	-0.056	0.107	0.002	0.001	463	501	1.01
L & E [E]	0.025	0.028	-0.032	0.076	0.001	0.001	563	991	1.01
FI [G]	0.029	0.068	-0.098	0.174	0.004	0.003	337	323	1.01
FI [I]	-0.008	0.066	-0.151	0.095	0.003	0.002	515	457	1.01
FI [E]	-0.018	0.038	-0.087	0.052	0.002	0.002	314	1, 009	1.01
ZA [G]	0.055	0.069	-0.059	0.2	0.007	0.006	140	103	1.02
ZA [I]	0.043	0.074	-0.084	0.194	0.006	0.005	221	156	1.02
ZA [E]	-0.01	0.062	-0.136	0.091	0.006	0.004	164	136	1.02
PA [G]	0.054	0.073	-0.067	0.166	0.009	0.008	170	59	1.02
PA [I]	0.028	0.056	-0.089	0.124	0.003	0.003	333	274	1.01
PA [E]	0.025	0.047	-0.076	0.109	0.002	0.002	426	509	1.01
EG [G]	0.08	0.043	0.005	0.162	0.002	0.002	324	673	1.01
EG [I]	0.013	0.058	-0.112	0.106	0.003	0.002	471	645	1.01
EG [E]	0.043	0.031	-0.012	0.106	0.002	0.001	430	923	1.01
BEA [G]	0.049	0.033	-0.01	0.114	0.002	0.001	462	834	1.01
BEA [I]	0.034	0.045	-0.055	0.119	0.003	0.002	281	320	1.01
BEA [E]	0.037	0.026	-0.014	0.086	0.001	0.001	499	1, 070	1.01
Thai [G]	0.085	0.049	0.005	0.184	0.003	0.002	353	628	1.01
Thai [I]	0.012	0.047	-0.081	0.099	0.002	0.002	431	813	1.01
Thai [E]	0.02	0.036	-0.052	0.088	0.002	0.001	398	715	1.01
BU [G]	0.053	0.027	0.005	0.105	0.001	0.001	540	1, 083	1
BU [I]	0.033	0.048	-0.06	0.127	0.002	0.002	435	707	1
BU [E]	-0.016	0.017	-0.047	0.017	0.001	0.001	487	841	1

Note. The abbreviations used represents as follows: FA: French Africa, BA: British Africa, L &E: Liberia & Ethiopia, FI: French Indochina, ZA: South Africa, PA: Portugues Africa, EG: Egypt, BEA: Belgian Africa, Thai: Thailand, and BU: Burma, while G is economic growth, I investments in education and E is education enrollment.

5.5. Colonial Types and Powers as Explanations of the Existing Relationship between Educational and Economic Development

Amid the ongoing challenges, African countries continue to direct a significant fraction of their budget towards higher education (CHE 2004; Muricho & Chang'ach 2013). However, due to the financial crisis that took place in the 1970s, which further worsened in the 1980s, public higher educational institutions across the continent were inevitably compelled to seek for external help even though the funding granted came with conditions that demanded changes in the education policies and systems (Hahn 2007). Nonetheless, the insolvency that created this desperation has been blamed on senseless spending, squandering of public resources, bad governance structures and leadership, poorly formulated economic policies, and corruption by the elite class (Hanh 2007). That is, the funding that was received inevitably established a platform that economically and educationally sustained the colonial-era policies and practices and promoted neocolonialism (Akala, 2021). Nonetheless, the results report positive correlation in the post-colonial period between education and economic development as shown in Figure 5.3 especially for British Africa.

Figure 5. 3 The colonial relationship between economic and educational development for the period 1905 till 1956.



Note. Following Acemoglu, Johnson, and Robinson (2002), the log of population has been used as a proxy for colonial development.

On that note, the sub-sections that follow examine the impact that neocolonialism has had in Africa on the post-independence relationship between educational and economic development within

each empire. Figures A.7 till A.10 represent the lag coefficient impacts of the first lag of GDP per capita including financial markets, industrialization, and human development index on higher education enrollment and investments in education by empire. The empires in consideration are as follows: French, Portuguese, and British Africa including, South Africa, Burma, Ethiopia and Liberia with Thailand, French Indochina and Brazil as test cases. The results broadly show that the higher the economic growth, the higher the relative change in educational development. Discussions that follow comprise of Bayesian estimates, descriptive analysis and the relevant literature as the interpretation of regression estimates follow and are in line with the work by Cai et al. (2023), Zungu et al. (2023), and Sznajderska et al. (2023).

5.5.1. British Africa

The period of the financial crisis in 1970 worsened by the 1980s and compelled higher education institutions in Africa to seek for external aid (Hahn 2007) even though the funding granted came with conditions that demanded changes in the education policies and systems. In response to Africa's desperation, structural adjustment programs (SAP) were initiated in the 1980s and was founded on three long-term goals, which are: increase the gross national product (GNP) by increasing productivity; obtain fiscal stability by aligning expenditure with the available resources as a result of implementing restrictions on fiscal and monetary policies; poverty reduction by prioritizing economic investment and reducing public expenditure that was directed on basic education, health cases, food and social services. The mentioned limitation imposed under SAP is strongly visible in the results, looking at Figure 5.4, no material change is observed on the relationship between economic growth and expenditure in education in British Africa when compared between the periods 1970 - 2000 and 2001 - 2021, while the link between economic growth and higher education enrollment further deteriorates by 31% even as the correlation between higher education enrollment and expenditure in education also drops by approximately 40%. The fact that the relationship between economic growth and expenditure in education remains the same and the higher education enrollment link towards both economic growth and education expenditure drops drastically shows a possible reduction in enrollment possibly due to unavailability of government expenditure in education. Moreover, in Figure A.1.9, there is almost no GDP per capita effect observed on expenditure in education for the periods 1980 – 2021. But

when a break point⁶ is applied in the year 2000, estimates for the period 2001 – 2021 remain insignificant, while for the period 1980 - 2000 the impact leads to a slight positive reaction. There is no higher education development reaction noted when GDP per capita changes. The effect of financial markets development on expenditure in education in Figure A.1.10 is positive and recurring in all time periods, while higher education development reacts positive only for the period 1980 -2021 and 2001 - 2021 but for the period 1980 - 2000 no reaction is observed. The impact of human development index on educational development leads to a positive and continual⁷ expenditure and enrollment reaction for all periods as seen in Figure A.1.11. In contrast, there is no industrialization effect seen in Figure A.1.12 on educational development as all posteriors of the coefficients are mostly at zero.

The reduction in public expenditure in basic education with no funding for higher education as was implemented under SAP explains the overall educational development disconnection from GDP per capita, financial markets and industrialization. Therefore, this shows the long-term disruptive effects that SAP policies continue to have on higher education expenditure as it can be seen that the negative effects still overshadow any positive changes that were made thereafter.

With the SAP policy, international financiers stifled higher (university) education in Africa. For example, in its policy paper, “Education in Sub-Saharan Africa: Adjustment, Revitalization and Expansion,” a further reduction of university enrollment was imposed by the World Bank. The argument put forward by the World Bank to support the mentioned policy was fiscal consolidation, which resulted in three different reforms: transferring the cost of university education largely to parents and students; reducing unit costs; and shrinking public sector participation in favor of the

⁶ **Break point:** A break point during the year 2000 allows for the impact of SAP and PRPS policies to be independently assessed since SAP was effective during the period 1980s till 1999, while PRSP was introduced in 2002 (Akala, 2021; Matasci, et al., 2019). Moreover, since SAP policies were designed to entirely disrupt higher education development and PRPS policies supported basic education, it is expected that results for the period 2001 -2021 should be most favorable as compared to 1980 – 2000 in countries that were victims of both adjustment programs. However, that would not be the case for a country like South Africa as it was not part of the SAP. Furthermore, apart from the break point being used as a control, it also served as a test for robustness (Ravnik & Zilic, 2011).

⁷ **Bayesian estimates [Figure A.1.9 till A.1.40]:** The interpretation of Bayesian estimates are in line with the work by Cai et al. (2023), Zungu et al. (2022), and Sznajderska et al. (2023) and can be broadly interpreted as follows: an effect is regarded as positive when the impulses appear on the right of the symmetrical line; an effect is regarded as negative when the impulses appear on the left of the symmetrical line; when the impulses are almost or exactly at the symmetry line or zero, then it referred as insignificant. Other than that, if the impulses follow a vertical line then it is either continual, persistent or recurring and if the impulse follows a diagonal trend, then it is either diminishing or emerging depending on whether the horizontal line is towards or away from the line of symmetry. An effect is referred to be volatile when the impulse is meandering.

private sector (World Bank, 1988). Thereafter, in 1994 the World Bank reaffirmed its stance on “Higher Education: The Lessons of Experience” (World Bank, 1994), by further promoting neoliberalism with the main objective of their policy focusing on the marginalization of university education relative to other educational sectors.

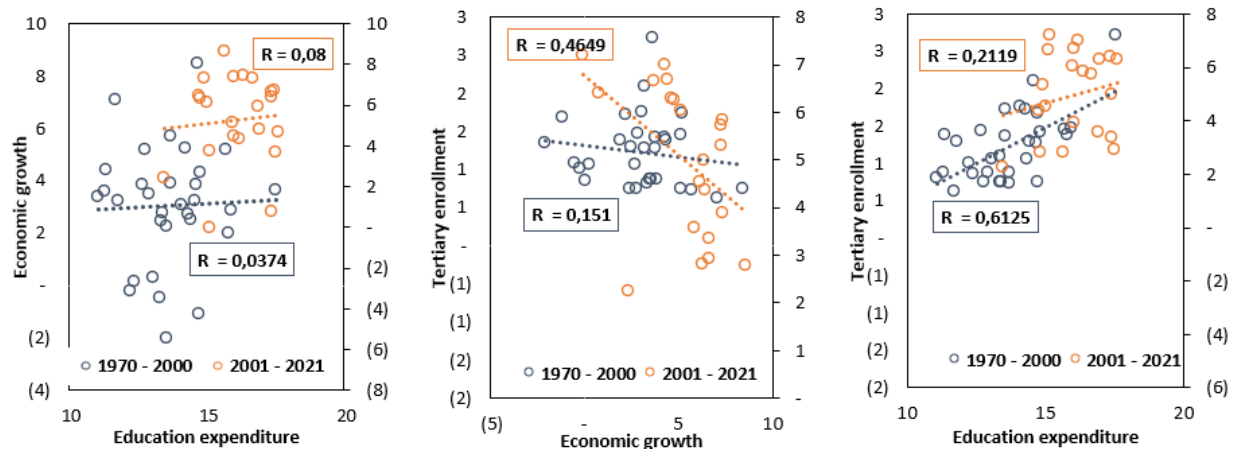
Later in 2002, the World Bank, together with its partners, introduced Education for All (EFA) Fast Track in low-income countries as an effort towards financing education strategies which was part of the poverty reduction strategy papers (PRSPs). PRSPs aimed at reducing levels of absolute poverty by treating education as a basic human right, expansion of access, quality improvement, cost reduction, promotion of social and cross region equity and improving efficiency in services such as education, health, agriculture and rural development, basic infrastructure, good governance, macro-economic strategy and financial (GoM 2001). Going by the results for the period 2001 – 2021, the effects of PRSPs policies seem to have been less stringent on university education as an impact of economic growth on both higher education enrollment and expenditure in education is positive and recurring. This then shows the impeding role that SAP and PRSPs policies have played in slowing down higher education development and discouraging African governments from investing in education and thus negatively impacting economic growth in these colonies as the relationship between economic growth and higher education enrollment has remained negative with a further deterioration. This is further supported by the estimates on effect of GDP per capita on educational development which is slightly positive for the period 1980 - 2021, however, the impact drops to zero when estimated for either 1980 - 2000 or 2000 – 2021 as seen in Figure A.1.9. The impact of financial markets index is inverse towards education expenditure and enrollment with the latter being negative for the entire and split periods, see Figure A.1.10. A slight positive effect is observed on educational development is seen from both human development and industrialization index which is least pronounced on the latter as supported by estimates in Figures A.1.11 and A.1.12.

The discussed results largely show the aftereffects of the major restructure that took place in these universities after these changes were implemented which subsequently impacted the access and management of these institutions as the cost was externally subsidized. Education becomes reconceptualized from an inherent public good to a market good with value only to the global economy. The introduced changes evidently transmute and makes education an economic venture

and investment (Murunga 2007; Saunders 2015; Ward 2012) rather than a public good as it was when it was still yet funded by the government (Brown 2015; Ward 2012), thus, promoting marketisation, corporatization, commodification and the consumerism rationale of higher education institutions (Hahn 2007). Subsequently, a form of secondary colonialism is identified as the involvement of the mentioned international bodies in managing higher education institutions in Africa is conditioned on African countries adhering to stringent economic policies (Hanh, 2007; Collins and Rhoades 2010) hindering economic development.

This is undoubtably evident in Figures A.1.9, A.1.10, A.1.11 and A.1.12, as the implementation of SAP and PRSPs contributes in changing the impact of expenditure in education on past expenditure in education from being positive to correlating strongly negative with the expenditure in education for the past year for the period 2001 till 2021. The same observation is also true for the impact of higher education development on higher education development for the previous year. Moreover, in the human development regression estimates, the effect of higher education enrollment on higher education enrollment for the past year drops by approximately half.

Figure 5. 4 British Africa's correlation between economic growth and education enrollment.



For example, due to the introduced policies that limited both intellectual freedom and focal responsibility, East African institutions of higher learning in Makerere and Dar es Salaam resorted in cancelling their declarations in 1990 as they were at risk of political uprisings. Muleke et al. (2017) used a descriptive survey design study with 316 participants (made of 4 educational officers, 8 policy makers and administrators including 296 secondary teachers) which established the effects of neocolonialism on the O-level Education policies in Uganda. Their findings show

the negative impact that neocolonialism has had on educational policies at O-level Education in Uganda. They conclude that local Ugandans benefit less from neo-colonially influenced educational policies at O-level education as they are designed to directly meet the global markets demands. In Figure 5.5, the impact that the cancelation had in Uganda and Tanzania is apparent and mostly in the latter as after withdrawal the economic growth association towards expenditure and overall enrollment in education in Tanzania improved by 20% and 13% respectively. The improvement in Uganda's expenditure in education is not visible in economic growth possibly due to governments limited expenditure in higher education; however, the disassociation between economic growth and education enrollment lessened by 26%.

However, other universities like those in Kenya and South Africa that did not cancel have witnessed a compromised quality of education that has depleted the available human and physical capital and increased indebtedness. That has made students in Kenya to be categorized as either parallel (paying) or conventional (non-paying) which has inevitably marginalized conventional students in different levels such as those that are parallel receiving more academic attention from lecturers than the rest (Mamdani 2007, 2008; Murunga 2007). As a result, Kenyan universities are known for offering courses that are poorly structured as well as misaligned with knowledge in similar fields of study (Wangenge-Ouma 2012; Murunga 2007) that largely explains Kenya's disconnection between higher education development and expenditure in education by 62% as supported by Figure 5.6.

Figure 5. 5 Changes in relationship between educational and economic development in Uganda and Tanzania before and After cancellation of partnership.

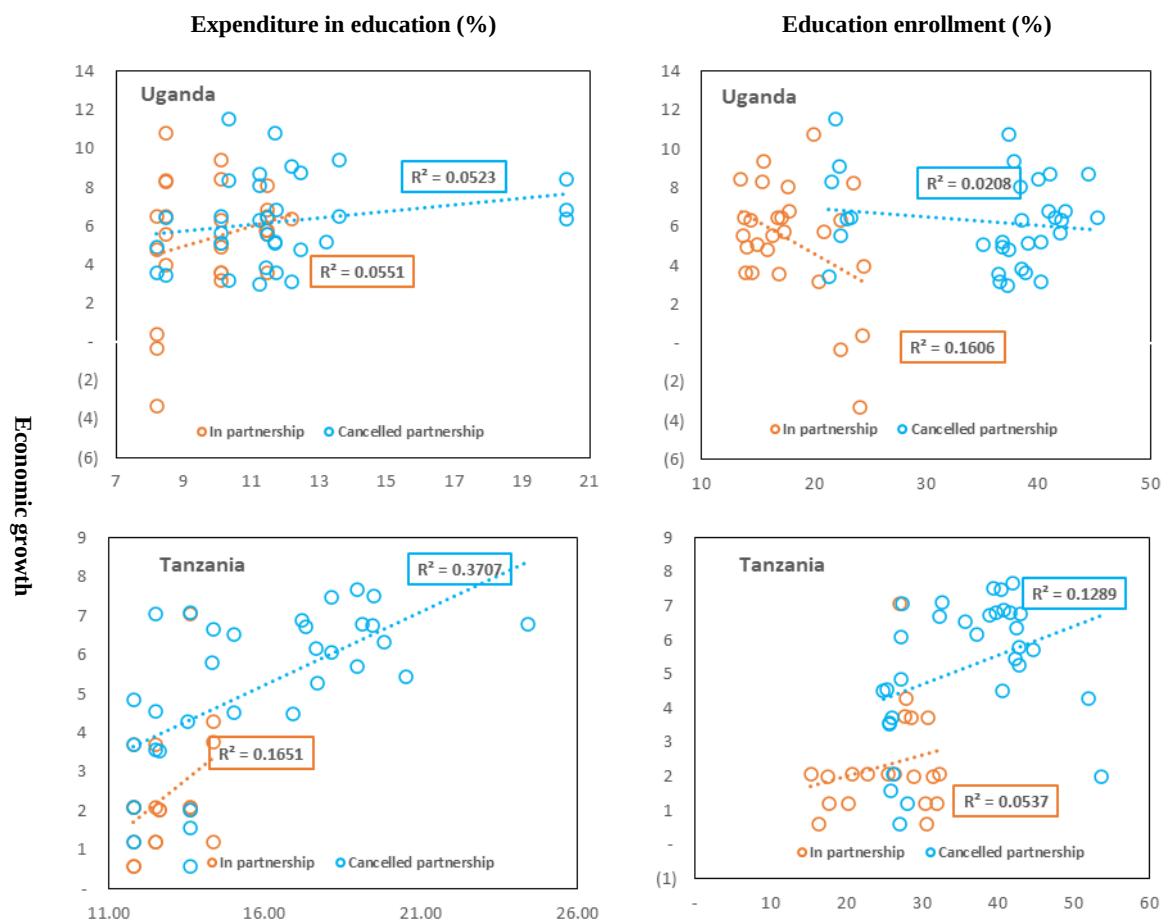
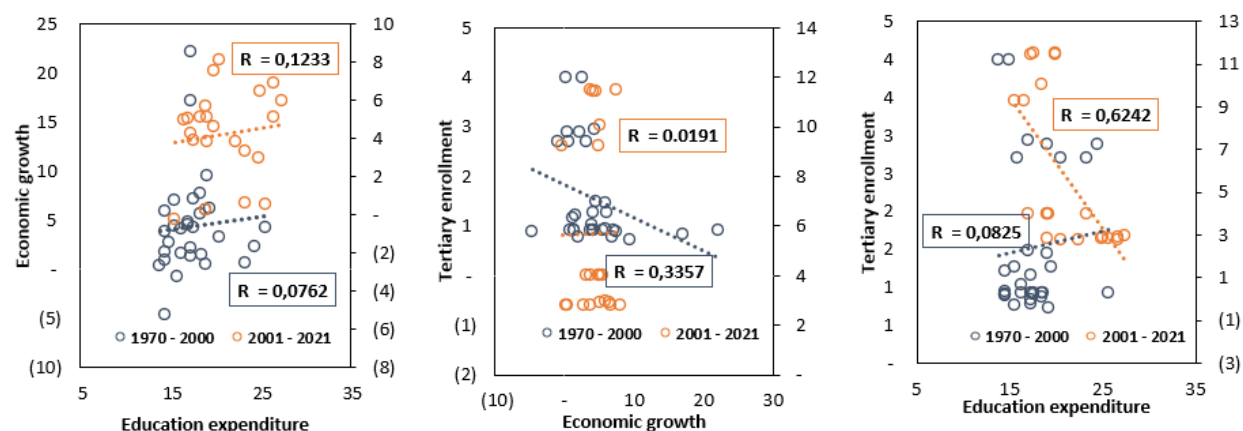


Figure 5. 6 The relationship between economic and educational development for the period 1970 till 2021 for Kenya.

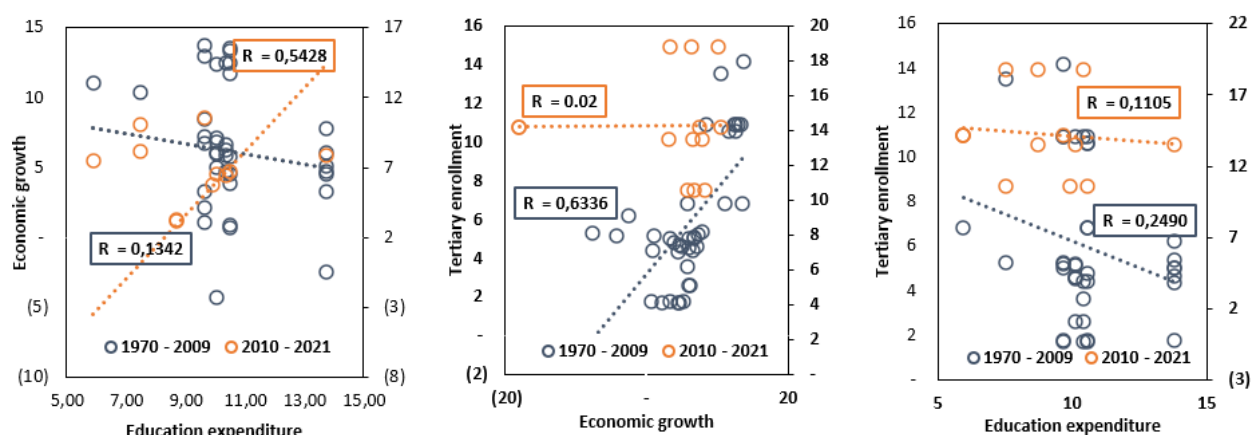


In the case of Burma, as it's also a former British colony, when comparing the period 1970 - 2000 with 2001 - 2021, a similar change is observed in the relationship between economic growth with education expenditure and higher education enrollment by approximately 41% increase and 63% decline, respectively, as seen in Figure 5.7. An improvement of about 13% is observed between higher education enrollment and expenditure in education. Moreover, the impact of GDP per capita on either expenditure in education or higher education enrollment leads to a recurring positive reaction which is more pronounced towards the latter as seen in Figure A.1.13. These results clearly demonstrate the impact of Burma's 2010 transition from an authoritarian military rule to a parliamentary democracy as during its former regime higher education was positioned as a catalyst for development even as supported by strong positive relationship between economic growth and higher education development. This change placed pressure on Burma as a nation to meet both regional and international expectations. However, policies reforms were implemented without considering the nations' values by first accounting for economic growth, human rights and national identity (Couch 2019). The changes seem to be already negatively impacting Burma's economic growth as it is presently less connected to higher education development. That even with no financial markets results due to unavailability of data, however, because GDP per capita effects on education development are similar with those of British Africa as seen in Figures A.1.13 and A.1.14 which strongly supports the observation made. Also, no effect is seen on educational development from human development index for most periods expect for the slight positive impact that is noted on higher education enrollment for the period 1980 – 2021 as supported by Figure

A.1.15. In Figure A.1.16, a slight positive industrialization index effect is seen on education expenditure and enrollment with results more pronounced on the latter.

Moreover, Burma's higher education policies have now been altered to suit international standards and to support international research (Howson & Lall, 2019), which discriminates on universities as regional institutions are abandoned in the process. As it can be seen in Figures A.1.13 till A.1.16 that expenditure in education and enrollment are not correlated to their history for the past year during the period 2000 till 2021 as it is for the period 1980 till 2021 where they were strongly and positively correlated with expenditure and higher education enrollment for the past year, respectively. Consequently, the impact of neoliberalism is progressively increasing the urban and rural divide and has compromised equality further intensifying the stratification of the system. On the other hand, introducing private higher education system inevitably increased enrollment, however, it is at the cost of quality and concern for public value (Baćević 2014; Couch 2019; Dodge 2013). Therefore, although regression results could not be controlled for the transitional period, despite being descriptively possible, they strongly and evidently show the negative impact of the neoliberal higher education policies in Burma's economic growth as supported by the deterioration observed in the link between higher education with economic growth and expenditure in education in Figure 5.7. In the long- run the imposed reforms in Burma's higher education will further worsen their already compromised education system and become entirely regarded as a commodity (Giroux 2004) as it is already the case in nations that have been long under neoliberalism with some in Africa being amongst the victims.

Figure 5. 7 Burma's correlation between economic growth and education enrollment.



5.5.2. Portuguese Africa

In Portuguese Africa, the change in the relationship between economic growth with expenditure in education and higher education enrollment is mixed, showing a 40 % increase and 72% decline, respectively, from the period 2001 - 2021 to 1970 - 2000 as shown in Figure 5.8. Moreover, the correlation between higher education development and expenditure improves by 28%. The reported change in the relationship between economic growth and educational development strongly suggests a reduction in higher education levels with slight increase in expenditure in education.

Regression estimates broadly magnify the observed such that, in Figures A.1.37 and A.1.40, no GDP per capita or industrialization effects are observed on either expenditure or enrollment in education at any period as all posteriors of the coefficients are confidently at zero. The impact of financial markets on expenditure in education is negative and continual in all time periods as seen in Figures A.1.38. There is no financial markets index impact detected on higher education development for the period 1980 - 2021, while when the period is divided estimates remain the same for the period 1980 -200, however, for the period 2001 and 2021 effects become strong and continually negative. In Figures A.1.39, expenditure in education does not respond to a human development index impact during the period 1980 - 2021, whereas effects are inverse for the period 1980 - 2000 and 2000 - 2021 with the latter being negative and recurring. Moreover, the response

of higher education development to a change in human development index is positive and continual for the period 1980 - 2021 as well as within split periods, 1980 - 2000 and 2001 - 2021.

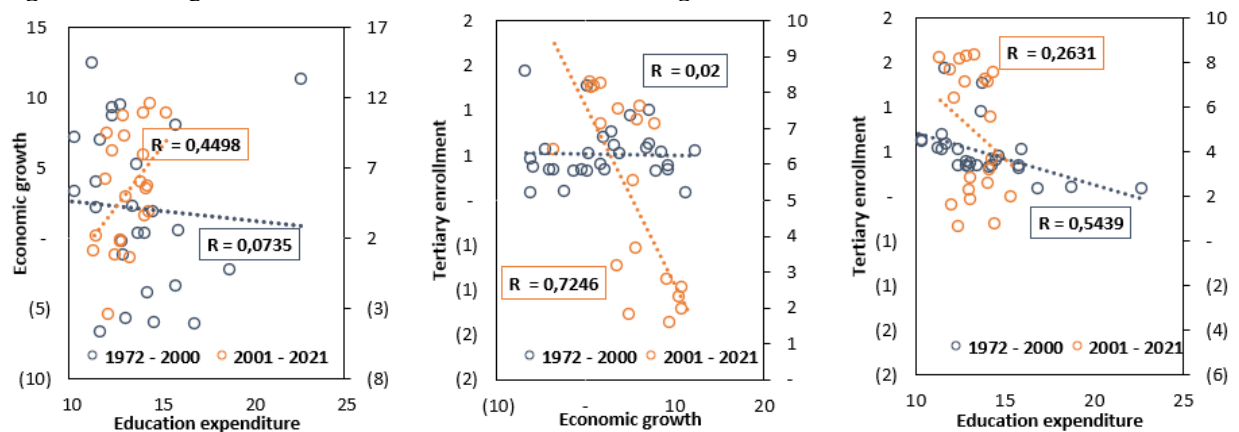
That then could possibly suggest that governments in countries that are under Portuguese Africa could be implementing policies that reduced higher education enrollment while at the same time making an effort to increase education investments. This is visible in the estimates, more specifically in the GDP per capita regression, in Figure A.1.37, where expenditure in education correlates positively to expenditure in education for the past year, whereas when the period is halved estimates are negative for the period 2001 - 2021. Moreover, the effect of education enrollment on expenditure in education is continual and inverse for the periods 1980 - 2000 and 2002 -2021 with the latter being negative, whereas for the entire period expenditure in education reacts negatively.

Similarly with the financial markets and industrialization regressions, higher education enrollment correlates strongly and positive with enrollment for the past year during the period 1980 - 2021, whereas when estimated within split periods, effects drop to even almost to zero for the period 1980 – 2000 as seen in Figures A.1.38 and A.1.40. Thus, strongly showing that countries under Portuguese Africa seem to be investing less in higher education as well as limiting enrollments.

The observed disconnection between economic and educational development is still highly related to the higher education development restrictive policies that were implemented under the SAP and PRSPs as issued by the World Bank. Nonetheless, other effects of neoliberalism cannot be omitted because as it stands, there exists a power relation between Portugal and its former African colonies that makes the Portuguese development corporation and aid to the African benefiting countries neocolonial in nature. For instance, these power relations are also visible in non-governmental organizations (NGOs) that were and have been established by Portugal in Africa after independence, such that, these NGOs are entirely dependent on project applications that originate from international and national agencies for financial support (Maher, 2023). As a result, the mentioned impeding factors seem to be also negatively affecting both financial markets and human development. Neocolonial disruptive effects are also seen in the estimates, in Figure A.1. 37, where the impact of expenditure in education on GDP per capita is positive and recurring for the periods 1980 - 2021, 1980 - 2000 and 2001 - 2021 with the latter being the least pronounced. The reaction of GDP per capita to an education enrollment effect is almost insignificant for the period 1980 - 2021, whereas when

estimated on a split period, results become inverse in the periods 1980 - 2000 and 2001 - 2021 with the latter being strongly negative. The only higher education development effect on financial markets development is negative and it is during the period 1980 - 2000, while the impact of expenditure in education is slight and negative across all periods as seen in Figure A.1.38. In the financial market's regression, it's quite different, as expenditure in education is not correlated with education investments for the previous years for the periods 1980 - 2000 however positive in all other periods. The educational development impact on industrialization in Figure A.1.40 is positive and continual over the entire and divided period, however higher education enrollment effects drop significantly in the period 2000 - 2021. On the other hand, no disruption is observed towards human development index as the effects of educational development on human development is positive and recurring for the entire and split periods as seen in Figure A.1.39.

Figure 5. 8 Portuguese Africa's correlation between economic growth and education enrollment.



For instance, after independence Mozambique's government opted to follow a socialist path (Newitt, 2017; Müller 2014); in 1976, however, the lack of material, financial resources as well as qualified national cadres impeded the ambition that the Mozambique Liberation Front (FRELIMO) had put in place with education being politically perceived as the driving force for social and economic progress. Therefore, FRELIMO's education policy focused on addressing the unequal education gap that was inherited from the colonial period which was evident as in 1970 about 98% of Mozambique's population was African but only 1-2% of university student were Africans by 1975. However, its educational institutions were in short of skilled workers required to educate the indigenes as about 200, 000 – 250, 000 Portuguese citizens had left the country by 1976, which

depressed educational development resulting in a significant loss of technical knowledge as well as the expertise in state administration and economy. This largely explains the observed reaction on expenditure in education in the period 1980 – 2000 which dropped due to a change in economic growth.

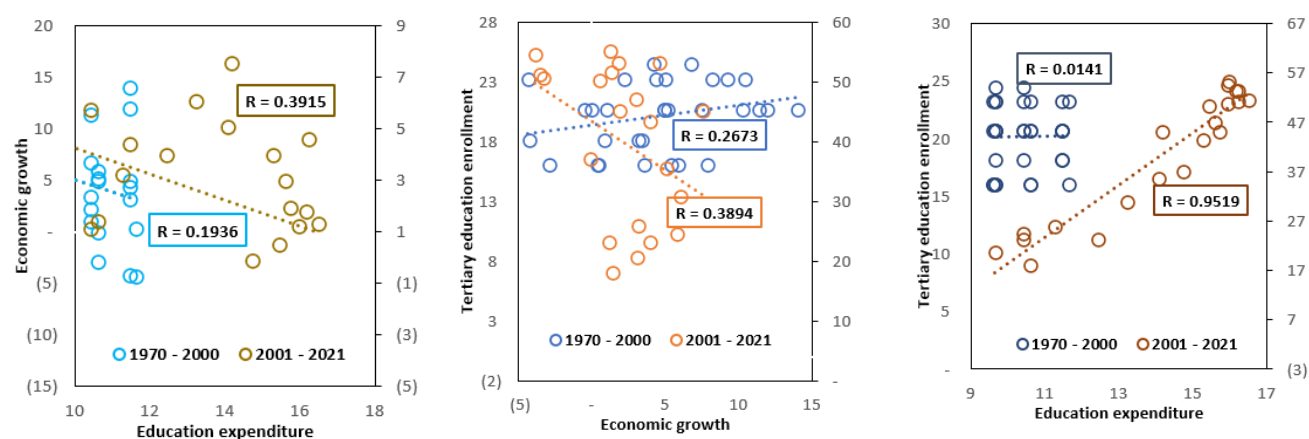
With that, FRELIMO resolved to rely on educational aid⁸ from socialist and non-socialist states with the socialist bloc, the German Democratic Republic (GDR) as one of its major providers for educational development (Matasci, et al., 2019). Following that, the aid that was received played a role in Mozambique's educational history as well as in the running of its only institution of higher learning, the Eduardo-Mondlane-University (Universidade Eduardo Mondlane—UEM) which opened for numerous East German aid workers to assume “solidarity” tasks at the UEM in the 1970s and 1980s (Matasci, et al., 2019; Bilale, 2007; Müller 2014). However, due to FRELIMO's socialist ambitions, the regulation of the education policies and systems were designed to only favour students with worker-peasant backgrounds for entry to university which greatly limited enrollments. Also, the role German advisors played towards the establishment of the first post-colonial educational system in Mozambique remains recognized (Molla, 2014). However, FRELIMO's reluctance towards "socialist solidarity" in higher education hindered the long-term impact of social aid on the development of higher education. Thus, this might explain the deteriorated relationship between economic growth and educational development from the period 1970 -2000 to 2000 - 2021.

However, it would seem that the weak relationship between educational and economic development worsened after Mozambique compromised its socialist regime by embracing neoliberal macro-economic strategies in the 1980s which introduced structural adjustment programmes (SAP) (Matasci, et al., 2019). This opened doors for international development agencies such as the World Bank and International Money Fund (IMF) to impose their education financing policies to Mozambique's development strategies such as Education for All (EFA) and the Millennium Development Goals (MDG) initiatives in the early 2000s through poverty reduction strategy papers (PRSP) which led authorities to be dependent on the new investments strategies that promoted neoliberalism values (Matasci, et al., 2019; Bilale, 2007). Consequently, these neoliberal strategies have increased the urban-rural divide and inequality as well as deepened

⁸ Cross, *An Unfulfilled Promise*, 50–59, 74

stratification which inevitably has greatly disadvantaged Mozambique's subsequent educational development (Chissale and Cross, 2014). This is supported by the results which show an increased disconnect between enrollment in higher education with both economic growth and expenditure in education. Therefore, this indicates that these neoliberal policies have led to the lack of interdisciplinarity diversity in Mozambique's educational development amid the ongoing education reforms. The inverse relationship between policy and change in the Mozambique setting largely explains the incoherence observed such that even as investments in education increase, there are high dropouts and repetitions rates due to an inefficient education system established under SAP and PRSPs.

Figure 5. 9 The relationship between economic and educational development for the period 1970 till 2021 for Brazil.]



Brazil is another fitting example of a non-African country also colonized by the Portuguese and another victim of the same type of neocolonialism (Murunga & Nasong'o 2007; Torres 2011). In this case, the World bank (WB), World Trade Organization (WTO), Organization Cooperation and Development (OECD) continue to influence the development process through their ongoing involvement in Brazil's higher education and state policies (Junior, et al., 2023; dos Santos & Guimarães-Iosif, 2013). The involvement of these international bodies in Brazil's higher education have ignored the public polices of the South and resorted in promoting the hegemonic culture of the global north by internationalizing education which is aimed at distancing a nation from its social issues by prioritizing the demands of the international funding agencies and those of the

global market (Junior, et al., 2023; dos Santos & Guimarães-Iosif, 2013). This is also supported by the perpetually deteriorating relationship between Brazil's economic growth and public spending in education as seen in Figure 5.13, which shows that Brazil continues to increasingly depend on external funding which inevitably implies that higher educational institutions in Brazil are being privatized and marketized at inclining rate and largely continues to impede economic growth as seen in Figure 5.13 that during the period 2001 -2021 any development in higher education leads to a significant reduction in economic growth.

5.5.3. French Africa

Within French Africa, most countries like Mali and Guinea opted for an alternative educational system after independence as the French colonial education system was not suitable for the post-independence development plan (Ochwa-Echel, 2013). For Mali, the new education system adopted was aimed at promoting and improving the quality of education, rehabilitate cultural values and decolonize the minds of locals (Yena, 1978). Thereafter, reforms were put in place with the objective of establishing an Africa-centered education system, however due to the already discussed higher education financial crisis of the 1980s, most reforms were unsuccessful with the World Bank as the only resort. This can evidently be seen in the results, in Figure 5.10, it can be seen when the period 2001 - 2021 is compared to 1970 till 2000 that the relationship between economic growth with higher education enrollment and expenditure in education improved by 33% and 10%, while a 10% increase is also observed on the link between expenditure in education and education enrollment. More specifically, the impact of GDP per capita on expenditure in education remains negative and recurring throughout the period 1980 – 2021 even when a breakpoint is applied in the year 2000, while the same reaction but slight is observed on higher education enrollment during the period 1980 – 2021 and 2001 – 2021, however, the effect for the period 1980 – 2000 is neutral as seen in Figure A.1.29. Moreover, the effect of financial markets, human development index and industrialization as seen in Figures A.1.30 till A.1.32 for the periods 1980 -2021 remains recurring, and slightly positive apart from the inverse impact that is seen in the period 2001 – 2021 when a break point is applied in the year 2000.

The aftereffect of the French colonial education system largely explains the weak economic and educational development link in the first period 1970/80 - 2000, however, the change in the education system seems to have initially relieved French African colonies from the colonial

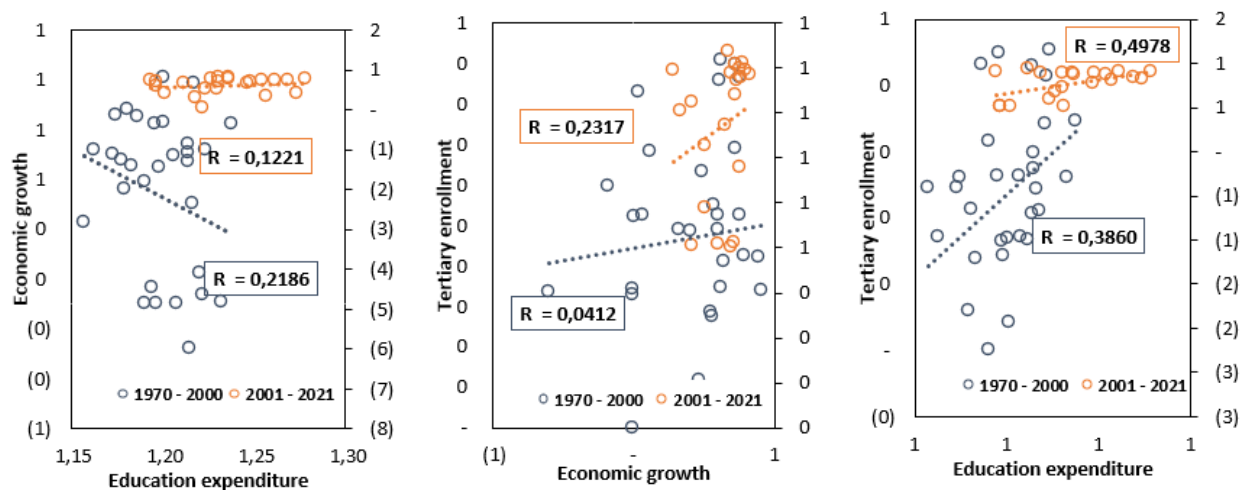
education system that was designed only to educate a few elites (Cogneau and Moradi 2014; Frankema 2012). This can be seen in Figure A.1.29, where the impact of GDP per capita on expenditure in education is slightly negative but almost zero, while no higher education enrollment is noted due to a change in GDP per capita at any period. Financial markets development effects on either expenditure in education or higher education development lead to a volatile and positive reaction for the period 1980 – 2021, see Figure A.1.30. However, when a break point is applied to the period, estimates become less apparent for the period 2001 - 2021. In Figure A.1.31, no reaction of expenditure in education is observed due to human development index effects in the period 1980 - 2021, whereas when the period is divided estimates are recurring and inverse between the period 1980 - 2000 and 2001 - 2021 with the latter negative. Moreover, the response of higher education enrollment to a change in human development is slightly positive, whereas within the split period's effects remain the same for the period 1980 - 2000 but for 2001 - 2021 the reaction of higher education enrollment drops to zero. On the other hand, no industrialization impact is observed on educational development at any point as supported by Figure A.1.32.

These results show that the subscription of these colonies into the SAP and PRSPs adjustments policy by the World Bank soon thereafter negated the improvement that was noted immediately after independence leading to the observed continual and negative higher educational development reaction during the period 2001 - 2021. Furthermore, in Figure A.1.29, the impact of expenditure in education on GDP per capita is strong positive and continual for the complete period as well as when a break point is applied, while the effect of higher educational development produces a positive and recurring GDP per capita reaction for the periods 1980 - 2021 and 1980 - 2000 with the latter being more pronounced. In contrast, there seems to be almost no effect for the period 2000 – 2021 from higher education enrollment to GDP per capita with posteriors of the coefficients confidently at zero. There seems to be almost no educational development impact on financial markets development apart from the slight positive effects from higher education enrollment during the period 1980 – 2000, see Figure A.1.30. In Figure A.1.31, human development index reacts positively to both expenditure and enrollment in education with the latter less apparent in all periods. Industrialization responses positively to expenditure and enrollment in education during the period 1980 -2021, whereas in the split periods the reactions remain the same for the period 2000 - 2021, however, drastically drops for 1980 - 2000 with completely no impact from expenditure in education as seen in Figure A.1.32.

These results reveal a disconnection between educational and economic development that strongly links to the involvement of France, World Bank and other international bodies in French Africa as the incidence of disruptions are shared across the periods just after independence and during the adjustment programs which inevitably narrows down to neocolonialism. More evidently, in the GDP per capita regression, in Figure A.1.29, expenditure in education does not correlate with expenditure in education for the past year for all other time periods, as the posterior of coefficients is far from zero apart from the slight positive in the period 2001 - 2021. The effects of higher education enrollment on expenditure in education is positive in both the entire and split periods, while no effect is detected from expenditure in education to higher education enrollment at any period.

In the financial development regression, in Figure A.1.30, the cross-effects of expenditure in education and higher education enrollment are positive in all other periods, while higher education enrollment effects are insignificant during the period 2001 - 2021. Also, in the industrialization estimates, expenditure in education relates positively with past expenditure in education for the period 1980 - 2021, while in the split periods the effects are inverse with those for the period 1980 - 2000 being negative and recurring, see Figure A.1.31.

