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Measuring the Effects of Foreign-Educated Leaders on Government Education Expenditure in Sub-Saharan Africa

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ABSTRACT

Education is the key to economic growth, development, and prosperity in sub-Saharan Africa. However, limited financial resources imply a trade-off between investment in education and other productive sectors. There is a pressing need to understand what motivates some governments to prioritize education while other governments neglect human capital development. Scholars have identified economic circumstances, corruption, colonial history, political stability, ethnic fractionalization, levels of inequality, and development aid to help explain differences in government spending on education in sub-Saharan Africa. Undoubtedly, modernizing a country's education system also takes decisive and strong leadership to direct government reforms and policies. Furthermore, given that 40 percent of African leaders have received education outside of sub-Saharan Africa, the existing literature has not yet examined what effect this trend has on education in their home countries. The research presented here questions whether leaders who receive their higher education outside of sub-Saharan Africa increase, decrease or have no effect on public spending on education compared to leaders who do not receive higher education outside of sub-Saharan Africa. The research uses fixed-effects regression models and multiple imputation to analyze time-series data of sub-Saharan African leaders' higher education between 1979 and 2016 from 42 countries and the effects on government spending. The research provides a better understanding of how leaders are influenced by their own educational experiences and how this might translate into differences in education policies once they are in power. The research provides robust evidence that the impacts could be greater than previously acknowledged.

Total Word Count: 9,200

Keywords: Sub Saharan Africa, human capital development, education, economic growth, education spending, fixed effects, multiple imputation.

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1. INTRODUCTION

Despite improved growth rates over the last two decades, sub-Saharan Africa lags behind all other regions on most development indicators (Sundaram et al, 2011). Average per capita income remains close to 1970 levels, and education exclusion rates are the world's highest (UIS, 2015). As a result, nearly two-thirds of the 95 million young workers lack the basic skills needed to be competitive in the labor market and less than 20 percent of youth can find wage paying work (Page, 2013). In addition to these concerning numbers, Sub-Saharan Africa is also home to the world's fastest growing youth population. This will translate into eleven million people entering the job market yearly for the next decade.

Human capital theorists argue that education is the key to economic growth, development, and prosperity (Holsinger, 2005). For sub-Saharan Africa, improved quality and access to education could produce the skilled workforce needed to drive the continent out of poverty and make it more competitive in global markets. However, limited financial resources imply a trade-off between investment into education and other productive sectors. Therefore, there is a pressing need to understand what motivates governments to prioritize education and human capital development.

Apart from economic circumstances, scholars identify factors such as corruption, colonial history, political stability, ethnic fractionalization, levels of inequality, and development aid to help explain differences in government spending on education in sub-Saharan Africa. Yet in many cases, the individual effort of a country's leader has also made a meaningful difference. In 1990, Zimbabwe spent four times more on education as a percentage of GDP relative to Zambia or Malawi and now leads sub-Saharan Africa in literacy rates (Swainson, 1995). In the last decade, Rwanda's enrollment rates in secondary schools increased 20-fold with greater efforts made towards increasing gender equality (Olzacki, 2017). Both Zimbabwe and Rwanda achieved these outcomes in large part because each country's President was a driving force behind improving the education system. However, the literature commonly overlooks the impact leadership and individual agency have on government policies in sub-Saharan Africa. Moreover, leaders frequently cite their own educational experience as guiding their decision to prioritize education, as in the case of Zimbabwe and Rwanda, which raises the question of why some leaders prioritize investment into the education system while others do not.

While it would be difficult to measure how personal qualities influence government spending, level and country of education are significant and frequently overlooked differences between leaders; 40.3 percent of sub-Saharan African leaders receive their education abroad (Constant & Tien. 21, 2010). Existing literature supports the idea that foreign-educated leaders are more likely to create strong networks, attract higher investment, become familiar with development theories supporting education, and therefore return home supporting higher spending on education. However, a contrasting

theoretical position suggests that subjective experiences shape perceptions and leaders removed from the higher education systems of their home countries end up less aware of local needs and deficiencies, and potentially adapt more outward facing strategies.

