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MASTER'S THESIS

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# Impact of Colonial Legacy on Development and Innovation in Africa

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## Declaration of Authorship

I, Raphael MATEUS MARTINS, declare that this thesis titled, "Impact of Colonial Legacy on Development and Innovation in Africa " and the work presented in it are my own. I confirm that:

- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Signed:

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Date:

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*“Special Thanks”*

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Aalborg University

## *Abstract*

Faculty Name  
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### **Impact of Colonial Legacy on Development and Innovation in Africa**

by Raphael MATEUS MARTINS

Several Economic Historians have dedicated themselves to reveal the causes of the economic backwardness the African continent has shown for several decades. More recently, few economies in the continent have shown a strong increase in terms of revenue. This thesis attempts to link previously led research in the context of colonial legacy to the more recent notions of Innovation Capabilities which are seen as an important attribute to achieve economic development. This thesis seeks, hence, to join two Economic subjects that are rarely treated together: Economic History and Innovation Economics. Colonialism is here defined as an exogenous shock. The empirical setting aims at comparing 35 states in a span of 29 years and revealing the consequences of such a shock on the cultural, institutional and economic setup of colonized economies. Moreover, a special attention is given to the impact of continuing relationships between the former colonizing power and the colony as a trigger of convergence in terms of innovation capabilities and economic development. The main findings suggest that Political and Social transformations during the colonial period had a significant effect on the post-colonial Institutions. In a second stage, Institutions demonstrated to be significant related with levels of Innovation and technology as well as absorptive capacity suggesting that colonial transformation set the base for Institutions with long term effects on the Economic Development of the country. Furthermore, the continuing relationships between the former colony and its colonizer have a mix effect and suggests thorougher investigation at the country level. Finally, the Thesis sets the path to a possible way of defining new policy implications taking into account the long-term effects of Historical legacy.





## Chapter 1

# Introduction

Why some nations fail while others succeed? This general inquiry has driven both Historians, Social and Political Scientists to dwell on such complex themes. While many countries across the globe have showed surprising industrialization, growth and development patterns, most countries of the African continent have remained behind. While a set of literature relies on Historical aspects of development, more recent studies describe new paths to development that are becoming increasingly important for a Nation to succeed. History offered an undeniably important legacy of today's society, even shaping important socio-cultural, political and economical aspects of various countries. Nevertheless, it does not provide a direct basis for policy intervention. Indeed, as History matters, it is important to identify the specific mechanism through which it affects the current state of economic development, so that policy makers may tackle crucial issues in countries severely shaped by these legacies. This thesis attempts therefore to link two distinct strands of Economic literature, namely Economic History and Innovation Economics, in order to identify the patterns through which Historical legacy still matters and to what extent it still impacts today's societies in Africa. It mainly contributes to the existing literature on colonialism literature and links colonial institutions to levels of capabilities developed within the realm of Innovation Economics. The main findings suggest that

### 1.1 Africa: the Economic disaster of the 20th century

African development has lagged behind other economies in the last half century. Indeed, the growth rate of per-capita income of African economies has been below world average. During the 1960–1973 period their average per-capita growth rate has been 2.0% while the world average was 3.0% and the OECD average 4.2%; From 1981-1988 African countries showed a negative average growth rate -0.1% as compared to a 2.9% for OECD countries. In the last 20 years, scholars have sought to find the causes of such a large gap both in terms of per-capita income and overall economic development between African economies and other developing regions in the world. A substantial part of this literature dwells on the impact of colonization on the current economic performance of former colonies. Three main lines of research have been established. Engerman & Sokoloff (1997, 2002) examined the importance of factor endowments and colonial rule for the subsequent economic development of colonies within the Americas. Meanwhile, Acemoglu et al. (2001, 2002) developed a research agenda that sought to better understand the historical origins of current institutions and their importance for long-term economic development. La Porta et al. (1997, 1998), on the other hand, focused on the legal institutions that were transplanted by the different colonial powers and the long-term consequences this had for investor protection and financial development.

These lines of research have set the basis for an extending literature on the consequences of colonization. Late 20th century articles emphasize the effect of colonialism in development patterns, where the identity of the colonizing power is important to subsequent growth (see Harrison, 1985; Hanson, 1989; Bertocchi and Canova, 1992, 1996 and Grier, 1997, 1999). Easterly and Levine (2003) explain how ethnic fractionalization tends to have a negative impact on social development and growth rates and Schmidt-Hebbel (1996) addresses the role of fiscal policies. Several authors emphasize the impact of geography on long-term growth (see Hall and Jones, 1999; Gallup, Sachs, and Mellinger, 1999; Diamond, 1997 and Sachs and Warner, 1997). However, as these colonial studies focus on comparing Africa with other regions, explaining the peculiar African setup, very few tackle a full analysis that compares African colonized states among each other. Indeed, while Africa lags behind compared to the rest of the world, there are still successes that overshadow the disasters within the continent. The heterogeneity of growth stories within the continent leads to search further the consequences of colonization other than simply attribute African economic development failure to geographical, climatic and internal institutional characteristics of the continent in general. Engelbert (2000a,b) argues that pre-colonial state legitimacy is important to explain differences in performance between African economies and replaces the African dummy explanatory power. Given the mounting evidence of a relationship between Africa's past and its current economic performance, a natural question arises. Why do these events, which ended years ago, continue to matter today?

## 1.2 The importance of Colonialism in African current development

Several authors have identified a dummy for Africa with a negative effect on economic growth (Grier and Tullock, 1989; Barro, 1991; Easterly and Levine, 1997; Grier, 1999; Collier and Gunning, 1999). In the previous two decades, several authors attempted to find the determinant of such a negative dummy. Easterly and Levine (1997) identified high ethnic diversity to negatively impact growth, Sachs and Warner (1997) studied the impact of openness in trade while Bertocchi and Canova (1999) and Sala-i-Martin (1997) linked the lack of growth to the country colonial heritage. Englebert (2000a,b) found that the inadequacies of arbitrarily imposed post-colonial institutions explains a significant proportion of the underdevelopment of the countries of sub-Saharan Africa. In an attempt to determine if colonization indeed has an impact on current growth, Gregory Price (2003) has tested an econometric model where "parameter estimates suggest that the partial effects of extractive institutions engendered by [...] colonial heritage account for approximately 30% of the growth gap between the former colonies in Sub-Saharan Africa and other non-industrial countries". Lange (2004) finds that among former British colonies, those that were governed by indirect rule are now less politically stable and have a worse rule of law. Nunn (2004) considered the long-run effects of Africa's slave trades. He found that, looking across countries, the larger the number of slaves taken during the slave trades, the worse is the country's subsequent economic performance. Colonialism has been shown to have an heterogeneous impact on the former colonies (Acemoglu 2000, 2001). It is therefore relevant to focus on the historical background of African states and economies to understand the current lack of growth. Nevertheless, in the last few years, the growth of certain economies in the continent

raised questions to why some countries succeeded to take off while others remained blocked or fail to develop.

### **1.3 Objective and outline of the thesis**

The thesis aims at adding clarity to the impact of colonization transformation on Institutions and the importance (or not) of economical ties between colonizer-colonized countries after decolonization on different levels of Innovation capabilities. It also aims at linking two different Economic literatures : Economic History and Innovation Economics. Although diverse studies on colonialism have been conducted very few attempt to link it to the new discussion on innovation and capabilities.

The outline of the thesis will be organized into 5 chapters. In the next chapter, I will review the African History starting from the first main contact between Europeans and the African continent in the 15th century. After having a grasp of the Historical background, the theoretical background from both the colonial History literature and Innovation Economics literature will be presented with a proposition on how to link both with the help of a framework. The following chapter introduces the methods and the present the analysis of Econometrical models that aim at prove the underlying assumptions. The next chapter will Discuss the diverse results and open the road for including a reflection on policy implication. The final chapter concludes with a summary of the results and answers the research question.

The main contribution of the Thesis rests in the different approach on the African colonialism as a part of the answer to current Development question economists ask themselves. Why do some countries lag behind? If it is due to Historical legacy, what can still be done?

The thesis will answer to the following questions: (a) Does transformation endured during colonialism affect the level of Institutions in former African colonies? (b) How do Institutions derived from Colonialism affect the level of capabilities? (c) Are continuing relationships between the formal colonizer and the colony important for Economic Development through the development of innovation capabilities?



## Chapter 2

# Review of the African History

In order to study the effects of African colonialism on subsequent development, one must, first study and understand the historical facts prior to the Scramble for Africa, as well as the way colonization was carried in different states.

### 2.1 African Continent prior external contact

Tracing back in the history of the continent, the first signs of first available evidence suggested that African societies were not far different in levels of both economic and social development from other societies around the world. Amin (1972) supported this claim. Complex social formations, sometimes accompanied by the development of the state were already present (p. 506). Various societies had developed customs, laws, ethics or rituals to solve conflicts and ensure order.<sup>1</sup> Some societies, more centralized, presented formal political systems and advanced legal institutions resembling modern day courts (Bohannon and Curtin, 1988, pp. 147–167; Adejumobi, 2000).

One of the first-hand written accounts from "pre-contact" Africa comes from the Moroccan traveller Ibn Battuta, who adventured himself to the empire of Mali in 1352. In the written, a road from Walata, located in today's Mauritania, to the capital of Mali was described as safe and the empire as well functioning with peaceful inhabitants (Ibn Battuta, 1929, p. 322). "The negroes possess some admirable qualities. They are seldom unjust, and have a greater abhorrence of injustice than any other people.... There is complete security in their country. Neither traveller nor inhabitant in it has anything to fear from robbers or men of violence." (Ibn Battuta, 1929, p. 329).