Figure 5. 10 French Africa's correlation between economic growth and education enrollment.



Additionally, France continued to increase its control by directing development funding to central governments instead of the newly formed sub-state or non-state actors in countries that signed into

this economic and security agreement (Martin 1995). France's refusal to embrace the post-independence economic change in its former colonies in part verifies the observed disconnect between economic growth and higher education enrollment. The fact that France chose to ignore the newly formed states or non-states but rather worked with colonial central governments was their way of preserving the colonially centralized, socialized and free-market-suspicious model of governance that was institutionalized during the colonial era which was in itself a rather vivid case of neocolonialism even though masked otherwise. As a result, this colonial governance model that France has strived to retain inevitably promoted the colonial education system aimed at educating only a few elites (Cogneau and Moradi 2014; Frankema 2012) as well as introducing economic dynamism which made these colonies even more socially and democratically underdeveloped as educational policies were highly colonial since they were designed to directly benefit France. That must have discouraged post-independence initiatives that had been undertaken as a resolution to break free from France.

Further proof of the mentioned continual control is also economically obvious as even decades after independence, the dependency of France on Africa in its energy and import of raw materials increased significantly from 30% in 1950 to 80% for 1988-89 with Gabon and Niger supplying France with 100% uranium towards its nuclear ambitions. For example, the Elf-Aquitaine group, a company based in France, extracts 70% of its oil from African deposits (Martin 1995). However, the benefits of this prolonged relationship between France and Africa seems to be only beneficial to the French (Gibbs, February 2024).

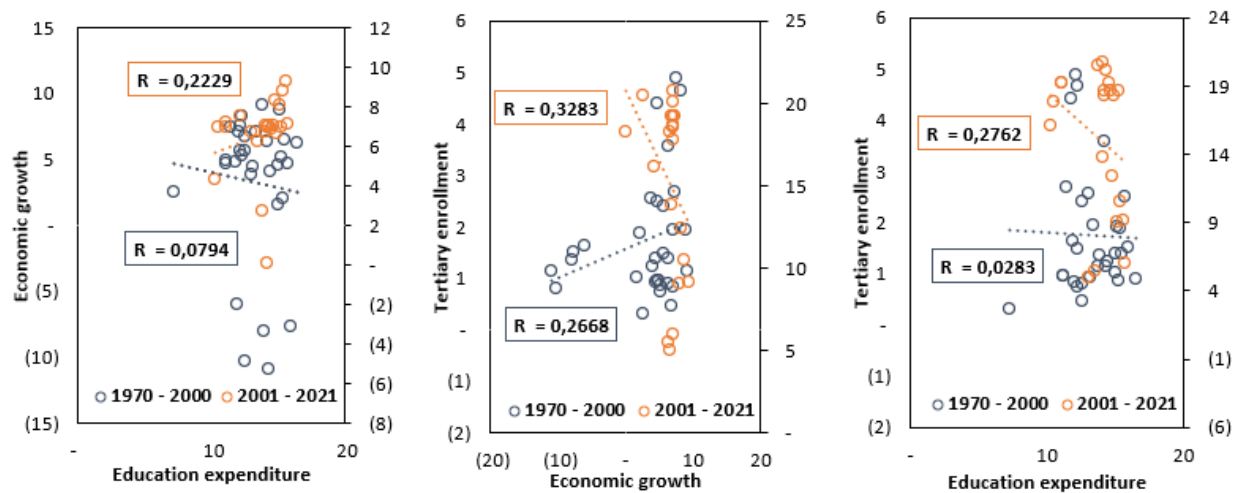
Moreover, the impact of the involvement of other international bodies like the European Union (EU), International Monetary Fund (IMF) and World Bank in French Africa in the 1980s served as a multilateral aid to these former French and Portuguese African colonies by making several attempts to assist in mitigating factors that have been responsible in further increasing the observed development disconnect. However, France opted for an alternative way that would still allow them to maintain their influence in Africa even as they remain members of the EU (Gibbs, February 2024). However, no visible positive multilateral impact is noticed in the results during the period 1980 – 2000 as the results remain negative and recurring.

Nevertheless, France continues to maintain its influence in Africa by promoting its post-colonial political project, which is evident by the recent investments made towards developing transnational

higher education (TNE) (Knight and McNamara 2017) which has been aimed at structuring mobilities of international students (Madge, Raghuram, and Noxolo 2015) and issuing of French degrees. This has been achieved by implementing the Bienvenue en France / Choose France higher education policy (Blanchard, 2009) which was launched in 2018 and is aimed at expanding the French TNE network in Africa. This policy is not only aimed at increasing the number of international students in France but also aids French higher education institutions with developing TNE as they operate as offshore campuses, targeting countries (such as Morocco, Senegal, Cameroon, Côte d'Ivoire etc.) which share a colonial past with France.

However, TNE policies largely resemble French colonial policies as the structures exhibit asymmetric power relations which still promote unequal opportunities amid stringent French immigration requirements. These state policies only promote the migration of migrants who have high utilitarian labor values for the knowledge economy (Bobée & Kleibert, 2022). Consequently, migration policies also have restrictions as they are accompanied by racial and gender inequalities (Kofman 2007; McDowell 2009). Sadly, French policies of managed migration favor students in relation to their economic capital resulting in the exclusion of Africans with lower education and economic capital from Africa (Kabbanji and Toma 2020). The TNE network that France has established in Africa is diverse as it constitutes of French-foreign universities, offshore campuses, academic partnerships, franchises, centers for continuing education, and online education. Moreover, the development and set-up of most offshore campuses is dependent entirely on business and engineering schools which operate independently from the state even as they are designed to enhance French interests within and across its former colonies (Campus France, 2018). This then implies that France has resorted to neoliberalism as these transitional higher education institutions disadvantage local higher education enrollments which inevitably promotes marketization and privatization of higher education as a result economic growth in these colonies is stunted as the recruits comprises of high-ranking scholars with high utilitarian labor values for the knowledge economy.

Figure 5. 11 French Indochina's relationship between economic and educational development for the period 1970 till 2021.



Treating French Indochina as a test case for French Africa as both are former French colonies, it can be seen that the results for French Indochina strongly resemble a neoliberal path. In Figure 5.11, it can be seen from the period 1970 - 2000 to 2000 – 2021 the relationship between higher education development with either economic growth or expenditure in education deteriorates by 76% and 37%, respectively, while a 30% improvement is noted in the relationship between expenditure in education and economic growth.

This roughly suggests that French Indochina is limiting higher education enrollment while attempting to improve spending towards education, however, the overall slight reaction of education development to any change in economic development reveals a disconnection. The fact that an increase in higher education leads to a decline in economic growth and expenditure in education largely suggests signs of marketized higher educational systems. Even more evidently, the reaction of financial markets development to expenditure in education in Figure A.1.34 is positive but drops to almost zero within split periods, 1980 – 2000 and 2001 - 2021, while the response due to a change in higher education enrollment is zero for the period 1980 – 2021, however, within equally split periods the results are inverse with those of the period 2001 - 2021 being negative and recurring. Similarly with GDP per capita and human development index where the impact of educational development is positive for the period 1980 -2021, while when the period is split expenditure in education effects drops significantly in the period 1980 – 2000, see Figure A.1.33 and A.1.35.

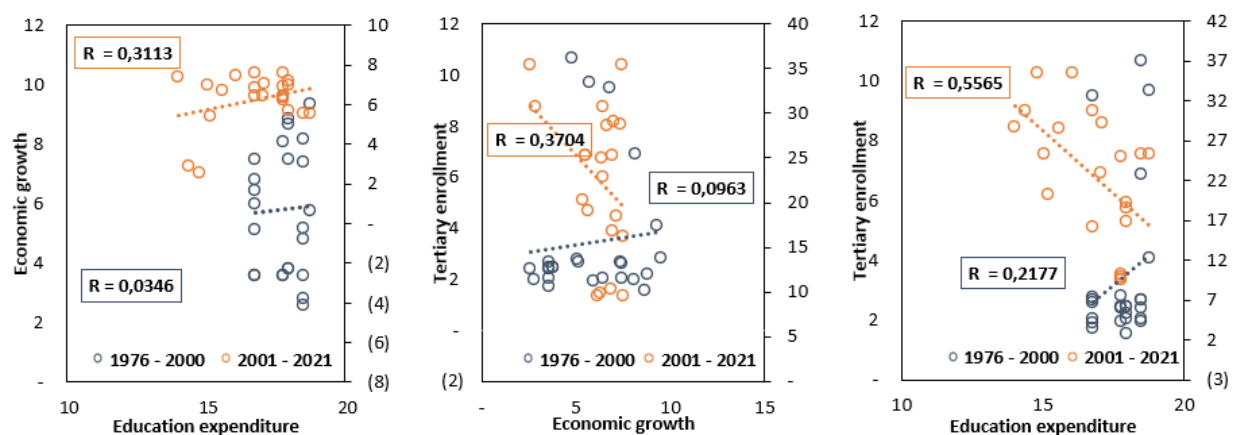
Thus, showing the outcomes of marketization policies that were openly accepted and implemented in the higher education institutions in Western European and North American countries (Theisens 2004, Tilak, 2005a) which eventually led to a drastic increase in the demand for higher education graduates inevitably forcing these higher education institutions (HEIs) to increase their intake (Tilak, 2005a & 2005 b, Theisens, 2004). Increasing intake meant accepting more students, however, this required more funding therefore prompting high taxation as well as stretched state budgets (Theisens, 2004, Tilak 2005a). Eventually, state budgets on social services such as higher education had to be reduced because high taxation and increase in state budgets were regarded as causes of economic problems and were also in violation of the "free market" belief on neoliberalism.

Consequently, the increase in student enrollment strained the governments expenditure in education which meant HEIs had to devise new ways of raising funds which they did by increasing or introducing tuition fees, marketing educational services, reducing research outputs and increasing private funding through privatizing institutions (Slaughter & Leslie, 1997; Theisens, 2004). The fact that there no educational development reaction is seen due either a change in GDP per capita or industrialization index as seen in Figures A.1.33 and A.1.36, respectively. Moreover, the impact of financial markets index on expenditure in education is negating and continual for the period 1980 - 2021, while within split period's the effects are inverse between the periods 1980 - 2000 and 2001 - 2021 with the last being negative as seen in Figure A.1.34. Also, the reaction of higher education development to financial markets index is slightly positive during the period 1980 - 2021, whereas within split periods remain positive but are less pronounce in the period 1980 - 2000. Additionally, in Figure A.1.35, the effects of human development index on expenditure in education is positive and continual, while when the period is split estimates remain the same for the period 1980 - 2000, but for the period 2001 - 2021 there are no effects detected. Similarly with the reaction of higher education development on expenditure in education, however, estimates for the period 1980 - 2000 are insignificant and strongly suggests increased neoliberalism in French Indochina's education polices as the government seems to be spending less and depending more on external funding. This is strongly evident in the industrialization estimates in Figure A.1.36 together with GDP per capita, financial markets index and human development index regressions together with Figures A.1.33 till A.1.36, respectively, as expenditure in education correlates positively with expenditure in education in the past year for the period 1980 -2021, however, when

the relationship is estimated within split periods, effects drop to zero for the period 1980 - 2000. There is also no higher education development effect on expenditure in education during the period 1980 - 2021, while within the split periods estimates only change to negative and emerging for the period 2001 till 2021. Moreover, the response of higher education to a change in expenditure in education is slightly positive during the period 1980 - 2021, whereas within the split period effects drop to zero for the period 2000 - 2021.

Vietnam is an example from French Indochina that also followed a socialist path and after independence during the 1986 economic reforms, its government made exceptions of several marketization policies in its higher education system which eventually were thoroughly implemented at the Vietnam National University- Hanoi (VNU-Hanoi) established in December 1993 (Nguyen 2010). Factors that evidently display the effects of marketization at VNU-Hanoi include cost-effective operations, diversified income strategies, institutional autonomy and a corporate culture as well as the absence of a students' union. These changes have transformed VNU-Hanoi from being a bureaucratic environment to an autonomous institution Mok (2008). The eminence of tuition fees, the commercialization of research activities, the expansion of student enrollment, the consulting services and university-industry partnerships, including the adoption of corporate culture clearly demonstrated that Vietnam's higher education institutions are in the process of marketization. Therefore, aftereffects of neoliberal changes are visible in Figure 5.12 as a drastic deterioration is suddenly noted in the link between higher education development with economic growth and expenditure in education.

Figure 5. 12 Vietnam's relationship between economic and educational development for the period 1976 till 2021.



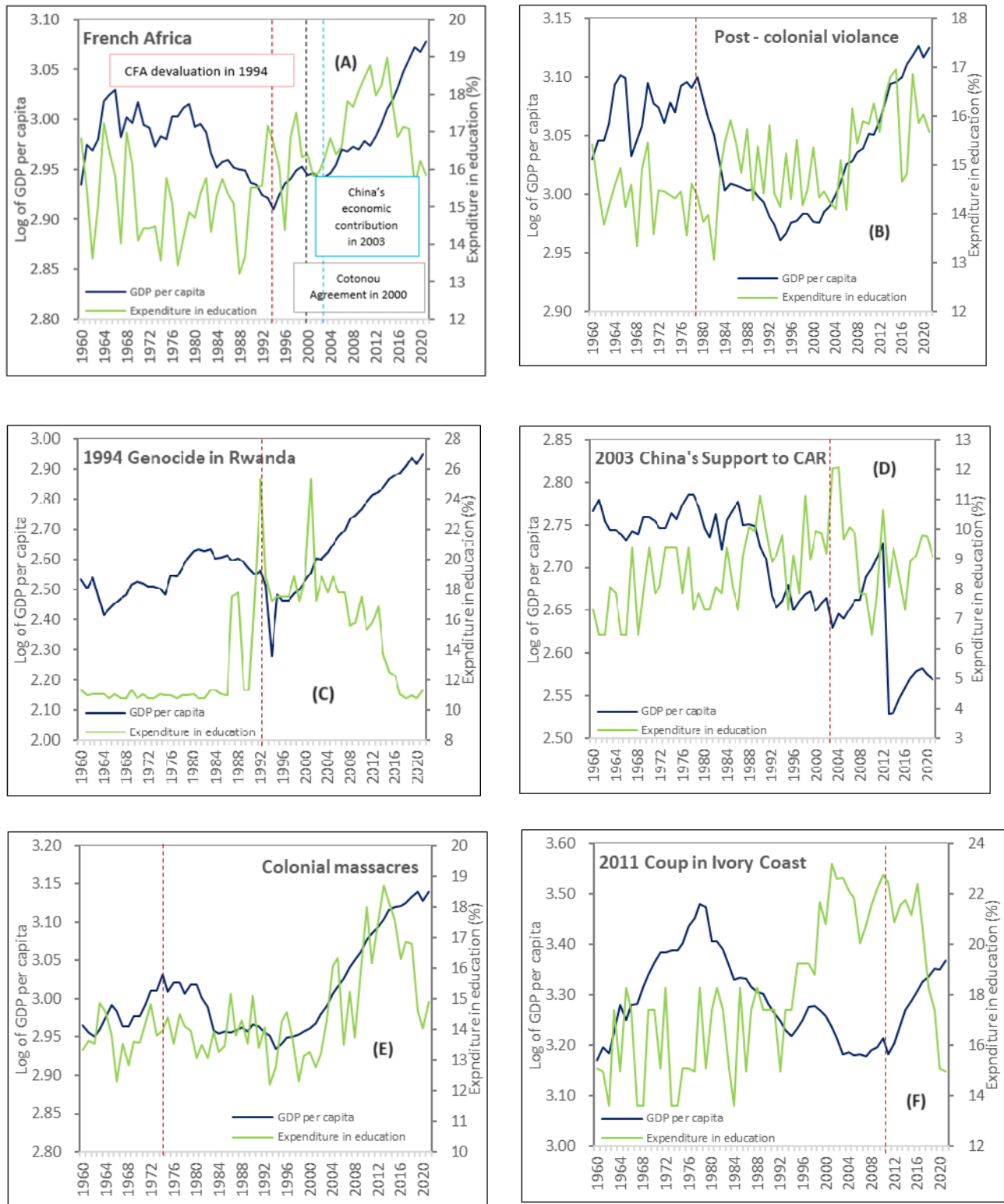
Other major unsuccessful attempts to break the relationship between France and its former African colonies that have been observed include the 100% devaluation of the CFA (Colonies françaises d'Afrique) franc in 1994 as the exchange rate for the CFA franc was artificially high thus slowing economic growth and hindering investment opportunities. After the devaluation, a significant growth in the economies as well as in education investments is noticed as seen in Figure 5.13 (A). Despite all this, the CFA franc is still the regional currency in some Western and Central African countries which makes France the main stakeholder of West Africa's commerce and economy (Gibbs, 2024). The aforementioned together with the Cotonou Agreement on free trade with the EU in 2000 (see Figure 5.13 (A)), which was later revised in 2010 making them the successor to the Lomé Conventions (European Commission 2010) and previously China in 2003, was the second after France in contributing 11% to the Economic Community of West African States (ECOWAS) imports. That then created the possibility of a new Fashoda Syndrome directed at China instead of France's traditional competitors in Africa which could have been a form of intervention to reshape and encourage for possible reforms.

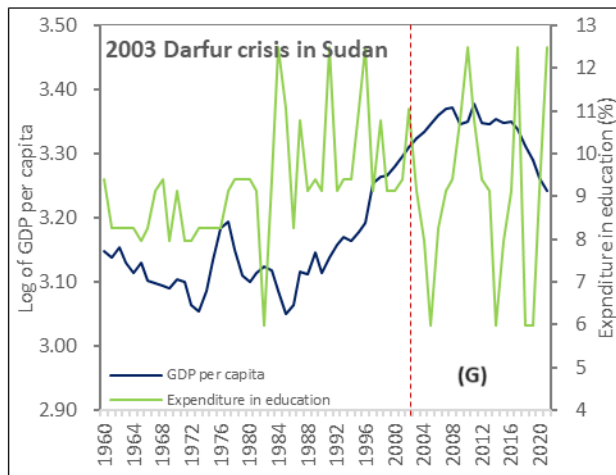
However, China's involvement in Africa seems to have also taken a neocolonial route as the Chinese seem to be using trade as a point of contact to make African ruling elites and governments promote and protect China's mercantilism and businesses in Africa that have posed both environmental and social concerns (Langan, 2017). For instance, the government of Zambia in 2011 backed-down on major tax reforms as Chinese businesses threatened to close-down their operations which are crucial to the Zambian economy. Another point is that extractive and exploitative colonial systems in Africa are highly resembled by China's trade, financial investment and aid that are aimed at mainly facilitating the export of raw materials to China (Balasubramanyam 2015). Another area where a possible neocolonial China is observed is in the illegal military weapons that they supplied, , which fueled the 2003 Darfur crisis in Sudan (Zhu 2017; Chen 2016) which introduced a sharp decline in education investments as supported by Figure 5.13 (G). Also, the mining and telecommunication infrastructure that China built in Central Africa Republic (CAR) in 2003 was security to their economic opportunity and contributed to the extended dictatorial regime and still largely neocolonial in nature as this partly explains the drop in Figure 5.13 (D) that followed, starting with education expenditure thereafter economic growth.

Likewise with France, there have been several post-colonial pitfalls that have made Africans even more resentful towards France due to their political interference and armed interventions. One of these pitfalls is the role that the French forces played by facilitating the training and expansion of the Forces Armées Rwandaises from 1990 till 1993 that eventually resulted in the 1994 Rwandan genocide (McNulty 2000) which largely explain the observed immediate drop in economic growth as well as expenditure in education in Figure 5.13 (C). There was also the incidence where there was a transfer of base sovereignty to Senegal in 2010 followed by the withdrawal of 1200 troops; and the assistance that France had in overthrowing the president of Côte d'Ivoire with UN's endorsement (Howden 2024; Bamford 2010). On the other hand, France has also continued to preserve its colonial cultural legacy by institutionalizing and promoting the use of French language as a way of maintaining its cultural legacy as well as directing most of their development funding towards education, scholarships and cultural institutes that could classify the current relationship that France has with its former African colonies as neo-colonial (Gibbs, 2024). Indeed, studies such as Cooper (2015) have evidenced an existing association between legal, social, and cultural elements of colonialism and economic restructures.

Therefore, the partial transition that took French African colonies from French capitalism to neoliberalism worked to the advantage of these colonies owing to multilateral collaborations between France and its counterparts as supported by the improved relationship between economic growth and education enrollment in Figure 5.10.

Figure 5. 13 The reaction of GDP per capita and expenditure in education to colonial massacres, post-colonial violence, genocides, coups, and political interference.





5.5.4. Liberia & Ethiopia

For Liberia and Ethiopia, as the only African colonies that were never colonized, the correlation between economic growth with either higher education enrollment or expenditure in Figure 5.14 improves by 9% and 10%, respectively, as the relationship between higher education enrollment and expenditure in education also increases by 27%. The results for Liberia and Ethiopia seem to be the most favorable in Africa compared to all other colonial territories as there is an improvement when comparing result from the period 1970 – 2000 against 2001 – 2021 in the relationships between education expenditure with higher education enrollment and economic growth even as the correlation between higher education and economic growth increases as also verified by regression estimate. In Figure A.1.18, the impact of financial markets index on expenditure in education is positive and continual for the period 1980 - 2021, while within split periods effects remain positive for the period 2001 - 2021 but zero for 1980 - 2000. Moreover, the reaction of higher education development to a financial market index effect is continually positive for the period 1980 - 2021, whereas within split periods estimates remain the same for the period 1980 - 2000 but for 2001 - 2021 they drop drastically to almost zero. The effect of human development index on expenditure in education is positive and recurring for the period 1980 - 2021, whereas when effects are considered within split periods the response of expenditure in education is recurring and inverse for the periods 1980 - 2000 and 2001 - 2021 with the latter being positive as

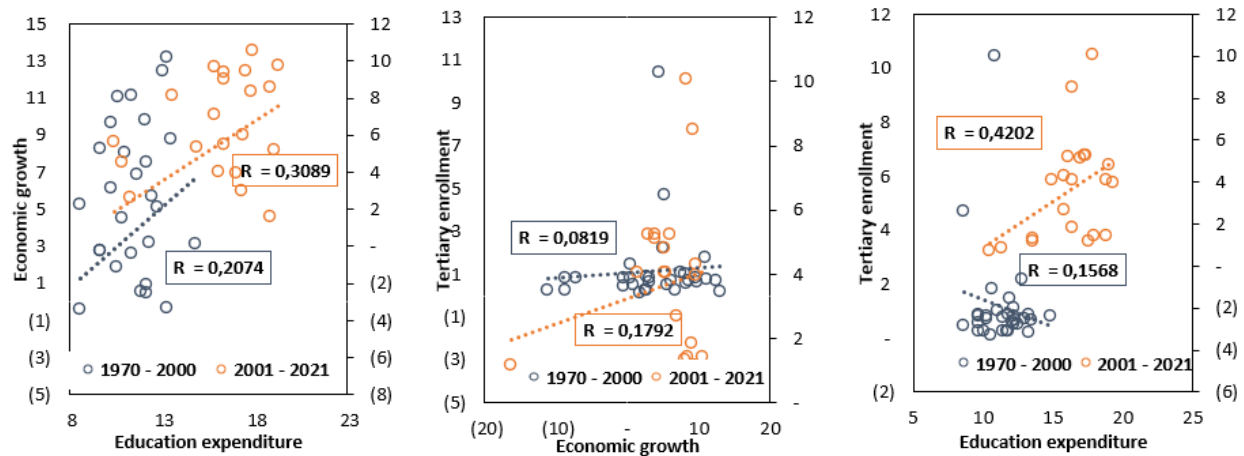
seen in Figure A.1.19. On the other hand, the reaction of higher education development to a change in human development index is positive and continual during the period 1980 - 2021 as well as when the period is split. However, no educational development reaction is seen due to either a GDP per capita or industrialization effect at any point in time as seen in Figures A.1.17 and A.1.20, respectively.

The observed incoherence that is mostly seen on human development index in the period 1980 - 2000 is largely due the disruption that was caused by SAP policies, whereas the negative financial market results for the period 2001 - 2021 are a proof of the role that the PRSPs policies have played. However, the absence of a colonial yoke seems to have protected higher education policies in both Liberia and Ethiopia from the most adverse neoliberal effects as compared to those that were officially colonized. The GDP per capita or industrialization disconnection from educational development for the periods 1980 – 2000 and 2001 - 2021 shows that both SAP and PRSPs policies have mostly been disruptive. Estimates in Figure A.1.18 and A.1.19 verify the abovementioned, since the impact of expenditure in education on higher education enrollment is inverse for the period 2000 till 2021 and 1980 till 2000 with the latter being negative. That could indicate that Liberia and Ethiopia's current education system is more resistant to neocolonialism.

For example, Ethiopia's government endorsed neoliberal reforms in its higher education policies in the late 1990's and since then the country has been unable resolve the worsening social inequality which has been partly escalated due to the neo-liberal reform prescriptions (Molla, 2014). This is also seen on the results since the correlation between higher education enrollment with higher education enrollment for the past year drops from slightly positive in period 1980 to zero in the period 2000 till 2021 as seen in Figure A.1.17.

These favorable results for Ethiopia and Liberia are further verified by estimates which show a positive effect on educational development due to a change on either the industrialization index, GDP per capita or human development index which is most and least pronounced on the latter and former, respectively, for the entire and split periods as seen in Figures A.1.17, A.1.19 and A.1.20. Moreover, in Figure A.1.18, the impact of financial market index is slight and inverse in the period 1980 - 2021 towards education expenditure and enrollment with the latter being positive, whereas within the split periods no effect is detected.

Figure 5. 14 Liberia and Ethiopia's correlation between economic growth and education enrollment.



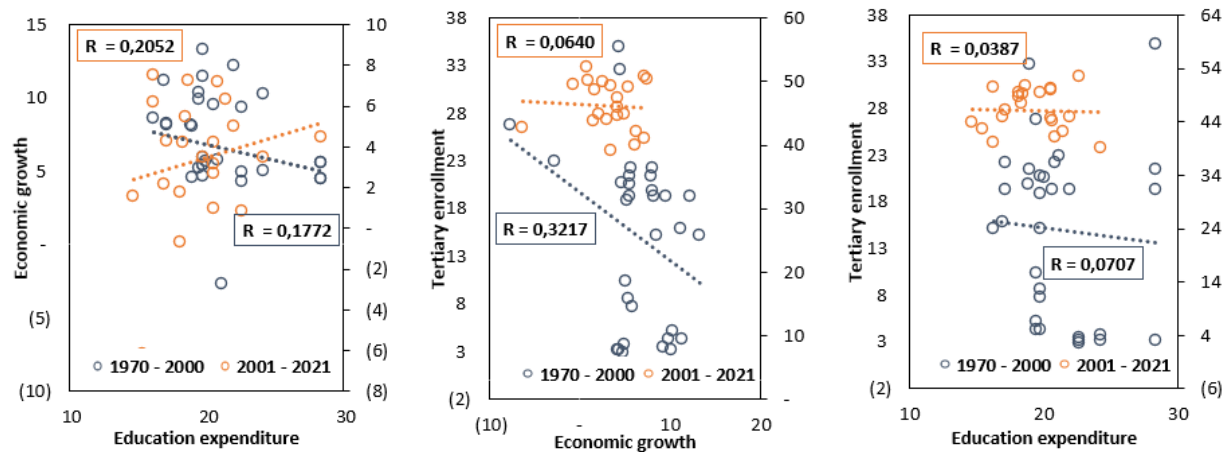
However, the case of Thailand as a test case for Liberia and Ethiopia is quite different as descriptive results show an improvement in the link between economic growth with expenditure in education and higher education enrollment of about 37% and 31 % in Figure 5.15, while no material descriptive change is observed in the relationship between expenditure in education and higher education enrollment. Moreover, no GDP per capita reaction is observed as a result of educational development for the period 1980 - 2021, whereas when the period is split the impact of education expenditure becomes slightly positive while on enrollment it remains symmetrical as seen in Figure A.1.21. In Figure A.1.22, the response of financial markets on educational development is positive and recurring with results being most pronounced on the education enrollment effects for the entire and split period. The response of human development index for the period 1980 - 2021 is inverse to education expenditure and enrollment with the latter being positive, whereas within split periods the effects drop to zero as seen in Figure A.1.23. Moreover, in Figure A.1.24, the impact of educational development on the industrialization index is slightly positive by both expenditure and enrollment for the entire and split period.

The disconnect observed between Thailand's educational and economic development during the period 1970 – 2000 as well as the sudden improvement in the period 2001 – 2021 can be attributed to several factors. Thailand, as it was never colonized, has a unique higher education development trajectory that is deeply rooted in Buddhism. The effects of neoliberalism coupled with country's history formed a development model that is conceptualized on its state, university, society, changing environments, and higher education functionality. However, the subsequent

unfortunate events such the Siamese Revolution and the Cold War and the military regime that confronted Thailand disrupted higher education development. Prior to this, Thailand was under military but due to the “Student Uprising, democracy, and soaring population; that took place during the period 1970s–1990s” it led to a pluralistic society favorable for higher educational development. That strongly supports why in Figure A.1.22, the effect of financial markets on expenditure in education is zero for the period 1980 - 2021, while effects are positive and continual within split periods 1980 - 2000 and 2001 - 2021 with the latter being most apparent. Moreover, the reaction of higher education development to a change in financial markets index is positive and continual for the period 1980 - 2021 as well as with split periods, 1980 - 2021 and 2001 - 2021 with the latter being least apparent. Also, a recurring and inverse human development index impact is observed on either expenditure in education or higher education development with the former being negative as seen in Figure A.1.23. Furthermore, no educational development reaction is noted due to either a GDP per capita or industrialization index change.

Prior to that, Thailand’s universities were controlled entirely by high ranking serving or ex-military personnel (Kirtikara 2002) which mounted to the mentioned uprising due to students’ dissatisfaction. Before 1959 Thailand’s universities were under the auspices of different governmental agencies (Suthasasna 1973) which were open to Western-educated commoners and elites who played a crucial role in revolutionizing Thailand’s political landscape. Thereafter, the demand for having access to higher education extended beyond the capacity of universities as they were unable to accommodate the increasing number of secondary-school leavers. That then compelled Thailand to successfully adopt the Western education models system by the promulgation of the 1969 Private College Act and the establishment of two open admission universities, Ramkhamhaeng University in 1971 and Sukhothai Thammathirat Open University in 1978, which aided drastically in lowering the demand for higher education. However, the 1997 crisis and the forces of globalization caused yet another setback as it compelled the government to revert back to the institutional autonomy policy which was implemented through the reforms that promoted globalization strongly explains the mostly unfavorable results for the period 2001 - 2021.

Figure 5. 15 Thailand's correlation between economic growth and education enrollment.



5.5.5. South Africa

South Africa's case is yet another example of where the impact of neoliberalism policies is visible. It can be seen from the results in Figure 5.16 that the change in the relationship from the period 1970 – 2000 to 2001 - 2021 between economic growth with expenditure in education and higher education enrollment is inverse with the latter showing a 45% drop, while higher education enrollment disconnects from expenditure in education by approximately 10%. Thus, showing that across the considered periods, education expenditure and economic growth remains disconnected in South Africa. These results show that a further deteriorated link between higher education development with economic growth and expenditure in education evidently implies that South Africa's government spending towards education is subsequently declining. Also, a further disconnection between higher education and economic growth shows that the benefits of higher education towards South Africa's economy are continually decreasing detecting a sign of neoliberalism.

This demonstrates South Africa's higher institutions are misaligned from market demands (CHE (2000)) which could possibly be due to unrealistic expectations on universities, as higher education institutions are expected to meet the demands of both the global economy as well as democratic society. Moreover, global hegemony as well as shifts in governmentality seem to have triggered changes towards South African education policies which largely relates to neoliberalism as well as globalization (Foucault, 1994). These policy changes have yielded some positive changes

mostly in overcoming the yoke of apartheid and racism (Leibowitz & Bozalek 2018) that had marginalized South Africa from Africa and the rest of the world. More precisely, in Figure A.1.25, no impact of GDP per capita is observed towards educational development apart from the slight negative higher education development reaction that is seen in the period 1980 - 2021. No industrialization impact is seen on expenditure in education, whereas the response of higher education development to a change in industrialization is slightly positive but in split periods effects are zero for 2001 - 2021 as seen in Figure A.1.28. Moreover, no impact of human development or financial markets index is observed towards expenditure in education at any point, while the response of higher education development to a change in human development is positive and persistent throughout but less apparent for the period 2001 - 2021 in the case of human development index as seen in Figures A.1.26 and A.1.27.

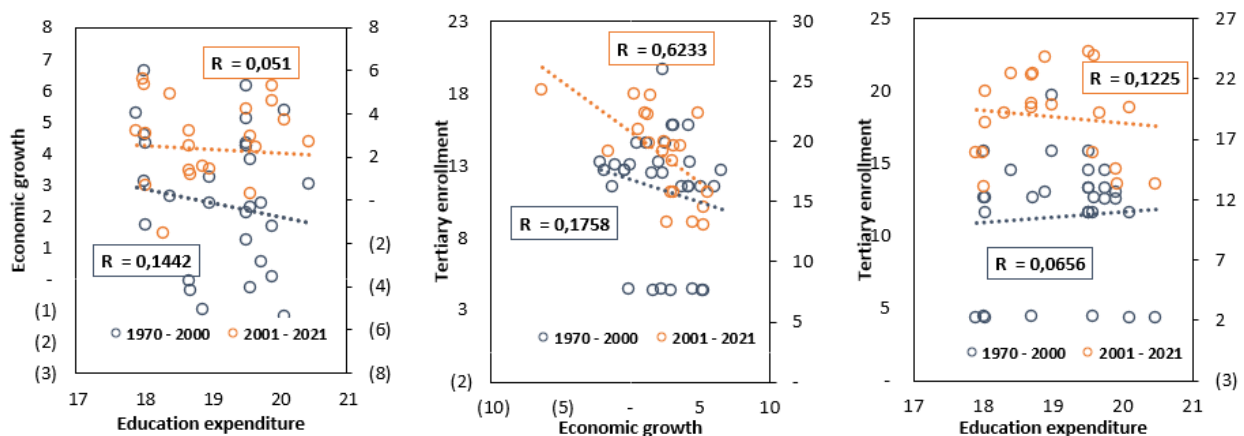
These unfavorable results illustrate that the burden of racism and apartheid together with democratic, globalization and marketisation demands have caused higher institutions in South Africa to struggle to find a balance and rather resorted to producing graduates who are fit for the global economy (Subreenduth 2013). Hence, it is currently difficult to link education to economic development in South Africa without critically engaging with neoliberalism, globalization as well as the impeding historical factors such as apartheid and racism. This largely explains why estimates for South Africa do not align coherently making it difficult to isolate neoliberal effects, for instance in Figures A.1.25 and A.1.26, higher education enrollment and expenditure in education are both less correlated to their past histories for the period 1980 - 2000 compared to 2000 - 2021. Moreover, in the industrialization regression, the aforementioned is also observed on higher education development. On the other hand, the response of GDP per capita on an educational development impact is positive and continual for the period 1980 - 2021, however, when the period is divided into two the effects of expenditure in education becomes less pronounced while higher education enrollment turns to a recurring negative.

Also, as the South African Notational Qualifications Framework (SANQF) was adopted in 1995 from the Notational Qualifications Framework (NQF), it poses further concerns because the NQF has both Scottish and UK origins which are not without flaws. As the goals designed in the SANQF solely suitable for international competitiveness rather than prioritizing the demands of formal education and training which would aid in fixing the shortfalls that are in the education system

which inevitably would positively contribute towards improving the link between economic and educational development. This call for a thorough examination is required of international implements such as funding agreements as well as the NQF due to their origins (Young 2003). That then explains the observed subsequent deterioration between economic growth and higher education development for the period 2001 – 2021.

This shows that in the case of South Africa, the observed impediments in higher education are not solely caused by neoliberalism policies but are also mixed with historical factors such as apartheid, race, gender, sexism and classism that still matter even today, including unrealistic academic expectations from the country's prevailing political economy in place of the demanding economy (Vally 2007). Other than that, the reaction of expenditure in education remains neutral any change in financial markets, human development or industrialization in Figures A.1.26, A.1.27 and A.1.28, respectively, while the response of higher educational development is positive and continual. This then show that the negative effects of neoliberalism are not solely towards GDP per capita but also on other aspects that attribute to economic development.

Figure 5. 16 The relationship between economic and educational development for the period 1970 till 2021 for South Africa.



5.6. Slavery and Slave Trade in Post-Colonial Africa

The sections that follow have been dedicated to examining the role that slavery and slave trade have played towards the post-colonial link between educational and economic development.

5.6.1. Slave Trade and Change in Precolonial Political Centralization

On account of all the results and findings that have been discussed in section 5.5, it is visible that the current link between educational and economic development within and across countries in Africa cannot be exclusively attributed to types and rules of colonial empires as there is need to further account for the relevance of factors like slavery and slave trade, ethnic fractionalization, ethnic diversity, precolonial centralization, hostility, Islam dominance, European settlers, Christian missions, number of empires and the length of colonial rule. Therefore, this section enriches the discussed results by introducing the mentioned evolutionary traits together with heterogeneity features across British and French Africa due to the availability of data.

On that note, Figures 5.20 until 5.23 show the lag coefficient effects of the first lag of economic growth, financial markets index, human development index including industrialization index on both higher educational enrollment and expenditure in education. Correlation plots displayed in Figures 5.18 and 5.19 descriptively explore the relationship between educational and economic development across all colonial factors that are present in the data by Huillery (2009) and Ricart-Huguet (2021). Hence, in the discussions that follow descriptive together with the regression results are used interchangeably to analyze, discuss, and draw conclusions.

Results demonstrate the post-colonial impact that slave trade continues to have on the relationship between educational and economic development, which to a great extent will assist in partly emphasizing that slave trade affected and greatly influenced indigenous African institutions as well as the type of colonization (Whatley 2014). As a result, it can be seen in Figure 5.18 that the correlation between economic growth with expenditure in education and higher education development in regions that experienced less and severe slavery is opposite with the latter being negative. Also, the correlation between expenditure in education and higher education enrollment is negative in regions that experienced the highest slavery intensity, whereas for those where slavery was the least intense, it is opposite. Moreover, in Figures 5.22 and 5.23, regression estimates show that the impact of economic growth on either expenditure in education or higher

education enrollment is inverse in regions that were exposed to the least and most slavery intensity with the latter being persistently negative. Also, the influence of human development index on expenditure in education is contrary between regions with low and high degrees of slavery with the latter being continual, volatile and negative in regions that were most severe, whereas opposite is the case for those that were least hostile as seen in Figures 5.20 and 5.22. Other than that, the impact of either financial markets or human development on expenditure in education shows a recurring positive reaction for precolonial centralization in regions that were most centralized as seen in Figure 5.20. An inverse reaction on higher education development by human development is seen in regions that had high and low degrees of either precolonial centralization with the latter being positive and more apparent. The effect of industrialization on higher education enrollment is continual and positive for precolonial centralization in both regions that experienced the least with the latter being less apparent, see Figure 5.21. Thus, indicating that high precolonial centralization is highly associated with post-colonial development, while low precolonial centralization is disruptive.

A trace of these recurring unfavorable discussed effects maps to the slave trade period, as prior to slavery was the precolonial era when properly established precolonial ethnic institutions were in place with their respective degrees of political centralization. However, the involvement of slave trade interfered with these precolonial ethnic institutions by introducing an inevitable change with regards to the bureaucratic systems that were in place for governance in each respective ethnic group (Whatley 2014). If it were not the case otherwise, as in regions least affected by slavery in Figure 5.23, the relationship between higher education with either economic growth or expenditure in education in regions that maintained strong precolonial centralization is positive, while contrary is the case for those that weakened. A recurring positive response on expenditure in education is observed in all levels for both precolonial centralization due to a change in economic growth, while the effect of economic growth on higher education development with regards to precolonial centralization remains negative but mostly in regions that were least centralized. High degrees of hostility seemed to have hedged against unfavorable effects of slavery as the response of higher education enrollment to an economic growth change is inverse in regions that were most and least hostile towards Europeans with the latter being negative. However, high hostility seemed to have disadvantaged regions from receiving investments as results suggest that this has post-colonially recurred as the impact of economic growth on expenditure in education leads to a persistent and

negative reaction as supported by Figure 5.20. Additionally, a persistent positive reaction of expenditure in education to industrialization is observed in regions that were most centralized, while no impact is observed in regions that were least centralized. Then, an inverse expenditure response to either a financial or human development impact between regions that had the highest and lowest degrees of hostility, with those that were highest showing a more apparent continually positive reaction. A recurring and positive reaction for higher education development to financial markets in regions that were most hostile to Europeans is observed, while in the opposite regions no impact is seen. A more pronounced positive reaction for higher education enrollment due to an industrialization influence is observed in regions that were most hostile, see Figure 5.21.

Moreover, the changes introduced by slavery occupations led to precolonial political institutions fortifying themselves against external as well as any internal threats such that they were impenetrable as these ethnic groups became susceptible to violence and insecurity that continually increased due to within and inter-ethnic conflicts caused by slave traders (Nunn, 2008). Due to the higher risk of intra-group trickery and kidnapping coupled with inter-group raids and warfare (Lovejoy, 2000; Nunn, 2017), large scale investments were also made towards strengthening security forces.