The research presented here questions these contrasting positions by studying whether leaders who receive their higher education outside of sub-Saharan Africa increase, decrease or have no effect on public spending on education compared to leaders who do not receive higher education outside of sub-Saharan Africa. The research uses fixed-effects regression models and multiple imputation to analyze time-series data of sub-Saharan African leaders' higher education between 1979 and 2016 from 42 countries and the effects on government spending.[1]

To study these hypotheses, the article is divided into five parts. The second section reviews the current debates surrounding the topic of education spending and economic development, the role of leadership and whether a leaders' education impacts education spending. The review also highlights how the effects of foreign study on education spending have largely been excluded from the literature, and why it could be the case that sub-Saharan African leaders receiving their education abroad might affect government expenditure within their home country. Section three outlines the research design, data compiled for the study, potential measurement errors, operationalization of the research, and statistical methods used. Section four presents an interpretation of the results, and section five discusses recommendations for future research and summarizes the study's conclusions.

2. LITERATURE REVIEW

2.1 Education and Development

Education creates the foundation for human resource development, which in turn drives economic progress (Besley, Reynal-Querol, 2011). Countries fall into a virtuous growth cycle when a skilled labor force drives innovation, boosts technological imports, adapts quickly to existing technologies, and increases domestic savings and investment. This, in turn, fuels output of goods and services, drives exports and distributes income more evenly, eventually feeding back into a cycle of government and household spending (Ranis et al, 2000). Accordingly, education presents one of the most reliable ways for developing countries to build and sustain economic growth.

In addition, recent literature argues that higher education has bigger impacts on growth outcomes relative to primary and secondary education. Empirical evidence finds that higher education improves national prosperity through increased productivity, better governance, and higher economic growth.

[1] Using the UNDP's definition of sub-Saharan Africa and excluding island countries of Comoros, Mauritius, Sao Tome and Principe and the Seychelles.

More specifically, a one-year increase in tertiary education corresponds to an increase in the long-run steady-state of African GDP per capita by 12.2% (Bloom et al, 2, 2006). The authors also find that a one-year increase in tertiary education could raise incomes by about 3 percent after five years and eventually by 12 percent (Bloom et al, 2, 2006). Moreover, higher investment in tertiary education facilitates technological diffusion, which in turn decreases knowledge gaps and helps reduce poverty. The literature agrees that investment into education, in particular into higher education, should be a core priority for governments in sub-Saharan Africa.

2.2 Key Factors Influencing Government Spending on Education

National incomes per capita differ significantly across sub-Saharan Africa; Equatorial Guinea, South Africa, and Botswana lead the continent in terms of GDP per capita, while Malawi, the Democratic Republic of Congo, Tanzania and Burundi trail far behind (World Bank, 2009). As one might expect, governments in wealthier countries spend a higher share of national income on education (Stasavage, 2005).

Incomes also vary significantly within sub-Saharan countries, with highest levels of income inequality present among middle-income oil-exporters such as Angola and South Africa (UNESCO, 2015). In Joseph Stiglitz' seminal work on inequality, Stiglitz finds that societies with greater levels of inequality are less likely to invest in public services that could enhance productivity – including education (Stiglitz, 2012). The literature confirms that in highly unequal societies, governments commonly formulate and legalize education policies favoring the rich, with elites themselves receiving a disproportionate share of public spending on education. Among poor countries, the median percentage of government expenditure on education going to the poorest household quintile is about 14 percent, while the richest household quintile receives nearly twice that amount (Holsinger, 2005, 299).

In addition to income inequality, high levels of ethno-linguistic fractionalization also affect government spending on education in sub-Saharan Africa, and often lead to conflicts over public policies.[2] Polarized societies are more prone to competitive rent-seeking and find it more difficult to agree on government expenditures on public goods, including education (Alesina et al, 1999; Easterly & Levine, 1997). More specifically, differences in preferences for curriculum, the language of instruction and location can deter public spending on schools, which indicates a negative relationship between a country's degree of ethnic fractionalization and public spending on education.