*A measure of Africa's initial prosperity and well being comes from data on urbanization and population density. Acemoglu et al. (2002) argued that an area's urban population is a good indicator of its level of economic development. Data on city size, available from Chandler (1987, pp. 282–301) and Bairoch (1988, p. 58), present data points in the 15th century for Sub-Saharan Africa. In Central Sudan, Gao's population reached 60,000, Kano's was 50,000, and Timbuktu's was 25,000. In current Nigeria, Katunga, the capital of Oyo, had a population of 50,000, while the city of Benin had a population between 60,000 and 70,000. Further south, Mbanza Kongo, the capital of the Kongo Kingdom,*

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<sup>1</sup>Order was enforced through kinship ties or a lineage system, where disputes were either resolved by consensus or through a council of elders.(SOURCE)

*had a population of 40,000. In Eastern Africa, prior to the arrival of the Portuguese, Kilwa's population reached 30,000 and the population of the city of Zimbabwe reached 40,000. (Nathan Nunn, 2005)*

## 2.2 The initiation of European contact in Africa – Part I: The Portuguese century of Discoveries

In the 15th century, a small European country, Portugal, decided that the globe would offer much more than just a portion of land in the Iberia peninsula. Setting sail towards the south, Portuguese sailors first reached Ceuta in North Africa to establish a trading point in 1415. The Portuguese started then the descent of African western coast, soon reaching islands of Cape Verde. The first struggle came when approaching the cape Bujador, a decade was needed for sailors to manage crossing the dangerous waters around the cape. Following their route to the south, the Portuguese became the first European colonial power in Africa that lasted through the 20th century. Settling in islands of São Tomé and Príncipe, continental Angola and Portuguese Guinea, the Portuguese soon reached the tip of the continent, in the attempt to unveil a new trade route to the so desired Indian spices. After disastrous attempts to sail past the Cape of Good Hope, Bartolomeu Dias finally achieved the prowess in 1488 opening the route leading to the Asian continent. The Portuguese soon reached the east coast of Mozambique and implemented a colonial rule. The century of Portuguese discovery was possible due to the Portuguese crown and more particularly, the prince, soon after named Henry the navigator, who invested in marine and sailing infrastructures, each travel brought knowledge feedback that allowed improving latitude measuring, wind mastery and improvement of ships where *Caravela's* soon left the place for *Nau's* that allowed Vasco de Gama to reach India in 1498. A more detailed description of Portuguese travels may be found in the work of Landes (1998) chapter VI.

What are, however, the real implications of such travels for the development of the African continent?

During these travels, Portugal initiated contact with African natives, took prisoners, initiated slavery and discovered new opportunities for profit. The latter being the crucial goal: as Prince Henry's biographer-hagiographer Zurara put it, "...it is evident that [no sailor or merchant] would want to go to a place where he did not stand to make money."<sup>2</sup>. Furthermore, it established the longest colonization within the African continent, namely, the colonies of Angola and Mozambique that lasted until 1975. Finally, In the quarter century before Columbus, the Cape Verde Islands and to a lesser extent the Madeiras became a testing ground for slave sugar plantations, to be followed by São Tomé in the 16th century. Indeed while in The Azores and Madeira, where initially populated people were unfree persons who were strained to move there — convicts, prostitutes, victims and orphans of religious persecution – The Cape Verde Islands, were ideally located to tap the slave trade that flourished nearby, soon serving as shipping station of blacks to Lisbon and to some of the other islands. Portugal set the path for the following era of Slave trade.

<sup>2</sup>Quote d in Huyghe , Coureurs d'épices, p. 121

## **2.3 The initiation of European contact in Africa – Part II: The Dark era of Slave Trade**

Right after the end of the Portuguese century of Discovery, the slave trade was established right at the beginning of the 16th century and lasted until the mid 19th century. During this time, European contact with Africa primarily took the form of the trans-Atlantic slave trade during which, according to Lovejoy (2000), approximately 12 million slaves were shipped to the American continent. The external demand for slaves incited individuals to engage in various unproductive activities. Slave raiders, slave traders and other middlemen captured and assured slaves transition to the coastal ports. Both activities are deemed unproductive as they do not provide any value creation. Darity (1992) describes the change in relative payoffs of the two types of activities and argued that the most lucrative activity throughout the 18th century for those Africans with the power to enslave rather than be enslaved was procurement of human exports for the slave trade (p.165). Another issue identified by several authors (Mario Azevedo 1982; Andrew Hubbell 2001; Joseph E. Inikori 2000; Martin Klein, 2001) explained that, as nearly all slaves were taken in large-scale conflicts or raids, it installed an environment of insecurity outside of the local community. This insecurity would then be transmitted within communities, as individuals began to turn on others close to them, including neighbors, friends, and even family. The slave trade had one peculiar feature compared to other cases of insecurity: individuals could indeed partially protect themselves by turning others within their community. Forms of small scale violence allowed to exchange slaves for guns and weapons (Abdullahi Mahadi 1992; Walter Hawthorne, 1999). Slave merchants and raiders further promoted internal conflict by forming strategic alliances with key groups within villages and states to facilitate slavery (Boubacar Barry 1992; Inikori 2003; Klein 2003). André Alvarez d'Almada (1984) identified that households located near ports were indeed, able to profit from the slave trade by "tricking" unsuspecting strangers and then selling them to merchants. With the arrival of the 19th century, the trans-Atlantic slave trade slowly ended. Slave trade declined giving space for the European colonization to start. The Scramble for Africa debuted with the Berlin Conference of 1884–1885 marking the beginning of official colonial rule.

## **2.4 The Scramble for Africa: Patterns of colonization**

The period of colonial rule differed substantially from the slave trade, however it perpetuated the alteration of returns to productive activities relative to unproductive activities. Here, it is essential to distinguish from Colonial policies of land expropriation, taxation, and forced labor targeting those that produced. Taxes were mainly raised through tools such as poll, head and hut taxes. Taxes indirectly served as a tool of extraction forcing the African peasantry into extractive employment relations. Furthermore, relatively high annual taxes could only be paid in the official colonial currency, restrained labor contracts for natives. These contracts were strictly enforced. Had a the native broken a contrat, he would receive severe punishment (Buell, 1928a,b; Nzula et al., 1979). Peasants were required to engage in employment that was provided without compensation or for wages well below the market rates. Some of the darkest examples, for instance, within the Belgian Congo, where natives were required to spend 40 hours each month gathering rubber for the colony. In the meanwhile, Uganda natives were obliged to provide 30 days of free labor a year on

the roads (Buell, 1928a, p. 567). Ironically, those engaged in unproductive activities managed to better avoid European extraction. Those working with the Europeans in the colonial administration were exempt from the taxation and forced labor. Therefore, after the European contact, the proportion of individuals engaged in unproductive activities increased over time. Patrick Manning (1990) exposed that, by the 19th century, much of the continent was militarized; great kingdoms and powerful warlords rose and fell as their fates were linked to fluctuations in the slave trade. Even in egalitarian communities were not spared. Indeed, the temptation to profit from the sale of captives or culprits kept the slave trade alive (p. 147).

*Trade data from the port of Quelimane, Mozambique, provide evidence of the extent of the switch from productive to unproductive activities during this time. Between 1806 and 1821, slave exports increased by 240%. At the same time, rice exports fell by 88% and wheat exports fell by 95% (Austen, 1987, pp. 68–71). In 1705, the Dutch Director-General wrote about similar drops in production that were occurring on the Gold Coast: bit has completely changed into a Slave Coast, and the natives nowadays no longer occupy themselves with the search for gold, but rather make war on each other to furnish slaves. (Richards, 1980, p. 46).*

It is therefore important to distinguish between three types of colony: a) centralized state – Benin, Botswana, Burundi, Ethiopia, Ghana, Lesotho, Rwanda, and Swaziland. b) white settlement – Kenya, Namibia, South Africa, Zimbabwe, and Angola and Mozambique c) others: (1) no significant pre-colonial state formation – Somalia and South Sudan; (2) colonies which did not experience significant white settlement and where there was either or where there was a mixture of centralized and decentralized societies – Congo Brazzaville, Nigeria, Uganda or Sierra Leone.



## Chapter 3

# Theory and Literature

### 3.1 Two distinct strands of literature

The review of the literature will focus on two different branches of Economics. First, the Historical aspect of African economies will focus on the second wave of colonialism from the 19th to the 20th century. The second part of the literature lies in the realm of Innovation Economics where different theories of growth, catching-up and technology will be discussed in perspective with innovation capabilities.

### 3.2 Colonialism Economic Literature: why History matters

The literature in History and Economic development stresses the importance of colonialism for the current level of development in pre-colonized countries. In this area, three main lines of research stand out. First, Engerman and Sokoloff (1997, 2002) examined the importance of factor endowments and colonial rule for the subsequent economic development of colonies within the Americas. Secondly, Acemoglu et al. (2001, 2002) developed a research agenda that sought to better understand the historical origins of current institutions and their importance for long-term economic development. Finally, La Porta et al. (1997, 1998) focus on legal institutions implemented through colonial powers and the long-term consequences these had for investor protection and financial development. This section presents the three main lines of research as well as more recent studies in the matter and other recent studies tackling the same issues with novelty.

#### 3.2.1 Factor endowments and colonial rule for Development *Engerman and Sokoloff*

Engerman and Sokoloff (1997, 2002) investigated the link between the availability of factor endowments and the development path the countries experienced. In their case, they focused on the American continent and looked at the geography and land endowments differences and determine its suitability to grow world traded crops. These usually were created in large-scale with slave labor and often incited higher levels of inequality at both the economic and political level. An empirical assessments outside America that supported these claims was presented by Nunn (2008a). The author looked at external trade of Slaves by comparing Atlantic Trade Slave to Red Sea, Indian Sea and Trans-Sahara slave trades, and found that the parts of Africa who provided the largest number of slaves (normalized by land area or historic population) are today the poorest parts of Africa. The author first tested the nature of slave selection to find that denser populated and most developed societies provided a larger number of slaves. He then constructed an instrument capturing distance between supply and demand of slaves. IV estimates were consistent with

previous OLS results suggesting that Africa's external trade in slaves did have a significant negative impact on the subsequent economic development of the different regions within Africa. However, in his paper, Nunn (2008b) was unable to prove any link between initial inequality in factor endowments and current income levels and underdevelopment.