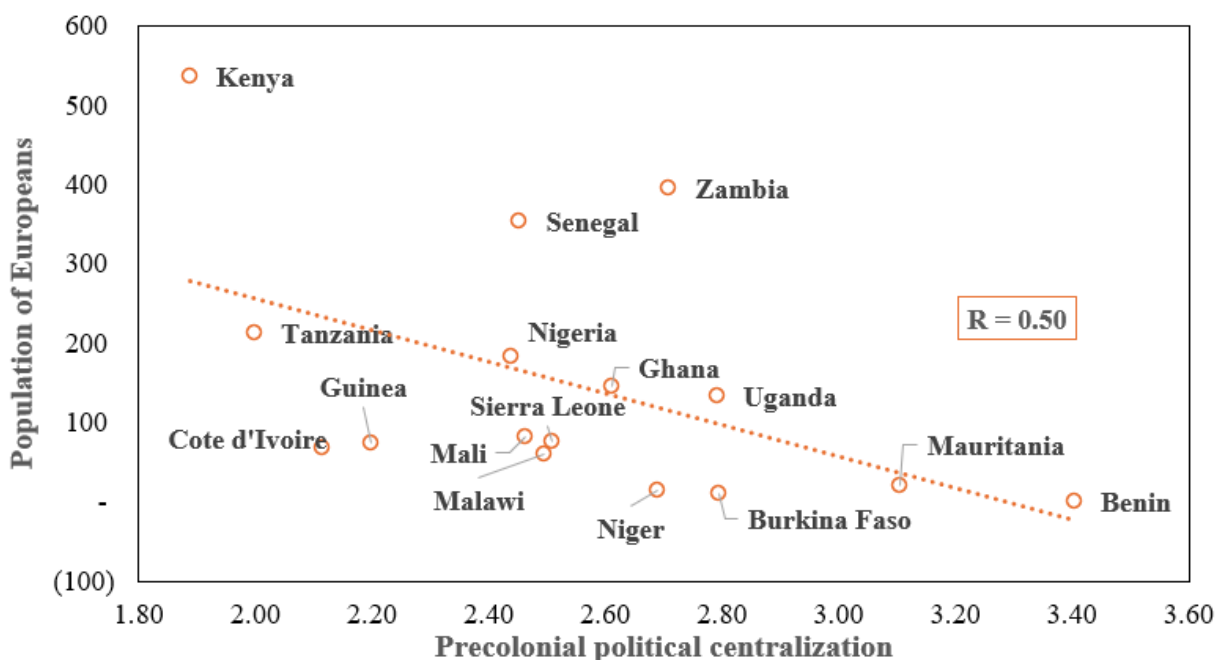
Slave trade triggered major African wars (Besley and Reynal- Querol 2014) by using African kings, chiefs, and headmen to raid villages and towns, enslaving locals to sell them to European “merchants” in the ports which in the process weakened African kingdoms and introduced absolutist ethnic institutions. This indicates that the degree at which slavery interfered with ethnic groups determined the level at which these institutions became less bureaucratic and more fragmented which in the process compromised the delivery of local public goods such as education (Baldwin, 2016). This is supported by results showing the correlation between economic growth with either expenditure in education or higher education enrollment as negative in regions exposed to the highest degree of ethnic fractionalization, while opposite in those least fractionalized. Also, in Figure 5.18, the correlation between higher education development and expenditure in education is inverse in regions that were least and most fractionalized with the latter being negative. A persistently negative reaction on expenditure in education reaction is observed in regions most fractionalized due to an economic growth impact, whereas opposite is the case in region least fractionalized, see Figure 5.22. However, the impact of economic growth on higher education

development remains positive and continual in both the least and most fractionalized regions. A reaction of expenditure to financial markets is also opposite in regions the most and least fractionalized with the latter being positive and recurring. A change in industrialization levels leads to a recurring negative expenditure reaction is observed in regions that had the least and most degrees of ethnic fractionalization with a more apparent effect on the latter as seen in Figure 5.22. This then shows ethnic fractionalization as a recurring post-colonial development impediment.

Another factor is that, European colonizers were using local chiefs and elites to rule ethnic groups already riddled with slave trade and its consequential aftermath and they persisted in using them to capture and kidnap locals as slaves continuing well into the colonization era. That roughly explains why a test for most European settlers is disruptive, as economic growth is less connected to higher educational development in regions that experienced the most European settlers such that the impact of economic growth on higher education development remains continual and negative in both regions as seen in Figure 5.23. A disruption is also observed on the impact that financial market development has on expenditure in education as an inverse reaction is seen in regions that had the least and most European settlers with the latter as positive and recurring, see Figure 5.20.

As a result, it is evident that slave trade played a significant role in obstructing the development of large-scale territorial states and in the same vein discouraged the formation of well-functioning institutions as well as the long-term dissolution of precolonial political centralization (Whatley & Gillezeau, 2011, Whatley 2015) that were solely responsible for the development and setup of educational and economic precolonial institutions. Thus, this shows that the exposure of these precolonial institutions to the slave trades is related to a low degree of political centralization as shown in Figure 5.17, which illustrates that a growth in the European population leads to a decline in the degree of precolonial centralization.

Figure 5. 17 The relationship between the economic growth of the Europeans and degree of precolonial centralization.



A pattern of fragmented ethnic groups devoid of state like institutions and political centralization is mostly observed within ethnicities that were severely impacted by transatlantic slave trades and of note it is quite interesting to observe the translation of this in the contemporary setting with regards to development as the relationship between higher education enrollment with economic growth and expenditure in education respectively strongly favours regions that were most precolonially centralized as supported by Figures 5.18. Also, the results in Figures 5.20 and 5.21 show that the impact of slavery is recurring even at present and the effects differ by the type of slave trade as in Figures 5.24 and 5.25 which cause a disruption in the relationship between economic growth and higher education enrollment with the Trans-Sahara being the highest followed by the Indian ocean then the Red Sea with the least being the Trans-Atlantic slave trade. Results show that the correlation between economic growth and higher education enrollment is more positive in regions that experienced less slavery as compared to contrary communities. This indicates that the exportation of indigenes through slave trade interfered with the establishment and expansion of precolonial educational institutions as they also targeted people that exhibited natural talents and/or intelligence who would have otherwise potentially played key roles towards

contributing to their respective precolonial educational and political institutions and also inevitably to both their colonial and post-colonial development trajectory.

Also, slavery intensity differed by regions with the most severe observed in regions like Bisa in Zambia and Yoruba in Nigeria, while Goroa in Tanzania and Teke in DR Congo suffered the least. Obikili (2016) goes into more specific details regarding this mentioning that individual would report bribery payments via survey – based evidence from Tanzania and Nigeria which were some of the places severely and symmetrically impacted by the Indian ocean and transatlantic slave trade. That, most likely, encouraged accountability and loyalty of the indigenous people towards their respective ethnic groups as the intensity of slave trade heightened and intra-ethnic group precolonial institutions were gradually dissipating which inevitably highly intensified the diversification of ethnic groups. That would have led to more interruption as it can be seen in the results that a negative correlation is observed in Figure 5.18 between economic growth with either expenditure in education and higher education enrollment in regions that had the most number of ethnic groups, similarly, the relationship between expenditure in education and higher education enrollment is opposite in regions that had most and least number ethnic groups with the latter being positive. As a result, Figure 5.23 shows a recurring negative higher education enrollment response to economic growth is observed in regions which had the highest number of ethnic groups, while a persistent and opposite reaction is seen in those with the least degree of the aforementioned. Moreover, the effect of economic growth on higher education enrollment does not discriminate as estimates remain positive and continual in regions that had both the least and most number of ethnic groups as seen in Figure 5.23. The response of higher education to human development is contrary in regions that had either least or most number of ethnic groups with the latter being negative and recurring as well as less pronounced in Figure 5.23. The impact of industrialization on expenditure in education leads to a positive and recurring response in regions that were the least and most ethnically diverse with estimates on the latter being more apparent, see Figure 5.23.

Figure 5. 18 The relationship between economic and educational development in relation to slavery ethnic fractionalization and number of ethnic groups for the period 1962-2021.

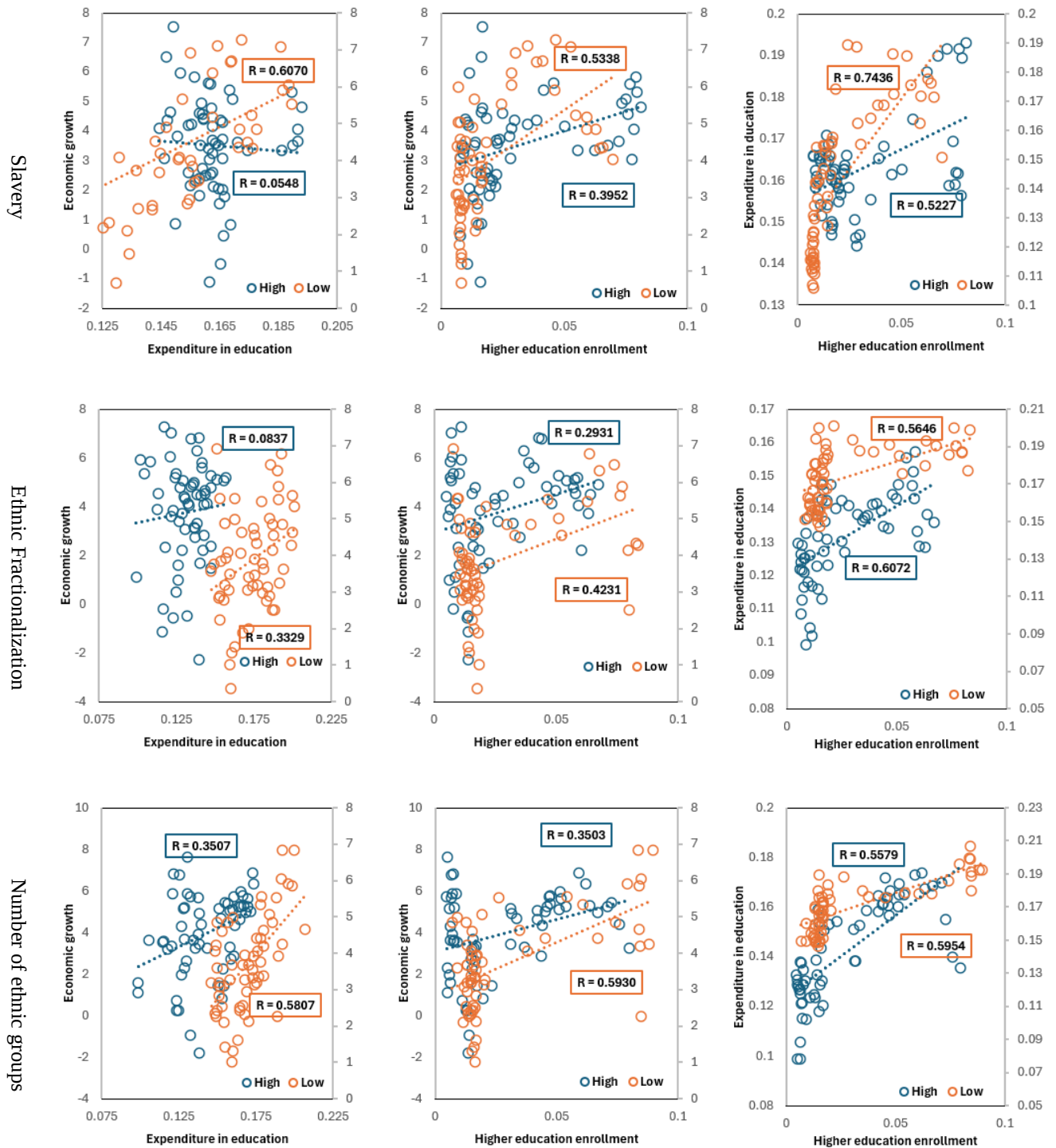


Figure 5. 19: The relationship between economic and educational development in relation to hostility for the period 1962-2021.

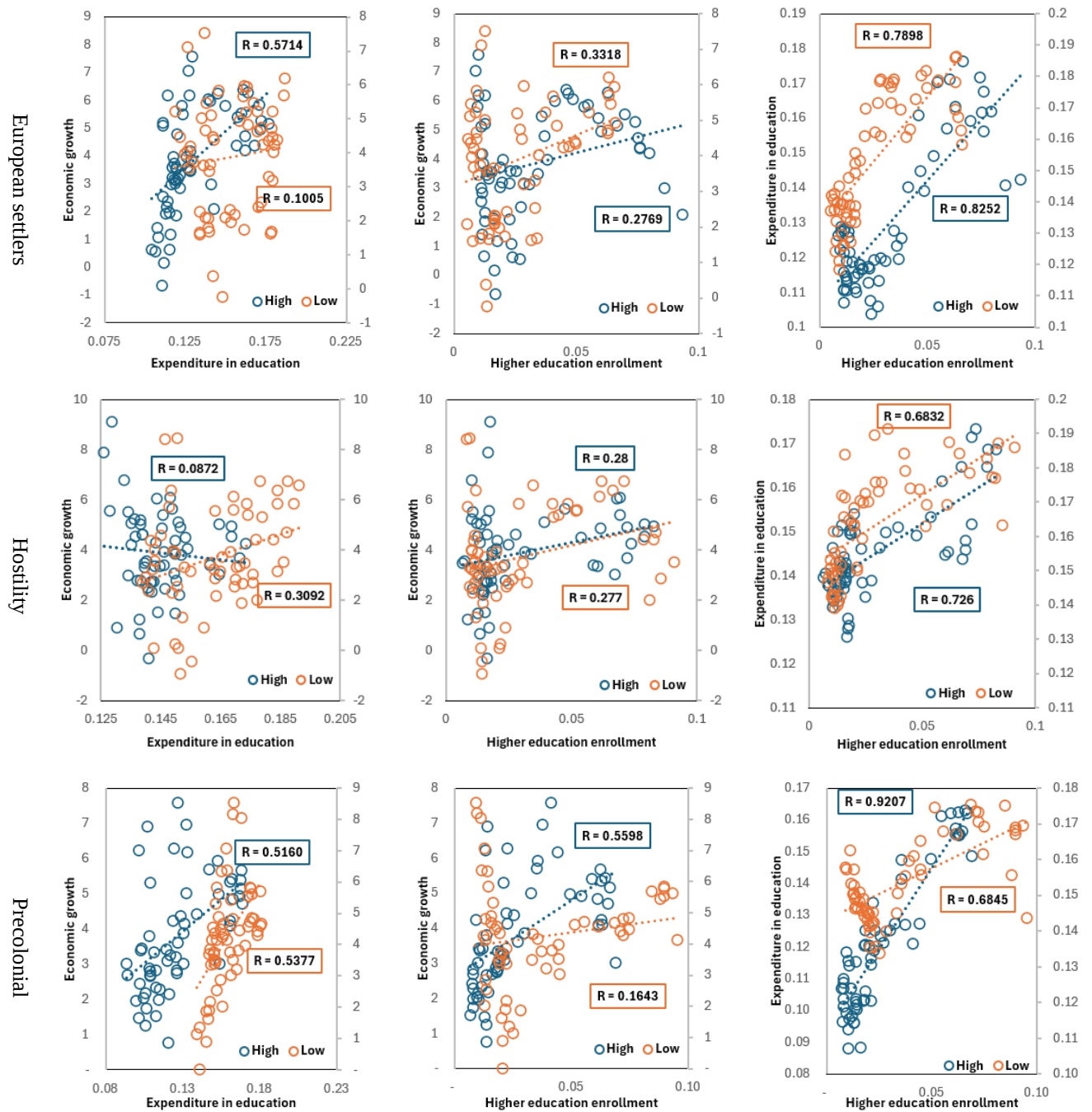


Figure 5. 20 Lag Coefficient impact of the first lag of economic development on expenditure in education for the first group of colonial factors.

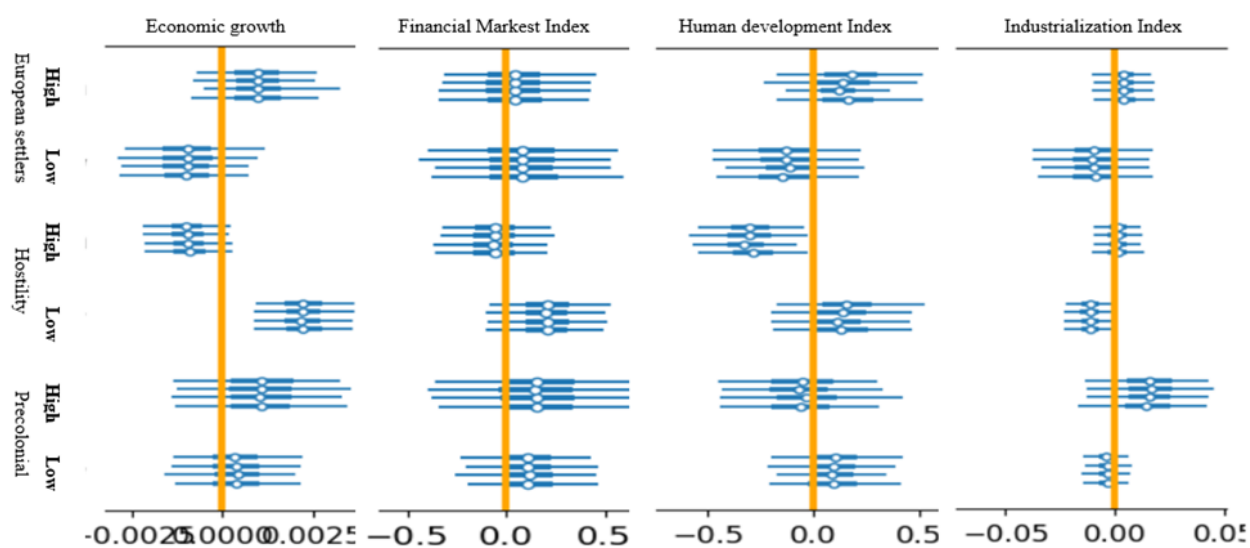


Figure 5. 21 Lag Coefficient impact of the first lag of economic development on higher education enrollment for the first group of colonial factors.



Figure 5. 22 Lag Coefficient impact of the first lag of economic development on expenditure in education for the second group of colonial factors.

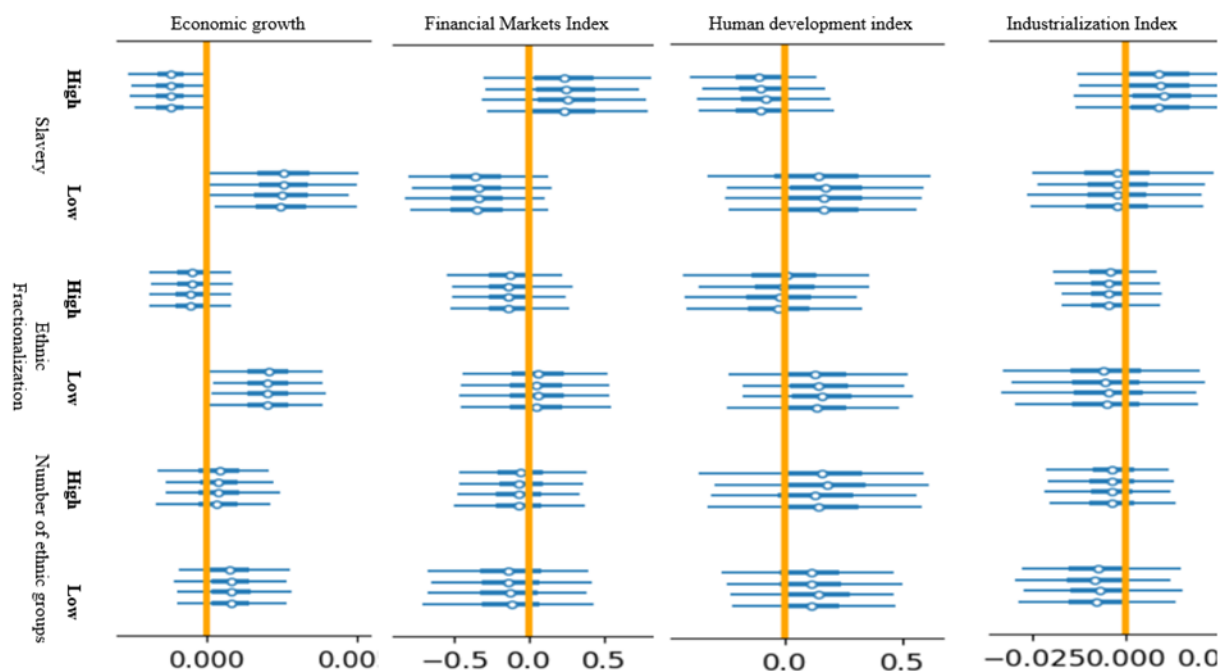


Figure 5. 23 Lag Coefficient impact of the first lag of economic development on higher education enrollment for the second group of colonial factors.

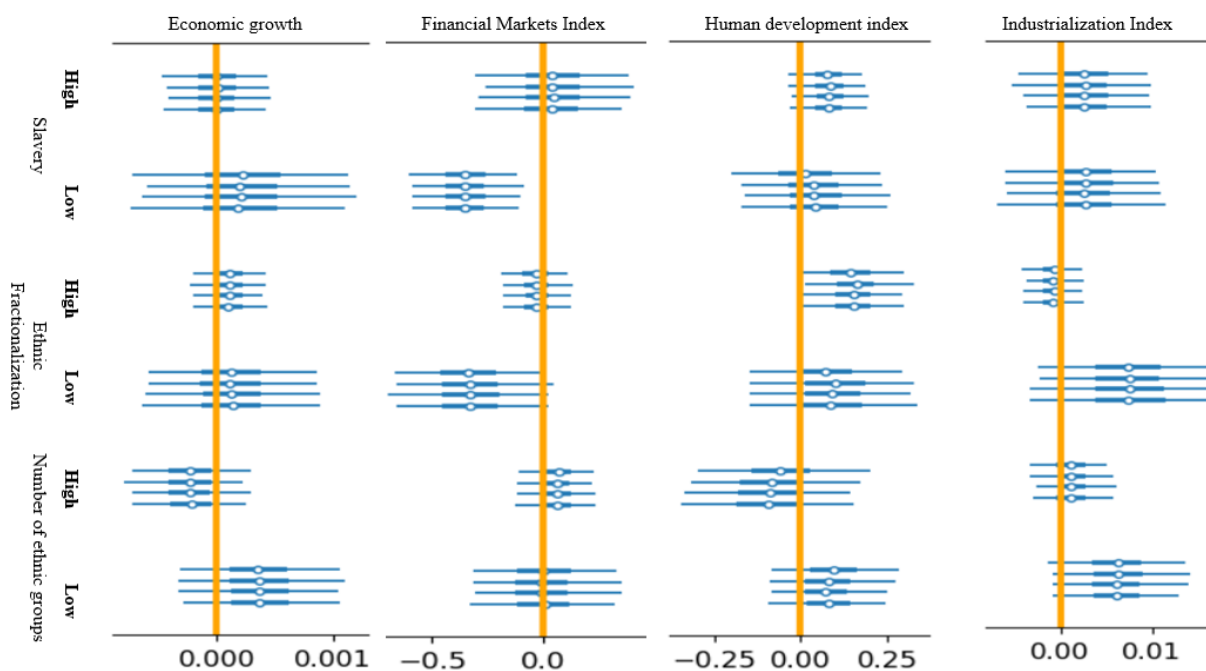


Figure 5. 24: The relationship between economic and educational development across different types of slave trade for the period 1962-2021.

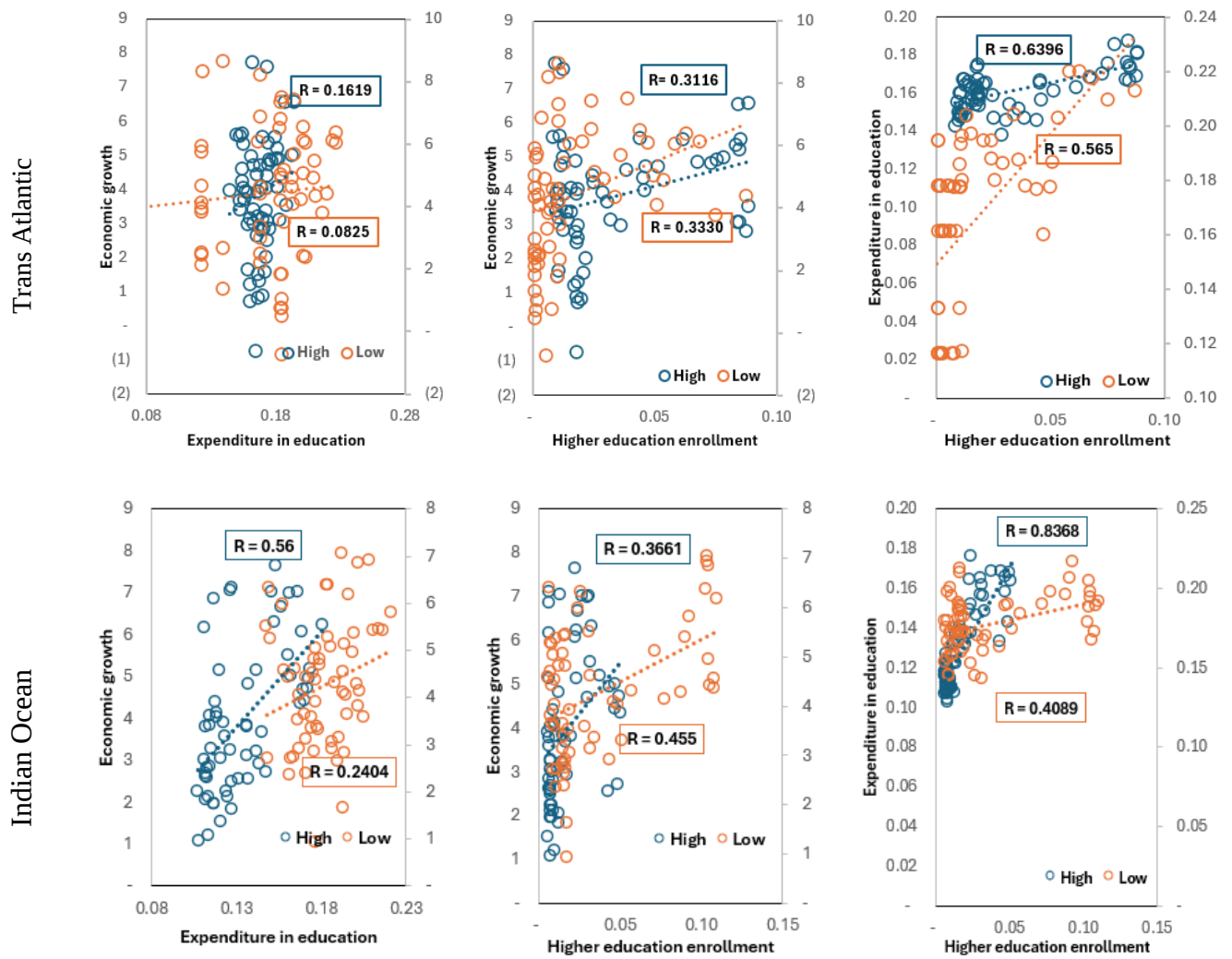
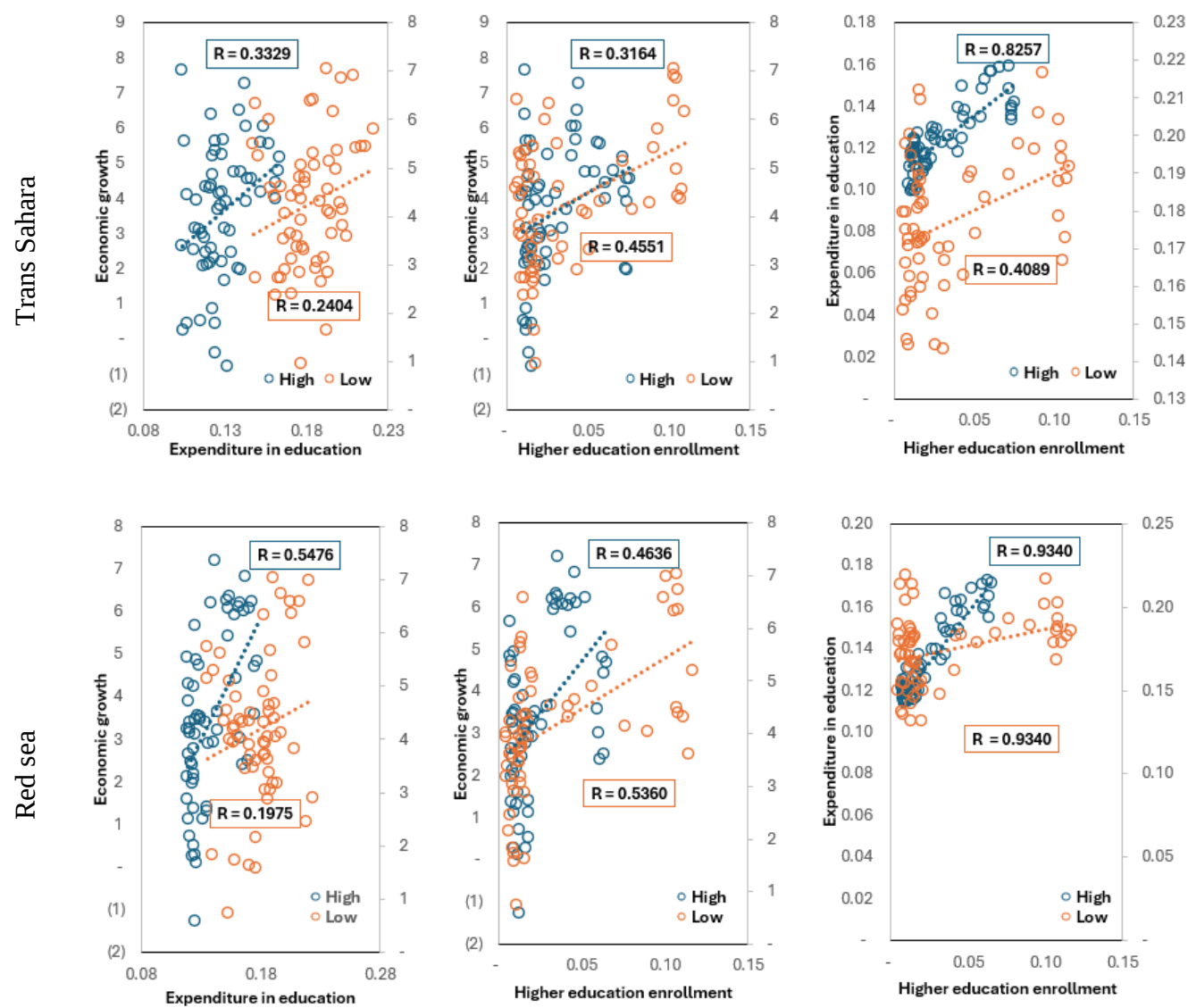


Figure 5. 25: The relationship between economic and educational development across different types of slave trade for the period 1962-2021.



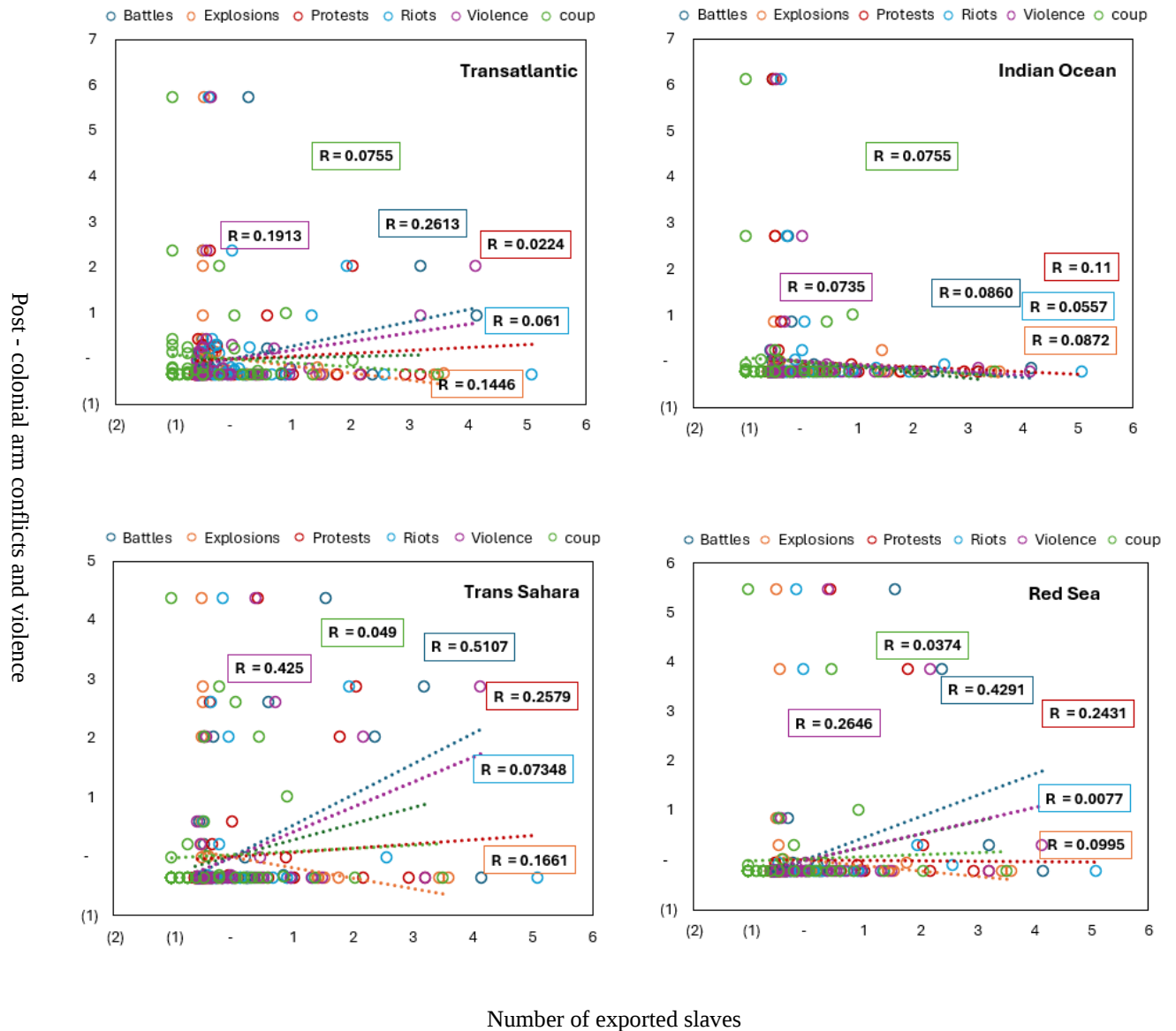
5.6.2. Ethnic Institutions and the Coup-Civil War

The insecurity and violence caused by slave trade compromised the precolonial inter-ethnic institutions risk-sharing mechanism and encouraged coups, conflict, and civil wars. The inclusion of potential rivals in power sharing schemes was, therefore, deemed necessary as a means of curbing any future risks of coups, whether emerging from within the particular ethnic group in question or otherwise. A major determinant for this inclusion would be the rivals leadership effectiveness and its coercive ability to stage and to potentially, successfully execute such a coup (Paine, 2021). The migration of the affected indigenous people to seek out greener pastures in other ethnic regions, due to the unbearable and inhabitable conditions in their own homelands, as a consequence of the aftereffects of slave trade prove to be none the better as their influx into those new ethnic regions ignites opportunities for more communal conflict which can escalate to large scale conflicts (Fearon & Laitin, 2011). In the inevitable sequence of events, the increased incidents of armed conflicts due to the aforementioned factors, consequently, disrupts all forms of development in those affected regions by weakening pre-existing precolonial ethnic institutions as well as destabilizing precolonial centralized structure which disadvantaged them with regards to development post-slavery and thus post-colonially explaining the negative results.

A rather specific example in this regard would be when the Belgian colonial administration enforced a forced labour system towards farmers in Rwanda and Burundi. They distinctly awarded authority to Tutsi chiefs and leaders against Hutu farmers to meet the requirement of certain coffee quotas without fail Blouin (2013). Communities which were affected by forced labor system were less likely to agree to risk-sharing agreements due to lack of trust. The use of these discriminatory colonial policies is one of the main reasons if not a major leading cause from which the 1994 genocide stemmed, having been proceeded by long period of ethnic violence and conflicts leading to a major economic and educational development disruption as a sharp drop is observed in both expenditure in education and economic growth in Rwanda's development trajectory (Blouin 2016) as seen in Figure 5.13 (C). This implies that the tribal discrimination caused a rift between these two ethnic groups culminating in increase of wars and conflicts, hindering the development of inter-ethnic risk-sharing institutions and discouraging cultural diversity rather promoting tribalism thereby impeding economic and educational activities. The case of Rwanda could also mean that most of the ongoing post-colonial conflicts, violence, coups and terrorism are largely linked to the

conflicts and civil wars that were caused by slavery and slave trade. A proof of the aforementioned can clearly be seen in Figure 5.26, where other types of slave trade except for the Indian Ocean slave trade are positively related to the ongoing post-colonial conflicts, violence and coups. More precisely, the Trans-Atlantic slave trade is 20% and 25% positively associated with battles and violence respectively, while the Red Sea slave trade is 43%, 22% and 24 % positively correlated with battles, protest and violence, respectively. Moreover, the Trans Sahara slave trade also correlates positively with battles, violence and protests at 51%, 44% and 24%, respectively as well as with explosions. The discussed descriptive results are also strong supported by the regressions estimates in Figures 5.27 and 5.28 which show a more positive and pronounced impact of economic development on education development in regions that experienced the least of any of the mention slavery with the highest discrimination being on higher education enrollment.

Figure 5. 26: Association between slavery exports and post – colonial violence, conflicts, and coup.



Note that the data that was used is Slavery export cross sectional data is for the period 1700 – 1900 obtained from Nunn (2008), while post-colonial armed conflict and event dataset is for the period 1997 till 2024 from [www.acleddata .com](http://www.acleddata.com) as guided in the paper by Raleigh et al. (2010).

Figure 5. 27: The response of higher education enrollment to a change in economic development across different types of slavery.

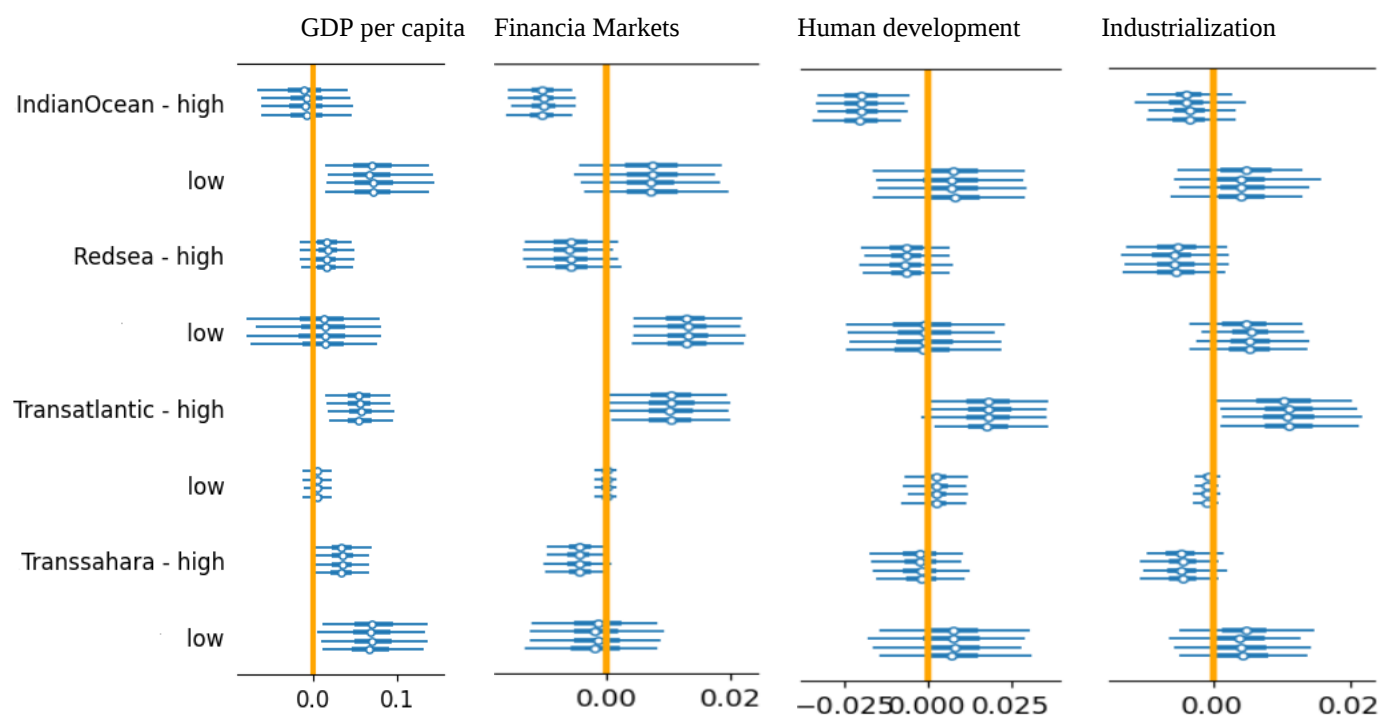
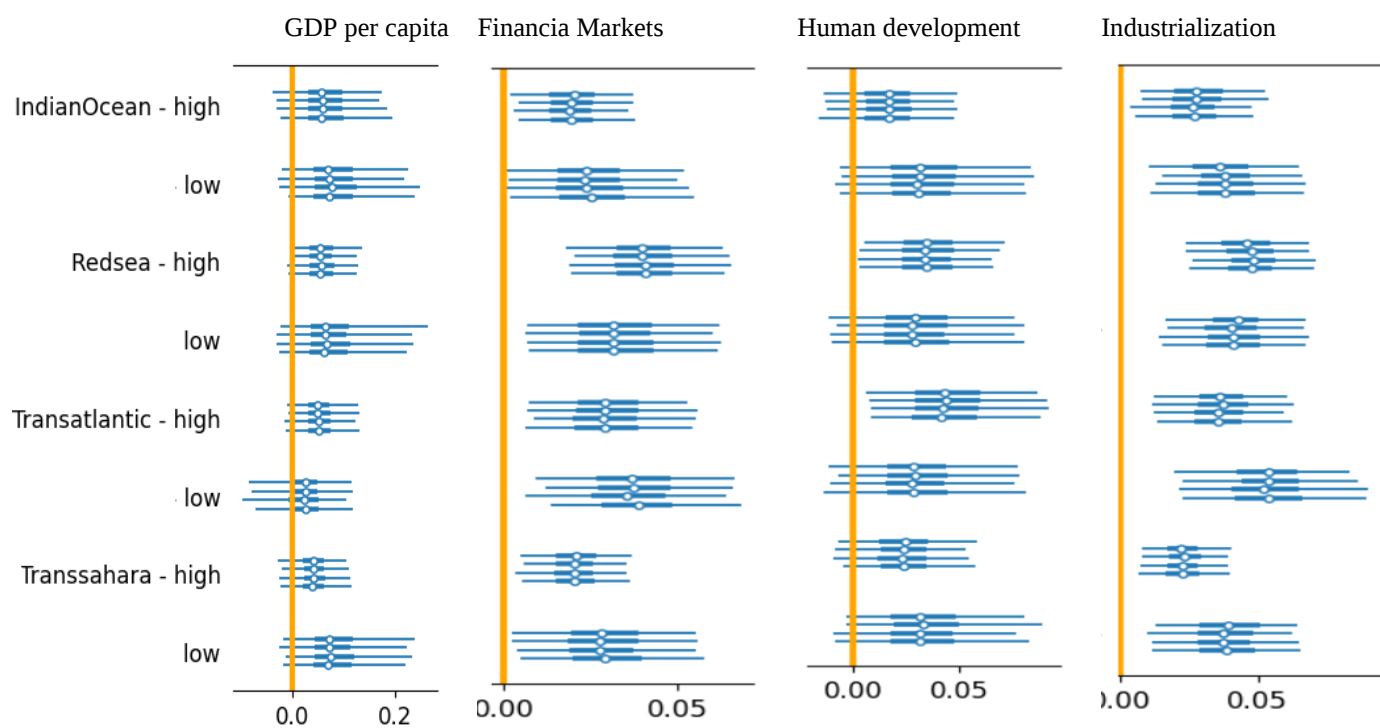


Figure 5. 28: The response of expenditure in education to a change in economic development across different types of slavery

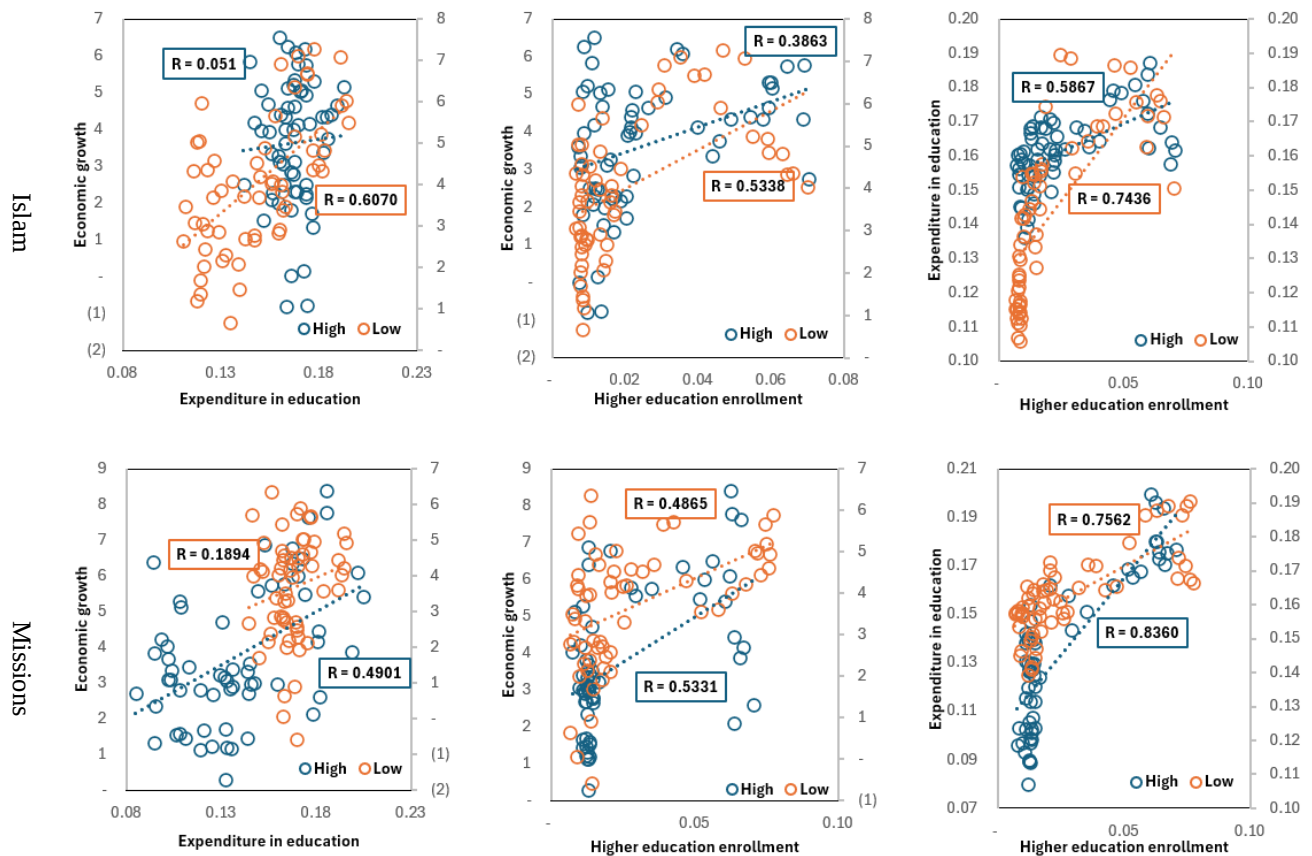


5.6.3. The Early Slavery – Arab

Another form of slavery that was the origin of slavery in itself in Africa having started long before any other was Arab slavery with the main drivers being the Arab Muslims (Gakunzi 2018). Therefore, it is fitting to enrich the previously discussed effects which leaned more towards the effects of European slavery with the post-colonial recurring impact of Arab slavery on the relationship between educational and economic development. Thus, the closest proxy which can be used to test for this relationship is Islam dominance (Gakunzi 2018), hence, its use in this section irrespective of the unbalanced dataset.