Furthermore, the literature highlights the negative impact of corruption on government spending; higher levels of corruption are associated with less education spending (Mauro, 267, 1998). In sub-

[2] Alongside colonial influences, the literature also cites geographical reasons, the slave trade, state size and urbanization as drivers behind ethnic fractionalization (Green, 2012).

Saharan Africa, corruption takes on many forms. Cultural and institutional factors often permit those who find themselves in prestigious government positions to profit from their situation and spread the benefits to their close circle of friends and family (de Sardan, 43, 1999). Once this is applied to government spending on education, the literature agrees that corruption contributes to inefficient and unfair spending practices. Reinikka and Svensson's case study on Uganda finds that even when the government increases education spending, many of the allocated resources do not reach schools; in the mid-1990s, only about 22 percent of earmarked funds reached schools due to corruption (Mbiti, 2016). Correspondingly, in more corrupt countries, it is often difficult to measure real investment into education.

Several external factors also influence education spending in Sub-Saharan Africa. The continent's colonial history shaped many aspects of each country's education system with notable differences between countries colonized by France, Britain, Portugal, Belgium, Germany and Spain. In general, missionaries established the first schools in the 1900s, and pressured European governments for financial support, with Great Britain and France increasing financing after the First World War (White, 1996). The French government took an active role in expanding education; in French colonies, education was characterized by the use of French language, enrollment quotas, and distinctions between rural and urban schooling (White, 12, 1996). British colonies established education systems later than the French, and Britain played a less prominent role in overseeing the administration of education. However, Kenya and Nigeria benefited significantly from British education funding, allowing enrollment rates to triple and quadruple between 1930-1950 respectively (White, 13, 1996). Moreover, subsequent studies found that at independence, former British colonies had higher levels of education than former French colonies, which helps explain the development gap between former British and French colonies in Africa (Grier, 1997). This implies that during colonization, the relationship between education spending and the effect of being colonized was positive. However, in the post-colonial period, the education systems were not suited for the development needs of growing populations. Following independence, in the 1960s and 1970s, the postcolonial governments lacked the financial and bureaucratic resources needed to administer educational programs, which led to underdeveloped education systems (Metzler, 2009). Therefore, following independence there was a negative relationship between a country's colonial history and governments' education expenditure.

The literature also highlights the impact official development assistance (ODA) has on education spending in recipient countries. However, there are mixed views on the relationship between foreign aid and education spending in sub-Saharan Africa (Dömeland & Kharas, 2009; Chauvin & Kraay, 2005; Crespo et al, 2008; Stasavage, 350, 2005). While some scholars argue that aid increases investment mostly into primary education, monitoring overseas aid in sub-Saharan Africa is a

complex process with portions of foreign aid bypassing the government budget, making accountancy challenging (Feyzioglu et al, 1998). For example, in 2006, net ODA to sub-Saharan Africa was $40 billion. From this amount, $15.5 billion was given in the form of development programs and projects implemented across different countries, which would not be accounted for as a government expenditure. Another $13 billion represented aid in the form of debt relief. Although debt relief has been associated with increased government expenditure on health and education in countries with improved or effective institutions (Dömeland & Kharas, 118, 2009), other studies find no statistically significant effects of debt relief on education expenditure (Chauvin & Kraay, 2005; Crespo et al, 2008). Therefore, the literature has not established conclusive evidence on the relationship between overseas aid and education spending.

Despite the extensive literature on sub-Saharan Africa's historical, cultural and economic factors, little credit is given to leaders and their role in directing government policies towards education. The next section covers the importance of leaders in influencing the development of education within their country.

2.3 Effects of Leadership on Government Policy

For the purpose of this study, a leader is defined as a decision-maker in charge of choosing the right direction for an organization or government to follow, often motivating subordinates to adopt their views. Leaders are also likely to pass on their knowledge and persuade others to their way of thinking (Lazear, 2011), and evidence from sub-Saharan Africa shows that leaders are often the main drivers behind major education policies and investments. For example, Rwanda's President Paul Kagame gave a speech in 2007 where he emphasized the need to invest more in higher education and promote gender equality within the education system. President Kagame pointed to his responsibility as a leader to be the one to "tackle and overcome the educational challenges in Rwanda" (Kagame, 2007). The following year, Rwanda's Ministry of Education passed a new higher education initiative identifying higher education as a primary tool for the country's development (Mineduc, 2008). Undoubtedly, other factors such as political stability or upcoming elections can also influence policy implementation, but Rwanda's example shows how leaders have the power to promote and publically prioritize initiatives.