### **3.2.2 Historical origins of current institutions**

#### *Acemoglu, Johnson, and Robinson*

Acemoglu et al. (2001) focused on the colonial impact on institutions. By looking at levels of disease and mortality the paper argued that high levels of mortality were characterized by low settlement by the Europeans and henceforth a higher tendency for the establishment of rent-seeking institutions. In contrast, when mortality was low, there was a higher tendency for developing institutions that ensured property rights. The methods of the paper identified a negative relationship between mortality and current institutions, and then a positive relationship between institutions and per capita income. The study lies among the most recognized within the colonial literature because of the strong empirical evidence based on a robust determinant of post-colonial institutions. Other authors attempted to expand the literature debuted by Acemoglu and colleagues. Lange (2004) made the distinction between direct and indirect rule, and presented results showing a positive effect between indirect rule and quality of institutions and governance. Dell (2008) focused on a more regional area and analyzed richer data at the micro level to support previous conclusion that Historical events have an impact on the current status of certain economies. In this case, the author estimated the effect of established institutions during Spanish colonization period in Bolivia and Peru on the current level of Household consumption. Also at the regional level, Banerjee and Iyer (2005) identified the relationship between revenue collection systems in former British colonial India and the current level of wealth, education and agricultural technology in different Indian districts. They found that districts where the revenue collection was ensured by British officials perform better after decolonization compared to those where land revenue was collected by native landlords.

### **3.2.3 Long term impact of legal institutions**

#### *La Porta, Lopez-de-Silanes, Shleifer, and Vishny*

La porta et al. (1997) focused on the legal institutions in former European colonies, making a clear distinction between the British common law system and the Roman civil Law system developed by France, Portugal and Spain while Scandinavian and German systems stay intermediate. The authors argued that, as the legal system was transplanted to the colonized states, British common law offers higher protection to investors compared to Roman civil law based systems, carrying on the analysis to determine that countries where investors protection was low, developed the least the capital markets. In the subsequent year, they demonstrated that French civil Law together with other religious characteristics and ethnicity were correlated with worse government performance. However, other studies carried in the last decade showed that legal origin is also correlated with other country characteristics, such as economic growth (Mahoney 2001), labor market regulation (Botero et al. 2004), contract enforcement (Djankov et al. 2003, Acemoglu and Johnson 2004) and comparative advantage (Nunn 2007b). La Porta et al. (2008) recognize the implications of such findings on the consistency of the original instrument. Other studies such as

Grier (1999) and Bertocchi and Canova (2002) respectively found that British present higher Education attainment at the end of colonization and both French and British colonies in Africa present higher levels of education and investment. These studies emphasize the impact of the identity of the colonizer on the long-term development of these colonies.

### 3.2.4 From the identification of patterns to the determination of causal links

Recent studies on the matter rely on richer data and more sophisticated econometric techniques in the attempt to find causal relationships between the different measures. For instance, Iyer (2007) used an identification strategy to examine the relative effects or rely on richer data and more sophisticated econometric techniques in the attempt to find causal relationships between the different measures. The author considered direct and indirect rule across regions within India and exploited the "Doctrine of Lapse" to address the problem of the endogeneity of the form of British rule and coded a dummy indicator to finally estimate the effect of colonial indirect and direct rule on the current investment in agriculture and agricultural productivity; and the relationship between direct rule and the availability of public goods such as education, health and roads. Berger (2008) looked at vaccination rates for a measure of local government quality today. By using the Historical border as a point to distinction of households between Northern and Southern Nigeria, the author used regression discontinuity estimation strategy to find that vaccination rates are significantly lower on the Northern side of this historical border. The author checked the results with a falsification test by changing the historical border to find that no change was perceived between the North and the South of the fake border. A significant difference only exists with the historic border, which does not correspond to any current boundary. In a similar method, Huillery's (2008a) analyzed the effects of colonial rule across districts within French West Africa. The author found a positive relationship between early colonial investments in education, health, and infrastructure and current levels of schooling; health outcomes; and access to electricity, water, and fuel. The study then tested for the causal effect of colonial policy on the different outcome measures with a regression discontinuity estimation strategy. The estimates provide strong support that colonial investments on infrastructure, education, and health have positive and persistent effects on these same measures today. Perhaps one of the most novel techniques was presented by Feyrer and Sacerdote (2009). The authors used a novel instrumental variables estimation strategy to provide the first causal estimates of the impact of the length of colonial rule. The authors restricted their sample to island colonies, arguing that how early an island was discovered was determined in part by its location relative to prevailing wind patterns assuming these same wind patterns most likely do not affect long-term development through channels other than through the island's date of discovery. The wind vectors surrounding an island could therefore be used as instruments to estimate the causal effect of the length of colonial rule on subsequent development. The first-stage estimates show that stronger westerly winds are associated with earlier discovery and more years under colonial rule. According to their second-stage estimates, the length of colonial rule has a positive effect on per capita income in 2000.

### 3.3 Innovation Economic Literature: New paths to Economic Development

A convenient starting point before proceeding to the literature of interest is to discuss the neoclassic growth theory of the 1950s (see Solow, 1956). In his model, accumulation of capital is the main factor creating an increase productivity. However, as the marginal productivity of capital decreases, the capital per work increases leading the capital-labor ratio to a constant in the long-run equilibrium where productivity growth ceases. The author explained the long-run economic growth by adding an exogenous variable - 'technological progress' - that allows to increase productivity creating a new Steady state. Ultimately, the long-run per capita GDP grows at the rate of Technological progress.

For several years, many mainstream economists have believed that differences in development levels across countries were to be driven by these mechanics. This resulted in an overall struggle to incorporate technology within their analysis, which is mainly due to the standard neoclassical assumptions of the Solow model that became widely accepted – namely, perfect competition, maximizing behavior, absence of externalities and scale economies, positive and decreasing marginal products. More importantly, the assumption that information is freely available (i.e. a "public good") and can be re-used incessantly. If we were to argue, if technology was indeed freely accessible it would eventually benefit all economies equally (see Denison 1967, p. 282), and therefore cannot be invoked to explain differences in economic development. Indeed, applied research soon confirmed that this theory did not really fit the evidence. The main prediction of convergence between rich and poor countries came to be refuted (see Islam 2003, Landes 1998). Economists have since then searched for alternative ways to understand the role of technology and innovation for economic development.

It is therefore outside of the mainstream economics sphere that an alternative approach was developed. Indeed, economic historian Alexander Gerschenkron analyzed the History of European catch-up<sup>1</sup> and identified several issues that may prevent backward nations from fully reaping the potential benefits. Even though the technological gap between a frontier country and a laggard creates a potential for high growth through imitating frontier technologies for the latter, technological catch up is not necessarily an automatic mechanism as it requires strong efforts and organizational and institutional change to succeed (Ames and Rosenberg, 1963). Taking the German example, when Britain industrialized, its technology was relatively labor intensive and small scale. However, technology eventually became more capital and scale intensive. As Germany entered the scene, as a late-comer, the entry conditions had already changed considerably. Gerschenkron therefore argued, Germany needed new institutional instruments to overcome these obstacles, mostly within the financial sector, "instruments for which there was little or no counterpart in an established industrial country" (Gerschenkron, 1962, p. 7). These results were emphasized in empirical works in Asia and Latin-America (see Kim 1980, Fransman 1982, Fransman and King 1984, Dalhman et al. 1987, Lall 1987). At the macro level, Fagerberg (1987, 1988) and Verspagen (1991) led the scene with the so-called "technology gap theory of economic growth". Meanwhile, the "new" growth theory centered on technology as the driving force of growth and development was developed by Lucas (1988), Romer (1990) and Aghion and Howitt (1992).

<sup>1</sup>One of his favorites examples was the German efforts to catch up with Britain more than a century ago.

The abundance of different approaches set the basis for a wide possibility for empirical settings. In this thesis the focus will be on economies that fail to efficiently capture technology from frontier countries. In this setting, several factors deemed complementary allow laggard countries to capture technology and therefore achieve higher levels of economic development and catching-up. A scan of literature identifies concepts such as "technological capability" (Kim 1980), "technological capacity" (Bell 1984), "innovation capability" (Dahlman et al. 1987), "innovative capacity" (Furman et al. 2002), "absorptive capacity" (Cohen and Levinthal, 1990) and the "systems of innovation" (Lundvall 1992, Nelson 1993, Edquist 1997). Two works summarize these diverse concepts (see Fagerberg and Godinho, 2004; Archibugi and Coco, 2005). Special attention is needed when dealing with these different concepts as "there is a big overlap between several of these concepts and the relationship between conceptual and empirical work in this area is often weak" (Fagerberg and Srhorlec, 2007, p.3).