On that note, a control for regions that were predominantly Islam leads to a negative association to which results show a less favorable correlation between educational and economic growth in region that were most predominantly Islam as compared to those that were least with the worst impact being between economic growth and expenditure in education as seen in Figure 5.29. Regression estimates in Figure 5.32 strongly support these results as the impact of economic growth on higher education enrollment is inverse between regions that were most and least predominantly Islam with the latter showing a continual positive reaction, whereas expenditure in education reactions are contrary to higher education enrollment. The impact of both industrialization and human development index on higher education enrollment show no discrimination as a change in financial markets towards higher education enrollment produces a more pronounced impact for regions with low Islam dominance. Moreover, the reaction of expenditure in education to either financial markets or human development index favors regions that are least dominated by Islam. This is results strongly suggest that even post-colonially, the aftereffects of Islam centralization are still detrimental towards higher education enrollment.

Figure 5. 29 The relationship between economic and educational development in relation to Islam, Missions and number of colonizers for the period 1962-2021.



A confirmation for these results are findings by Okoye and Pongou (2014) in which they showed that Northern Nigeria experienced limited to no colonial educational investments as it was ruled by the Islamic Sokoto Caliphate and Borno emirates who opposed the expansion of missions. Additionally, according to Michalopoulos and Papaioannou (2018), ethnic groups like the Ashante in the South benefited the most from missionary education after they allowed them to infiltrate their regions after 1890. However, the expansion of mission schools was restricted to the South and not allowed to spread to Northern regions that were predominantly Islam. Apart from the role missions played in setting up education institution and supporting the development of ethnic institutions, they also aid in abolishing slavery which also significantly reduced inter-ethnic conflicts and violence thus allowing for more development. This implies that the presence of missions in any particular region would inevitably encourage development therein as there would less constraints to prevent it, mainly those associated with

slavery and its aftereffects as already shown that slavery and slave trade would be automatically reduced there due to mission settlement. Also, as the post-colonial impact of slavery has already proved to be detrimental towards both education and economic development, which largely explain the ongoing violence and coups, it can be seen that regions which were privileged to have mission settlers, contemporarily experience less aftereffects of slavery and slave trade and are less exposed to conflict and violence as Figure 5.30 shows a negative relationship between the number missions towards conflict, violence and protest. Additionally, it can also be seen that currently there are more educational and economic benefits in regions that experienced the highest mission settlement when compared to areas where there were less as shown in Figures 5.31 and 5.32 that the impact of economic development on educational development on the former regions remains positive, apparent and continual, whereas in the latter regions the reaction of education enrollment and expenditure is either negative and continual or less pronounced.

Figure 5. 30: Association between increase in the number of missions and the number of conflicts and violence incidents.

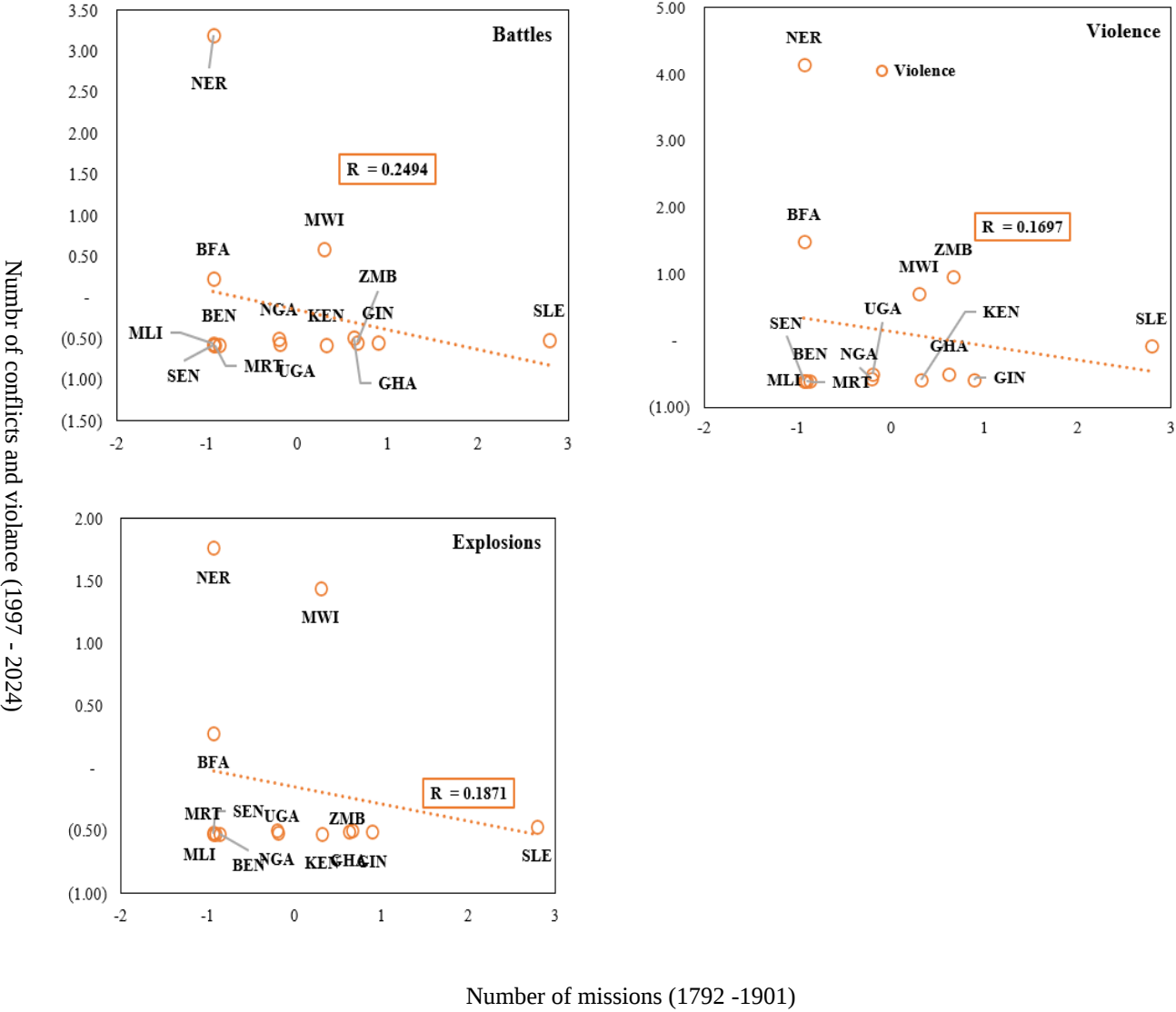


Figure 5. 31 Lag Coefficient impact of the first lag of economic development on expenditure in education for the third group of colonial factors

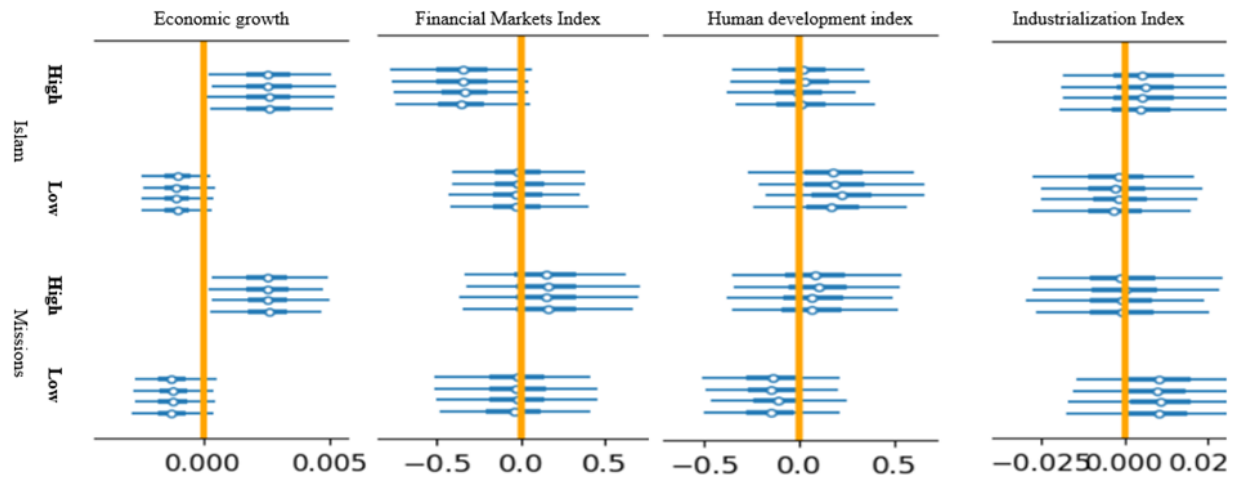


Figure 5. 32 Lag Coefficient impact of the first lag of economic development on higher education enrollment for the third group of colonial factors.



5.7. Robustness Check

The goodness of fit statistic that were performed served as the initial model stability and robustness check. And then, a breakpoint test is then conducted as seen in Figures A.1.9 - A.1.40 to check the robustness of the discussed estimates, where the series is divided into two parts, with the first subsample covering the period from 1980 to 2000 and the second subsample from 2001 to 2021. The same hyperparameters for the hierarchical priors and BVAR are maintained, and the number of lags is still set at 2. The purpose of dividing the series into two parts is to investigate the similarity between the responses of variables to shocks in each sample. The impulse response function of the reaction of educational development to an economic growth shock differs slightly across the two sampled periods. These results may differ due to several factors with the possibility of an impact of structural changes in the observed period, which may lead to differences in the results. One reason may be the wrong selection of variables, however, also the wrong specification of the model could be the reason. The latter is possible, but the fact that for the period 1970 till 2000 effects of economic growth on tertiary education enrollment for French Africa, British Africa, French Indochina including Liberia and Ethiopia are clearly consistent with those for the period 1970 till 2021 is visible which then leads to the opposite conclusion.

It is also even more beneficial to compare the Bayesian model fits to those achieved by the classical VAR as way to check whether the BVAR recovers predictions that are close to those of a classical VAR. Hence, as an additional stability and robustness check, the BVAR is further compared to the classical VAR. As it can be seen for the case of South Africa in Table 5.12 that the intercept parameters that have been obtained from a classical VAR are broadly in agreement with those of the Bayesian model with some differences in the implied relationships defined by the estimates for the lagged terms. Also, the residual correlation estimates reported by the classical model that are in Table 5.12 agree quite closely with the multivariate gaussian correlation between the variables in the Bayesian model. All parameters are significant since they are all within 94% HDI confident interval. Furthermore, the alpha and lag parameter estimates of the Bayesian model are plotted against those of the classical model estimates. It is evident from Figures 5.33 and 5.34 that the Bayesian VAR model ability to recover the observed is similar to the classical VAR. Similar magnitudes in the estimates for the alpha and lag terms can be observed for both models and a

clear relationship between the first lagged GDP numbers and enrollment along with a very similar covariance structure.

Table 5. 12: Intercept parameters of the classical VAR.

	Confidence interval		
	Parameters	Lower	Upper
Intercept GDP per capita	0.26	0.11	0.46
Intercept Investments	0.17	0.097	0.3
Lag 1: GDP per capita	0.01	-0.059	0.028
Lag 2: Investments	0.00	-0.042	0.045

Table 5. 13: Residual correlation estimates from the classical VAR.

	GDP per capita	Investments
GDP per capita	1.00	(0.14)
Investments	(0.14)	1.00

Figure 5. 33: Plot the Bayesian alpha parameter estimates (i.e., 0.263929 and 0.164849 for enrollment and investments, respectively) against the classical VAR estimates.

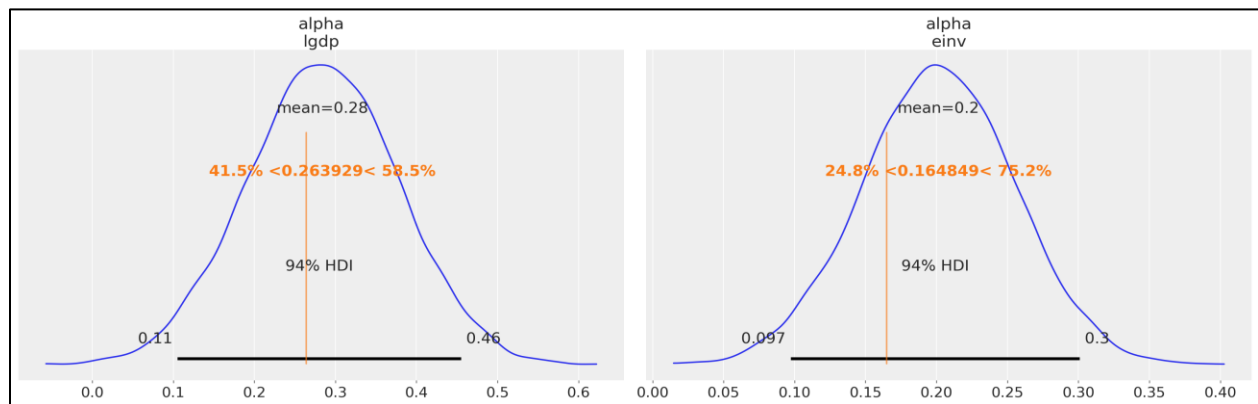
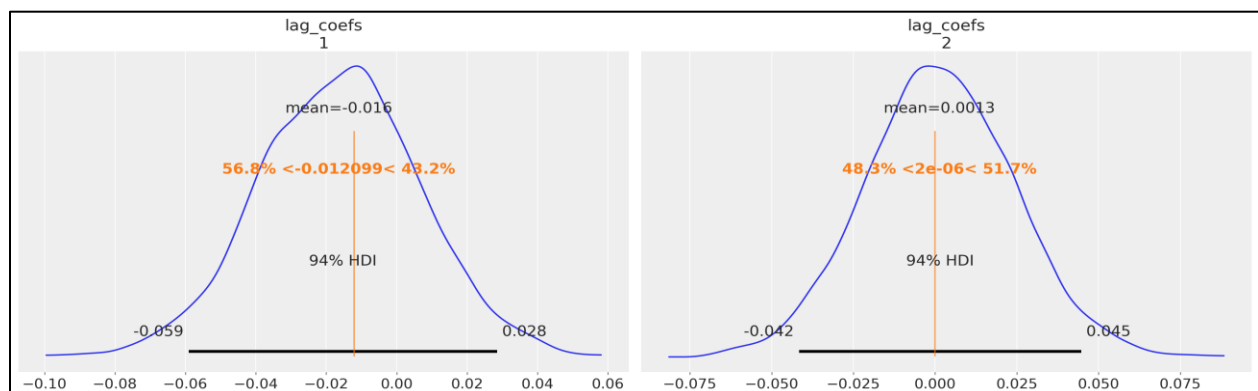


Figure 5. 34: Plot of Investments for the Bayesian lag coefficient estimates (i.e., -0.012099, 0.000002 for the first and second lag respectively.) against the classical VAR lag estimates.



5.8. Concluding Remarks

This chapter has been dedicated to determining the role that Africa's colonial and slavery history has contributed towards the current correlation that is observed between educational and economic development across Africa. Moreover, for a more dynamic approach, the Bayesian vector autoregression has been used to explore the mentioned relationship. Hence, the sections that follow present the observed findings as well as remarks.

5.8.1. Colonial Empire

A thorough assessment of the relationship between educational and economic development reveals a declining correlation when comparing the current period to the previous one, and this can ultimately indicate whether a country's educational policies are increasingly becoming more neoliberal. In this context, with the following colonies in consideration, it can be observed that for South Africa, Ethiopia, British Africa including Ethiopia and Liberia the relationship between expenditure in education and economic growth show a deteriorating correlation in both periods (i.e., 1980 – 2000 and 2001 - 2021) meaning their policies are becoming more neoliberal.

Also, for French and Portuguese Africa the same disconnection is observed in the first period and it is less during the second indicating that these colonies are currently less neoliberal as compared to the period 1980 - 2000. Overall, during the periods in consideration, where colonies experienced a deteriorated correlation between economic and educational development, implies that educational institutions were or are less bureaucratic and more autonomous.

The resultant implication of these higher educational institutions being changed to an autonomous state coupled with the restructures which impacted access and management has led to the reconceptualization of education from an inherent public good to a market good with value only to the global economy. As education has become more of an economic venture and investment (Murunga 2007; Saunders 2015; Ward 2012) rather than a public good with government funding (Brown 2015; Ward 2012), this has promoted the marketisation, corporatization, commodification and consumerism rationale of higher education institutions (Hahn 2007) which is essentially a business model (Collins & Rothe 2019; Jeffery & Collins 2018; Shahjahan 2012). A pattern of secondary colonialism is seen in these colonies brought upon them by the international bodies that

are now managing these higher educational institutions as they are obliged to adhere to stringent economic policies (Hanh, 2007; Collins and Rhoades 2010) pointing towards neocolonialism.

To start with, with no material improvement between economic growth and expenditure in education, the correlation between economic growth and higher education enrollment deteriorates even further by 40% and a 10% disconnection between expenditure in education and higher education enrollment is seen in South Africa. The subscription and adaptation of South African higher education institutions to the NQF (Young 2003) which as mentioned encompasses funding which obligates them to adhere and meet global economic requirements. This demonstrates the misalignment between South Africa's economic development and educational development as higher education institutions are expected to meet the demands of both the global economy as well as the prevailing political economy in place of the demanding economy (Vally 2007; CHE 2000) hence its recurring deterioration. Global hegemony coupled with shifts in governmentality have all contributed in triggering changes towards South African educational policies suggesting a form of neoliberalism and globalization (Foucauldian 1994; Knight & De Wit 1997). Therefore, it can be seen that the shortcomings in South African higher education are not effective in entirely addressing and meeting the current economic demands of the country but nonetheless it must be taken into consideration that the country's history in the form of apartheid, race, gender, sexism and classism also play a part coupled with neoliberalism (Baatjes 2005; Badat 2010; CHE 2000).

In the case of French Africa, the relationship between economic growth with expenditure in education and higher education development remained negative and continual, while an improvement is observed in the association between economic growth and higher education enrollment during the period 1980 – 2001, owing to the formation of new education systems post-independence which was contrary to the French one in that it promoted re-instilling African culture, making education available to all and removing the colonization mindset. The multilateral involvement of other international bodies during the 1980s like the World Bank that introduced SAP and PRSPs seems to have alleviated the pressure French African colonies had from the French colonial education system. Worth mentioning is that despite African French colonies acquiring their independence, France did not “handover” its reign of power over them but instead continued directing development funding to colonial central governments which was after signing into economic and security agreements (Martin 1995). The fact that France choose not to acknowledge

the newly formed states or non-states is already an indication of neocolonialism as this would imply no change in the governance structure as France use this approach to preserving the colonially centralized, socialized and free-market-suspicious model of governance that was institutionalized during the colonial era not forgetting that their educational system limited education enrollment aiming only at educating a few elites (Cogneau and Moradi 2014; Frankema 2012), inevitably promoting economic dynamism that resulted these colonies to be more socially and democratically underdeveloped. France also introduced transitional higher education institutions as well as offshore campuses which are aimed at extracting graduates with high utilitarian value who would play a significant role in the knowledge economy thus reducing local higher education enrollment which then negatively affects economic development. A similar outcome is seen in French Indochina, Vietnam to specific, where after choosing a socialist path post-independence eventually opened up to marketization policies which negatively interfered with the correlation between economic development and higher education enrollment.

As for British, there is a negative and continual relationship between economic growth on expenditure in education for both periods (i.e., 1980 -2021 and 1980-2000), whereas the period 2001-2021 shows an inverse case with a positive and recurring impact). The period 1980-2000 has a slightly negative and recurring reaction between higher education enrollment to economic growth and it is positive and continual for the periods 1980-2021 and 2001-2021. These results show the impact of the subsequent implementation of SAP and PRSPs policies which disrupted higher education enrollment and thus negatively affecting economic growth as British Africa had well standing ethnic base educational institutions with the highest enrollment when compared to other African colonies. For example, in the case of Uganda and Tanzania, the relationship between higher education enrollment and economic growth improves significantly after they withdrew from said policies, whereas in Kenya the relationship continues to worsen overtime as they have not disentangled themselves. In the case of Burma, that had been previously under military rule with their higher education directly serving internal economic needs, once the government transitioned to a parliamentary democracy and welcomed external marketization policies this saw a plummeting in the correlation between economic growth and high education enrollment.

The impact of GDP per capita in Portuguese Africa on both expenditure in education or higher education enrollment is positive and continual and robust to a breakpoint. This indicates a coherent

education and economic relationship and to further elaborate on this Mozambique is considered. Post-independence Mozambique had also taken a more socialist route but due to 1980s financial constraints they also resorted to external aid however they were firm in that they refused altering their policies to meet international demand, so in essence the effect of SAP and PRSPs was reduced as supported by the positive results. Unfortunately, this positive effect was short-lived and did not yield any longstanding benefits for the country as the socialist agenda of the FRELIMO set at forming education policies and systems that worked only in favor of students with worker-peasant backgrounds for university entry which subsequently greatly limited enrollments and thus stunting economic development.

5.8.2. Slavery and slave trade

Results indicate that slavery and slave trades played a major role in interfering with bureaucratic systems within ethnic groups which in turn lowered the degree of precolonial centralization and compromised the delivery of local public goods such as education (Baldwin, 2016). Firstly, findings show the use of local/chiefs as slave raiders to recruit slaves from other ethnic groups or at times inter-ethnic groups trickery coupled with European bribery disrupted the development of ethnic institutions. A post-colonial test of the aforementioned shows that the correlation between economic growth and higher education enrollment is more positive in regions which experienced the least slavery. A percentage of the enslaved would be those who had natural intelligence and who could potentially contribute to the development and expansions of their respective ethnic institutions which inevitably would have reduced the observed post-colonial disruption and violence in regions that experienced the highest intensity of slave trade.

As findings indicate, slavery and slave trades elicited a lot of conflicts, civil or inter-ethnic wars more precisely. Some intolerances however stem from mistrust between ethnic groups especially when it comes to inter-ethnic risk sharing institutions or power sharing as it were, as is the case between the Tutsi's and Hutus of Rwanda and Burundi where a discriminatory forced-labour system was in favor of one group while the other was done a disservice at its hands, which was one of the main causes for the 1994 genocide leading to an economic and education development disruption.

A control for regions that experience the highest and least European settlers in a way of accounting for both European slavery and settlement leads to a more favorable correlation between economic

growth and higher education enrollment on the latter, therefore, demonstrating the post-colonial after effect of European colonial settlement as higher education development impediment which translates even to the present.

A test for Islam centralization as a proxy for Arab slavery, results in Islam dominance as a post-colonial higher education enrollment impediment with estimates suggesting that even post-colonially, the aftereffects in regions that experienced the highest Islam centralization and or Arab slavery are still detrimental towards higher education enrollment.

On the other hand, results illustrate that the presence of missions in any particular region would inevitably encourage development therein as there would be less constraints to prevent it, mainly those associated with slavery and its aftereffects as already shown that slavery and slave trade would be automatically reduced there due to mission settlement. Also, as the post-colonial impact of slavery has already proved to be detrimental towards both education and economic development, which largely explain the ongoing violence and coups, results show that regions which were privileged to have mission settlers, contemporarily experience less aftereffects of slavery and slave trade and are less exposed to conflict and violence.

Chapter Six: Conclusions, Policy Implications and Recommendations

6.1. Introduction

As noted by Hopkins (2009), the academic efforts that have been put in place to explain Africa's development trajectory from the 1970's until now have followed an exponential path. With only a few notable contributions, selected papers that were published between the 1970s and 1990s addressed Africa's growth, politics, and social development. Out of the few, only a couple were featured in top-field and general-interest journals, which were attempts to explain the "African dummy" using a cross-country comparison (Easterly and Levine 1997). However, according to Durlauf (2009), the findings from the mentioned contributions came with several data-related shortcomings, such as measurement issues, endogeneity-related concerns, and a few degrees of freedom, including untracked observations.

Notably, a significant peak was observed in the mid-2000s in the academic contribution trajectory, with the focus being Africa's political economy. Collier and Gunning (1999) presented a paper that compares the earlier contributions to those that have been made since the mid-2000s. The main cause of the sudden peak is the fact that scholars eventually realized that the conflicts, corruption, authoritarianism, and wrong policies that were found to be the causes of postcolonial development disruptions inevitably have colonial and precolonial roots (Bates 2017). Broadening the research scope and further enabling an interdisciplinary research focus allowed for more academic work to be done that linked Africa's development trajectory to its colonial and precolonial heritage (Christensen and Laitin 2019; Austin and Broadberry 2014) which added to the work that was already done, and it entailed post-independence factors such as democratic transition, foreign aid, trade, and agricultural policies.

To an extent, economists have even tested the initial historic and political science conjectures that were made, as well as added to the mediation on the inquiries raised by anthropologists and sociologists. These new contributions improved on identification by implementing spatial regression discontinuity as a remedy to the plethora of natural historic experiments as well as exploring within-country variations. That, coupled with a plethora of historical data, including historical records (Lamoreaux 2015), colonial "Blue Books", ethnographic maps, survey data, and lab-in-the-fields experiments (e.g., Sánchez de la Sierra 2020 and Lowes et al., 2017) has led to

significant improvement on the earlier contributions that were based on cross-country econometrics (see Durlauf, Johnson, and Temple 2005). Consequently, several empirical studies, like that of Nunn (2008) and others (Michalopoulos & Papaioannou, 2013; Obikili, 2013; Okoye & Pongou, 2014; Ricart-Huguet, 2021) have shown that a large part of Africa's economic, institutional, and social underdevelopment has colonial and precolonial origins. However, very little has been done to determine the role that Africa's history has played in its educational investments and development trajectory, which was largely hindered by the lack of better and more refined data on colonial institutions and investments in education (Michalopoulos and Papaioannou 2020). For instance, Fenske (2013), in a quasi-random experiment, failed to find a significant association between post-independence educational investments and polygamy. One other issue that has not been thoroughly explored is the role that Islamic centralization and thier educational institutions played on literacy, social, and political development.

The investigation that is carried out in this thesis is structured in two parts. First, the effect of Africa's history (colonialism, slavery, and slave trade) (CS) on investments in education and the development of educational institutions is ascertained. This was achieved by determining the effect of Africa's CS history on investments in education and examining the role of Africa's CS history in explaining contemporary education. Secondly, the effect of Africa's CS history on the relationship between educational development and economic development is investigated by using Africa's CS history and the ranking of colonial and slavery factors as intervening effects on the relationship between educational development and economic development, as well as on the relationship between investments in education and economic development.

6.2. The Legacy of Colonial Educational Investments and Development of Education

The established roadmap in Chapter 1 combined with the expansive evidence that has been presented in the literature review elaborates on colonial educational development, investments, and policies. The contribution by Fourie and Swanepoel (2015), amongst others, has shown that the occurrence of colonial educational development, investments, and policies was not arbitrary (Jedwab, Meier zu Selhausen and Moradi 2018).

Among the identified gaps, the colonial educational system needs to be thoroughly explored with possible tests that can help understand the response of colonial education to railroad investments as well as precolonial ethnic institutions and centralization. An analytical understanding of the spread of education and Christianity that is less biased would be beneficial, more specifically the impact of religious competition (Gallego and Woodberry 2010). This would allow for protestant missions and Roman Catholic missions to be compared, as these sects were decentralized and differed in their ideologies (Caicedo 2017 and Waldinger 2017). Thus, a more accurate causal identification approach can only be guaranteed when higher-quality colonial institutions and investment data are available, which would require more colonial and precolonial sources to be accessed and digitized. An even more robust econometric analytical approach, as suggested by Eaton and Kortum (2002), is to integrate some “reduced-form” estimates with quantitative models of international trade, such as vector autoregression models.

The impact of colonial education policies on political and instructional development also needs to be explored. It would also be insightful if the observed low export share in skill-intensive and complex sectors (Romalis 2004, Ciccone and Papaioannou 2009, and Nunn 2007) could be explained by the impact that colonial policies have had on industrialization levels. Moreover, as the correlation between economic growth and schooling quality is highly significant, it would be ideal to analyze the differences across types of education and their respective curriculums.

As an effort to address the mentioned gaps, this study seeks to ascertain the effect of Africa’s colonial and slavery (CS) legacies on investments in education and the development of educational institutions. This is examined in two ways: first, by determining the effect of Africa’s CS history

on investments in education, and secondly, by examining the role of Africa's CS history in explaining contemporary education.

Colonial comparability is enhanced by the educational investments and development data that accounts for colony district-level factors which is obtained from Huillery (2009) and Ricart-Huguet (2021), while precolonial development measures and missions data is taken from Cagé and Rueda (2016). These data cover 16 African countries: Benin, Burkina Faso, Cote d'Ivoire, Ghana, Guinea, Kenya, Malawi, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Tanzania, Uganda, and Zambia. Initially, descriptive analysis is performed on the data and the outcomes show that the growth the European population and educational infrastructure investments were highest in British Africa and French Africa, respectively. Moreover, a positive correlation is observed between the European population with either the number of students or expenditure in education in French Africa, while in British Africa the number of students is more correlated with educational expenditure and the African population. Thus, indicating that an empire control on colonial educational investments and development shows that the British empire invested the most and were more educational towards the African population than the French. Hence, an empire control improves identification for colonial educational development and investments. This is further supported by the highest mean-severity for colonial factors that were mostly disruptive (Rodney 1972; McAlexander & Ricart-Huguet 2022; Okoye and Pongou 2014; Nunn 2008) being in French Africa, while colonial factors that were developmental (Michalopoulos and Papaioannou 2018; Alesina et al. 2019; Jedwab and Moradi 2016) as well as those that attracted investments are highest in British Africa. However, the severity of colonial ecology is not skewed towards a single empire. Thus, descriptive outcomes prove to be inadequate which resulted in the adoption of instrumental variables (IVs) together with ordinary least squares (OLS) that significantly improved the degree of identification and findings are as below.

First, the causality confidence is improved when railroads and disease prevalence are used as instruments for the European population which addresses any endogeneity concerns going forward. Mostly because the distribution of colonial roads and disease prevalence dictated the location where Europeans settled to inevitably invest and develop (Jedwab, Meier zu Selhausen, and Moradi 2018; Alesina et al., 2019).

Second, the main observation is that precolonial and colonial educational development partly explains the significant differences that intergenerational mobility has had on contemporary development which is connected to deep evolutionary traits (Ashraf & Galor, 2013), geographic heterogeneity (Michalopoulos, 2012) and ecological features (Cervellati, Chiovelli, & Esposito 2019).

Moreover, the French colonial administration together with their educational system and policies are associated with an economic and educational attainment disruption, while opposite is the case for the British administration with their colonial language policy. Thus, indicating that the French empire promoted precolonial, colonial, and post-colonial development incoherence. This is also further justified by results in French Africa where it can be seen that colonial schooling is highly disassociated with other institutions, while in the British educational system it is more coherent with all other institutions. Also, regions that were recipients of the first precolonial schools as well as those that experienced the most European settlers are associated with high educational development and investments.

Interestingly, the impact of Islam centralization shares some common outcomes with the French empire towards colonial and contemporary development, as a further spread of Islam leads to an independent disruption towards economic and educational development, respectively. That implies that Islam centralization was also territorial and had a closed-door policy that was not ethnic based as they were not open for any collaboration with missions (Okoye & Pongou, 2014; Obikili, 2013) inevitably impeding investments and development of education.

Results also shows that precolonial centralization was disruptive only towards increase in the number of colonial teachers but not towards investments. This disruption could be partly linked to the hostility and resistance that the Europeans were confronted with in regions that were more precolonially centralized due to intense indigenous bureaucratic systems which is strongly evident for French Africa (Lowes and Montero, 2018; Moscona, Nunn and Robinson 2017a, b). Additionally, results identify that hostility indirectly hindered colonial educational development through the disengaging (McAlexander & Ricart-Huguet, 2022) impact that it had on the colonial administration, as also supported by the more inverse relationship that is illustrated between hostility and the colonial administration than with the number of teachers. Another disruption that

is observed in French Africa is in regions that were susceptible to high ethnic fractionalization, while high ethnic diversity proves to be an educational setback in British Africa. These results combined with the strong positive association between high slavery intensity with either high ethnic fractionalization (Nunn 2008) or high ethnic diversity (Whatley and Gillezeau 2011; Green 2013) that has already been established, implies that educational investments and development were largely hindered by high ethnic fractionalization and diversity including high slavery intensity. Also, high ethnic fractionalization proves to have been a precolonial schooling impediment. On the same note, as violence and insecurity were primarily caused by high slavery which eventually made those regions more ethnically diverse (Nunn 2008), a test on the impact of colonial violence is highly recommended. Consequently, results show a current urbanization and human development disruption that is noted in regions that were exposed to severe colonial violence which occurred due to ethnic conflicts and tribal divisions (Sachs and Warner 1997). The creation of artificial states that was introduced through the Scramble for Africa (Michalopoulos and Papaioannou 2016; and Amin 1972) together with high slavery must have intensified the level at which ethnic groups were being fractionalized and even further underdeveloped those exposed regions. As a result, a test of the impact of the period before, during and after the scramble reveals a re-emergence of the malaria prevalence disruption towards development, which indicates that the colonial era and the Scramble for Africa were disruptive towards precolonial institutions. As the effect of population density is highest and positive for the colonial period, it could imply that prior to this period colonial remuneration was low possibly due to high slavery exports but improved as slavery become abolished (Heldring and Robinson 2012) through the contributions that were made by missionaries amongst others.

With regards to Christian competition, an indirect interruption is detected towards urbanization which is caused by a protestant mission station disruption. Moreover, in regions where the first precolonial schools were established are also shown to be currently receiving less assistance from international businesses or investors. However, when a coastal control is applied on the results, precolonial and protestant indirect effects become insignificant, which could imply that the observed interferences were less in coastal colonies.

6.3. Historical Legacies and the Dynamic Relationship between Educational and Economic Development

As colonial and precolonial historical features are strongly intertwined, for example the paper by Whatley (2015), it is shown that both colonial education investments and precolonial ethnic policies are linked to slave trade. Therefore, a gap which is highly endorsed by Michalopoulos and Papaioannou (2020) that needs to be explored is a synthesis examining the interplay of the various historical features. Another gap that they still recommended is identifying and examining the role that colonial and precolonial feature played on the economic trajectory during and after independence in shaping the political equilibrium (Bates 1987).

Heterogeneity can also be explored over time on condition that the exact period when the impact of colonial and precolonial factors is most noticeable is identified. The success of the latter can create an enablement where the impact of historical legacies with either policies and macroeconomic shocks towards the development trajectory can be determined. This work attempts to close the mentioned gap by evaluating the extent to which Africa's colonial and slavery history still explains the current relationship between economic and educational development.

Development data for French Africa, British Africa, Liberia & Ethiopia, South Africa, Portuguese Africa, Egypt and Belgian Africa on GDP per capita, education enrollment, educational investments, industrialization, and human development for the period 1960 to 2021 is obtained from TheGlobalEconomy.com; as well as financial market index (FMI) for the period 1960 to 2020 from the FD Index Database.

These datasets are initially used to understand the time series trends and as a start it can be seen that most of the time series trends follow a normal distribution. Moreover, the most unstable development trends are seen in Liberia and Ethiopia as well as Burma and Thailand while development trends in British and French Africa are the most positively related. However, Thailand seems be the most under developing colonial territory which is evident by the monotonic decline observed in economic growth and education development.

In order to account for the impact that history has had in this nexus, the relationship between economic and educational development is modelled within and across colonial and slavery clusters in their level of severity. The severity clusters are formed using colonial data by Ricart-Huguet (2021) and Huillery (2009) for the period 1905 to 1956 on 16 colonies as well as missions data by Cagé and Rueda (2016). Severity levels for colonial factors like slavery, ethnic fractionalization and hostility that were disruptive according to literature (Huillery 2009; Obikili, 2013; Okoye & Pongou, 2014; Cagé & Rueda, 2016; Nunn, 2008; Michalopoulos & Papaioannou, 2013; Rodney, 1972; Heldring & Robinson, 2012) are the highest in French Africa, while those that were developmental are highest in British Africa.

Thereafter, panel data analysis tests are performed in order to ascertain that the data is stationary, cointegrated and causal. Development trends for African and non-African countries all share the same integration order. Unit roots as well as stationarity levels are achieved at the third difference of industrialization, financial markets index, investments in education, education enrollment and human development index, whereas for economic growth it is at the rate of change. Moreover, education enrollment trends are stationary with unit roots even when no level of differencing is applied. Also, as the null hypothesis in the Johansen-Procedure is not rejected at any other rank except when $rank = 0$, it then indicates that there are multiple cointegrated relationships in both the African and non-African settings.

Granger causality, descriptive analysis together with the impulse of the lag coefficient for the first lag of economic development varies similarly on education investments and enrollment, which implies that educational development is still currently highly neocolonial and neoliberal. Similarly, traces of the aftereffects of the severity of slavery and slave trade together with ethnic fractionalization and missions amongst other colonial factors strongly and persistently continue to influence the current relationship between economic and educational development.

6.4. Policy Implications

Some possible policy recommendations emanate from this study as colonial; slavery and contemporary findings and conclusions discriminate more evidently across colonial empires and policies.

6.4.1. Neocolonialism

Findings have established a disconnection between educational and economic development which has been attributed to neocolonialism and neoliberalism as their involvement has caused higher education institutions to be regarded as a commodity rather than a public good (Torres 2011). The identified channels through which the mentioned has been achieved is through the introduction of neoliberal policies in African higher education institutions which have promoted international competitiveness and privatisation, accreditation and globalization including institutionalizing efficiency and accountability (Akala 2021). An examination of the role that colonialism has played in the current link between higher education and economic development reveals a declining correlation when comparing the current period to the previous one indicating that African higher education institutions policies are increasingly becoming more neoliberal.

The main event that opened a door for neocolonialism and neoliberalism is the financial crisis that occurred in the 1970s further worsening during 1980s. Prior to this, higher education institutions were entirely funded by and subjected to national governments guaranteeing the direct contribution of higher education institutions to a nation's economic development. There is therefore an urgent need for nation governments to intervene and restore higher education institutions national development role by introducing measures to aid in halting the already diverged relationship between educational and economic development as caused by neoliberal ideologies. A possible recommendation is that African governments should not allow their higher education institutions to be used as a marketplace for the production of instrumental and academic knowledge (Collins & Rothe 2019; Tabulawa, 2017) which is irrelevant to a nation's development but only beneficial to the global economy. This then can be done by incorporating a nation's development plan in both private and public higher education institution as well as on external funding policies.

Consequently, the success in the implementation of the recommendations will inevitably aid in reducing stratification levels, solve for the inequality problem and reduce the urban-rural divide which have been escalated by neoliberal education funding strategies such as privatisation and

decentralisation which in turn have compromised Africa's development trajectory. This will undoubtedly lead to the inclusion of African values (Sefa Dei and Opini 2007; Waghid 2018) in the curriculum and policies of higher education institutions and thereby rekindle a cultural oriented knowledge which challenges the hegemony of Western forms of universal knowledge, respects diversity and acknowledges lived experience. Therefore, centering Africa's higher education institutions on Africa's values and norms will definitely foster an academic discourse amongst local scholars that is focused on addressing Africa's development (Metz & Gaie 2010; Sefa Dei and Opini 2007) shortcomings rather than promoting Eurocentrism. With so many values and norms being indirectly sown when adapting Western education policies propagated through neoliberalism and globalization, African ideologies, preservations and values are slowly eroded away giving way to a more Eurocentric African student or worker, so it is then vital that Africa sees value in the preservation of their salient cultural distinctiveness and identities.