### 3.3.1 Capacities and Capabilities: A panacea to overlapping notions

#### Social Capabilities

Moses Abramovitz recognized the potential of a country to "borrow and adapt" technologies in a process of catch-up (Abramovitz, 1994a, p. 87). The author then defined the concept of "social capabilities" perceived at the "collective" level where broad social and cultural factors foster or hamper actions taken by public and private sector organizations. The author specified various important factors included in this broad and fuzzy notion of "social capabilities" across several works: Technical competence – measured through the level of education; Experience within organization and management of large scale enterprises; financial institutions and markets capable of mobilizing capital on a large scale; Honesty and trust; Government efficiency and stability in defining (enforcing) rules and pursuing growth (Abramovitz, 1986, pp. 387-390; 1994a, pp. 34-35; 1994b, p. 88). Despite the acknowledgement the concept received the author himself admitted the concept was "vaguely" defined (Abramovitz 1994a, p. 25). It is therefore relevant to recur to similar concepts developed in parallel that overlap with one of the various aspects of "social capabilities". Indeed, one of these concepts, "absorptive capacity" – which in development economics literature refers to the capacity of a developing nation to absorb technology from investments (Adler 1965, Eckaus 1973) – was adapted to the context of Knowledge, and the capacity to capture it. This concept was developed both at the micro level (see Cohen and Levinthal, 1990), and the macro level (see Rostow 1980, p. 267-277). The former applies the concept at the firm level and explains its capacity to recognize and assimilate external information to transform into commercial output (Cohen and Levinthal, 1990, p.128). At the macro level, the author emphasized the importance of the stock of existing and emerging Knowledge capital each country possesses. He argues that economic growth is enabled by the absorption rate of knowledge, which in turn depends on the amount of trained men (i.e. Human capital) and capital. The aim here is for economies to increase the Human Capital in order to accelerate the rate of absorption of Knowledge. Other several authors extended Cohen and Levinthal's notion of absorptive capacity at the aggregates levels (both regional and national level – see Keller 1996, Eaton and Kortum 1999, Griffith et al. 2004). It is, however, important noting that the original scope of the term as presented by Cohen and Levinthal is much wider than the simple definition of "absorption". The authors associate the capacity of absorbing a piece of knowledge

to the capacity of transforming it into commercial use. Conversely, several authors make a definitive distinction between both – Zahra and George (2002) define the later stage as "transformative capacity"; Fagerberg (1988) and colleagues (2007) distinguish between competitiveness in "technology" (i.e. compete on technology) and "capacity" (i.e. exploit technology commercially).

### **Technological capabilities**

In the last two decades of the 20th century, an emerging set of empirical works studied the industrialization of Asia with focus on capabilities building (see Johnson, 1982; Amsden, 1989; Wade, 1990; Hobday, 1995; Kim, 1997; Nelson and Pack, 1999; Kim and Nelson, 2000), but it was Kim that developed the notion of "technological capability" as "the ability to make effective use of technological knowledge in efforts to assimilate, use, adapt and change existing technologies. It also enables one to create new technologies and to develop new products and processes[...]" (1997, p. 4). The definition proposed by Kim notably approaches the notion of "absorptive capacity" presented above – to the point the author used both terms interchangeably (Kim, 1997). The notion has been commonly decomposed into three different notions in the literature: production-, investment- and innovation- capabilities where the first allows firms to adapt products to the market demand, the second assures the construction of new productive sites and the latter ensures the creation of new Knowledge. Similarly to the concept of "absorptive capacity", originally developed in the context of firms, technological capabilities have been expanded to several levels of aggregation. "National" technological capabilities rely on the capacity to collect and use financial resources efficiently, the development of general and technical skills, the capacity to acquire technology from abroad (e.g. Foreign Direct Investment (FDI)) and the efforts led towards the improvement of Research and development (R&D) and inventions (Patents) (Lall, 1992). Other studies assimilated the notions of innovation with imitation and other efforts towards growth (Fagerberg, 1987, 1988), where the process of catching-up is far from being guaranteed, and highly depends on whether or not a country is equipped with necessary capabilities. An important notion developed by Verspagen (1991), defined "low growth traps" where poor countries with relative low "social capability" risk to stay "trapped". Moreover, Fagerberg and Verspagen (2002) introduce a dynamic notion, where it supposedly becomes more and more inevitable to develop innovation. This finding urges policy makers, especially in Developing countries, to consider these notions.

### **3.3.2 Beyond theory: potential issues with the use of capabilities**

The overlapping aspect of the various notions described in the above paragraphs raises a question on how to move from theoretical aspects to empirical implementation of these notions. Indeed, as Abramovitz recognizes the difficulty to thoroughly assess the wide and complex notion of social capabilities, an empirical setting relying on loosely defined notions would diminish the scope for precise and meaningful interpretation. Notions of narrow technological capabilities and its relation to broader social, institutional and political factors are hard to operationalize. Luckily, recent years have seen an improve in availability of data. Nevertheless, the struggle remains in Developing countries where sources of data are scarce and sometimes unreliable.

### 3.4 Integrate History and Innovation

The two branches of Economic literature reviewed above present completely different roots and focus. To facilitate the understanding of the link and mechanics linking both literatures, there is a need to integrate both aspects in a framework leading to Development. I hence base myself on the integrated framework proposed by Fagerberg and Srholec (2007).

Contrasting the framework with the previous literature review, Figure 3.1 presents an overview of the factors the authors deemed important for Economic Development. This framework allows to link the bottom part (our notion of colonialism discussed in the thesis) with the top (Innovation Economics indicators envisaged above). The focus within this network is to move towards the top while understanding how the bottom affects the diverse factors above it. And while Nature and History seem to matter for Development, little can be done about it (i.e. not in the realm of policy implications).

The bold attempt is to include measurements from most levels presented in the framework and test empirically how these contribute to Economic development. As it surpasses the scope of this thesis, here we will hence focus on the middle part of the framework starting with History and moving upwards from institutions, to notions of capabilities.

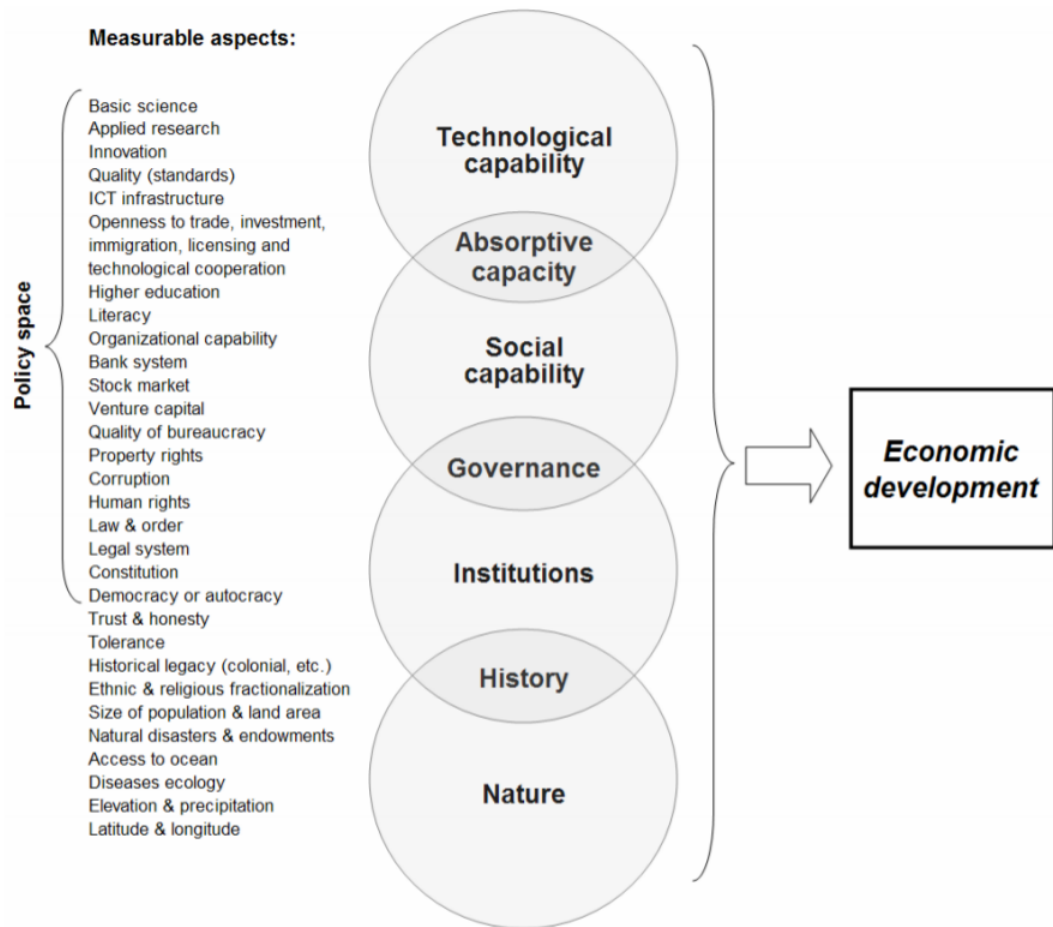


FIGURE 3.1: Integrated Network of capabilities and Economic development (Source: Fagerberg and Srholec (2007))



## Chapter 4

# Methods and Analysis

This chapter of the thesis specifies the methods and the choice of variables. For the purpose of this empirical research, the analysis follows two stages: the first focuses on the outcome of colonialism on the post-colonial institutional setting of African economies; and the second takes departure from the findings of the first stage to link to Innovation Economics measures. The aim is to depict to which extent, institutions directly driven from colonial power, still matter to the subsequent level of development in these economies. Note that few assumptions had to be made in order for the empirical setting to be interpreted. First, colonialism here has been treated as an exogenous shock, the thesis does not dwell on why a country had more or less chances of getting colonized, and in which manner. To that extent, the only variables that might conflict and present an endogenous power of type of colonialism, are the control variables used in the first stage of models, namely, geography, ethnic fractionalization and slave trade. Once more, the variables they are controlling for do not *directly* cause the mode of colonialism led by the European power but rather the overall institutional impact it had on the country. Second, the thesis did not focus on the extent to which previous historical events, such as slave trade, affect these same levels of institutions. I strongly suggest consulting empirical works by other authors that fully explain the mechanisms through which these 'far ago' events still have strong impacts few centuries later (see Slave trade Historical overview in Chapter 2 of this thesis, where several sources were invoked). Third and last, an important assumption here is that although institutional conditions might have long-run effects on subsequent development (as empirically discussed by several authors, cf. the stock of literature on colonialism), it is a quite static variable and therefore would not explain short to medium run fluctuations in the levels of development. A deriving assumption, a bit more crude, is that it might even be overridden by other *persistent* effects in the long-run such as continuing interactions with the previous Colonizing power. The remaining of this chapter will be as follows, the first section will describe the econometric setting of the two stages. The subsequent sections describe the variables used in both models<sup>1</sup> and their respective models with preliminary analysis. A separate section will link both stages in light of the theoretical framework.