The power relation dynamic between Western and African countries does not seem to be mutually symbiotic as upon closer inspection it becomes apparent that it is biased and more in favour and to the advantage of the West (Mazrui 1978; Leibowitz & Bozalek 2018). So, as African universities continually shed away their cultural values and policies from within their institutions to accommodate the West, a sense of deculturalization one might say, the Western harbours of knowledge continue to uphold their own values without faltering while continuing to extract from Africa as well as requiring global economic demands to be met. For example, France has also continued to preserve its colonial cultural legacy by institutionalizing and promoting the use of French language as a way of maintaining its cultural legacy as well as directing most of their development funding towards education, scholarships and cultural institutes that could classify the current relationship that France has with its former African colonies as neo-colonial. Thus, in French Africa the greatest economic and educational disruption is observed as they were highly territorial, using a closed-door policy that inevitably was and still proves to be incoherent. A test for colonial language policy yields inverse results towards educational attainment for the French and British colonial language policy with the latter being positive. Therefore, a policy recommendation for French colonies whose educational policies have remained colonial is a liberalization of their education policies to accommodate the characteristics of the different societies in such a way that delays the introduction of the French language which allows people to be taught in their local dialects from elementary school levels.

The policy recommendation on the French colonial language is also applicable to regions that were highly dominated by Islam, as result these regions also show a closed-door policy. However, a policy reformation in regions that are predominantly Islam could be quite challenging because most if not all policies are religion based. Perhaps, a possible approach could be to revise the current policies and introduce restrictions that would mediate against any religious interference. A similar religious disruption is also observed on educational attainment as you get closer to regions that were highly influenced by protestant missions which inevitably hinders urbanization. This shows that there is a religious policy constraint which requires restrictions to be introduced in current educational policies that would marginalize the observed interference.

It is then recommended that, first and foremost, that African higher education institutions be reclaimed by their own national governments coupled with a reform and reconstruction of their policies to meet African values. The introduction of Slow scholarship and pedagogy with more emphasis on the teaching and learning of African values, thought and reflective ideas with a shift away from global entanglements would be another recommendation. It is also a means of addressing the quality of education, inequality in the education system and dealing with individual, institutional as well as disciplinary differences (Leibowitz & Bozalek 2018). Additionally, to further address the equity of access would be that, instead of higher learning institutions being for either private or public learning, a rather impactful change would be observed if they would collaborate to form more formidable faculties and student bodies to continue in the preservation of the right to quality education (Baatjes 2005; Collins & Rothe 2019; Shahjahan 2012).

Hence, there should be a high degree of resistance against the corporatization higher education institutions and reconceptualization of educational policies to promote and develop critical thinking, political awareness and agency (Baatjes, 2005; Leibowitz & Bozalek 2018). Creating this holistic and conducive higher educational learning space promotes the sharing of ideas, inclusive of new ways of learning and appreciating constructive criticism, the students and intellectuals become more aware and assist a great deal to identify and eliminate any lingering forms of neocolonialism within the educational space. This will hopefully culminate to more African research outputs, knowledge hubs and digitization instead of them primary being of Western origins (Mazrui 1978; Naidoo 2010; Peet 2002).

In fact, the movement for resistance against neoliberalism and globalization saw a rekindling by the “student uprising, democracy, and soaring population; that took place during the period 1970s–1990s” in Thailand (Scott and Guan 2022) and the fees must fall protest that took place in South Africa (Mamdani 2007; Ndlovu 2017). This further emphasizes on the imminent need for the shift towards African curricular and pedagogies adopting policies to highly resist neoliberalism (Kamola 2011), otherwise, radical movements and protest such as these will without a doubt surge.

Therefore, another recommendation would be for African governments to refrain from being entirely reliant on Western funding in higher educational institutions and so encourage formulating new funding strategies or negotiate in such a manner that the amended education policies and agreements do not leave them at the mercy of the West. For instance, in the case of Tanzania and Uganda, when they realized that their educational funding partnership agreements with the West limited both intellectual freedom and focal responsibility, they resorted to withdrawing their subscription in 1990 as they were at risk of political harassment which as evidenced resulted in a significant immediate positive improvement in the link between educational and economic development.

Furthermore, there is need to incorporate poverty-reduction strategies within the development framework as an inclusive means to the general public in order to retreat from privatization, marketization and biased structural adjustment programmes. As a result, decentralizing governance, having formidable institutions and the formation of new local partnerships will become a reality (Craig & Porter 2006). And as education access expands to all coupled with investments therein (Rhoades et al. 2004), these will ultimately contribute to a sustainable, regional and national economic development.

6.4.2. Neo-slavery and slave trade

An impediment towards economic development caused by colonial violence is also significant as colonial violence stems from either tribal conflict (Blouin 2013; Blouin and Mukand 2016) or slave traders as shown in the results. For example, the conflict amongst ethnic groups that took place in Rwanda and Burundi was a major contributing factor for ethnic violence and the 1994 genocide that disrupted economic and educational activities (Blouin 2013; Blouin and Mukand 2016). The disruption caused by high slavery on the link between educational and economic development confirms colonial violence results. Additionally, in the autoregression results, the

development of education is highly disconnected from economic development in regions that were severely affected by slavery, Islam dominancy, European settlers and ethnic fractionalization which can still be largely mapped to colonial violence as caused by slavery and slave trade. Hence, a possible implication for these regions could be for policy makers to consider improving their policies in such a way that they are less repressive because policies that are entirely repressive tend to be counter-productive if development initiatives are not in place to aid in determining the drivers of violence further assisting in improving the education of youth, socio-economic inequalities, including skills by creating community awareness and education programs. Moreover, Sugiharti et al. (2023) also confirmed in detail the suggested recommendation where they argued that lower criminal activities are positively associated with higher investments and longer length of schooling. Therefore, crime rate can be deterred by creating more employment and educational opportunities as well as establishing an economic climate which attracts higher investments. Thus, a good economic climate is only guaranteed when the income distribution is adjusted in such a way that equity increases while both poverty and crime decrease. Also, poverty levels can be lowered by improving the income distribution which inevitably contributes in suppressing crime in a way that governments could include people who are living in poverty as well as those who belong to the lower income bands in their budget. Lastly, organizing of community awareness programs together with having good law enforcement and judicial systems in place can also aid in further reducing criminal actions.

6.5. Recommendations for further research

As the study of Africa's development economics has yielded the most meaningful results when Africa's history and development trajectory are both accounted for in any given research area, future work should then examine the role of Africa's colonial and slavery history on the ongoing policy reformations. To be more precise, an investigation needs to be carried out to determine the response of the effect of Africa's history to possible policy reforms that have taken place on the development equilibrium. An investigation on the inter-relationship between precolonial, colonial and post-colonial educational curriculums would be a significant contribution. This might require one to combine historical data with precolonial and colonial details on pre-colonial and colonial educational institutions.

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Appendices: Supplementary derivations and results

Appendix.I. Causal set up where Z is either a valid or invalid instrument

Figure A.1.1. illustrates four cases in a causal relationship between outcome (Y) and predictor (X) with probable IVs and ε is all factors that affect Y when X is held constant. These four cases (a, b, c and d) presented are not empirically different if the weakest of the IVs approach is used. Observable variables are not effective for testing whether the chosen Z variable is a valid instrument. The validity of an instrument in a causal relationship is only assumed in case (c and d) and not in case (a), and (b). Case (a) demonstrates causal set up where Z is an invalid instrument for X even though Z is related to the unobservable variables that are in ε , Z affects Y except through X. Leading to bias estimates of the causal relationship between X and Y because the relationship between ε and Z allows for an indirect association between Z and Y. In practice, it is impossible to test whether a relationship between Z and ε exists when the instrument that is used is correlated with unobserved variables in ε that are causally related to Y. Moreover, case (b) demonstrates a causal set up where Z is an invalid instrument for X even though Z is not related to the unobservable variables that are in ε , but Z directly affects Y except through X. When X is held constant, the instrument Z should not affect Y (Pearl 2009), as a result the exclusion constraints are violated. This is also in line with Morgan and Winship (2014), who suggest that there is no other way to reject an invalid instrument other than to use an empirical test that could be used in a situation where an empirical relationship appears even though the IV identifying assumption is valid. The empirical test could also be used to identify an IV in a condition where empirical association between the instrument and the outcome is detected after conditioning the predictor. To determine the validity of an instrument, reliance must be placed on recent knowledge, theories, and insight. However, a validity test is not sufficient to address sampling variability that may occur in finite samples and/or make estimates to be biased and affect the strength of the relationship between X and Z when an instrument is valid, see case (d).

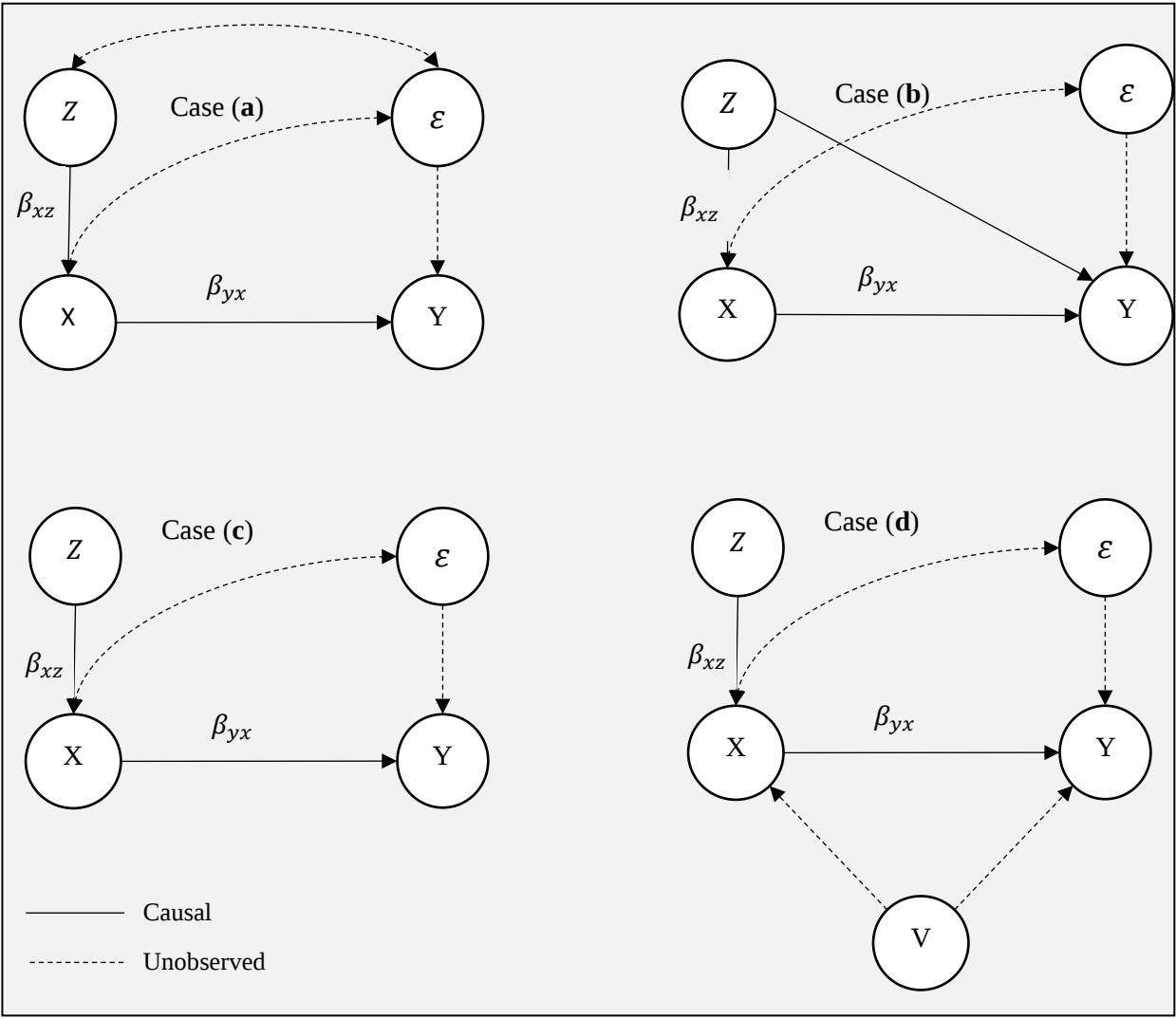


Figure A.1. 1: Causal set up where Z is an invalid instrument in case (a) and case (b), and a valid instrument in case (c) and case (d) on a target regression model.

Appendix.II. OLS and Instrumental variable results

Table A.1. 1 Cross sectional estimates for 16 African countries showing first-stage effect of railroads on the European population and reduced-form effect of railroads on infrastructure investments in education (1905–1956 average).

	OLS	2SLS	First stage	Reduced form
	(1)	(2)	(3)	(4)
	Investments in Education		European population	Investments in Education
Railroads, in Km	0.20 ** (0.08)		0.28 *** (0.04)	0.45 *** (0.07)
European population, logged	0.67 *** (0.11)	1.26 *** (0.21)		
African population, logged	0.17 (0.15)	0.04 (0.17)	0.06 (0.09)	0.24 (0.15)
Malaria index	0.48 (0.32)	0.68 (0.35)	-0.55 (0.28)	0.34 (0.34)
Tsetse fly index	0.09 (0.06)	0.11 (0.06)	-0.04 (0.03)	0.08 (0.06)
Ethnic fractionalization	-0.13 (0.09)	-0.08 (0.10)	-0.06 (0.06)	-0.18 (0.10)
Presence of Islam 1913	0.33 (0.18)	0.61 ** (0.22)	-0.59 *** (0.09)	0.02 (0.18)
First British/French precolonial school	3.85 ** (1.30)	3.40 * (1.37)	1.88 * (0.75)	4.41 ** (1.37)
First precolonial school	-2.23 (1.28)	-2.29 (1.35)	-1.59 * (0.76)	-2.19 (1.36)
District (N)	301	301	277	312
R ²	0.31	0.24	0.47	0.22
District FE	Yes	Yes	Yes	Yes
Weak instruments		85.19 ***		
Wu-Hausman		6.95 **		

Note that all continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05. Outcomes are logged to reduce dependency on extreme observation.

Table A.1. 2 Cross sectional estimates for 8 French colonies showing first-stage effect of railroads on the European population and reduced-form effect of railroads on infrastructure investments in education (1905–1956 average).

	OLS	2SLS	First stage	Reduced form
	(1)	(2)	(3)	(4)
	Investments in Education		European population	Investments in Education
Railroads, in Km	0.35 *** (0.09)		0.17 ** (0.06)	0.49 *** (0.09)
European population, logged	0.55 *** (0.13)	1.61 *** (0.33)		
African population, logged	-0.14 (0.19)	-0.34 (0.25)	0.27 (0.15)	-0.17 (0.19)
Malaria index	0.55 * (0.26)	0.92 ** (0.34)	-1.43 *** (0.37)	0.42 (0.27)
Tsetse fly index	0.06 (0.05)	0.13 * (0.06)	-0.01 (0.04)	0.04 (0.05)
Ethnic fractionalization	-0.38 (0.20)	-0.08 (0.28)	0.12 (0.14)	-0.40 (0.20)
Presence of Islam 1913	-1.03 *** (0.27)	-0.38 (0.38)	-0.32 (0.18)	-1.16 *** (0.26)
First British/French precolonial school	3.96 ** (1.43)	5.72 ** (1.93)	2.13 (1.41)	3.69 * (1.51)
First precolonial school	-4.60 ** (1.44)	-7.00 *** (2.00)	-1.84 (1.53)	-3.89 * (1.51)
District (N)	101	101	92	112
R ²	0.64	0.38	0.58	0.56
District FE	Yes	Yes	Yes	Yes
Weak instruments		26.03 ***		
Wu-Hausman		14.04 ***		

Note that all continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05. Outcomes are logged to reduce dependency on extreme observation.

Table A.1. 3 Cross sectional estimates for British colonies showing first-stage effect of railroads on the European population and reduced-form effect of railroads on infrastructure investments in education (1905–1956 average).

	OLS	2SLS	First stage	Reduced form
	(1)	(2)	(3)	(4)
	Investments in Education		European population	Investments in Education
Railroads, in Km	0.17 * (0.09)		0.25 *** (0.05)	0.44 *** (0.08)
European population, logged	0.79 *** (0.12)	1.31 *** (0.23)		
African population, logged	0.44 ** (0.16)	0.32 (0.19)	-0.15 (0.11)	0.61 *** (0.18)
Malaria index	1.09 (0.63)	1.19 (0.66)	-0.45 (0.37)	0.94 (0.70)
Tsetse fly index	0.39 ** (0.13)	0.40 ** (0.14)	-0.13 (0.08)	0.37 * (0.15)
Ethnic fractionalization	-0.07 (0.09)	-0.02 (0.10)	-0.03 (0.07)	-0.14 (0.10)
Presence of Islam 1913	-0.66 ** (0.25)	-0.50 (0.27)	-0.20 (0.14)	-0.92 ** (0.28)
First British/French precolonial school	1.62 (1.68)	0.44 (1.82)	1.94 * (0.92)	3.44 (1.84)
First precolonial school	0.89 (1.67)	1.52 (1.75)	-1.45 (0.92)	-0.08 (1.84)
District (N)	200	200	185	200
R ²	0.46	0.40	0.46	0.33
District FE	Yes	Yes	Yes	Yes
Weak instruments		54.09 ***		
Wu-Hausman		4.13 *		

Note that all continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05. Outcomes are logged to reduce dependency on extreme observation.

Table A.1. 4 Cross sectional estimates for 16 African countries showing first-stage effect of railroads on the European population and reduced-form effect of railroads on students (1905–1956 average).

	OLS (1)	2SLS (2)	First stage (3)	Reduced form (4)
	Students		European population	Students
Railroads, in Km	0.16 * (0.07)		0.36 *** (0.04)	0.43 *** (0.07)
European population, logged	0.71 *** (0.10)	1.15 *** (0.18)		
Malaria index	1.19 * (0.49)	1.31 * (0.51)	-0.21 (0.17)	1.04 * (0.52)
Tsetse fly index	0.05 (0.06)	0.07 (0.06)	-0.03 (0.03)	0.02 (0.06)
Ethnic fractionalization	-0.16 (0.10)	-0.10 (0.11)	-0.11 * (0.05)	-0.25 * (0.11)
Presence of Islam 1913	0.65 *** (0.18)	0.88 *** (0.20)	-0.45 *** (0.10)	0.27 (0.18)
District (N)	277	277	301	288
R ²	0.29	0.24	0.32	0.17
District FE	Yes	Yes	Yes	Yes
Weak instruments		97.51 ***		
Wu-Hausman		4.86 ***		

Note that all continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05. Outcomes are logged to reduce dependency on extreme observation.

Table A.1. 5 Cross sectional estimates for 8 British colonies showing first-stage effect of railroads on the European population and reduced-form effect of railroads on students (1905–1956 average).

	OLS (1)	2SLS (2)	First stage (3)	Reduced form (4)
	Students		European population	Students
Railroads, in Km	0.26 ** (0.10)		0.37 *** (0.05)	0.58 *** (0.09)
European population, logged	0.87 *** (0.13)	1.55 *** (0.23)		
Malaria index	1.57 * (0.70)	1.73 * (0.76)	0.03 (0.38)	1.37 (0.78)
Tsetse fly index	0.50 *** (0.15)	0.50 ** (0.16)	0.00 (0.08)	0.49 ** (0.16)
Ethnic fractionalization	-0.15 (0.12)	-0.06 (0.13)	-0.11 (0.06)	-0.26 (0.14)
Presence of Islam 1913	-0.03 (0.27)	0.18 (0.30)	-0.27 (0.15)	-0.29 (0.30)
District (N)	185	185	200	185
R ²	0.40	0.31	0.27	0.26
District FE	Yes	Yes	Yes	Yes
Weak instruments		64.11 ***		
Wu-Hausman		7.15 ***		

Note that all continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05. Outcomes are logged to reduce dependency on extreme observation.

Table A.1. 6 Cross sectional estimates for 8 French colonies showing first-stage effect of railroads on the European population and reduced-form effect of railroads on students (1905–1956 average).

	OLS (1)	2SLS (2)	First stage (3)	Reduced form (4)
	Students		European population	Students
Railroads, in Km	0.07 (0.04)		0.34 *** (0.07)	0.20 *** (0.04)
European population, logged	0.42 *** (0.06)	0.63 *** (0.12)		
Malaria index	1.21 *** (0.24)	1.29 *** (0.26)	-0.29 (0.19)	1.04 *** (0.28)
Tsetse fly index	-0.02 (0.03)	-0.01 (0.03)	-0.05 (0.04)	-0.05 (0.03)
Ethnic fractionalization	-0.17 * (0.07)	-0.14 (0.08)	-0.11 (0.13)	-0.22 * (0.09)
Presence of Islam 1913	-0.26 * (0.12)	-0.13 (0.14)	-0.56 ** (0.20)	-0.48 *** (0.12)
District (N)	92	92	101	103
R ²	0.61	0.57	0.29	0.44
District FE	Yes	Yes	Yes	Yes
Weak instruments		26.57 ***		
Wu-Hausman		2.44 ***		

Note that all continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05. Outcomes are logged to reduce dependency on extreme observation.

Table A.1. 7 First-stage panel effect of tsetse fly on the European population and reduced-form effect of tsetse fly on educational development (1905–1956) for 8 French colonies.

	(1)	(2)	(3)	(4)
	Teachers		European population	Teachers
	OLS	2SLS	First stage	Reduced form
Tsetse fly	-0.08 * (0.03)		-1.37 *** (0.07)	-0.27 *** (0.03)
European population, logged	0.12 *** (0.01)	0.24 *** (0.05)		
African population, logged	0.11 *** (0.01)	0.08 *** (0.02)	0.00 (0.03)	0.10 *** (0.01)
Civil administration, logged	0.46 *** (0.02)	0.36 *** (0.05)	0.86 *** (0.04)	0.56 *** (0.02)
Hostile events against Europeans, logged	-0.03 (0.03)	-0.03 (0.03)	0.16 ** (0.06)	-0.00 (0.03)
Ethnic fractionalization	-0.04 (0.06)	0.09 (0.07)	-1.14 *** (0.13)	-0.18 ** (0.06)
Precolonial centralization index	0.11 * (0.05)	0.37 *** (0.11)	-2.21 *** (0.11)	-0.15 ** (0.05)
Indicator of a precolonial trading post	1.07 *** (0.04)	0.93 *** (0.08)	0.71 *** (0.10)	1.14 *** (0.04)
District (N)	3 118	3 118	3 118	3 118
R ²	0.49	0.46	0.27	0.45
Year FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Weak instruments		83.01 ***		
Wu-Hausman		5.71 **		

Note that all continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Table A.1. 8 French panel estimates showing the first-stage panel effect of malaria on the European population and reduced-form effect of malaria on educational development (1910–1956) for 8 French colonies.

	(1)	(2)	(3)	(4)
	Teachers		European population	Teachers
	OLS	2SLS	First stage	Reduced form
Malaria	-0.03 * (0.02)		-0.76 *** (0.03)	-0.12 *** (0.02)
European population, logged	0.12 *** (0.01)	0.16 *** (0.02)		
African population, logged	0.11 *** (0.01)	0.10 *** (0.01)	0.31 *** (0.03)	0.15 *** (0.01)
Civil administration, logged	0.46 *** (0.02)	0.42 *** (0.02)	0.89 *** (0.04)	0.57 *** (0.02)
Hostile events against Europeans, logged	-0.03 (0.03)	-0.03 (0.03)	0.04 (0.06)	-0.03 (0.03)
Ethnic fractionalization	-0.04 (0.06)	0.01 (0.06)	-1.09 *** (0.12)	-0.17 ** (0.06)
Precolonial centralization index	0.11 * (0.05)	0.21 *** (0.06)	-2.23 *** (0.10)	-0.15 *** (0.05)
Indicator of a precolonial trading post	1.07 *** (0.04)	1.02 *** (0.04)	1.18 *** (0.10)	1.21 *** (0.04)
Nobs	3 118	3 118	3 118	3 118
R ²	0.49	0.49	0.38	0.46
Year FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Weak instruments		548.36		
Wu-Hausman		4.74		

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Table A.1. 9 First and second stage effects of Islam dominancy, colonial language policy, post-independence violence and neo-colonialism on contemporary development for British Africa.

	First Stage	Second Stage		
	Educational Attainment	Night light	International business/investors	Present living conditions
European population, logged	0.01 (0.03)	0.36 *** (0.08)	(0.04) (0.04)	0.05 ** (0.01)
Education investment, logged	0.00 (0.02)	(0.01) (0.06)	0.01 (0.04)	-0.03 ** (0.01)
Students, logged	0.00 (0.02)	0.23 *** (0.05)	(0.03) (0.03)	0.03 ** (0.01)
Presents of Islam	-0.14 * (0.07)	0.49 (0.60)	0.39 (0.33)	0.04 (0.11)
Ethic fractionalization	(0.04) (0.03)	(0.05) (0.08)	0.09 * (0.04)	0.00 (0.01)
Former presence of slavery	(0.03) (0.12)	-0.79 ** (0.30)	0.22 (0.16)	0.05 (0.05)
Type of slavery	(0.01) (0.06)	(0.13) (0.15)	-0.17 * (0.08)	0.03 (0.03)
British colonial language policy	0.47 ** (0.16)	1.54 (1.06)	(0.02) (0.59)	0.14 (0.20)
Colonial violence	0.03 (0.11)	-1.34 *** (0.28)	0.10 (0.15)	-1.12 * (0.05)
Post – independence violence	0.37 * (0.16)	2.03 *** (0.42)	(0.28) (0.23)	0.27 *** (0.08)
Educational attainment		0.48 (1.09)	0.31 (0.60)	0.20 (0.20)
Education attainment*Islam		(0.22) (0.50)	(0.29) (0.28)	(0.06) (0.09)
Education attainment*British language		(0.05) (0.93)	(0.46) (0.51)	(0.12) (0.17)
Nobs	119	119	119	119
r-squared	0.37	0.71	0.33	0.37
First Precolonial Schools	Yes	Yes	Yes	Yes
First British/French Precolonial Schools	Yes	Yes	Yes	Yes

All continuous predictors are mean-centered and scaled by 1 standard deviation. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.

Table A.1. 10 Examining Africa's development trajectory in relation with the three main historical legacies.

	Before the Scramble	The Scramble	Colonial	Slave Trade
	1792-1859	1860-1901	1905-1956	1792-1859
Population Density	0.89 *** (0.14)	0.23 *** (0.01)	1.19 *** (0.20)	0.30 *** (0.02)
Distance to Precolonial School in Km	0.00 0.00	0.00 0.00	0.00 0.00	0.00 ** 0.00
Distance to Coast in Km	0.00 0.00	0.00 0.00	0.00 0.00	-0.00 *** 0.00
Slavery Intensity	-0.89 ** (0.28)	0.11 *** (0.03)	(1.02) (0.66)	(0.05) (0.03)
Malaria index	-0.12 *** (0.03)	0.00 0.00	-0.84 * (0.35)	0.00 0.00
Distance to Railroad	0.00 0.00	(0.05) (0.03)	0.00 0.00	(0.06) (0.03)
nobs	450.00	860.00	312.00	998.00
r.squared	0.13	0.38	0.15	0.33
All continuous predictors are mean-centered and scaled by 1 standard deviation. The outcome variable is in its original units. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.				

Table A.1. 11 Examining French Africa's post-colonial development trajectory in relation with the three main historical legacies.

	Before the Scramble	The Scramble	Colonial	Slave Trade
	1792-1859	1860-1901	1905-1956	1792-1901
Population Density	1.65 *** (0.41)	0.28 *** (0.02)	2.81 *** (0.57)	0.23 *** (0.02)
Distance to Precolonial School in Km	0.00 0.00	-0.00 *** 0.00	0.01 0.00	-0.00 ** 0.00
Distance to Coast in Km	0.00 0.00	0.00 * 0.00	0.00 0.00	0.00 0.00
Slavery Intensity	(1.79) (1.33)	(0.01) (0.04)	(1.42) (1.46)	(0.02) (0.04)
Malaria Index	-0.26 * (0.12)	0.00 (0.01)	-2.27 ** (0.77)	0.01 (0.01)
Distance to Railroad	(0.01) (0.01)	0.05 (0.03)	(0.01) (0.01)	(0.01) (0.03)
nobs	132.00	168.00	112.00	188.00
r.squared	0.17	0.68	0.24	0.58
All continuous predictors are mean-centered and scaled by 1 standard deviation. The outcome variable is in its original units. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.				

Table A.1. 12 Examining British Africa's post-colonial development trajectory in relation with the three main historical legacies.

	Before the Scramble	The Scramble	Colonial	Slave Trade
	1792-1859	1860-1901	1905-1956	1792-1859
Population Density	0.76 *** (0.13)	0.24 *** (0.02)	0.82 *** (0.19)	0.34 *** (0.02)
Distance to Precolonial School in Km	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
Distance to Coast in Km	0.00 0.00	0.00 0.00	0.00 0.00	-0.00 *** 0.00
Slavery Intensity	-0.67 ** (0.21)	0.09 ** (0.03)	(0.70) (0.61)	-0.09 * (0.04)
Malaria Index	-0.10 *** (0.02)	0.00 0.00	(0.35) (0.35)	0.00 0.00
Distance to Railroad	0.00 0.00	(0.06) (0.03)	0.00 0.00	-0.09 * (0.04)
nobs	318.00	692.00	200.00	810.00
r.squared	0.17	0.36	0.15	0.32
All continuous predictors are mean-centered and scaled by 1 standard deviation. The outcome variable is in its original units. Standard errors are heteroskedasticity robust. *** p < 0.001; ** p < 0.01; * p < 0.05.				

Appendix.III. Bayesian results

Figure A.1. 2: Non-centered parameterization of the key likelihood for each of the individual empire components (1981-2021).

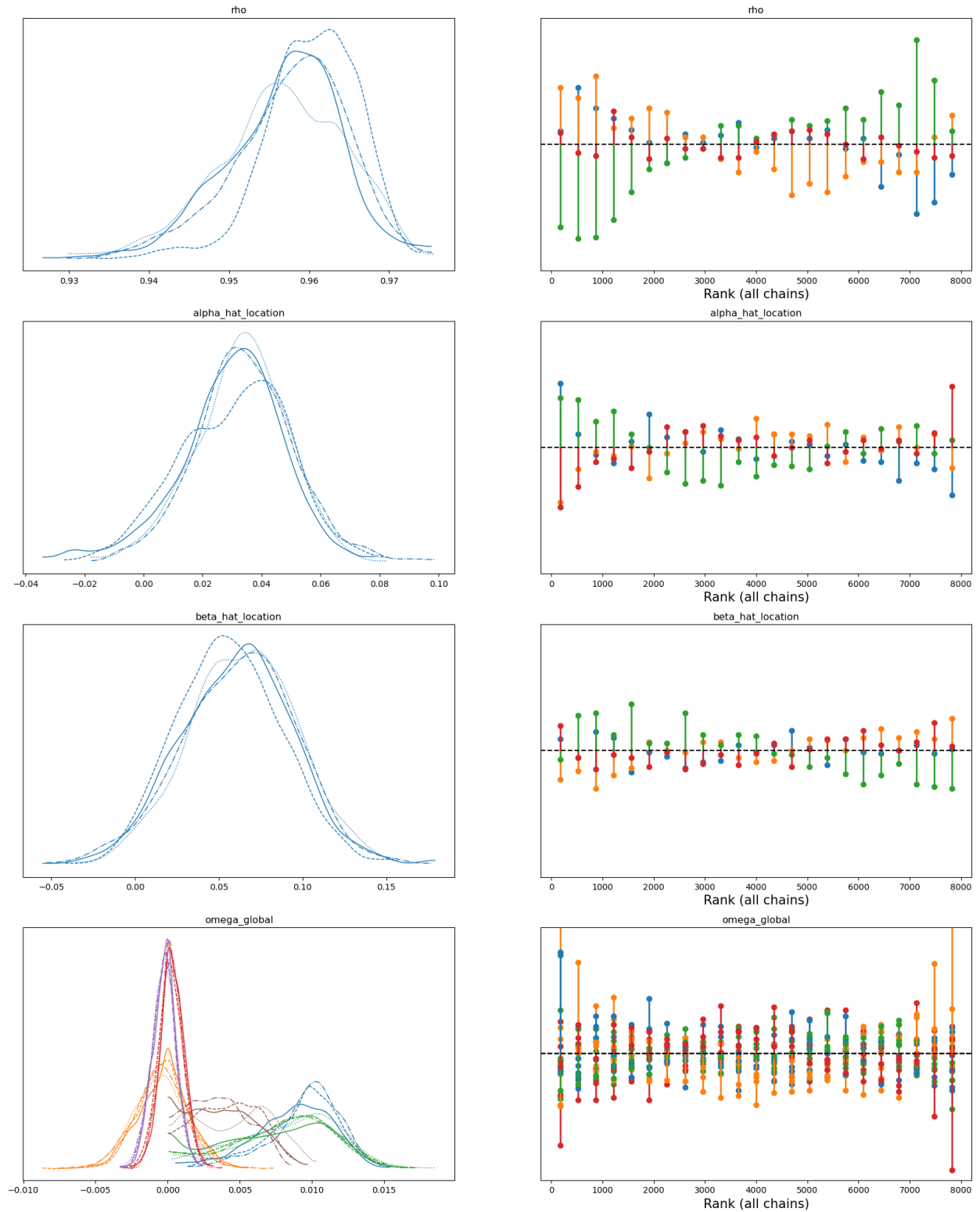


Figure A.1. 3: Prior correlation estimates.

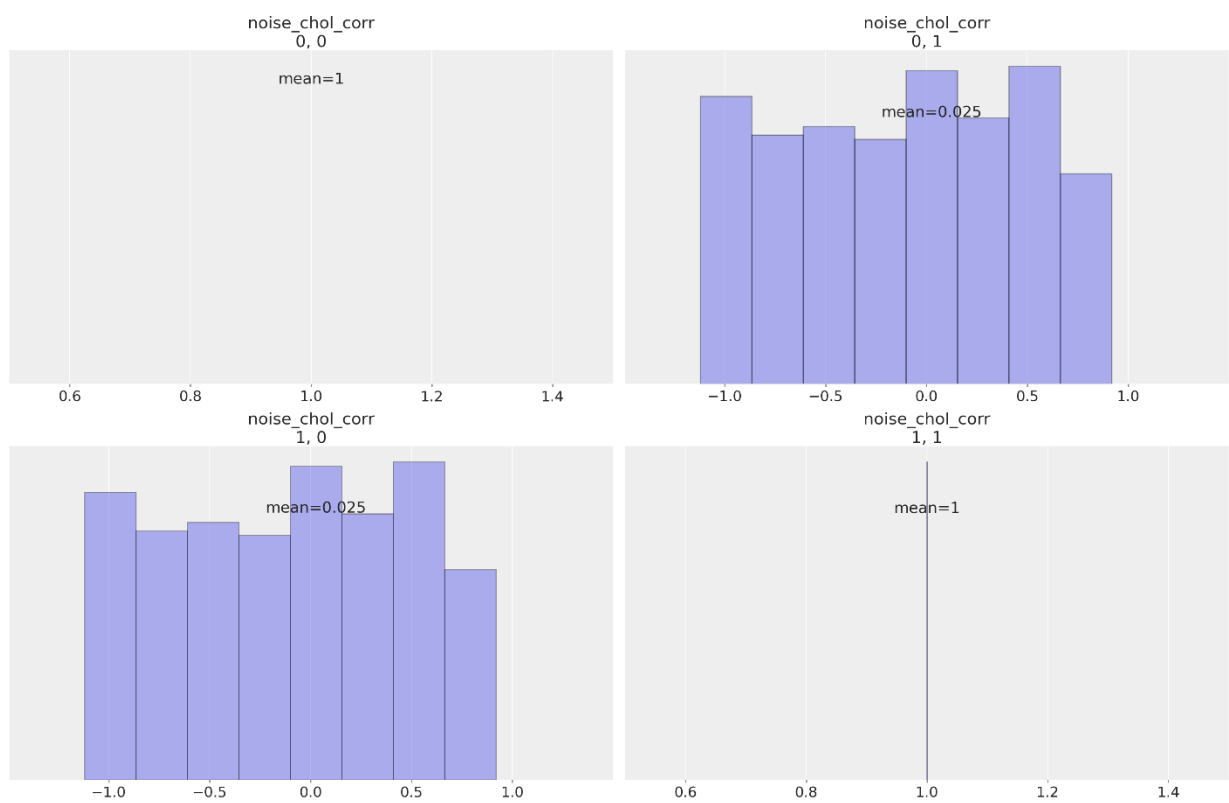


Figure A.1. 4: Posterior correlation estimates.

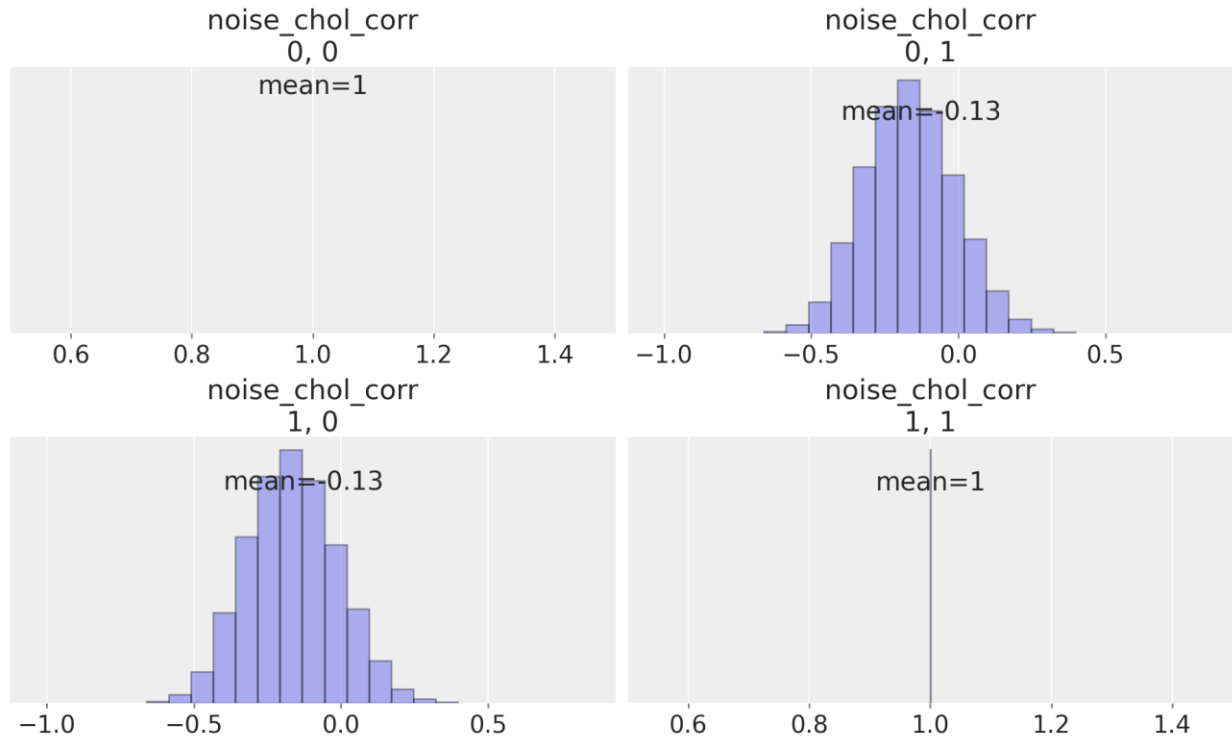


Figure A.1. 5: Model fits for each country to ensure that the predictive distribution can recover the observed data.

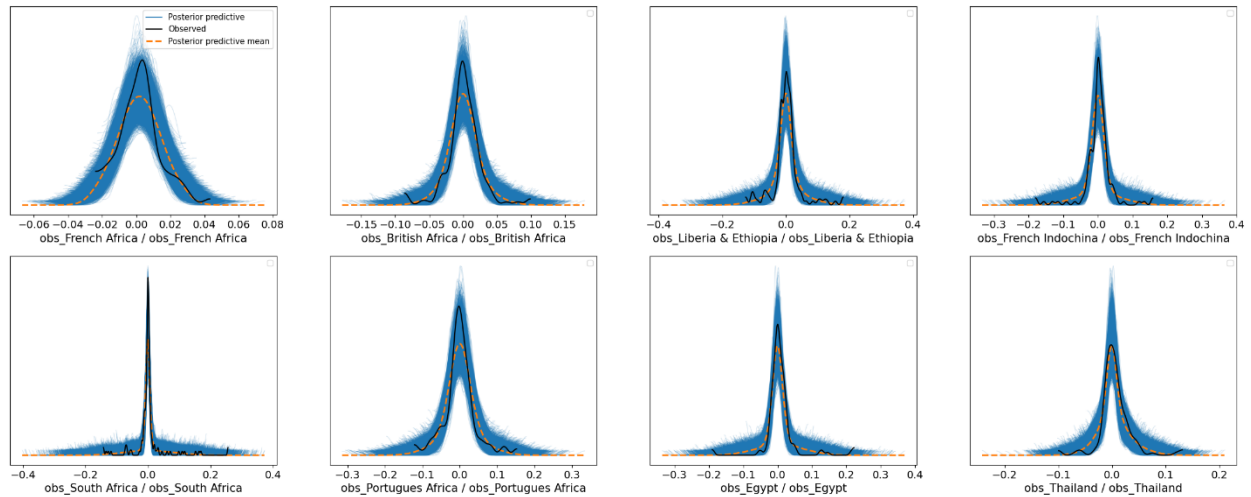


Figure A.1. 6: Intercept Parameters for each empire and Economic Measure (1981-2021).