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<sup>1</sup>A table in Appendix gathers information about all the variables and their respective sources

## 4.1 Data and econometric specifications

Data used in this thesis were sourced from different empirical contributions as specified in the following paragraphs. The two stages present two different econometric settings. The first relies on cross sectional comparative statics allowing for direct comparison between outcomes of colonialism. The second stage relies on both cross-sectional and temporal data gathered in a panel from 1980 to 2009. The Data encompasses 35 African economies with previous colonial experience. The majority of the sample is dominated by British and French colonies, nevertheless, in the attempt to move forward the analysis from the simple comparison between two colonial powers in Africa, the sample includes Portuguese, Belgian and Italian settlements. Table 4.1 summarizes the main aspects of colonization. Descriptive statistics of the different variables are available in the Annexes. Both stages rely on OLS estimates, and special attention was given to underlying assumptions. Where assumptions were violated, econometric transformations corrected the issues. In the first stage, Heteroskedasticity corrected model was conducted to ensure robustness of coefficients. In the second stage, a factor analysis was conducted in order to reduce the sample and avoid redundancy among dependent variables.

TABLE 4.1: Colonies in the sample

ISO code	Colony	Region	Metropole	Onset Colonialism	End of Colonialism	Duration of Occupation
BDI	Burundi	Eastern Africa	Belgium	1897	1962	65
RWA	Rwanda	Eastern Africa	Belgium	1899	1961	62
SEN	Senegal	Western Africa	France	1816	1906	90
DZA	Algeria	Northern Africa	France	1830	1962	132
CIV	Cote d'Ivoire	Western Africa	France	1839	1960	121
CMR	Cameroon	Middle Africa	France	1845	1960	115
GAB	Gabon	Middle Africa	France	1852	1960	108
MRT	Mauritania	Western Africa	France	1858	1960	102
TUN	Tunisia	Northern Africa	France	1869	1956	87
BEN	Benin	Western Africa	France	1878	1960	82
MLI	Mali	Western Africa	France	1880	1960	80
GIN	Guinea	Western Africa	France	1881	1958	77
TGO	Togo	Western Africa	France	1884	1960	76
MDG	Madagascar	Eastern Africa	France	1885	1960	75
BFA	Burkina Faso	Western Africa	France	1896	1960	64
NER	Niger	Western Africa	France	1897	1960	63
TCD	Chad	Middle Africa	France	1900	1960	60
MAR	Morocco	Northern Africa	France	1904	1956	52
ETH	Ethiopia	Eastern Africa	Italy	1935	1950	15
AGO	Angola	Middle Africa	Portugal	1506	1975	469
MOZ	Mozambique	Eastern Africa	Portugal	1569	1975	406
ZAF	South Africa	Southern Africa	United Kingdom	1652	1994	342
GMB	Gambia	Western Africa	United Kingdom	1661	1965	304
KEN	Kenya	Eastern Africa	United Kingdom	1841	1963	122
GHA	Ghana	Western Africa	United Kingdom	1844	1957	113
LSO	Lesotho	Southern Africa	United Kingdom	1845	1966	121
NGA	Nigeria	Western Africa	United Kingdom	1851	1960	109
EGY	Egypt	Northern Africa	United Kingdom	1876	1956	80
SWZ	Swaziland	Southern Africa	United Kingdom	1880	1968	88
BWA	Botswana	Southern Africa	United Kingdom	1885	1966	81
MWI	Malawi	Eastern Africa	United Kingdom	1885	1964	79
ZWE	Zimbabwe	Eastern Africa	United Kingdom	1888	1980	92
ZMB	Zambia	Eastern Africa	United Kingdom	1889	1964	75
UGA	Uganda	Eastern Africa	United Kingdom	1890	1962	72
SDN	Sudan	Northern Africa	United Kingdom	1898	1956	58

### 4.1.1 Data

#### Colonial transformation

Studies on colonialism have had the issue of finding appropriate Data sources and estimates that would have to be robust enough in order to drive meaningful conclusions. As years pass and a wider number of scholars become interested in the topic, new and more advanced measures are reported and allow for a thorough analysis of several aspects of colonialism. In this thesis, I rely on recent estimates of Colonial transformation compiled by a group of Swiss scholars where the main aim was to finally provide an harmonized set of indicators that allowed for direct comparison within economies, and therefore diminish the concerns of choosing carefully counter-factuals that would otherwise harm economic interpretation. The work of Ziltner and colleagues (2017) not only provides a range of 15 full indicators of colonialism activities, but the authors also assessed three levels of major transformation that, although inter-related, should be treated as distinct effects of colonizers in Africa and Asia. For the purpose of the thesis, the sample was restricted to the African colonies in the sample. First analysis of the data by the authors themselves proved consistent with empirical findings by Economic historians and economists of the colonialism theory, that among European colonizers, "British colonies political domination was in general less direct and less violent. Plantation colonies experienced more investment in infrastructure and more violence during decolonization." (Ziltner et al., 2017).

**Level of Political transformation:** The extent to which European settlers affected African colonies really differed from case to case, as seen in the previous chapters, form of colonialism has played an important role on subsequent institutions, the authors have therefore distinguished between direct and indirect rule and for the latter, captured the intensity of interference in internal affairs. The form of colonialism often correlates with overall colonial violence. To that extent, the authors have included notions of resistance against both a anti-colonialism resistance; b colonial domination and exploitation; and c violence during decolonization The first depicts the varying impact of colonial violence against resistance movements in the aim of preserving autonomy and sovereignty – often carried by traditional elites. The second indicates resistance against general measures of colonial domination – taxation, expropriation, forced cultivation, forced recruitment or forced labor. This form of resistance is often carried by peasants and workers. The third occurred during decolonizations, and often led by young educated elites. The three types were coded in relation to the level of violence instead of simply capturing presence (or absence) of violence. The total colonial violence behind a simple aggregation of the three types of colonialism. Among African economies, the most violent colonial experiences were depicted in Algeria and Angola and therefore, British violence was considerably low compared to other European counterparts Ziltner et al., p. 163). The authors also accounted for the degree to which colonial policies intentionally (or not) created and/or reinforced occupational specializations in army/police, administration/education, and in the economy, along ethno-linguistic and or religious lines. Furthermore, they captured the quantitative aspect of colonially induced immigration. Finally, according to the authors, the transfer of administration has been somehow neglected so far, whereas it is an important aspect for the development of post-colonial institutions. They therefore measured the gradualism in the transfer of administration at decolonization.

**Level of Economic transformation:** The level of economic transformation captures the overall impact on the economy that the political transformation fails to account for. The first measure the authors considered were trade policies, relating to how open or constrained on tariff trade with the metropole was. The measure of trade concentration takes into account the proportion of trade with the metropole relative to the total trade. One of the most important effects of colonialism is on the levels of investment. To that extent, the authors considered the investments in infrastructure at different levels such as, a) transport links (railways, streets) into the interior, b) local transport systems such as tramways, telecommunications, and c) gas, electric, and water works. Finally, the size of plantation economy and the extent of mineral extraction were included in this aspect of Economic transformation.

**Level of Social Transformation:** The last factor of transformation – social – encompasses the immigration of people from the metropole which for the majority corresponds to less than 10% of the overall national population. The authors estimated the level of colonially induced labor immigration<sup>2</sup> from other colonies or areas. Finally, the indicator includes the extent of successful missionary activities, and a measure of colonial impact on border creation as “the percent of the population of a country that belongs to a partitioned group” (Alesina, Easterly, and Matuszeski, 2006, p.12).

### Measuring colonial Institutions

"Institutions matter" has been an important claim many social scientist made in the past few decades and indeed, several empirical works have proved how institutional indicators affect economic development and growth (see works of Knack and Keefer, 1995; Mauro, 1995; Hall and Jones, 1999; Acemoglu, Johnson and Robinson, 2001, 2002; Easterly and Levine, 2003, Dollar and Kraay, 2003). Unsurprisingly the stock of Data and indicators measuring institutions have exploded in the last decades, where three of the most used include the (a) International Country Risk Guide indicator of institutional quality, (b) Kaufmann, Kraay, and Mastruzzi (2003) measure of government effectiveness and (c) Polity IV dataset collected by Jagers and Marshall (2000). An overview of Glaeser et al. (2004) presents substantial flaws within these measures opening the path to a rising literature of criticism towards the way institutions have been measured. Out of the different works on this issue, Stefan Voigt (2013) has made an interesting overview of the main arguments. It is unrealistic to expect capturing all aspects of different institutions within one only estimator. The author mentions as an example the "rule of law" and describes it as being "too broad and fuzzy to contain meaningful information" (Voigt, 2013, p.2). The authors also raises awareness towards the fact that many of these indicators are purely subjective rather than being measured objectively. Furthermore, he argues that institutions should be divided into two different categories: *De Jure* and *De facto*. The former captures what is intended in the legislation and the latter represents how is actually implemented. Indeed, in several countries the gap between what is said and what is done is substantially high, and base an analysis on simply the former would fail to capture the real impact of the institution. The main questions to ask when choosing institutional indicators would hence aim at choosing the

<sup>2</sup>“Colonially induced” means that work immigration has not only been tolerated but encouraged, independently of permanent settlement in the colony. Work immigration has been encouraged by means such as opening markets, recruitment/deployment from abroad, providing permits/licenses for agencies, etc.” (Ziltener et al., 2017, p.175)

specific institution(s) needed to be captured, and determine better way to estimate with highest level of objectivity. Although, theoretically, these arguments are important guidelines, in practice it is difficult to achieve such measures, especially when attempting to capture institutions in a long period and even harder when this period lies in the past, where Data points for several nations are simply absent. However, several economists have sought to improve representativeness of Data in both cross sectional and temporal dimensions. An example of such effort was made by two Economists, Fulvio Castellacci and Jose Miguel Natera who have gathered most indicators in regards to National Innovation System, institutions and innovations. Furthermore, they undertook multiple imputations methods to balance the panel ending up with an acceptable data set.

This thesis relies hence on a widely used technique to extract a notion of institutions – factor analysis. This method pioneered by Adelman and Morris (1965, 1967) and later used by Temple and Johnson (1998)<sup>3</sup>. This method is based on a very trivial assumption that variables referring to the same factor are likely to present strong correlations. It allows to reduce the complexity of a large data into a small number of composite indicators. Indeed as Putnam (1993) argues, it is "the most reliable and valid means of combining multiple indicators of a theoretical variable into a single index" (Putnam, 1993, p. 216). This method allowed not only to extract an aggregate measure of institutions but also set the base for the second stage model with two measures of capabilities. Table 4.3 and 4.4 present respectively the Pearson correlations with p-values and the factor loadings where 3 main factors emerge:

- a Technology capabilities: take the form of direct input to and output from innovation activities.
- a Absorptive capacity: a rather narrow interpretation of the original absorptive capacity, here, the the interest is in only measuring to which extent nations are capable to absorb knowledge due to its level of education.
- a Institutions as the gathering of several variables depicting several aspects of institutions.

TABLE 4.2: Pearson correlation matrix

	1	2	3	4	5	6	7	8	9	10
1 Patents										
2 Scientific Articles	0.74***									
3 R&D spending	0.77***	0.83***								
4 Internet users	0.07***	0.14***	0.18***							
5 Primary enrolment	0.36***	0.57***	0.59***	0.48***						
6 Secondary enrolment	0.48***	0.67***	0.63***	0.27***	0.78***					
7 Tertiary enrolment	0.47***	0.55***	0.49***	0.13***	0.44***	0.63***				
8 Human rights	0.31***	0.44***	0.32***	0.09***	0.27***	0.33***	0.27***			
9 Women's rights	0.36***	0.54***	0.43***	0.22***	0.33***	0.41***	0.32***	0.57***		
10 Political rights	0.38***	0.53***	0.50***	0.32***	0.52***	0.55***	0.35***	0.53***	0.54***	
11 Civil liberties	0.41***	0.59***	0.52***	0.32***	0.56***	0.59***	0.41***	0.58***	0.57***	0.92***

Several variables in the sample present high correlations (>0.7) among each other. A factor analysis is therefore justified. Common criteria of factor selection suggested the extraction of three factors. Furthermore, in order to avoid bias and errors due to restrictive sampling, the factors were calculated using the whole original sample

<sup>3</sup>A number of articles utilize Factor analysis and principal components for the same purpose. cf. Englebert, 2000; Fagerberg and Srholec, 2007,2008, 2017; Castellacci and Archibugi, 2008; Fagerberg, 2013

(i.e. including countries all over the world) and then restricted the scores to the selected countries in the colonial data. As we expect factors to present a certain degree of correlation between them – as it appears to be in real world situations – an oblique "oblimin" rotation was chosen with a standard principal components extraction method.

Three main factors were retained and labeled according to their corresponding components.

TABLE 4.3: Measuring Capabilities

	Innovation and technology	Institutions	Education
Patents	0.88		
Scientific Articles	0.83		
R&D spending	0.81		
Internet users	0.46		
Primary enrolment			0.46
Secondary enrolment			0.90
Tertiary enrolment			0.55
Human rights		0.70	
Women's rights		0.61	
Political rights		0.87	
Civil liberties		0.91	

### Control variables

Following the Economic literature on colonialism, several empirical evidences argued for geographical, ethnicities and counterfactual effects on institutions and growth. In the first stage, former, the first control is the time lapsed between the decolonization of a certain country and the year of observation for the dependent variable (i.e. 1980). This control allows to adjust for the time a former colony disposed to change its institutional setup and implement (or not) new policies. Let us consider two examples, for instance, the former Portuguese colonies of Angola and Mozambique became independent the year after the fall of dictatorship in Portugal, in 1975. The lapse between decolonization and the year of observation is therefore 5 years, during which both Angola and Mozambique regained administrative power over the country. Conversely, the British colony of Ghana, became independent in 1957, having therefore 23 years to restructure itself and shape its institutions. A second general control is the Gross Domestic Product in 1950, around a decade before the main wave of decolonization. The third control is the overall duration of colonization, which differs slowly between most countries in the sample except from Portuguese colonialism experiences that lasted several centuries. Here the choice was made, so that these two colonies would be included in the sample, and although it is difficult to access consistent data for all former African colonies, this empirical research attempts to move forward than simply a comparison between French and British colonial examples. Finally, the model includes the geographical dummy for landlocked countries. The two Historical controls taken into account were Ethnic fractionalization and the logarithm of Slave trades exports.

### 4.1.2 Econometric setting

The analysis is divided in two steps. The first stage presents a cross-sectional regression of the relationship between the different measures of colonial transformation and the institutional factor. After a first scan on the data and statistical tests, the data presented a presence of Heteroskedascity through white and Breush-Pagan tests. To avoid biased coefficients and interpretation an Heteroskedasticity corrected linear model available within the software Gretl provided consistent coefficients<sup>4</sup>. The date of analysis is the year 1980 where a large majority of the countries were already independent. The second stage of the analysis takes start in 1980 where institutions together with other measures of continuing interaction between the country and the previous colonizer are tested against the two measures of capabilities (i.e. innovation and technology, education) in a random effects panel model. The choice between random effects and other panel data models was determined through common statistical tests. As random effects proved to be consistent with the data. To understand the difference through time, the two separate sets of models were tested in a 28 year period and in an 18 year period. the aim here is to depict a change between the two decades.

### 4.1.3 Stage I

The first model depicts a negative and significant relationship between political transformation and institutions, suggesting on average that an increase in level of political transformation leads to to the decrease of the institutional factor. Conversely, a social transformation has a positive relationship with the level institutions. Control variables were included in the model and present some significant results. Similarly, the more years have lapsed between independence and 1980 the better the score of institutions. However, the model discards any significant relationship between the level of ethnic fractionalization and the level of institutions. It is important to depict that clearly the Historical background of the country is on average important for its level of institutions, this confirms previous claims by Acemoglu, Robinson among others that established this link long ago. What this model presents as different is the inclusion of a notion of direct interaction between the former colony and the colonizer in terms of colonial transformation. And this also confirms that the effect of colonialism is heterogeneous. Indeed, political and social transformation display opposite signs. The model seems to explain over 90% of the distribution.

The next section confronts the institutional level with measures of innovative capabilities taking into consideration potential flows between the country and its previous colonizer.

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<sup>4</sup>cf. Gretl manual for specifications of the Heteroskedasticity corrected model

Heteroskedasticity-corrected estimates  
Dependent variable: institutions

	Effect of Colonial transformation on Institutions
constant	1.680 (1.100) [0.1396]
log of political transformation	-0.5459* (0.2825) [0.0652]
log of economic transformation	-0.2720 (0.1981) [0.1824]
log of social transformation	0.2620** (0.1186) [0.0369]
dummy for landlocked	-0.4667*** (0.1576) [0.0068]
ethnic fractionalization	-0.3207 (0.4420) [0.4751]
Malaria	0.5055* (0.2475) [0.0522]
log of Slave Trade	-0.05260** (0.02311) [0.0320]
time since independence (until 1980)	0.01109** (0.004917) [0.0334]
area ( $km^2$ )	1.735e-07** (7.783e-08) [0.0354]
latitude	-0.002031 (0.004261) [0.6379]
$n$	35
$R^2$	0.9044
$\ell$	-54.63

Standard errors in parentheses

$p$ -values in brackets

\* indicates significance at the 10 percent level

\*\* indicates significance at the 5 percent level

\*\*\* indicates significance at the 1 percent level



#### 4.1.4 Stage II: Innovation Economics - Capabilities

As discussed in the review of literature, the new path to economic development depends on the sets of capabilities the countries develop and allows them to capture, adapt and utilize technology both present within the country and external knowledge. Nevertheless, as discussed, measuring capabilities is a critical process. To overcome these issues, a factor analysis allowed to extract three different factors: Institutions, Innovation and Technology and Education.