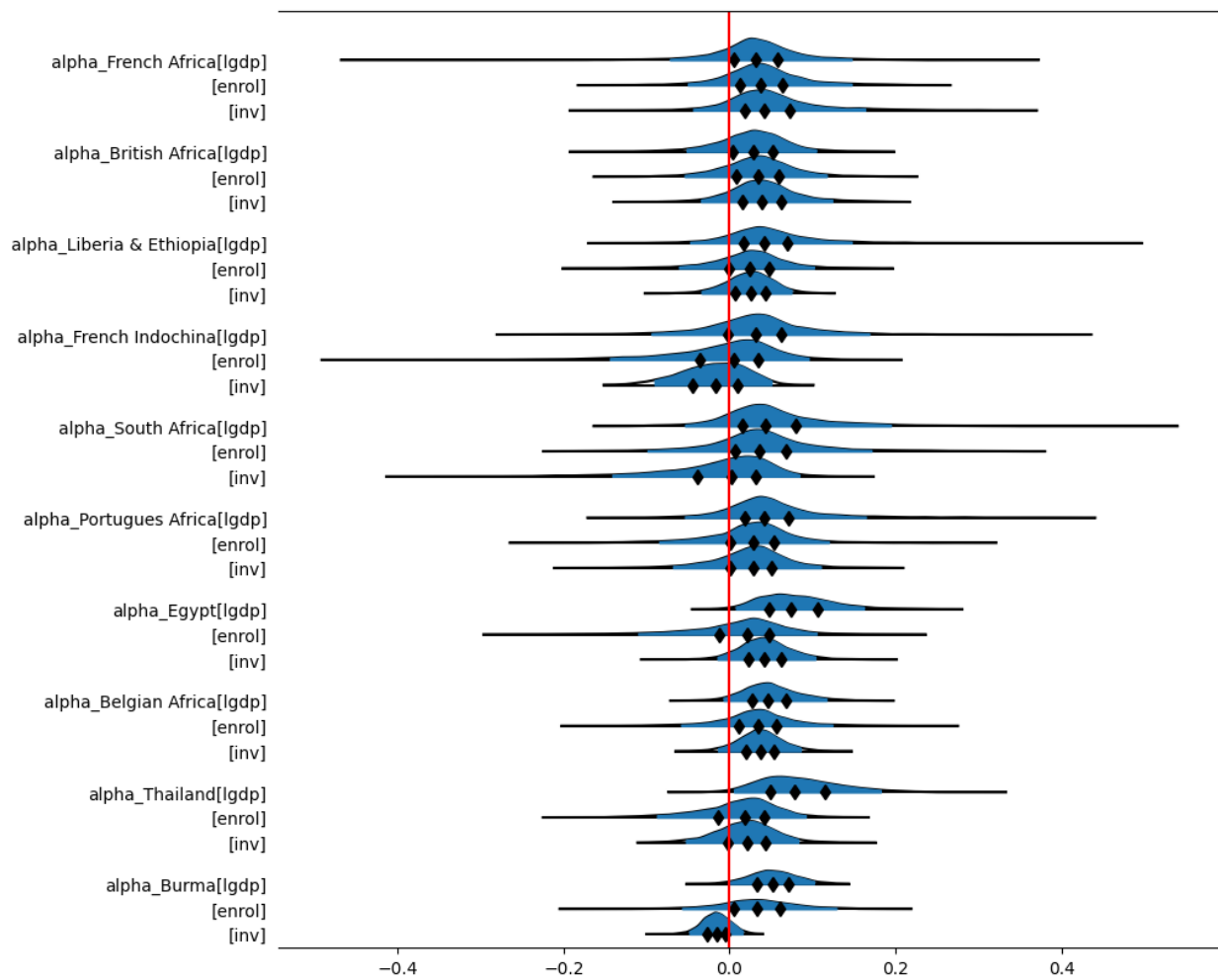


Figure A.1. 7: Africa's Posterior Predictive Checks on Hierarchical VAR by empire territory (1981-2021).

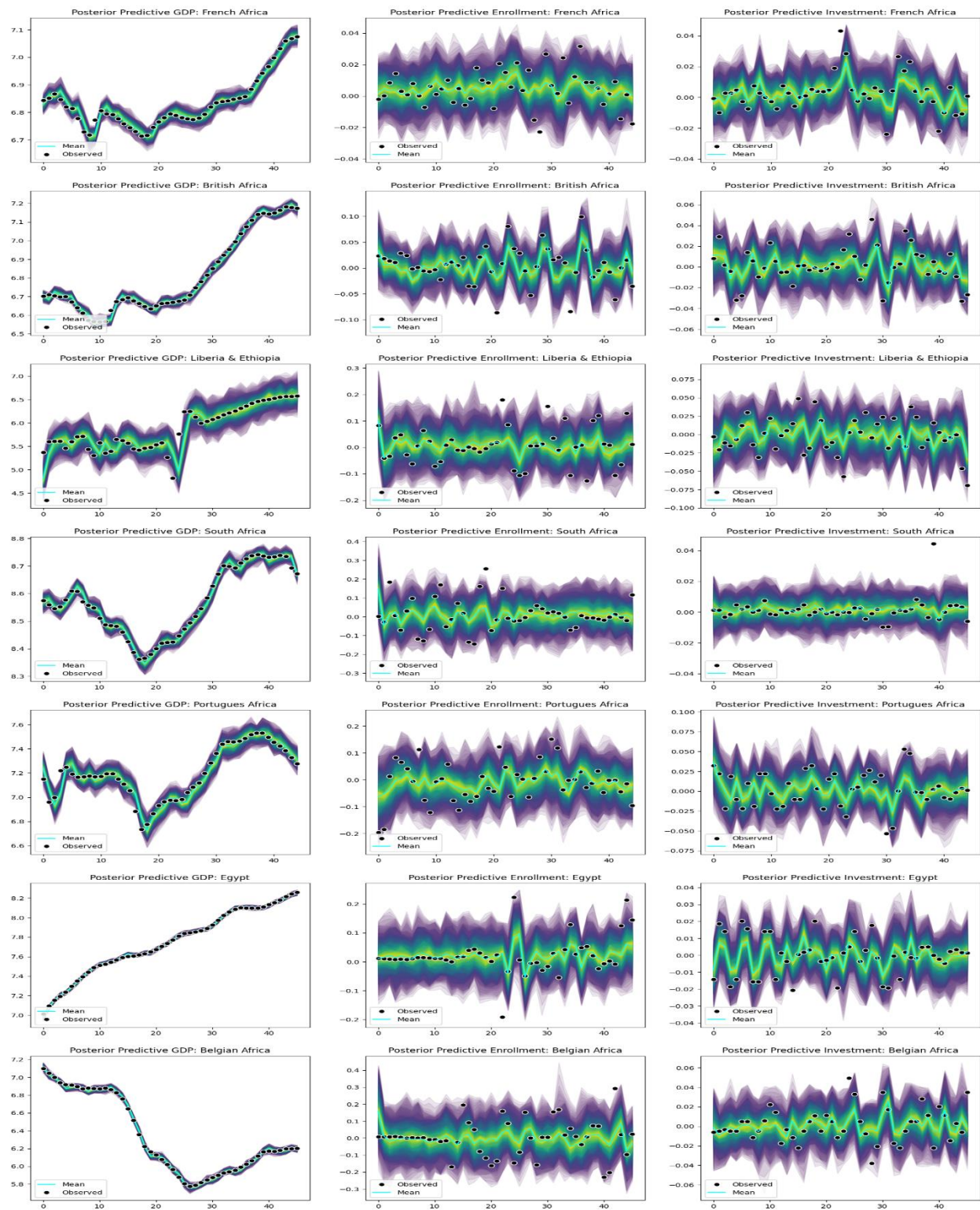


Figure A.1. 8: The structure of a VAR with 2 lags and 2 equations in the case of South Africa.

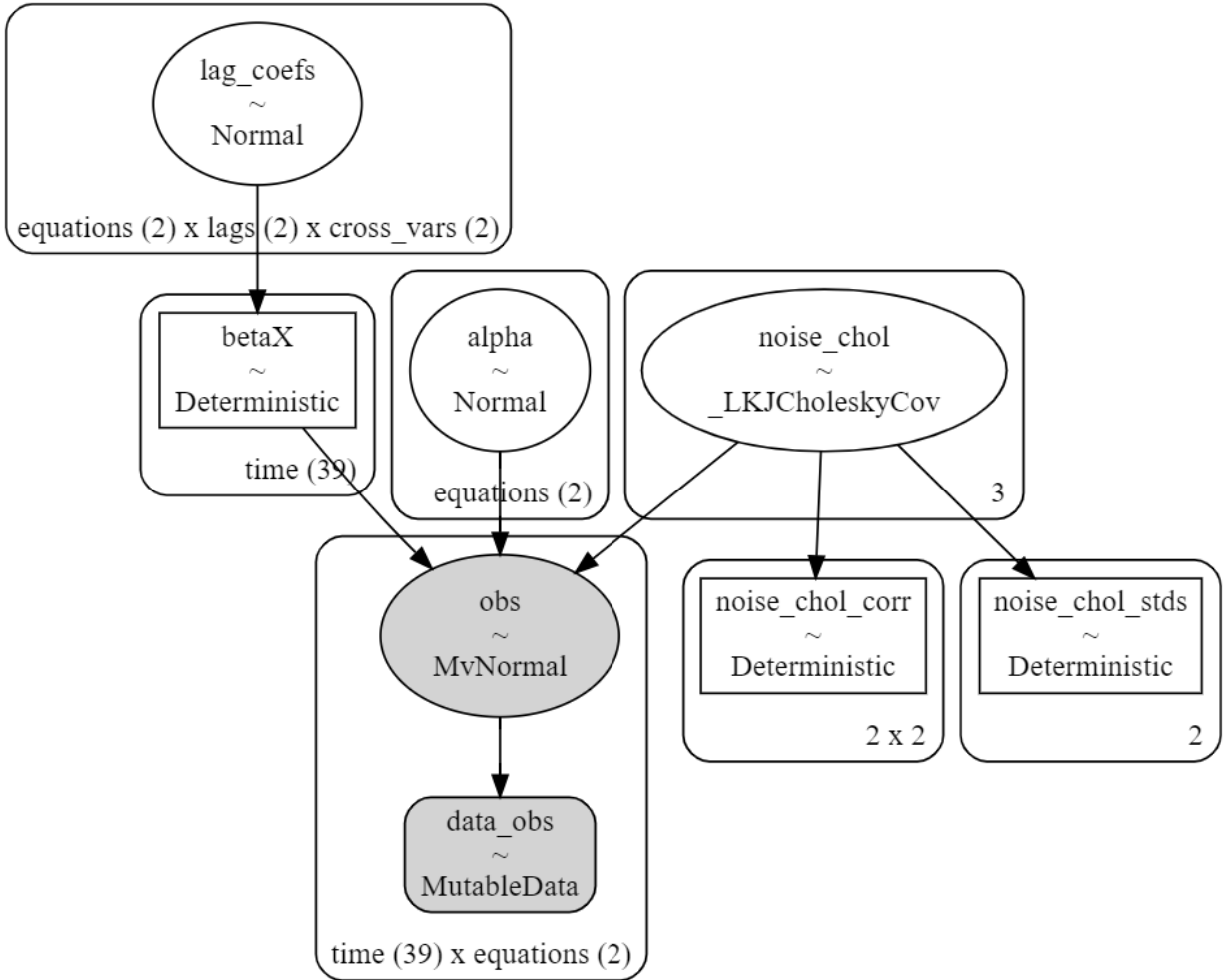
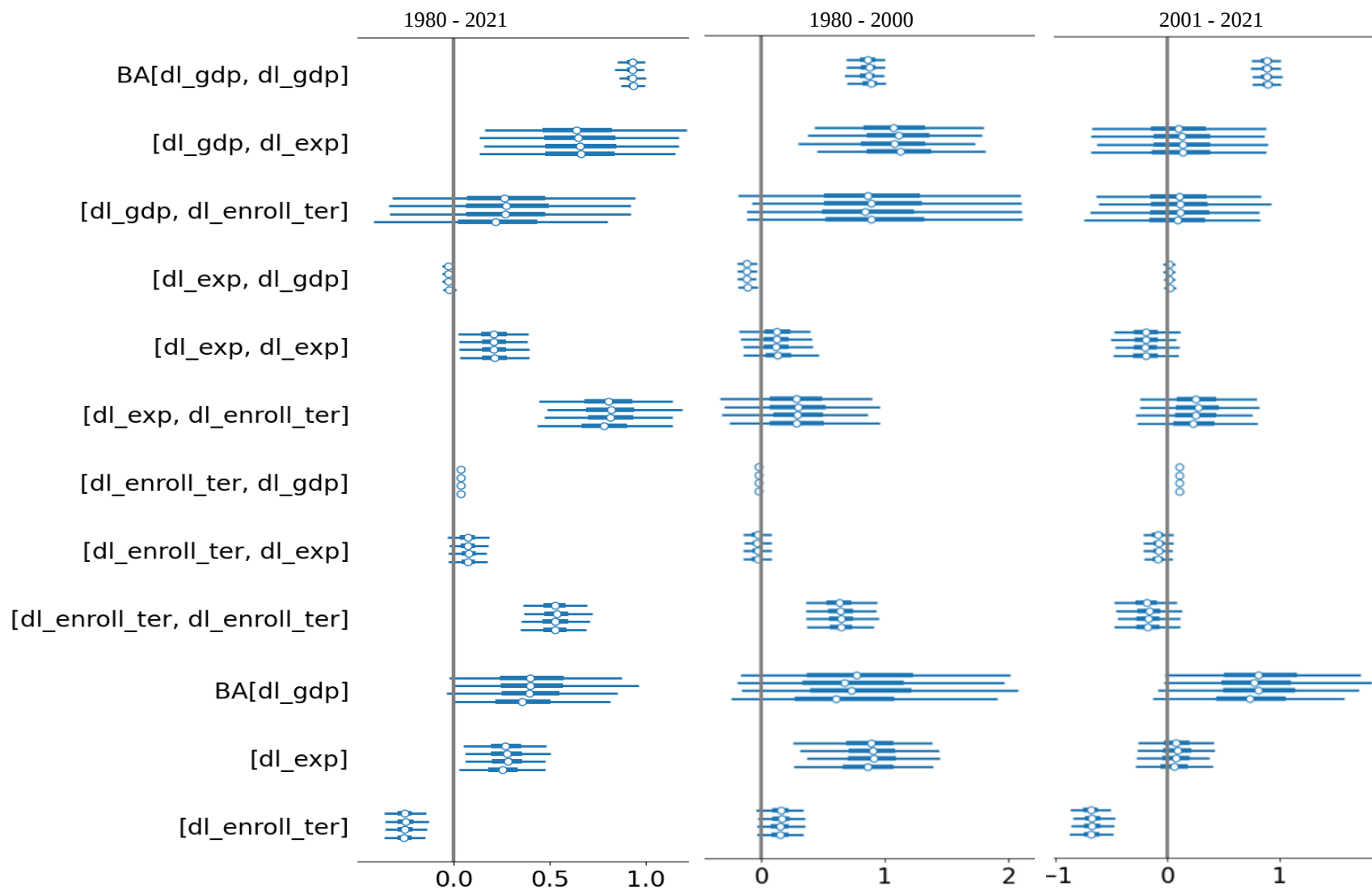


Figure A.1. 9: British Africa's correlation between educational development and GDP per capita.



Keynote. The above results as well as all other can be interpreted as follows: [dl_exp, dl_gdp] refers to the impact of GDP per capita (dl_gdp) on expenditure (dl_exp), likewise the rest.

Figure A.1. 10: British Africa's correlation between educational development and financial markets index.

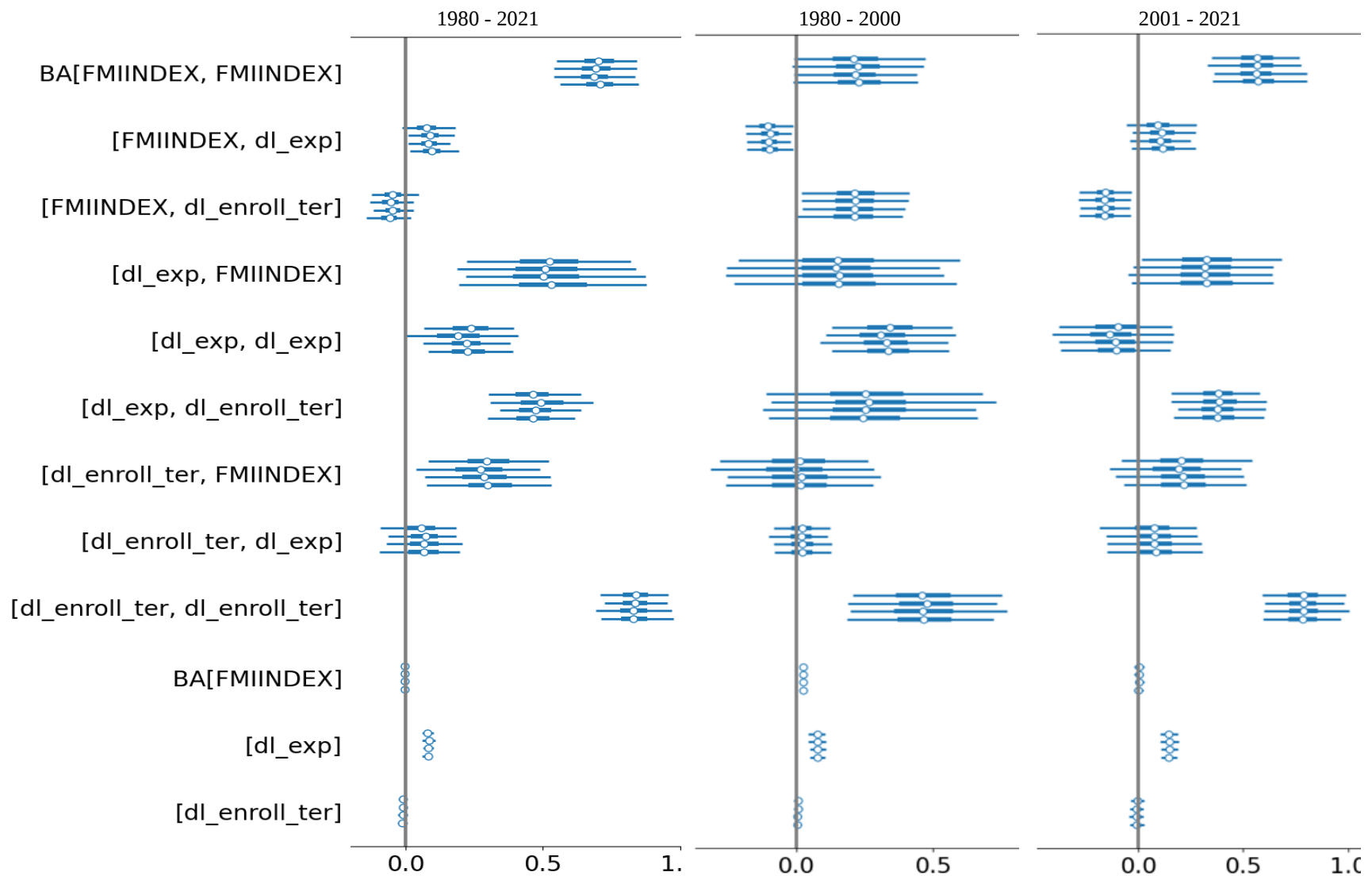


Figure A.1. 11: British Africa's correlation between educational development and Human Development Index.

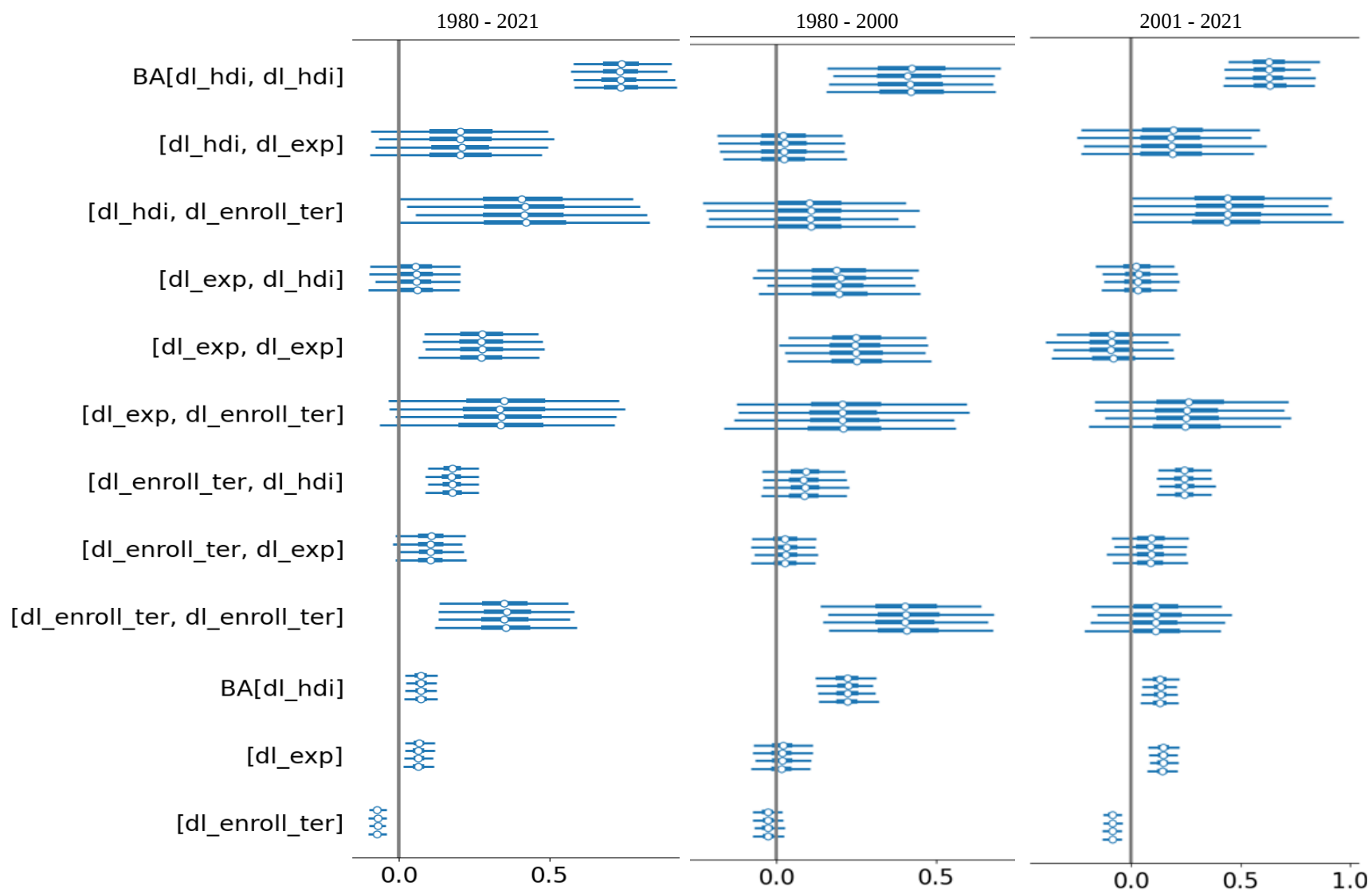


Figure A.1. 12: British Africa's correlation between educational development and Industrialization Index.

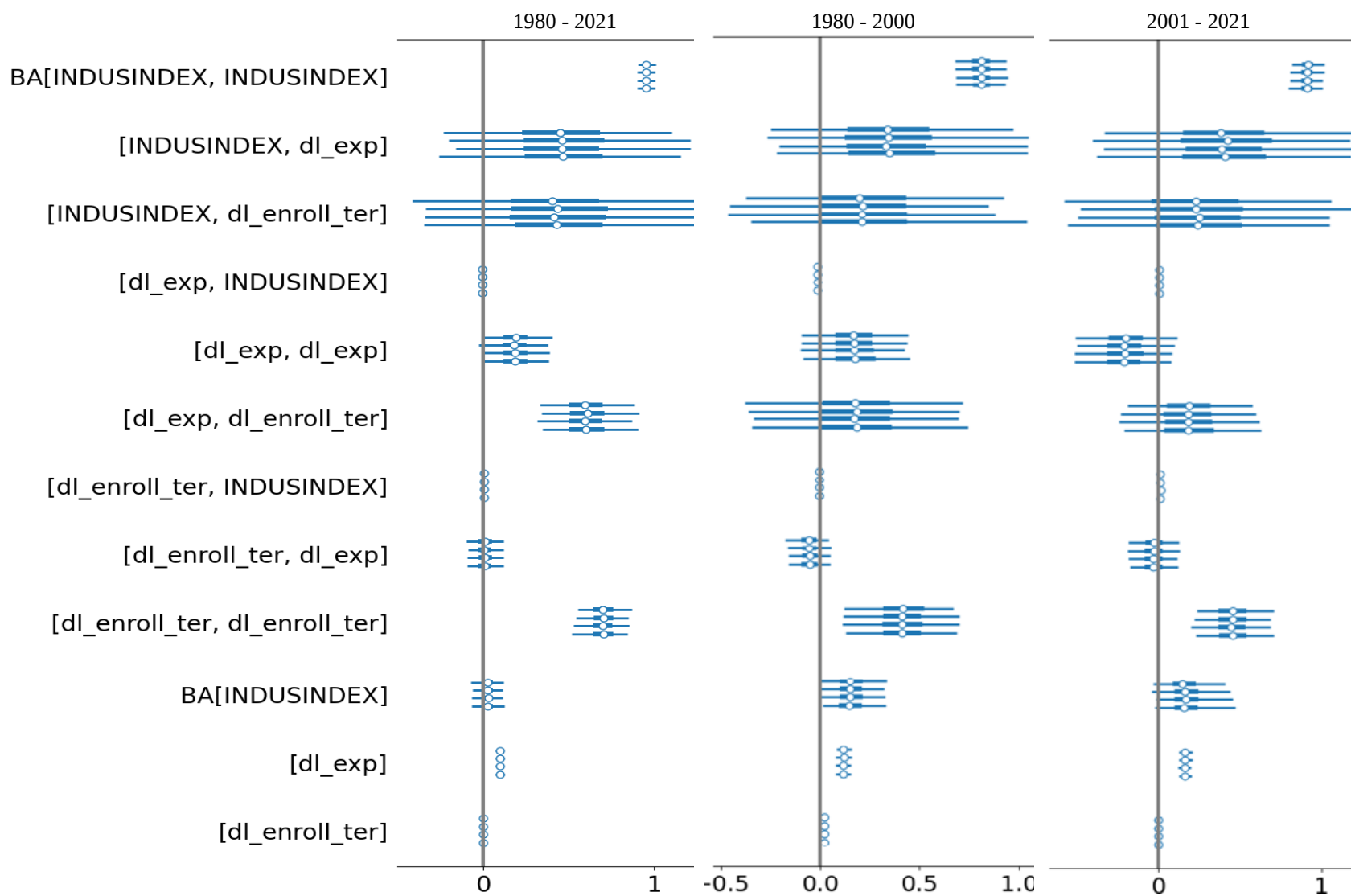


Figure A.1. 13: Burma's correlation between educational development and economic development.

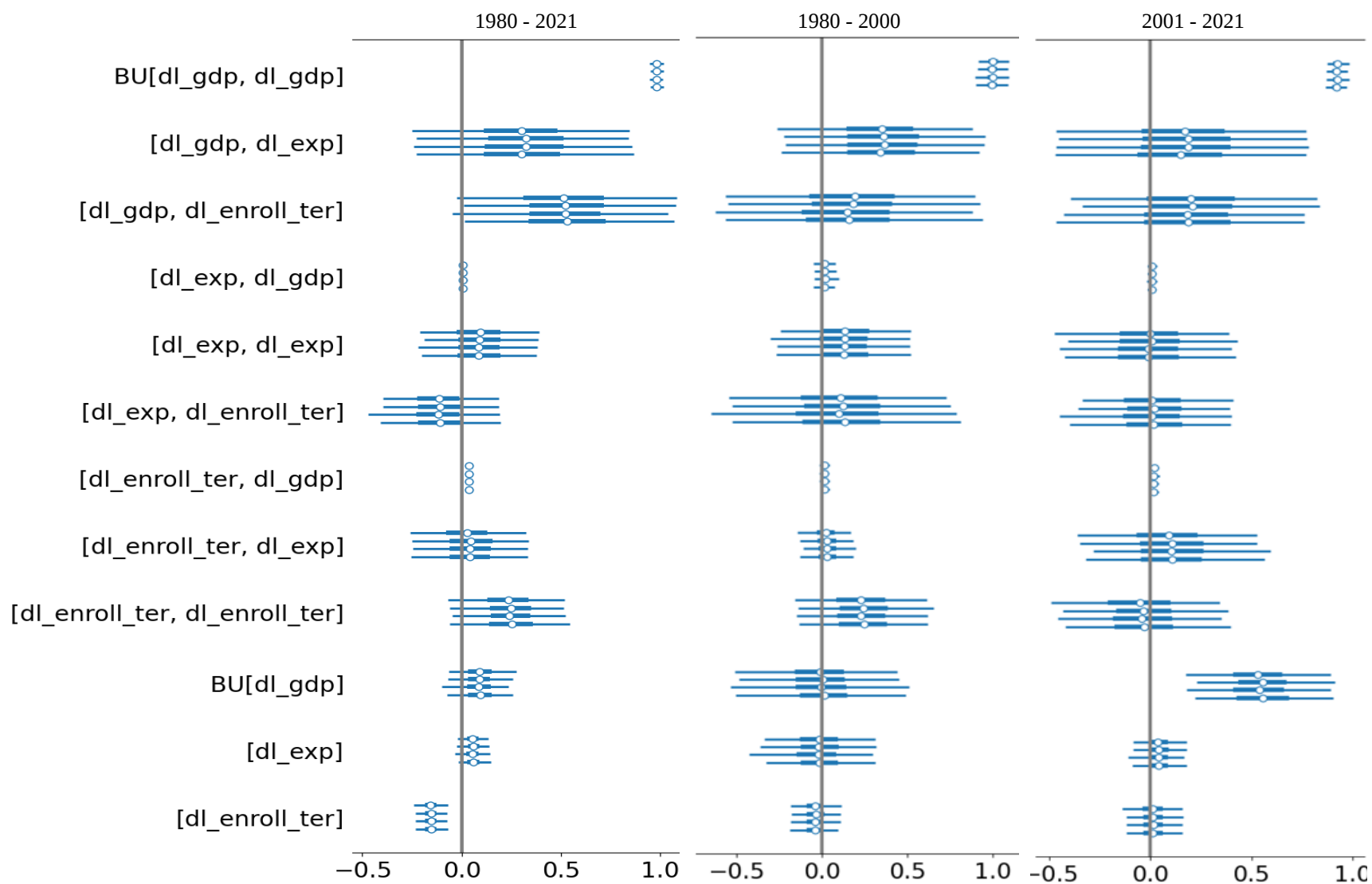


Figure A.1. 14: Burma's correlation between educational development and financial markets index.

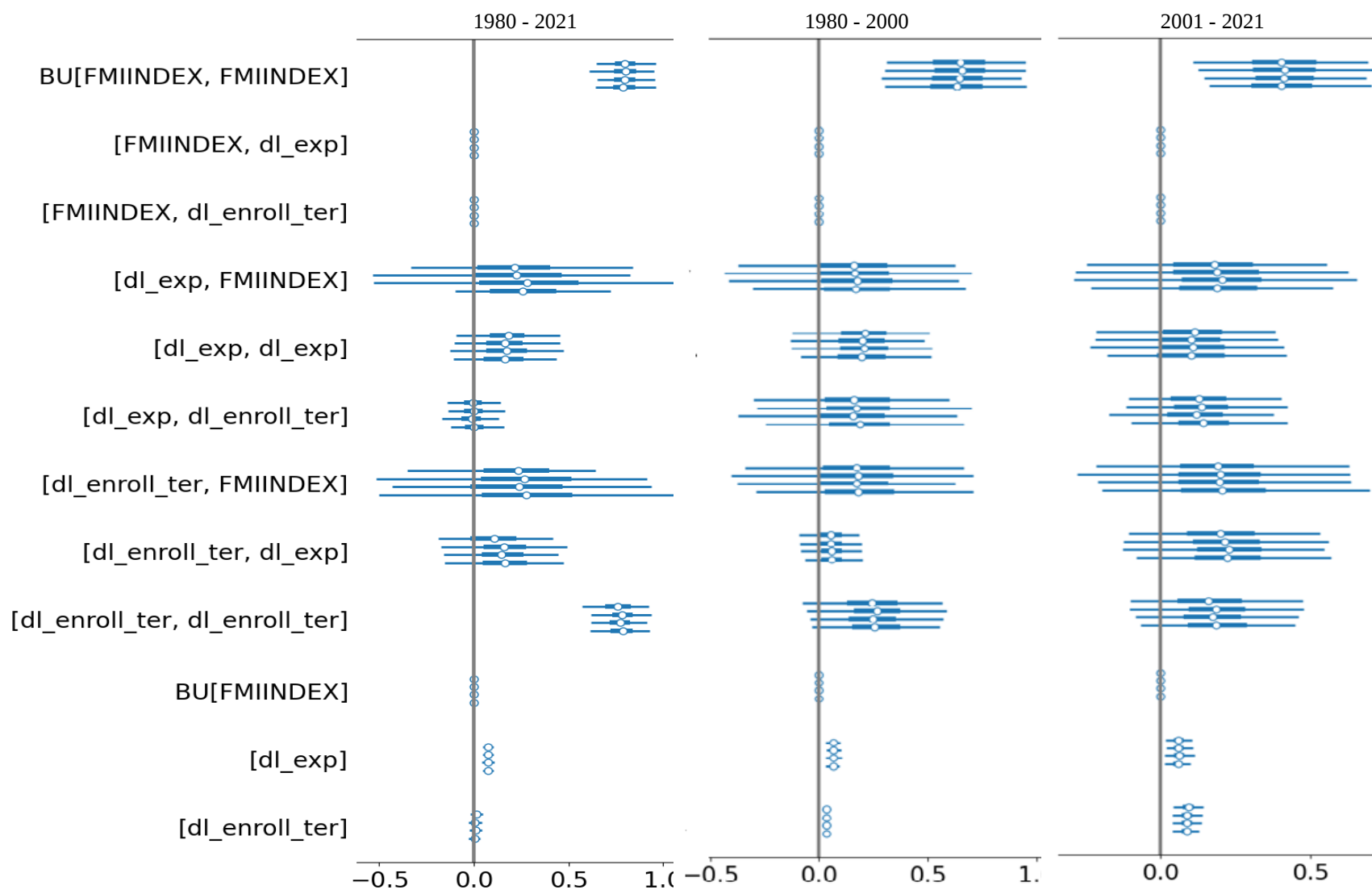


Figure A.1. 15: Burma's correlation between educational development and human development index.

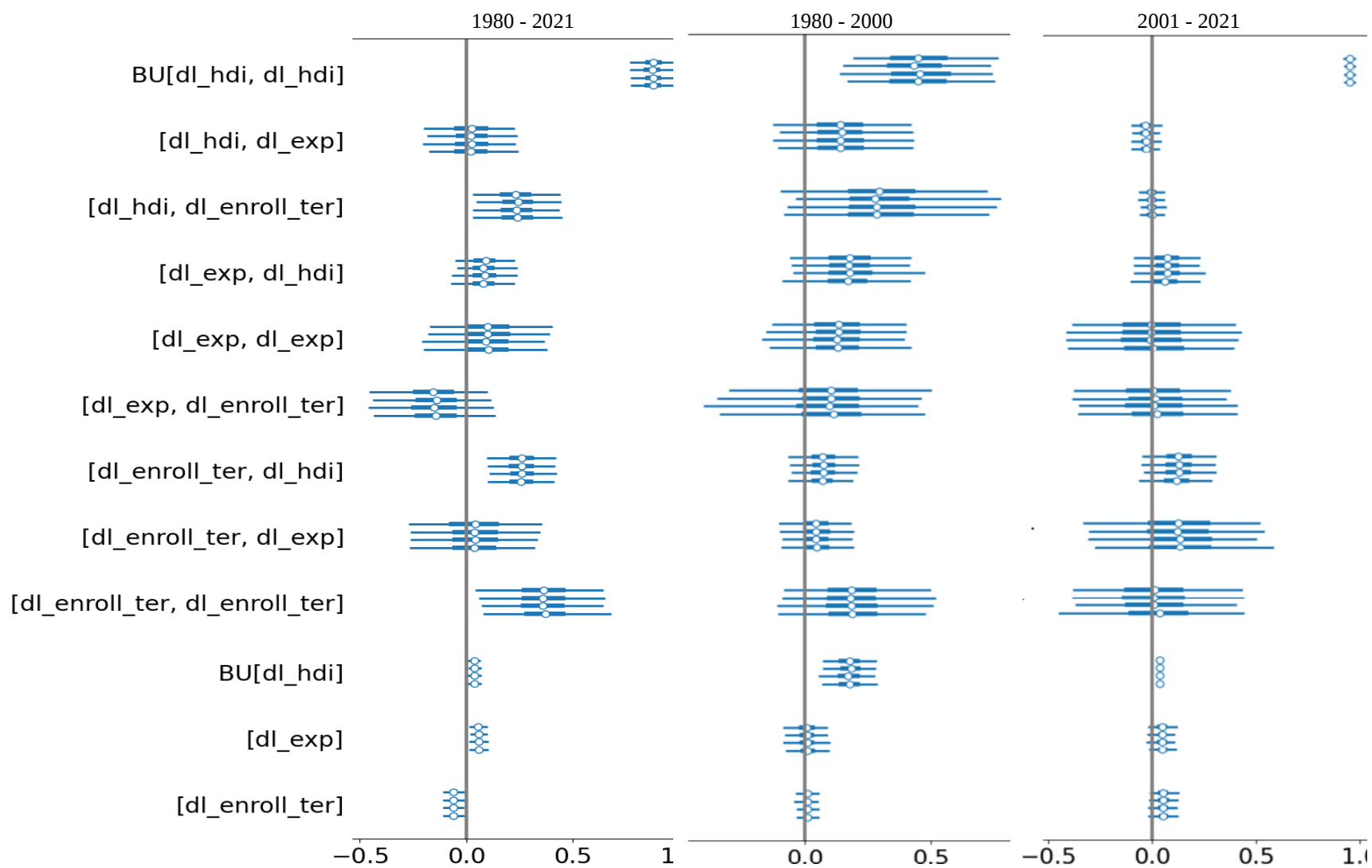


Figure A.1. 16: Burma's correlation between educational development and industrialization index.

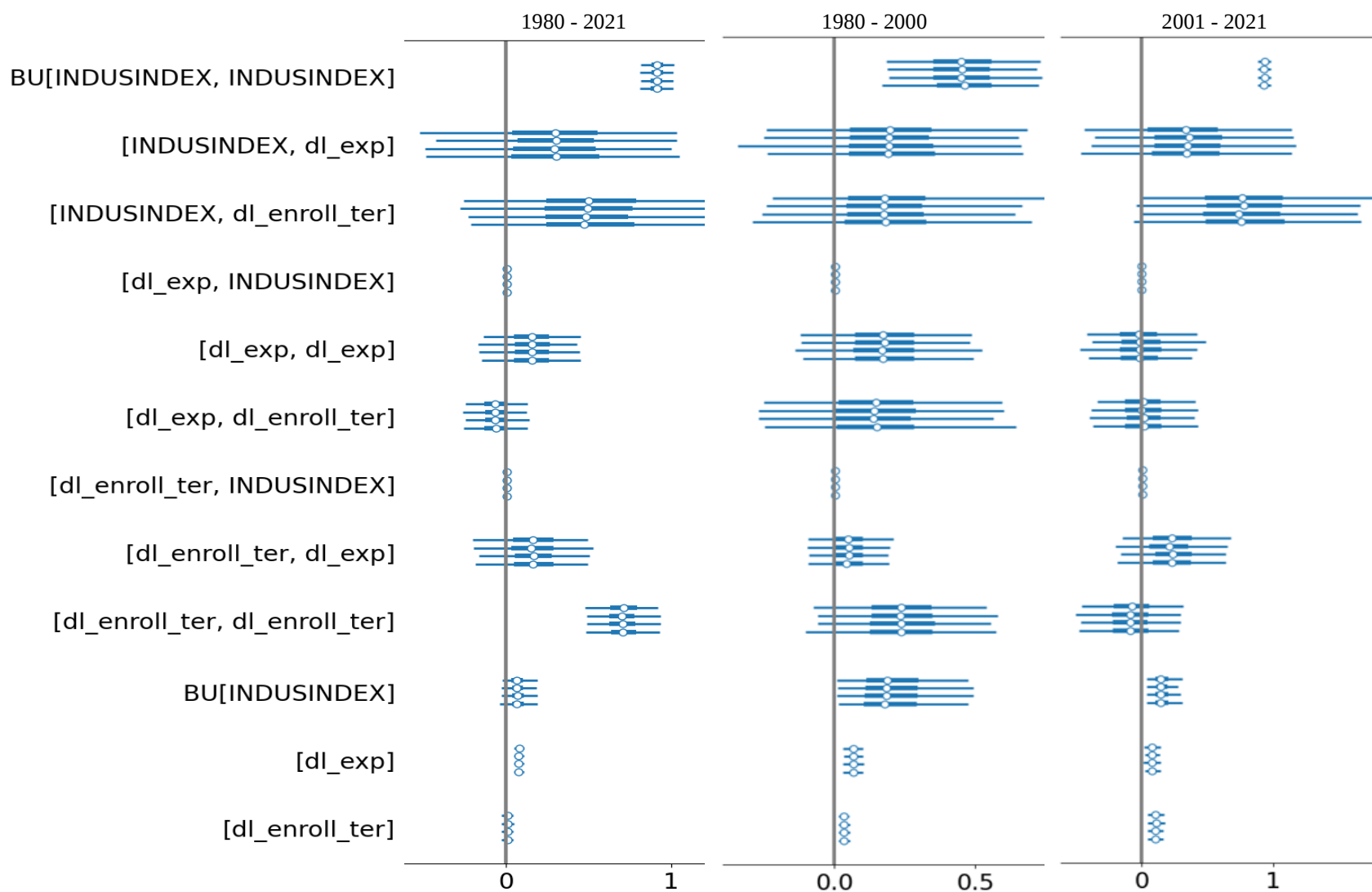


Figure A.1. 17: Liberia and Ethiopia's correlation between educational development and GDP per capita.

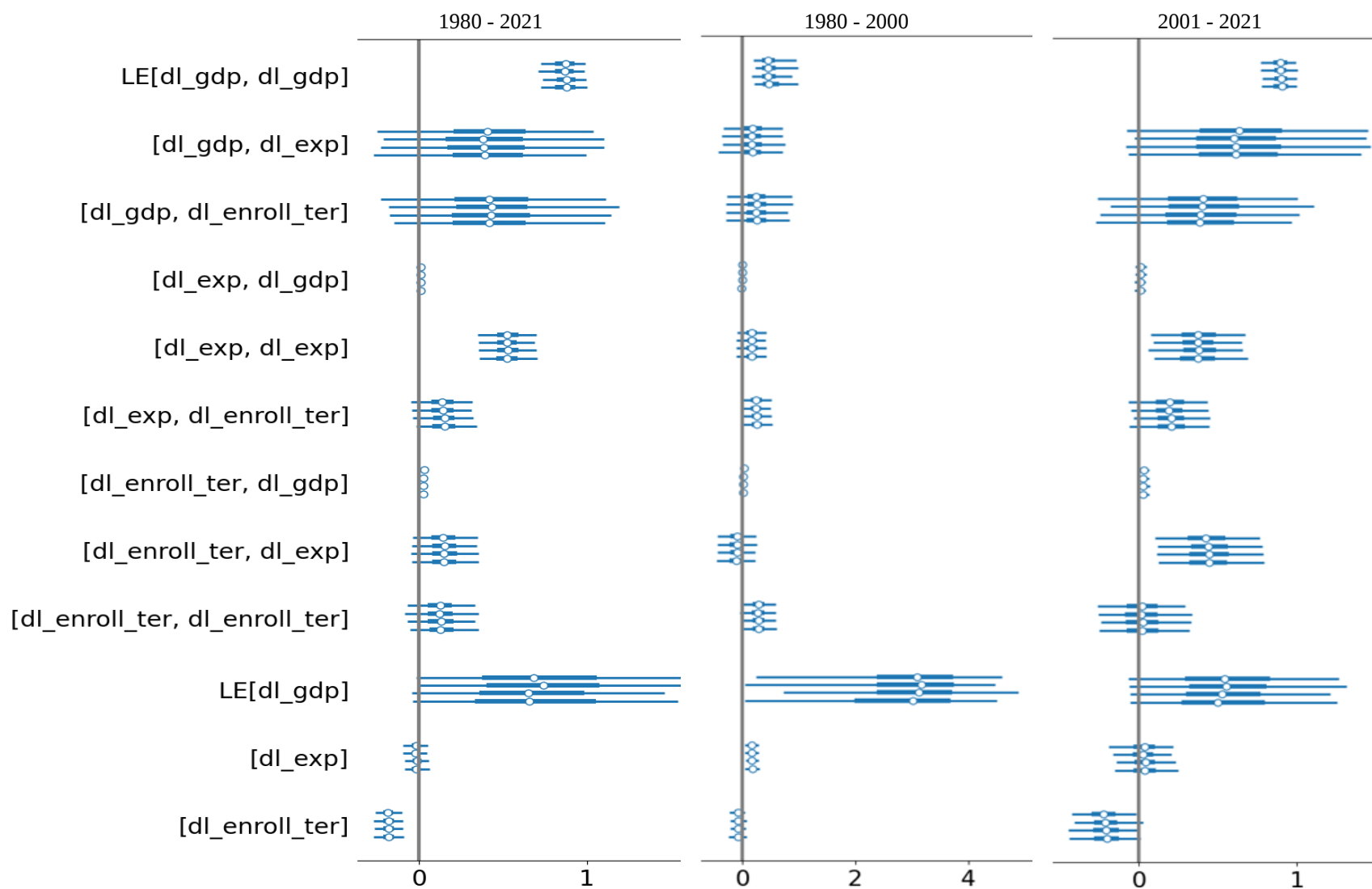


Figure A.1. 18: Liberia and Ethiopia's correlation between educational development and financial markets index.