##### Innovation and technology

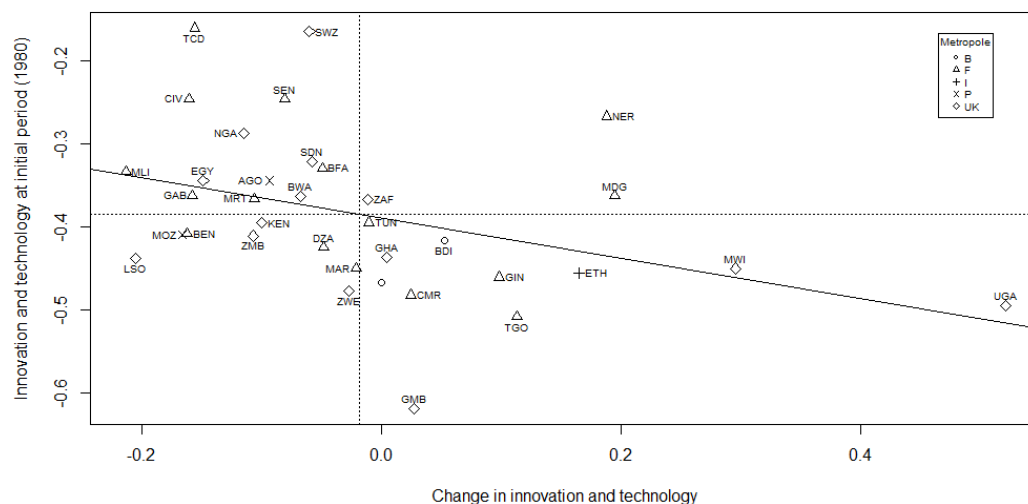


FIGURE 4.1: Evolution of the level of technological capabilities

The change in Technological capacity compared to the initial level (i.e. 1980) suggests some intuition on the dynamics among post-colonial economies. As the lines in the plot indicate sample means, a majority of countries rests in the top right rectangle, where the initial level of technological capabilities is high within sample average and the change over 29 years remains low. Conversely, some countries, who started at very low levels, are "catching up". Nevertheless, few countries who initially had low technological capacity presented low change over time, they are falling even more behind. The regression line between the two variables presents a negative trend suggesting the lower the initial level of innovation, on average, the more change a certain country will have.

##### Absorptive Capacity

The narrow view of absorptive capacity (based on education variables) presents a different plot, where a few more countries gather in the bottom left rectangle suggesting the level of education is on average low and slow to change. Note that top right rectangle is dominated by former British and French colonies which are economies that are said to move ahead (considering only the African sample). In contrast with the previous diagram, the trend goes upwards suggesting that the more the education in a country is developed at the initial level, the more positive

change to improve is possible for that country, this explains how countries at lower levels cannot improve their education system.

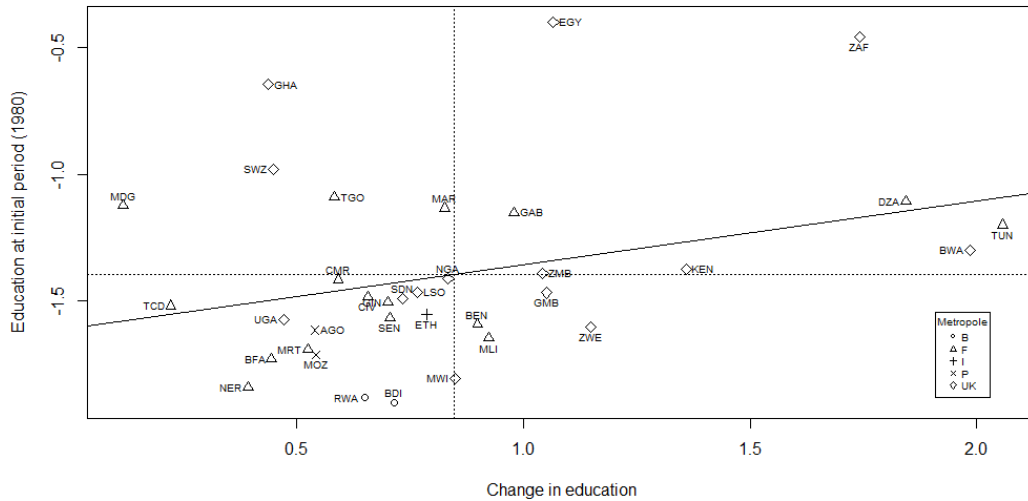


FIGURE 4.2: Evolution of the level of absorptive capacity

### Institutions

The Institutional diagram presents a similar disposition as innovation and capabilities. The difference lies in the concentration of the countries in the bottom right corner (compared to the top left corner for innovation and technology), it suggests therefore that most countries started at a low level of institutional and had a big change. This fits in the rational behind between colonial legacy, where due to colonization institutions had big room for change wheter positive or negative change. On average, the improvement is positive.

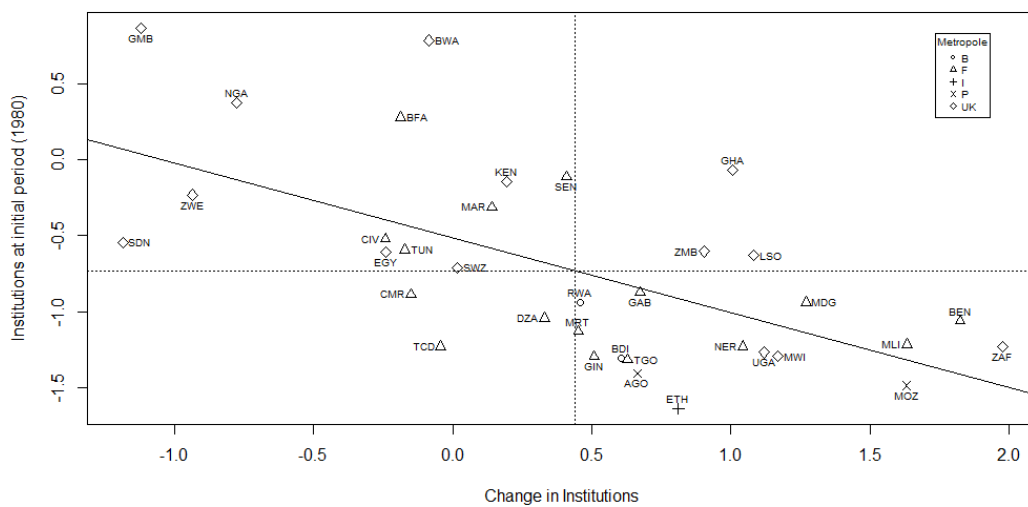


FIGURE 4.3: Evolution of the level of social capabilities

### 4.1.5 Measuring post-colonial interaction with former European Colonizer

Returning to the assumptions taken in for the empirical analysis. The expectation is that although institutions do matter in the long-run other variables could have a clear impact at the short- to medium- run to innovation capabilities. In the case of the African economies, these variables would be interactions with the former colonizing power. Three measures of direct interaction have been implemented in the second stage regressions. The proportion of trade flows and the share of aid received by the former colonizing power and the percentage of FDI flows from former colonizer. These three types of interactions present different types of flows, whereas FDI and Trade are strictly professional flows that allow a certain flow of knowledge or capital, Development aid is based on help given to resolve pressing issues in the country. Their contribution is of different nature and has different implications in terms of economic development to the country.

#### Stage II

In this second step of the analysis, there are two sets of regressions based on different dependent variables: education and innovation and technology. Within each set there are two models, the first depicts the whole period. The second model restricts the first decade from the analysis. Due to the panel data structure, Stage II models depict both time and country effects of the regressors. Within the two sets of models (each one for a measure of capability identified by the Factor Analysis), the first model considers the whole time span from 1980 and the second model ignores the first decade in the sample, focusing on 1990 onwards. The year 1990 was taken as an arbitrary choice following the fact that some colonies became only independent at the end of the 80s, the world has also endured great changes (e.g. end of cold war and fall of Berlin wall).

The first set of regressions on innovation and technology shows that for the whole period of observation, Institutions do matter, they negatively impact the level of the score. Similarly, Development aid does not contribute positively to the level of Innovation and Technology. Conversely, the existence of trade flows between the colony and its former colonizer enables the improvement of the innovation and technology score. The second model with the restricted sample demonstrates that institutions still negatively impact the level of innovation and technology. The difference with the previous model is that Development Aid is not significant anymore and Trade flows appear to negatively impact this level of Innovation capabilities.

The shift from one decade to the other demonstrates that the impact of these interactions are at the short to medium term and can vary over the years. It is still interesting to depict that institutions have a high significance level regardless of sample restriction or not, and therefore suggests that the legacy left by political and social colonial transformations matter through the institutional setting they established.

Random-effects (GLS) estimates  
Dependent variable: innovation and technology

	Analysis from 1980 to 2008	Analysis from 1990 to 2008
constant	-0.4875** (0.02478) [0.0000]	-0.5136*** (0.02813) [0.0000]
Trade Flows	0.06260*** (0.02216) [0.0048]	-0.04366* (0.02514) [0.0830]
Development Aid	-0.05725*** (0.01841) [0.0019]	-0.01159 (0.01928) [0.5480]
FDI flows	0.0001894 (0.0006399) [0.7673]	0.0003446 (0.0005459) [0.5280]
institutions	-0.05180*** (0.004270) [0.0000]	-0.04796*** (0.005829) [0.0000]
GDP	1.782e-05*** (2.117e-06) [0.0000]	3.095e-05*** (2.601e-06) [0.0000]
Latitude	-0.0006448 (0.0008571) [0.4520]	-0.0002180 (0.0009612) [0.8207]
Area ( $km^2$ )	1.629e-08 (2.317e-08) [0.4820]	-7.412e-010 (2.595e-08) [0.9772]
dummy for landlocked	-0.01894 (0.02964) [0.5230]	-0.01334 (0.03324) [0.6884]
$n$	1015	665
$\ell$	872.1	489.2

Standard errors in parentheses

$p$ -values in brackets

\* indicates significance at the 10 percent level

\*\* indicates significance at the 5 percent level

\*\*\* indicates significance at the 1 percent level

The second pair of models on Education as a proxy of Absorptive capacity shows very similar results for the whole sample, where Trade and Development Aid impact the level of Education, this time with opposite signs. The main difference is depicted in the restricted sample: FDI flows become positive and significantly related with the level of education. In both cases Institutions are still significantly related with the overall level of education.

Focusing on the differences between 1980 and 1990, the first two models on Absorptive capacities suggest that at first, aid from the previous colonizing power is positively associated with better levels of education, significant at the 0.01% level. It is however extremely interesting when the sample is restricted to 1990's onwards and aid loses its explanatory power to the benefit to bilateral FDI. This model seems to support the wide belief that Aid, once perceived as important for development, seems to lose its explanatory power from the 90s to the end of the last decade.