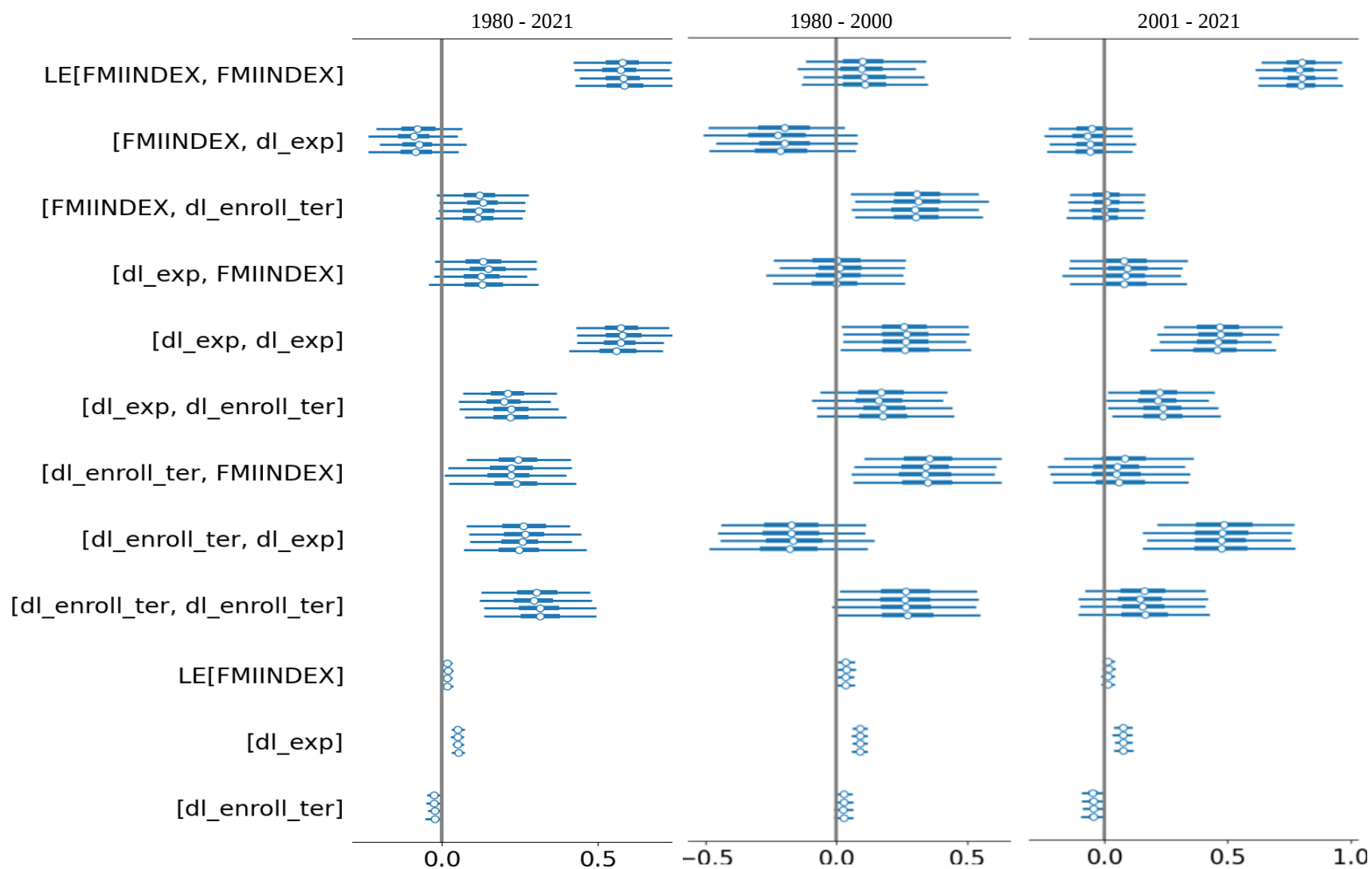


Figure A.1. 19: Liberia and Ethiopia's correlation between educational development and human development index.

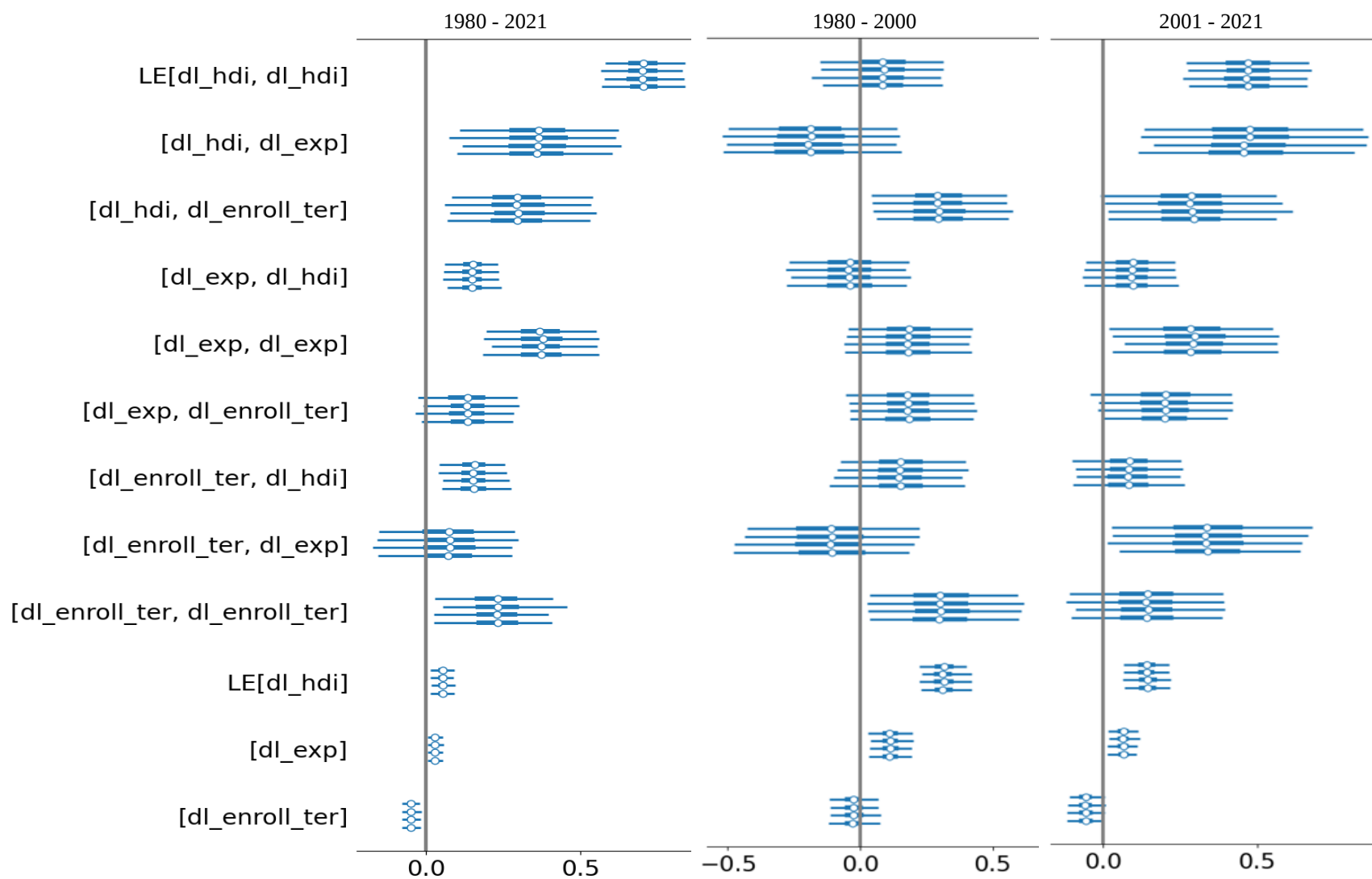


Figure A.1. 20: Liberia and Ethiopia's correlation between educational development and industrialization index.

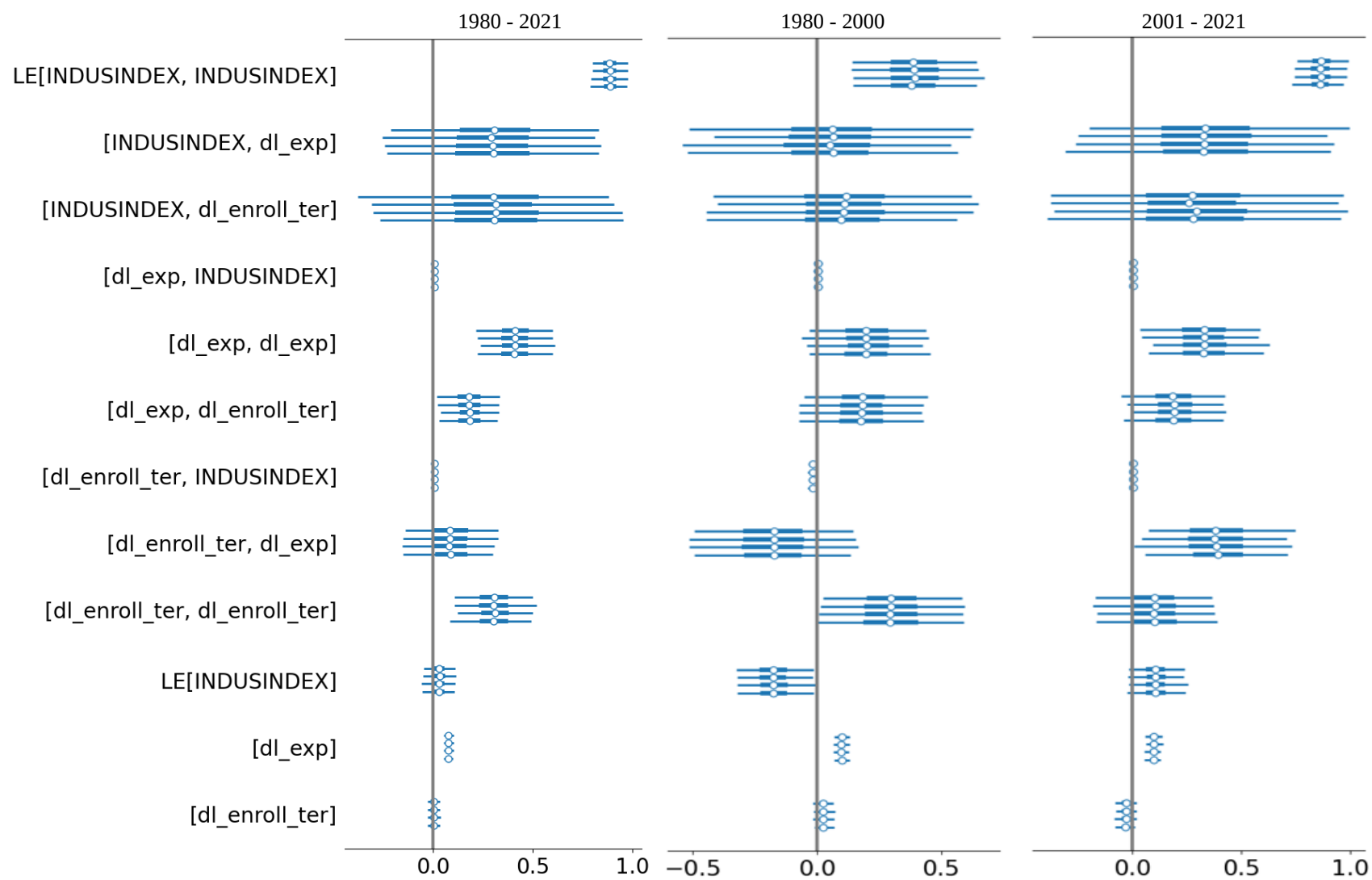


Figure A.1. 21: Thailand's correlation between educational development and GDP per capita.

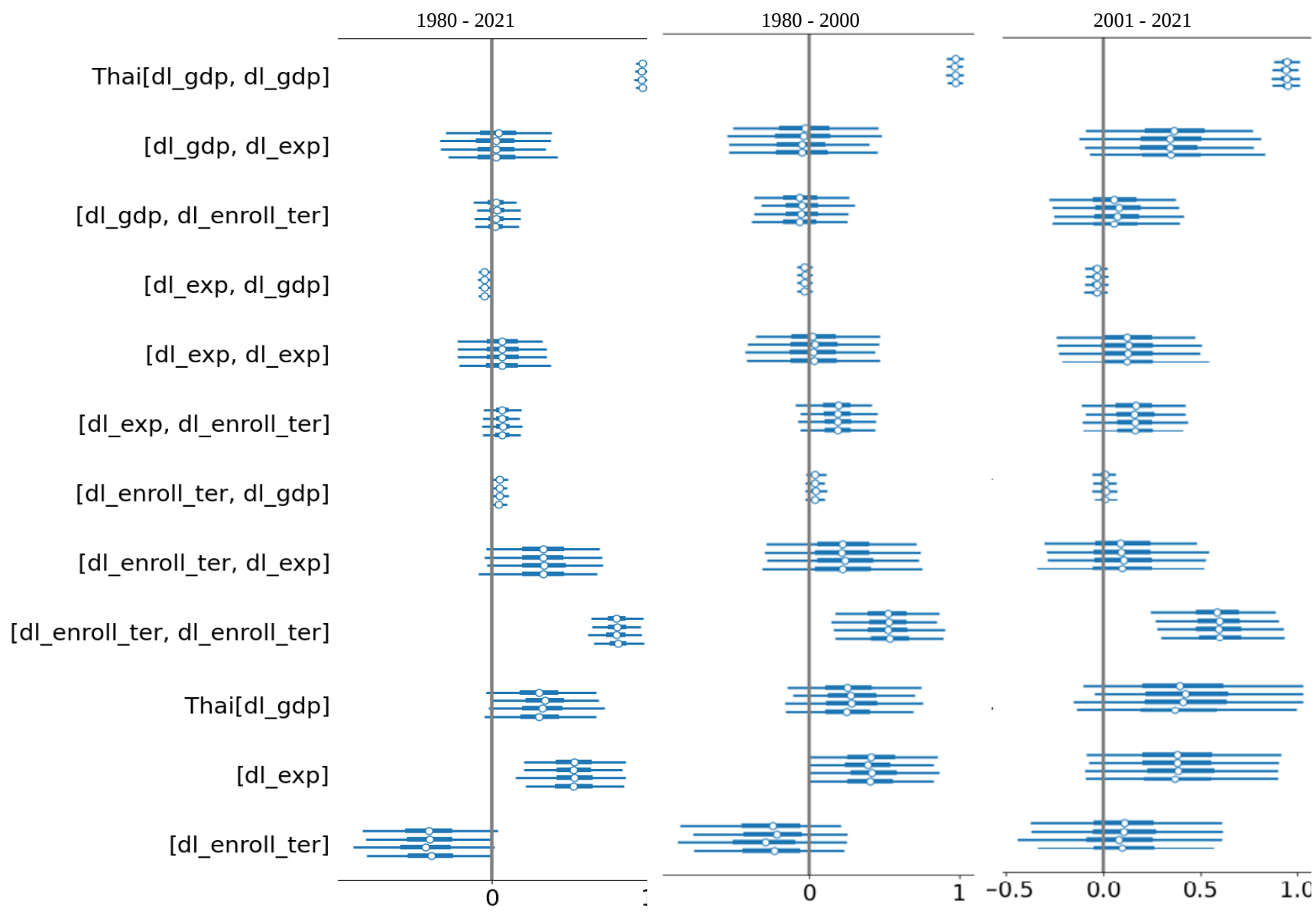


Figure A.1. 22: Thailand's correlation between educational development and financial markets index.

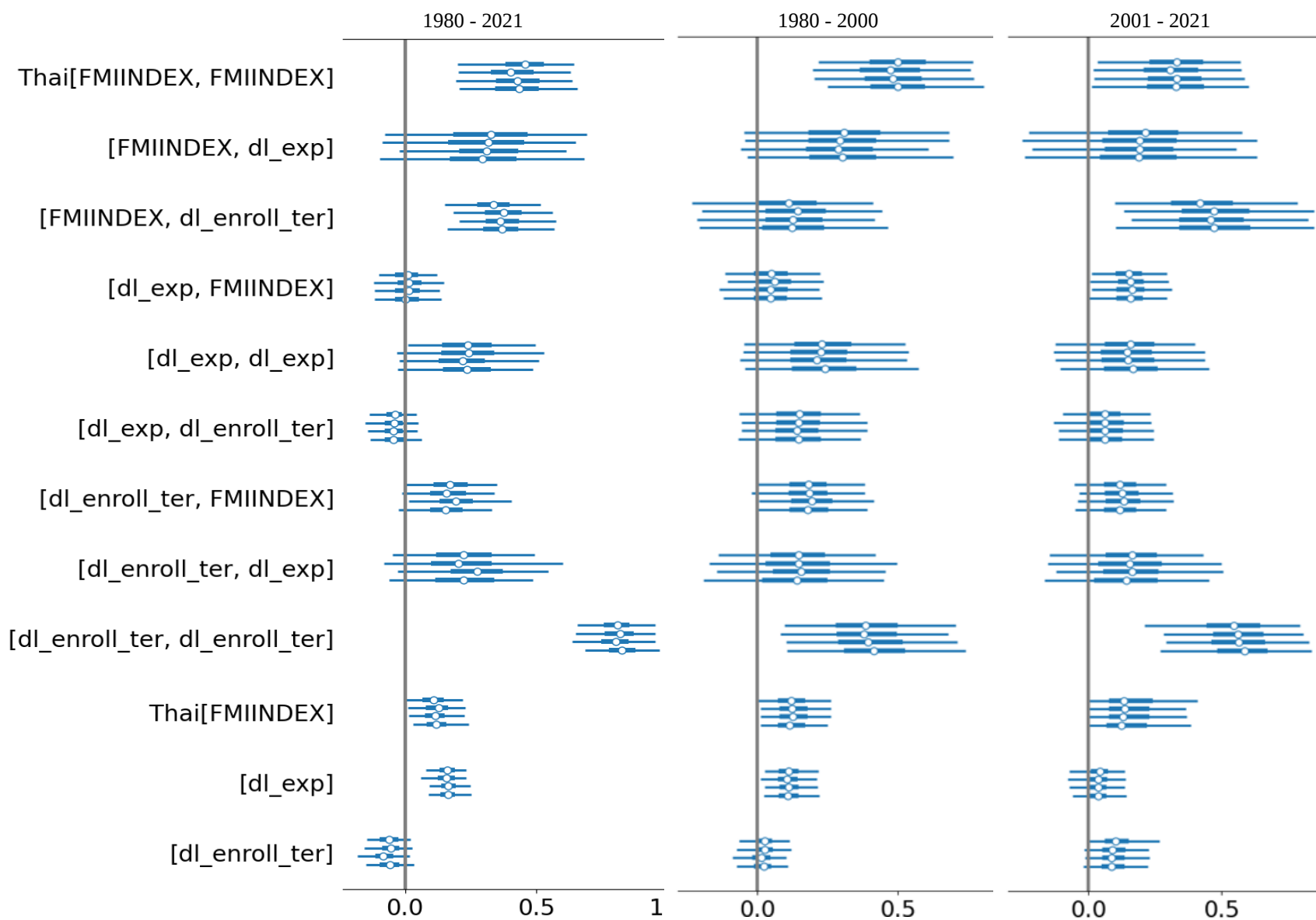


Figure A.1. 23: Thailand's correlation between educational development and human development index.

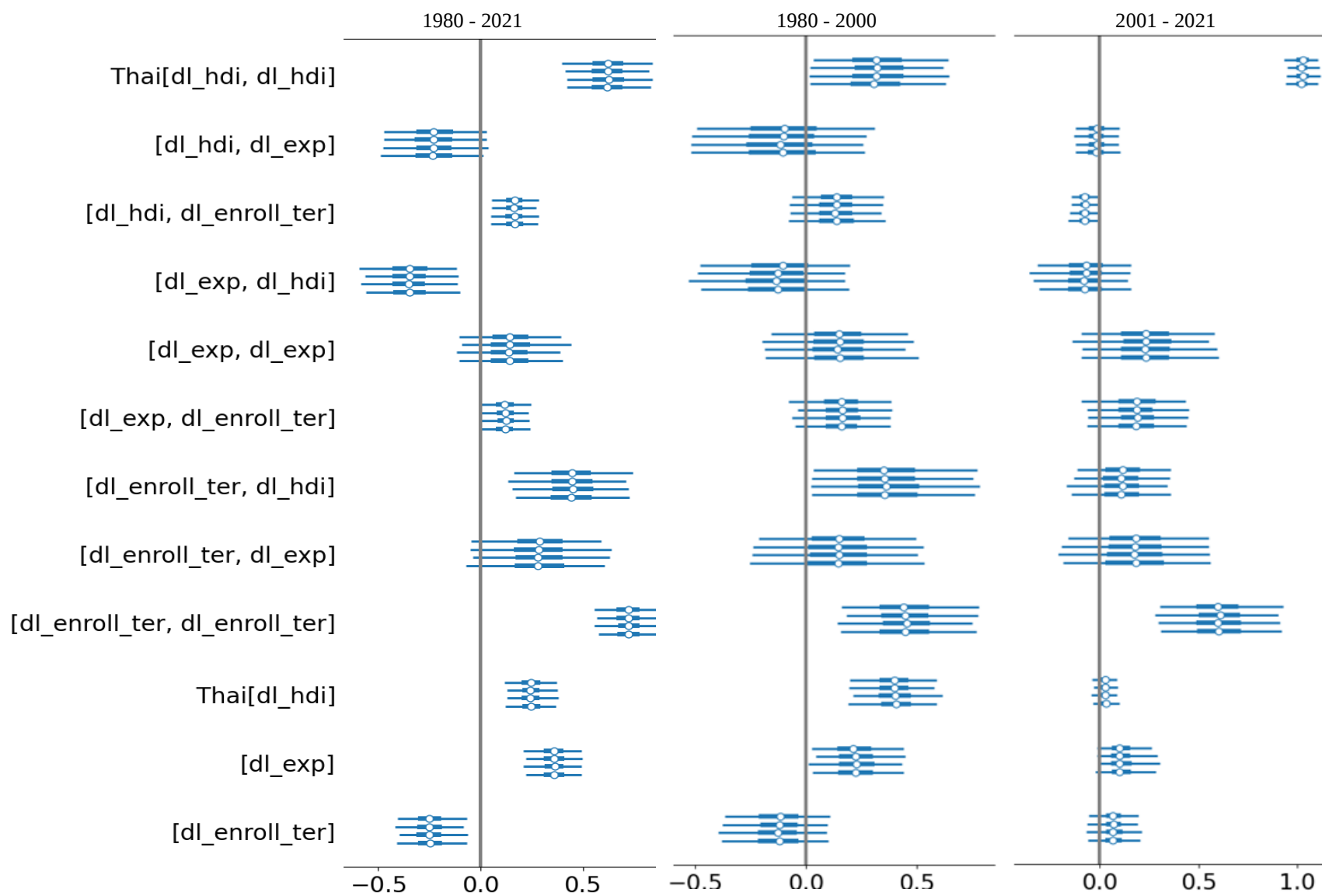


Figure A.1. 24: Thailand's correlation between educational development and industrialization index.

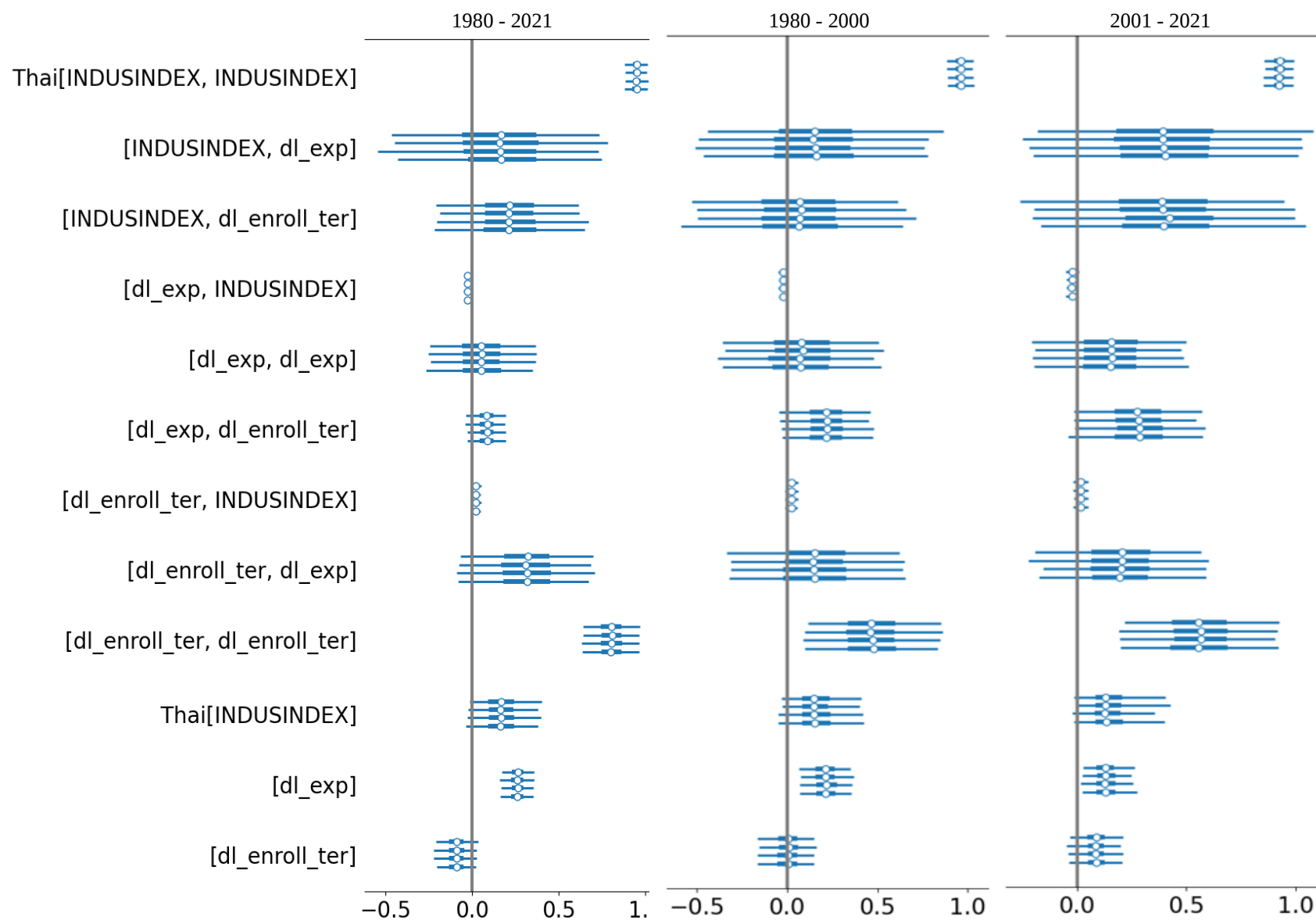


Figure A.1. 25: South Africa's correlation between educational development and GDP per capita.

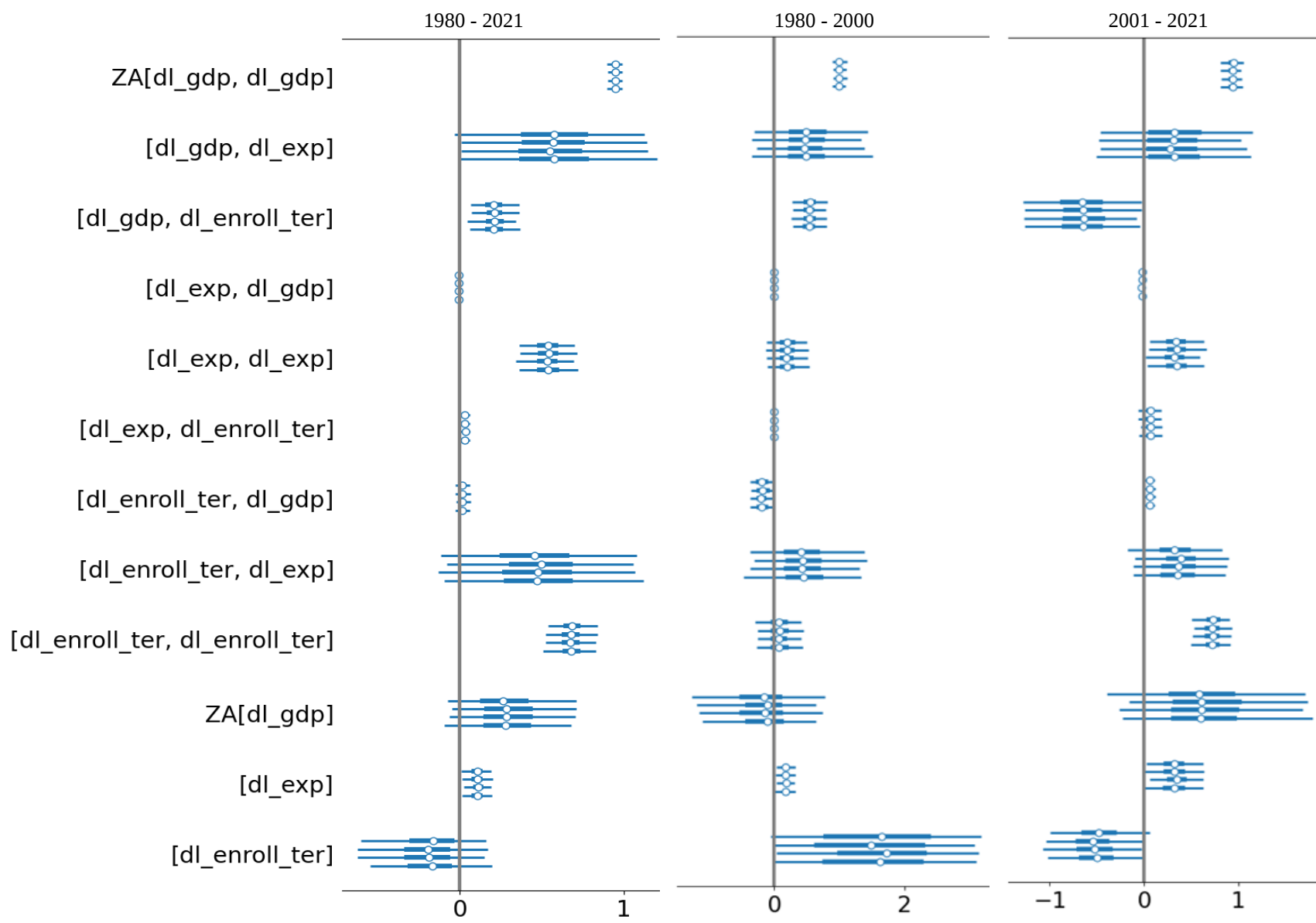


Figure A.1. 26: South Africa's correlation between educational development and financial markets index.

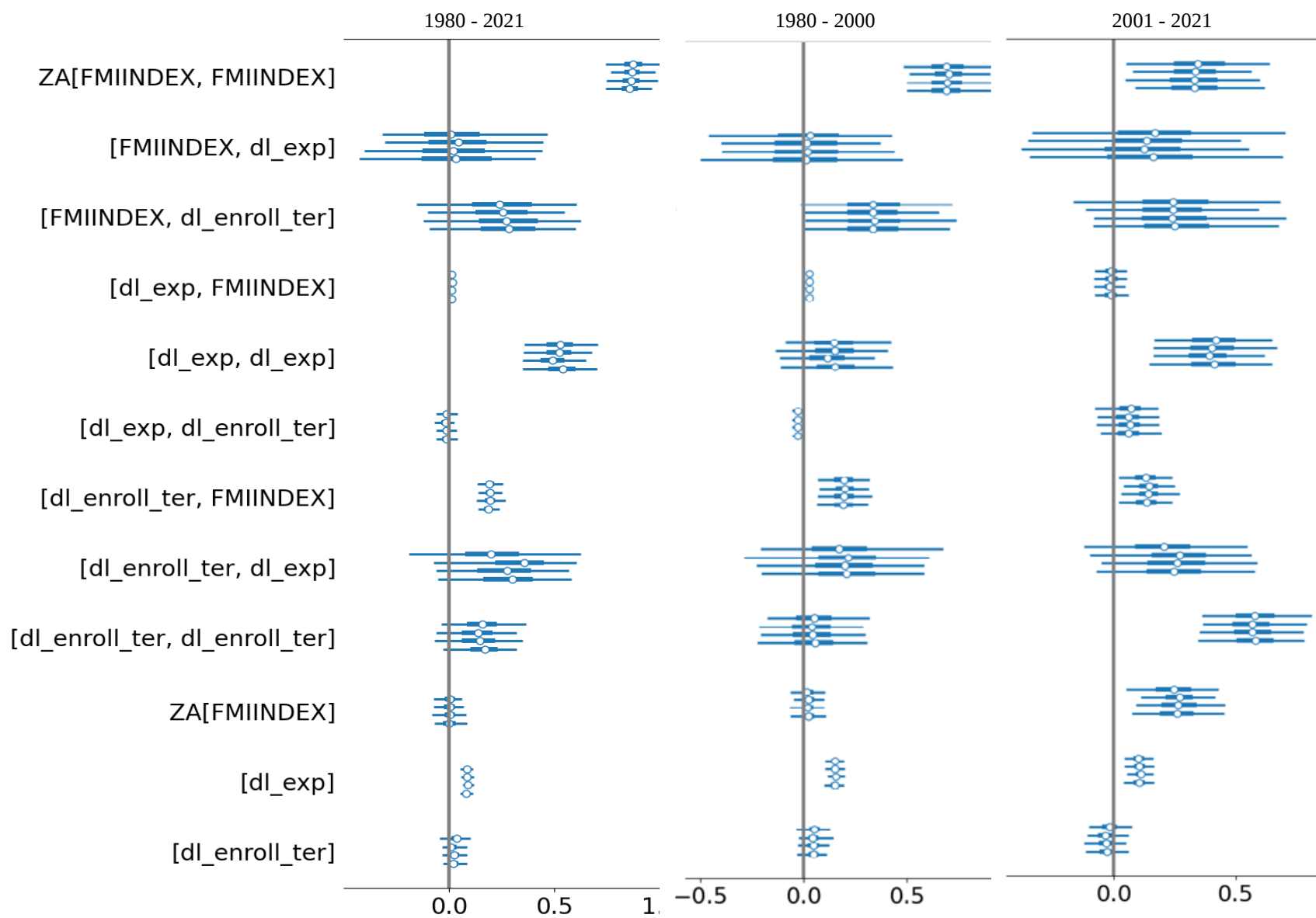


Figure A.1. 27: South Africa's correlation between educational development and human development index.

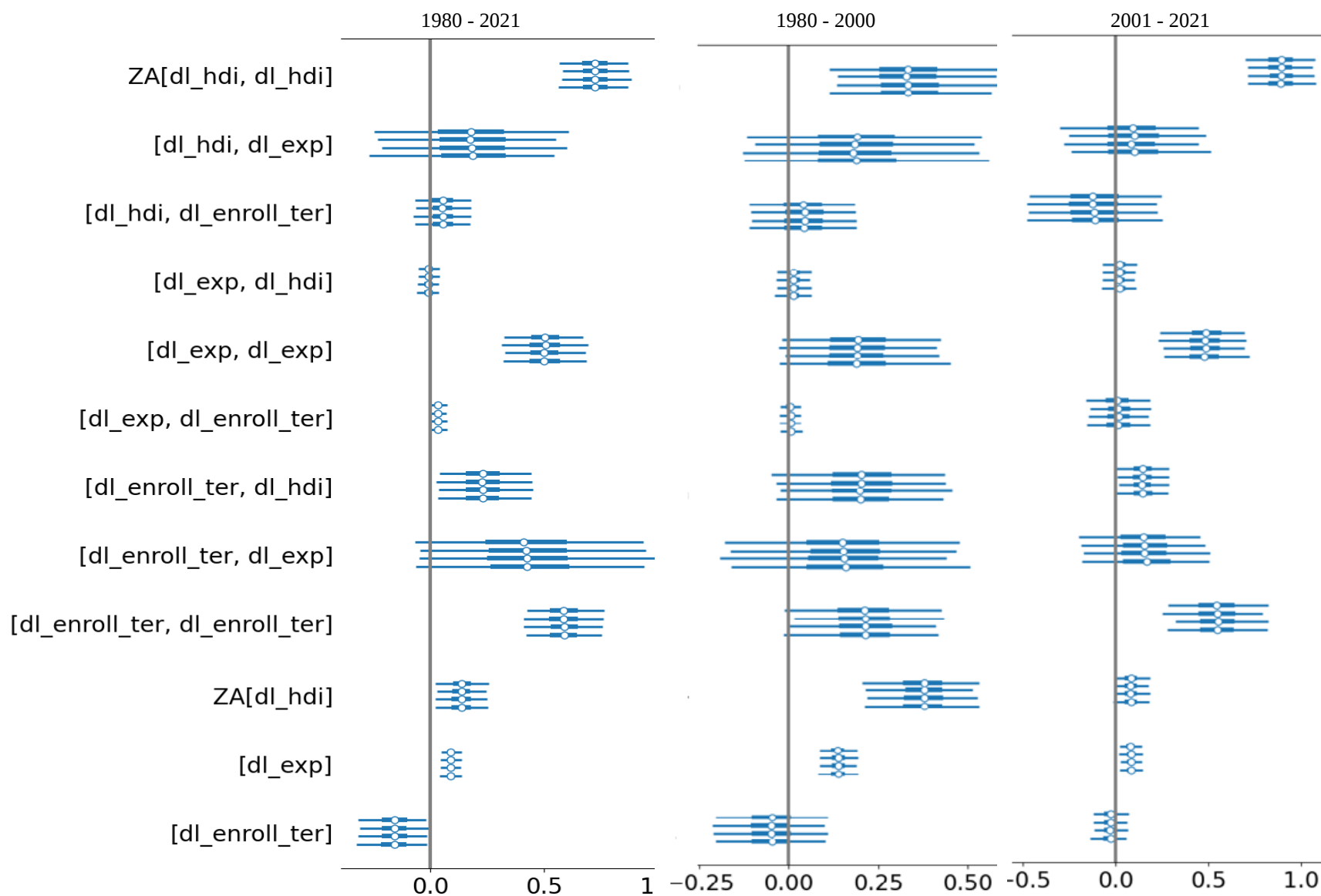


Figure A.1. 28: South Africa's correlation between educational development and industrialization index.

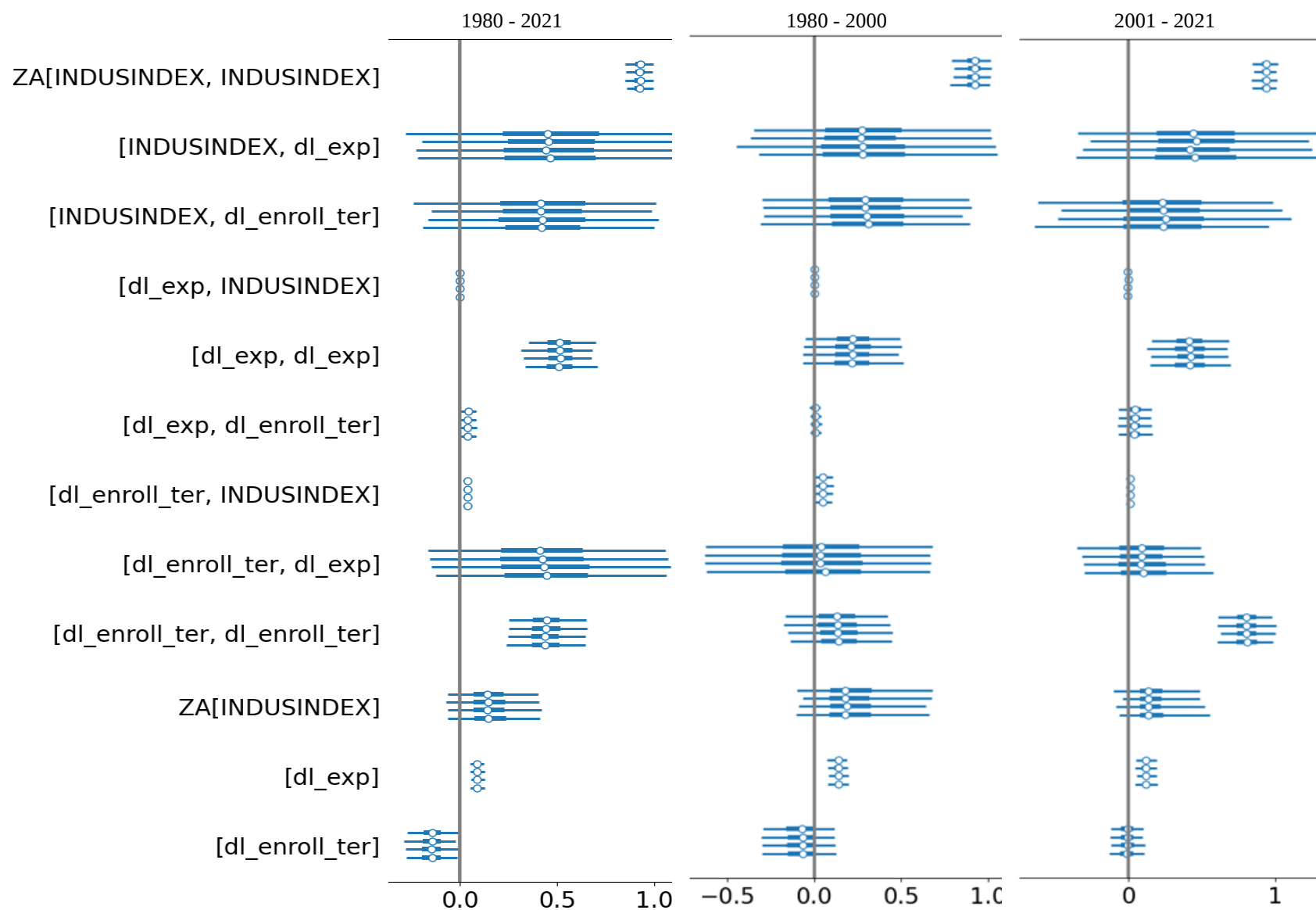


Figure A.1. 29: French Africa's correlation between educational development and GDP per capita.