Random-effects (GLS) estimates  
Dependent variable: education

	(1)	(2)
constant	-1.487*** (0.08962) [0.0000]	-1.359*** (0.1085) [0.0000]
Trade flow	-0.1314* (0.07038) [0.0622]	-0.02877 (0.07734) [0.7100]
Development Aid	0.2797*** (0.05830) [0.0000]	0.09708 (0.05904) [0.1006]
FDI flows	0.003136 (0.002024) [0.1216]	0.003338** (0.001668) [0.0459]
Institutions	0.1273*** (0.01354) [0.0000]	0.1257*** (0.01794) [0.0000]
GDP	0.0002151*** (6.746e-06) [0.0000]	0.0001873*** (8.122e-06) [0.0000]
Latitude	0.0003620 (0.003125) [0.9078]	0.001187 (0.003772) [0.7531]
Area ( $km^2$ )	1.455e-07* (8.450e-08) [0.0854]	1.549e-07 (1.019e-07) [0.1289]
dummy for landlocked	-0.1145 (0.1081) [0.2895]	-0.1493 (0.1304) [0.2529]
$n$	1015	665
$\ell$	-408.4	-289.8

Standard errors in parentheses

$p$ -values in brackets

\* indicates significance at the 10 percent level

\*\* indicates significance at the 5 percent level

\*\*\* indicates significance at the 1 percent level



## Chapter 5

# Discussion

In the previous sections, I have conducted two empirical stages giving intuitions on the impact of colonial transformations on post-colonial institutions, and the importance of these institutions in the long-run. Institutions, clearly, as seen before, seem to matter. Political and social transformations were significantly related to the institutions variable extracted through factor analysis. In turn this institutional variable seems extremely important for the development of both innovative capabilities and absorptive capacity.

Following the framework by Fagerberg and Srholec (2007), this analysis suggests that although History lies out of the realm of policy making, by identifying the channels through which these colonial transformations persisted until today should give enough insights to design a set of policy implications. In this specific case, political and social transformations had the major impact on the long run and are complemented by current interactions with the former colonizing power.

Based upon the History of the different colonial experiences throughout the African continent, it is undeniable that certain actions left long enduring scars in those Nations. Several authors have identified that institutions matter (Acemoglu and Robinson, 2002; La Porta et al., 1997). In the attempt of understanding deeper to which extent colonial transformations have a persistent impact on today's former colonies, I set up an empirical setting following two stages. After depicting that Political and Social transformations impacted the level of today institutions. In the extension of the analysis with the second stage model, Institutions still matter. The second aspect to take into account is the on-going interaction with former colonizers as first partners in trade, aid providers or direct investors. Considering both aspects, in terms of absorptive capacity, FDI is clearly an important channel associated with better Human capital (through education) and is clearly related to Political transformations during the colonial period. Going back to how the indicator was first calculated, it encompasses several aspects of violence, education and immigration. It is therefore primordial to conduct country specific studies in a more qualitative manner to understand the exact channels through which these political transformations persist today. This exercise will help defining a good set of policies that could tackle the pre-conditional issues of History in these economies.

### 5.1 Policies Implications to consider

However focuses policies cannot be driven without further investigation and go beyond the scope of the research, in light of results and discussion, there is potential for policy reflection. I would suggest, before anything, to analyze country specific data more thoroughly to depict consistences and discontinuities with the results shown in this thesis.

The relative position of diverse countries according to the two sets of capabilities provide an opening for reflection.

The country that has a good innovation and technology capability but low level of education depicts a country where skilled labor is imported and may even come from the previous colonizing country. It is therefore important to lean policy towards the development of local knowledge and skills through schooling and in-job training and facilitate the development of absorptive capacity.

In the opposite situation, where a country has a rather good educational system but lacks innovative output and technological capabilities. Openness to collaboration in scientific output, access to English language if the country is not a former British colony and protection of international tourists as well as attracting capital and foreign investments. It would equip these countries with necessary opportunities to generate innovative output.

Countries with promising capabilities Scoring relatively high in technological capabilities and catching-up in absorption capacity. An economy in this situation could seek to improving technical infrastructures and improve labor mobility and trade, to foster absorptive capacity and gain technical knowledge in ICT to become competitive at the international level.

These suggestions become only valuable once validated through thorougher analysis at the country and sectoral levels. It goes beyond the scope of this thesis to discuss country-specific issues. The aim, should nonetheless, to tackle issues hampering the development of these economies. The identification of such legacies opens the opportunity for policy implications where History initially lies out of its scope. The main results of the two stages of analysis identified a strong importance of political and social colonial transformation on the long-term institutions of the country. The second stage depicted a shift from an early importance of Trade and development aid that loses all explanatory power from the 90's onwards for education. Finally, the illustration of several capabilities allowed the identification of inconsistencies between level of Technological capabilities and Education. Where these inconsistencies are found, policy implications may be formulated.

**Potential for improvement** The thesis could implement wider sets of capabilities and institutions variables. The general lack of consistent data permitting comparisons across countries hampers the development of econometric modeling, to the point where the threat of omitting variable bias may become imminent. The idea was therefore to simplify the modeling and provide robust estimates by conducting statistical test and variables aggregation. In the process of selecting Data, the priority was given to objective data when possible, and the avoidance of selecting too broad indicators that would be challenging to interpret. The presence of challenges and potential for improvement, also presents potential for further research, if indeed, results seem plausible, the same methodology may be implemented with more thoroughly gathered data and more sophisticated econometric modeling.



## Chapter 6

# Conclusion

After reviewing the History of Africa from 15th century, it was clear that European influence in the continent was very important and at times devastating. Such interactions left legacies that lasted through ages, whether in cultural influences (e.g. language, etc.) or in more Economical and Political system. One of the first questions this thesis attempted to answer was the possibility for colonial transformation to affect the post-colonial institutional setup. In the first stage of the Analysis, a cross sectional OLS model depicted that both Political and Social transformation were significantly related with the level of institutions in 1980. It is therefore clear that, as several authors pointed previously (cf. Acemoglu et. al., 2001,2002; La Porta et al., 1999), that Colonialism had an impact on Institutions. The second concern is to see to which extent these resulting Institutions affect the level of innovation capabilities in the country. The second stage, based on a random effects panel model, depicted a strong and significant relationship between the level of Institutions and the Absorptive capacity proxied by education and Innovation and technology factor. Finally, in the assumptions made in the beginning of the analysis, Institutions were believed to loose explanatory power in the presence of other dynamic variables such as continuing relationships between the former colonizer and the colony. However, the results showed that Institutions remained significant even in the presence of those variables, which violates the initial assumption. Notwithstanding, continuing relationships still have an important impact on the current level of Development of capabilities, but should be studied further as some negative relationships were depicted. When such interactions are beneficial or not is very important to determine in further research as it may hamper the country from disrupting the current institutional setup. Finally, the realm of History lies out of policy implication, nevertheless, due to the study of mechanisms through which these colonial legacies persisted open the way to more comprehensive policy solutions aimed at adjusting to the country specific characteristics. To do so, I suggested to conducted country specific studies and combine it with econometric findings to determine areas towards which policy should be directed. The Thesis contributes to scholars in the realm of Economic History and Innovation Economics as it presents a new approach to study colonialism in Africa. It contributes to scholars looking into new ways of developing policy implications. Although modeling in this thesis is not new nor innovative, combining Factor Analysis and use Factors as dependent as well independent variables is refreshing and solves issues regarding data reduction. Finally, the thesis as still room for improvement and could be complemented with an in-depth case study of one of the Economies where Policy Implications may then be driven.



## Chapter 7

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# Appendix A

TABLE A.1: Appendix A : Descriptive statistics

	Mean	Median	Minimum	Maximum	Std. Dev.	Source
Political transformation	4.03	4.03	3.04	4.61	0.38	Ziltener, P., Künzler, D., \ Walter, A. (2017)
Economic transformation	4.05	4.04	3.22	4.45	0.29	Ziltener, P., Künzler, D., \ Walter, A. (2017)
Social transformation	3.88	4.03	2.56	4.61	0.40	Ziltener, P., Künzler, D., \ Walter, A. (2017)
Ethnic fractionalization	0.62	0.71	0.04	0.93	0.24	Nunn, N. (2008)
Malaria	0.81	1.00	0.00	1.00	0.32	CEPII
Area (km <sup>2</sup> )	627560.00	411470.00	10014.00	2507300.00	607740.00	CEPII
Dummy landlocked	0.40	0.00	0.00	1.00	0.49	Own calculation
years from independance to 1980	18.80	20.00	-14.00	74.00	12.29	Own calculation
Latitude	3.01	7.94	-29.69	34.10	17.29	CEPII
GDP	2920.40	1885.60	643.77	11307.00	2556.80	Castellacci, F., \ Natera, J. M. (2011)
Innovation and technology	-0.42	-0.44	-0.66	0.10	0.14	own calculation based on Castellacci, F., \ & Natera, J. M. (2011)
Institutions	-0.30	-0.35	-1.77	0.98	0.63	own calculation based on Castellacci, F., \ & Natera, J. M. (2011)
Education	-0.74	-0.90	-1.68	1.53	0.66	own calculation based on Castellacci, F., \ & Natera, J. M. (2011)
Trade	0.11	0.07	0.00	0.89	0.15	Fouquin, M., \ Hugot, J. (2016)
Development aid	0.14	0.10	0.00	0.86	0.15	Tierney, Michael J., et al., 2011
Bilateral FDI	0.88	0.00	-6.52	87.88	5.72	UNCTAD
Log of Slave Trade	9.8954	11.356	3.912	14.399	3.5275	Nunn, N. (2008)