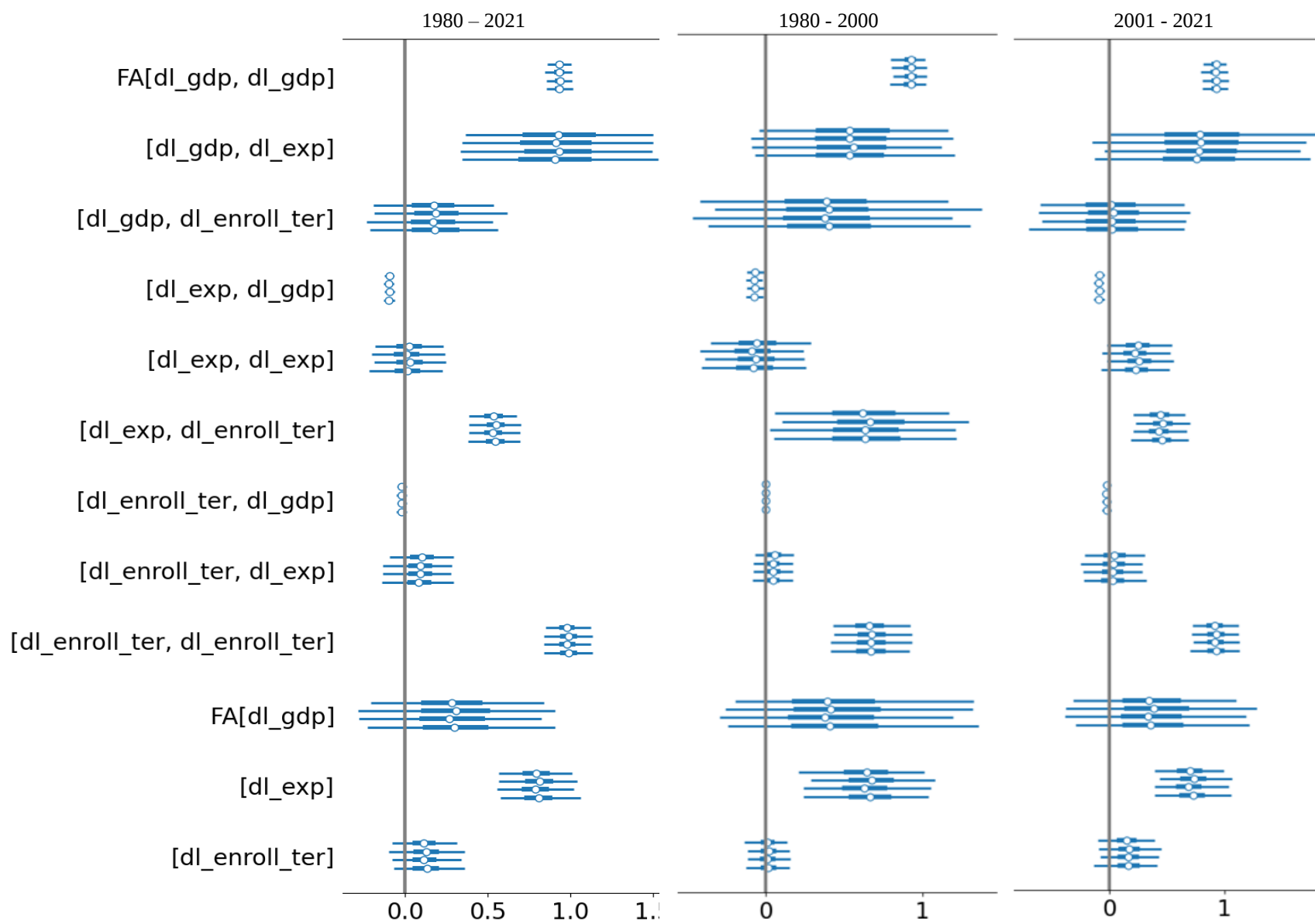


Figure A.1. 30: French Africa's correlation between correlation between educational development and financial markets index.

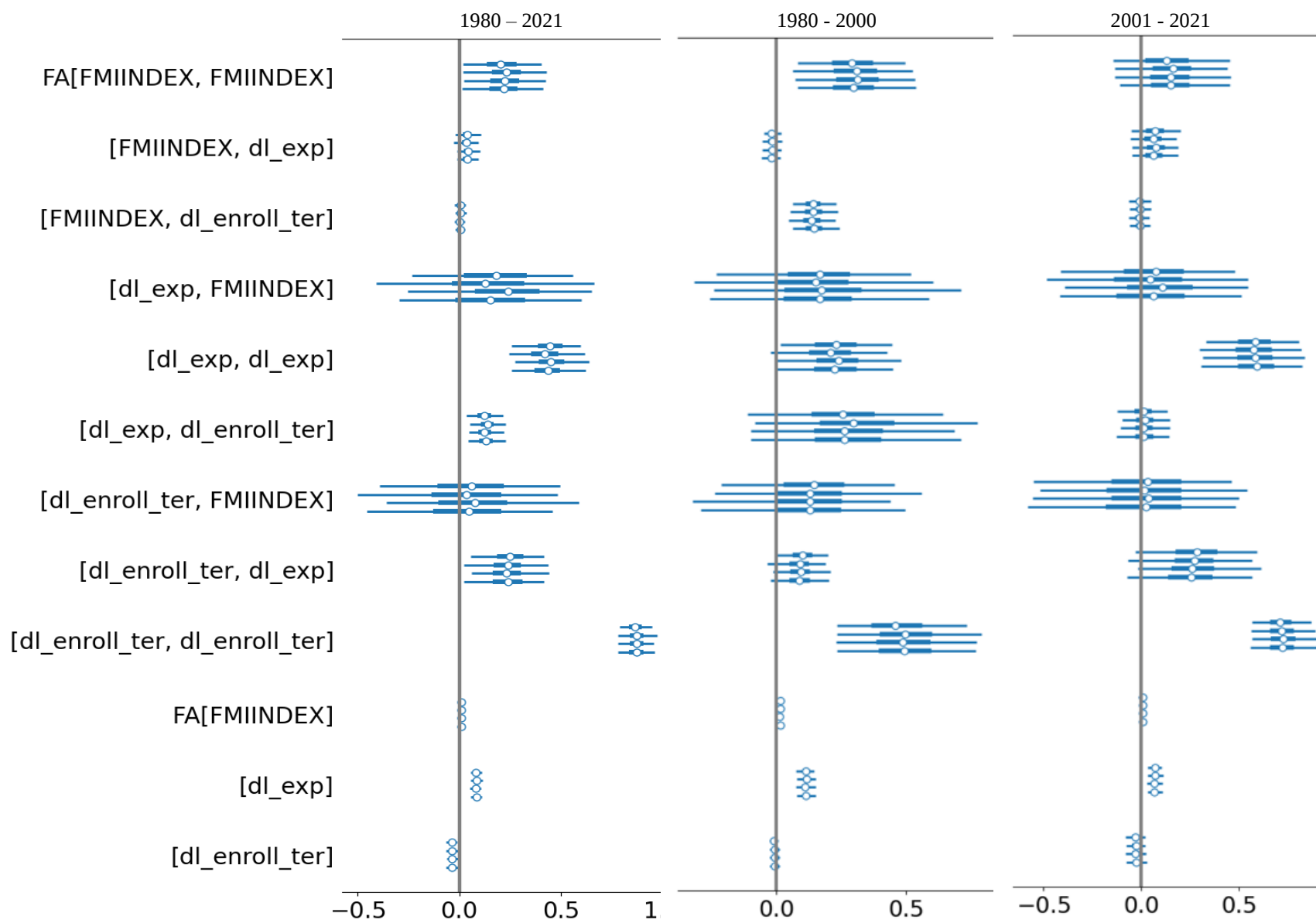


Figure A.1. 31: French Africa's correlation between educational development and human development index.

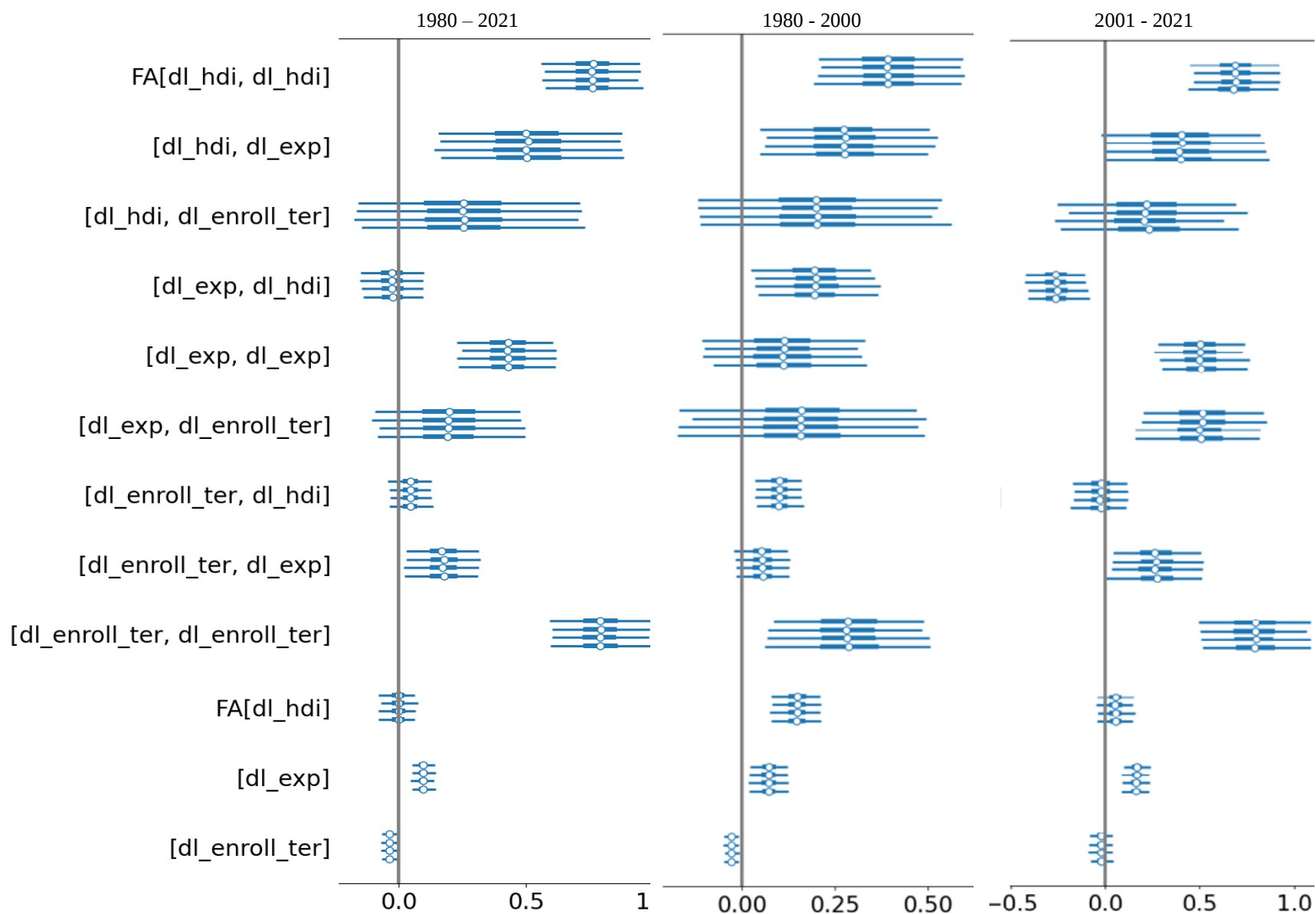


Figure A.1. 32: French Africa's correlation between educational development and industrialization index.

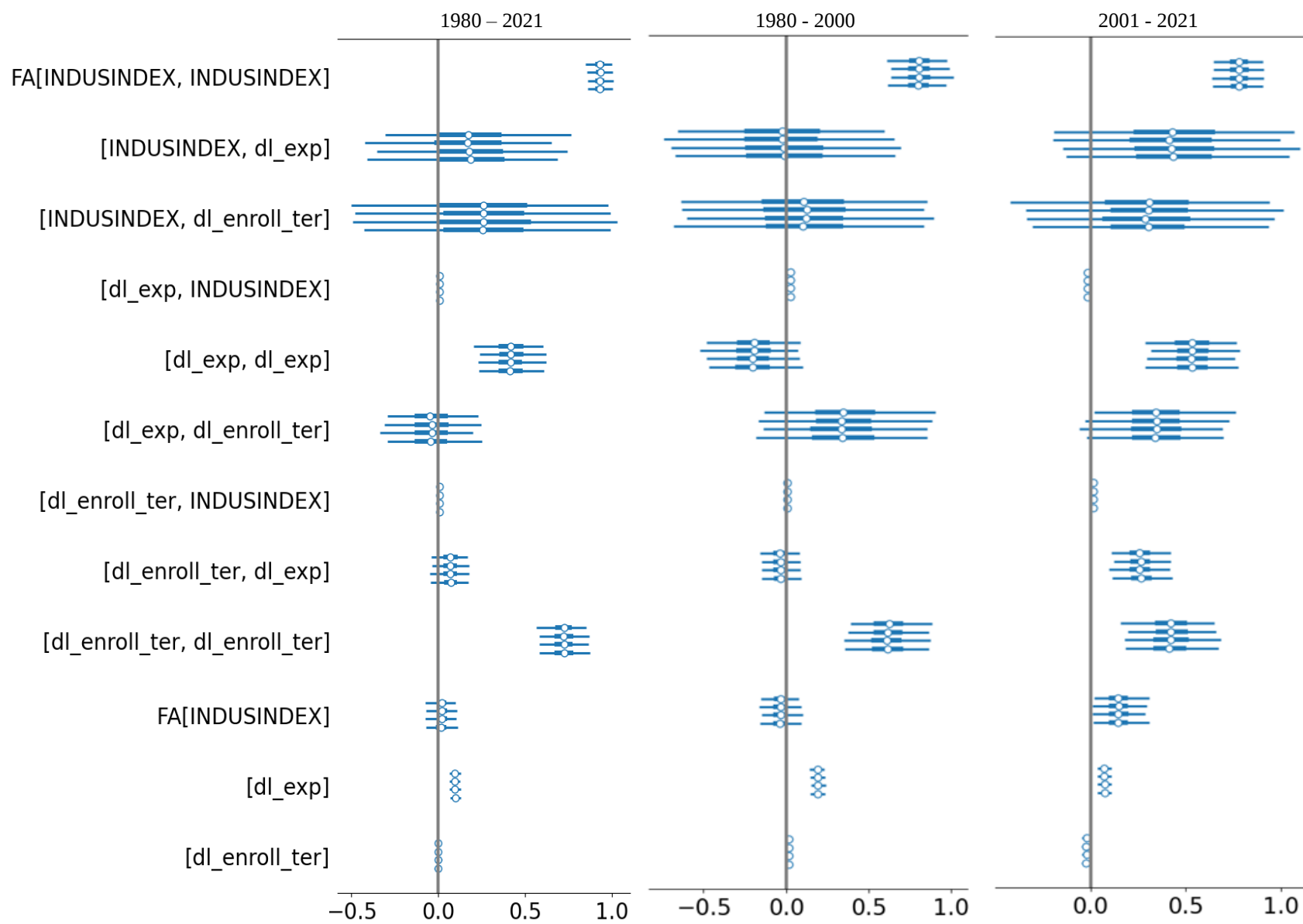


Figure A.1. 33: French Indochina's correlation between educational development and GDP per capita.

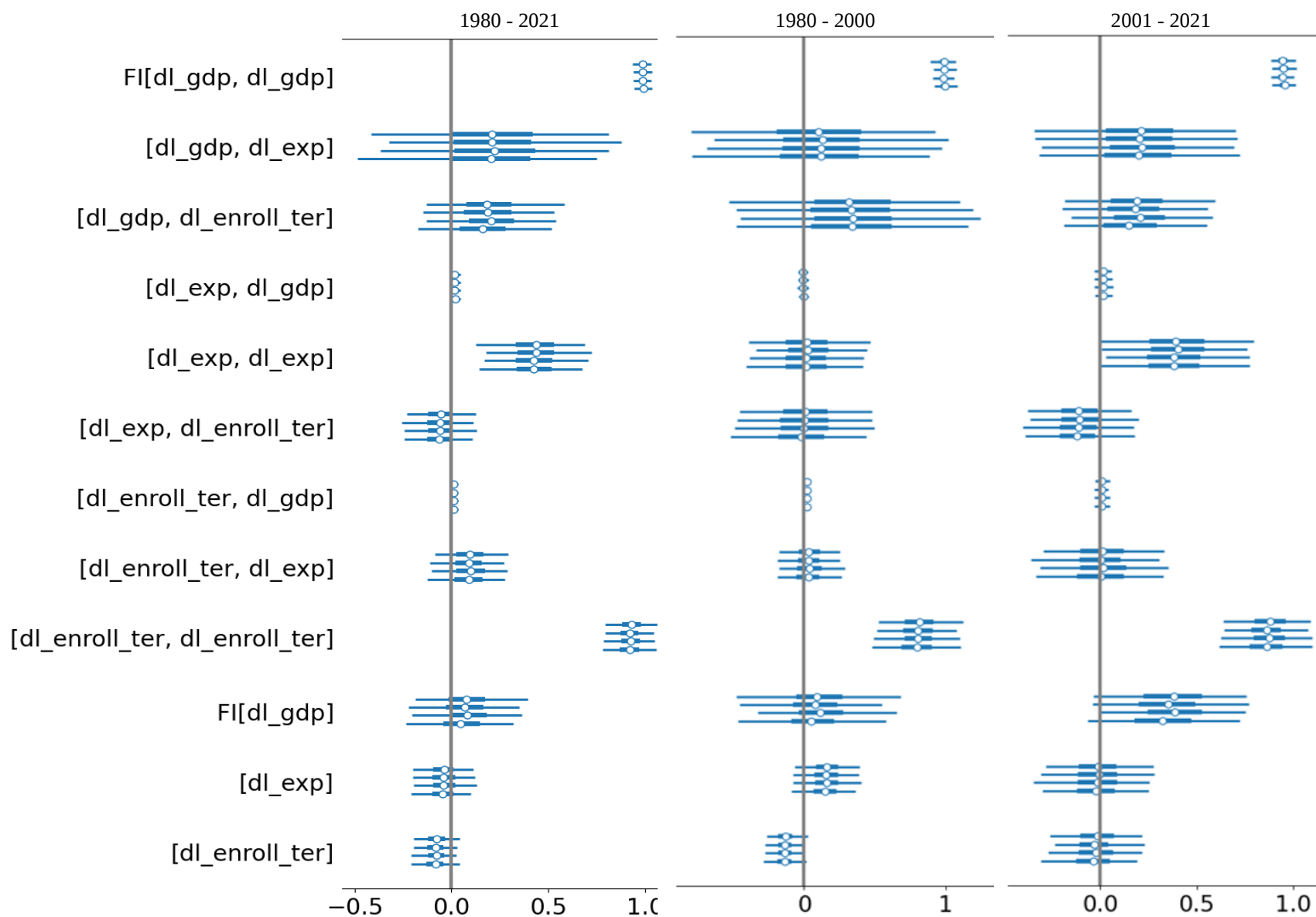


Figure A.1. 34: French Indochina's educational development and financial markets index.

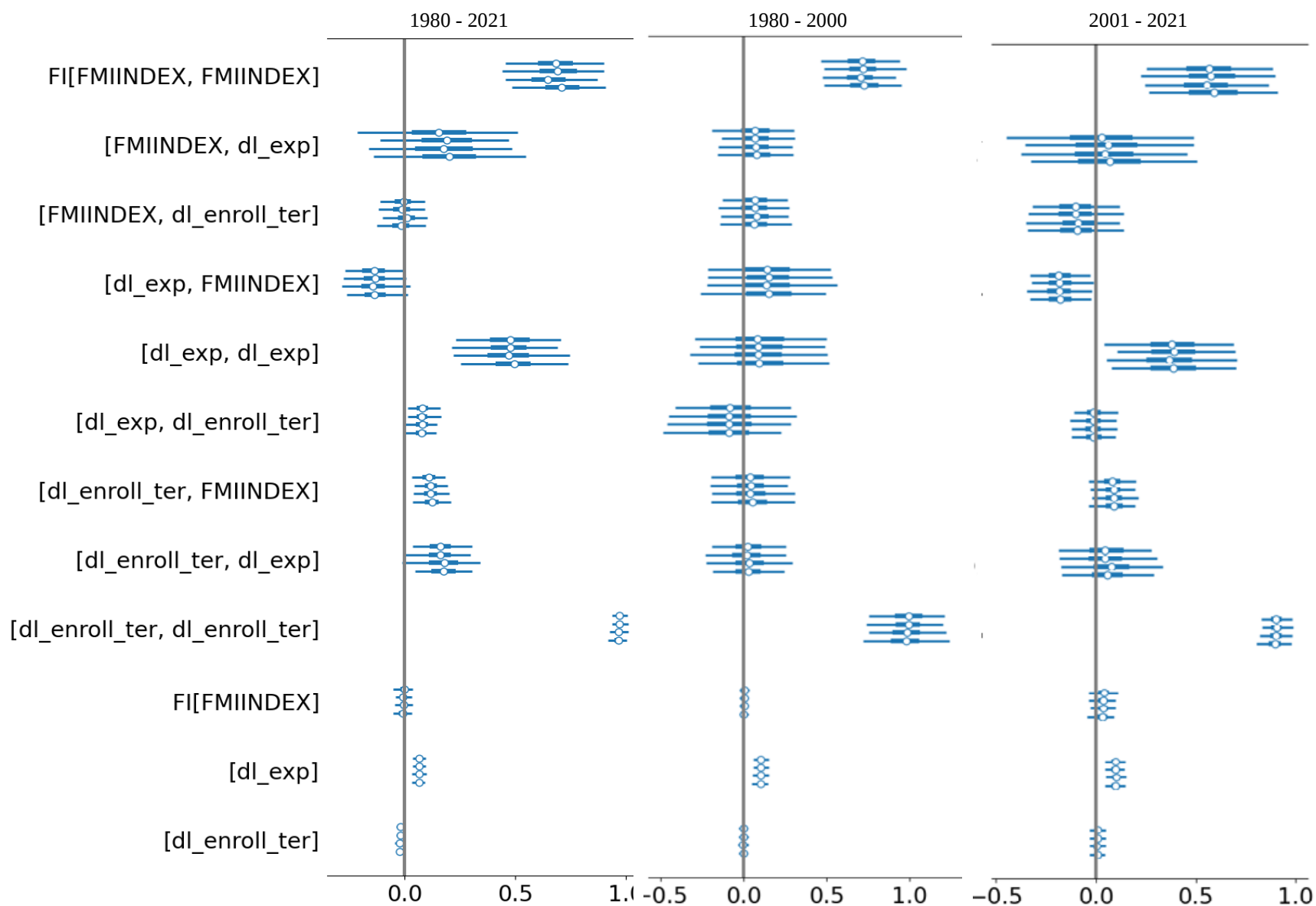


Figure A.1. 35: French Indochina's correlation between educational development and development index.

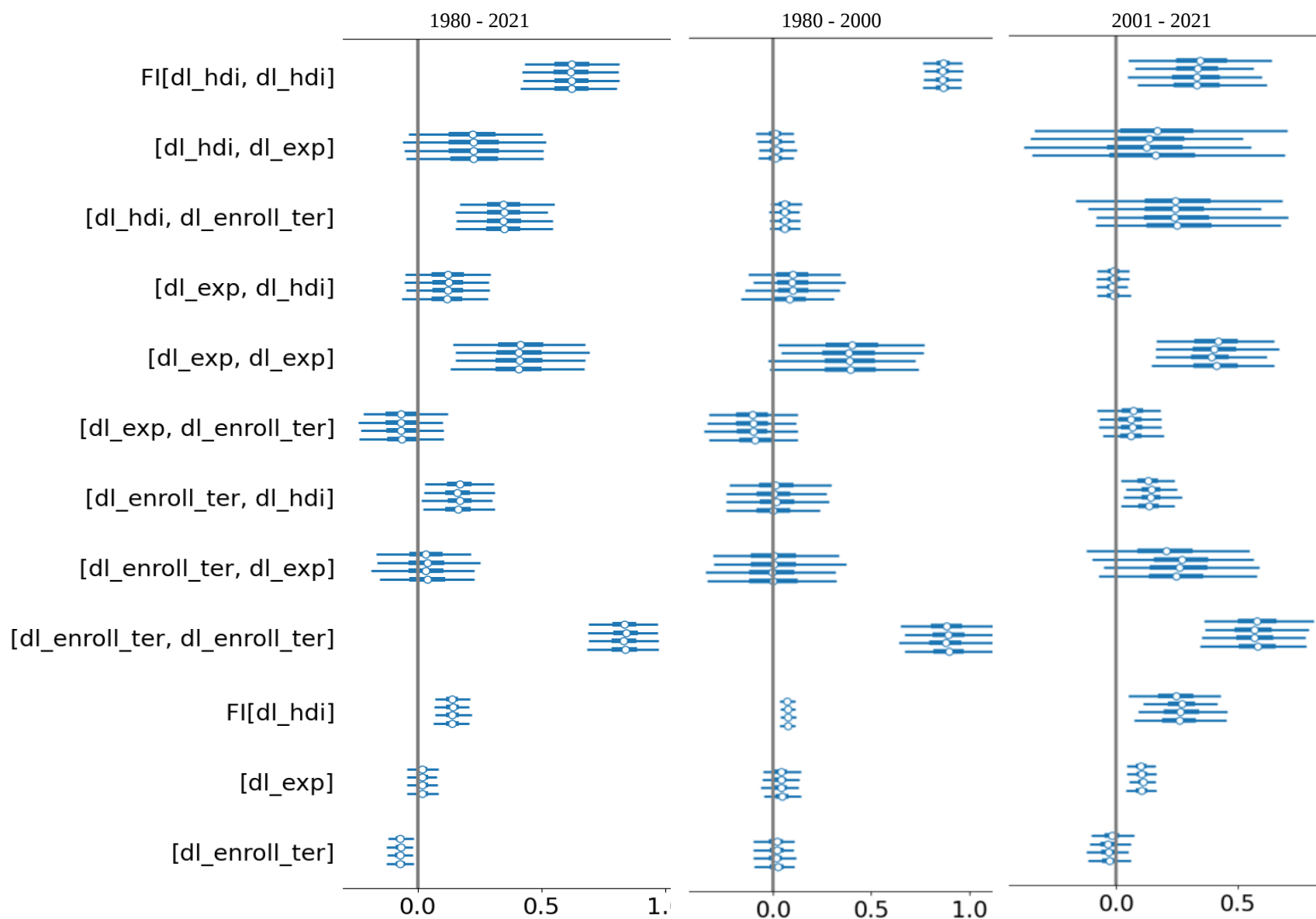


Figure A.1. 36: French Indochina's correlation between educational development and industrialization index.

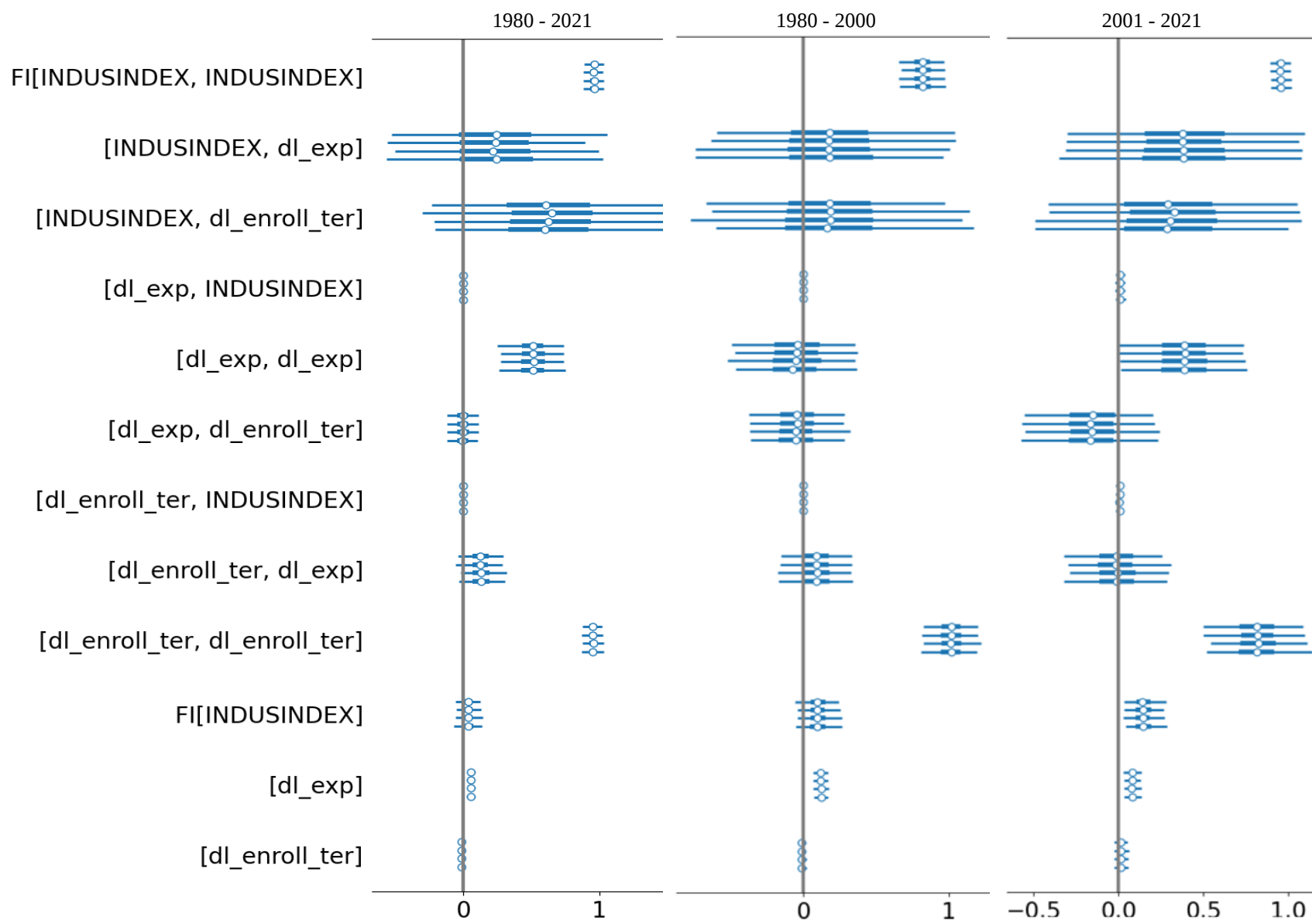


Figure A.1. 37: Portugues Africa's correlation between educational development and GDP per capita.

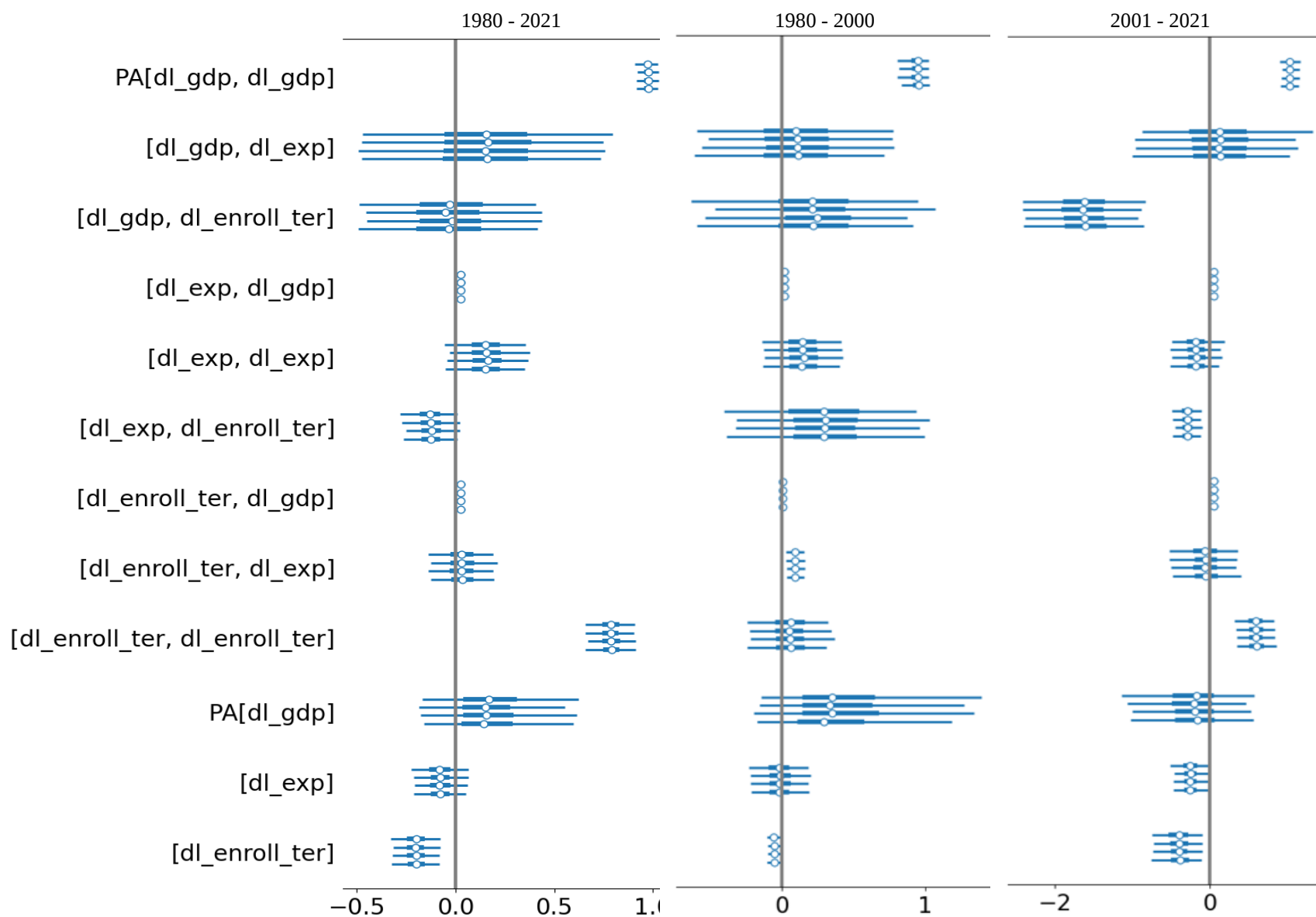


Figure A.1. 38: Portugues Africa's correlation between educational development and financial markets index.

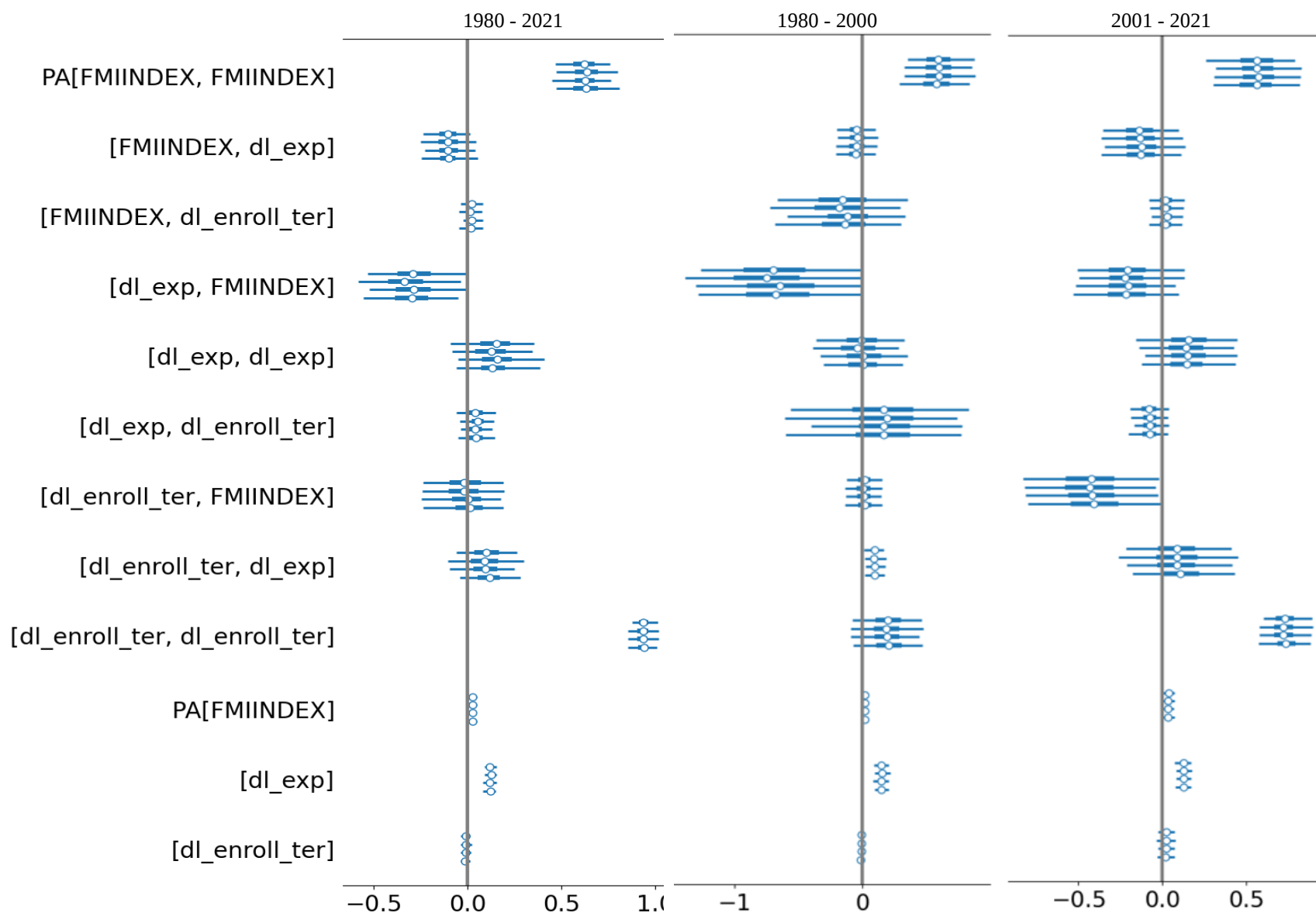


Figure A.1. 39: Portugues Africa's correlation between educational development and human development index.

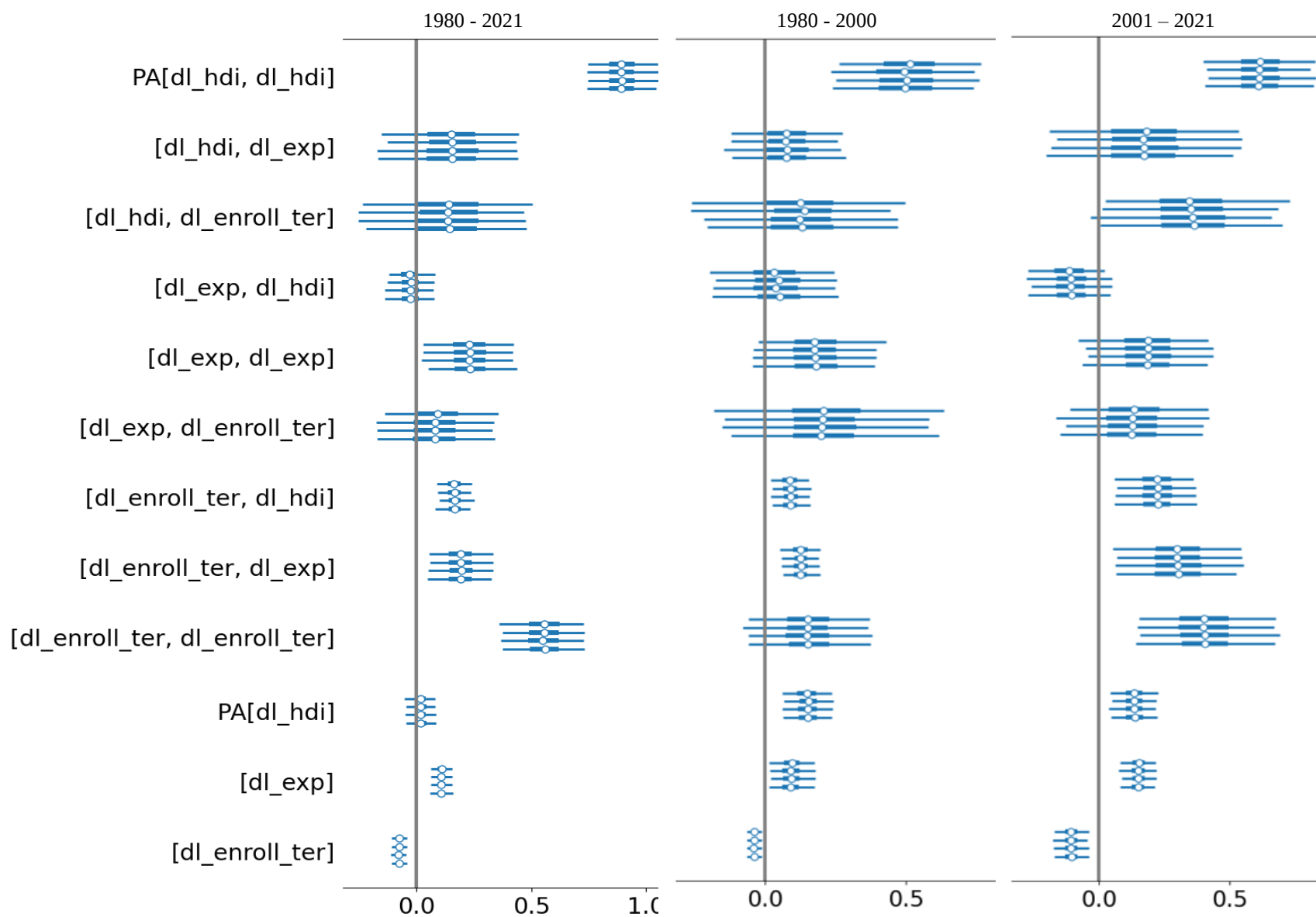


Figure A.1. 40: Portugues Africa's correlation between educational development and industrialization index.