The literature on leadership has studied the effect government leaders have on foreign policy decisions, finding that exposure to certain subject areas enhances interest and participation. For example, leaders who were trained in foreign affairs were more motivated to participate in constructing their government's foreign policy and stay informed on relevant decisions (Hermann,1980). Although Hermann's study focuses on a government leader's influence over foreign policy, it could be assumed that the same would be true for national policy as well. In this way, the literature supports the idea that leaders prioritize certain policies based on experience or interest, and

therefore influence policy outcomes. This is further confirmed by Jones and Olken's study on the effect of national leaders on economic growth (2004). Their work establishes that leaders can have a causative influence on their country's economic growth through their impact on monetary policy (Jones & Olken, 2005; Jones & Olken, 2004). The literature supports the idea that individuals and historical figures guide outcomes, meaning that national leaders in sub-Saharan Africa can exert influence over education policy and spending.

2.4 Effects of Leaders' Educational Background on Policy-Making

At 91 percent, Zimbabwe has the highest literacy rates in sub-Saharan Africa, along with an Education Sector Plan to provide inclusive and quality education. Many scholars of African education systems cite Zimbabwe as a leading example of how a country can successfully develop its education system following colonialism. Zambia, Zimbabwe's northern neighbor, provides an interesting comparison to examine why some countries invest more into education than others. Zimbabwe and Zambia were both formerly part of the Federation of Rhodesia and Nyasaland under British rule from 1953 to 1963. In 1992, Zambia and Zimbabwe had similar percentages of rural populations, and both were relatively stable countries with comparable measures of corruption. Yet in 1992, Zimbabwe invested 22.3 percent of GDP into the education system while Zambia invested only 2.09 percent of GDP. The literature explains the difference came as a result of Zimbabwe's higher gross national income per capita, which was twice as high as Zambia's, and Zambia's higher level of ethnic fractionalization. While these differences certainly explain part of the divergence, they do not tell the whole story; another factor not considered by the literature is the role individual country leaders played at this time.

Robert Mugabe was Zimbabwe's President from 1987 through 2017. Although his mandate was marked by controversy, it also presents an interesting case study in how leaders influence government policy towards education. Mugabe has been credited as the guiding force behind improving Zimbabwe's education system; by 1990 his government already spent nearly four times more on education as a percentage of GDP than Zambia or Malawi (Swainson, 1995). Among many factors attributed to Zimbabwe's success in education, scholars pinpoint the choice by Mugabe and his government to maintain the British O and A level examinations to set a curricular standard with internationally recognized qualifications (Jansen, 2017). Historians identify Mugabe's personal experiences of attending the University of Fort Hare in South Africa and later working as a teacher as motivating his interest in prioritizing education in Zimbabwe and overseeing aspects of Zimbabwe's education policy (Jansen, 2017; Chutel, 2017).

Zambia's President at the time, Frederick Chiluba, also frequently mentioned personal experiences that shaped policy motivations and decisions during his term. In a speech President Chiluba gave in

Washington D.C. in 1992, he spoke about living through detention without trials, brutal prison conditions and how this transformational experience moved him to support democracy, allow greater freedom, and permit official opposition parties. Yet not once during his speech does President Chiluba mention education, nor does he express the need to build up Zambia's education system. Both President Chiluba and President Mugabe were described as talented orators with charismatic personalities. However, one of the most significant differences between these two leaders is their educational background. While Mugabe received a tertiary education along with two master's degrees, President Chiluba dropped out of secondary school to work as a bus driver before working his way up to become chairman of the Zambia Congress of Trade Unions. As these examples illustrate, a leader's own educational experience can greatly influence how they approach and prioritize their country's education system once in power.

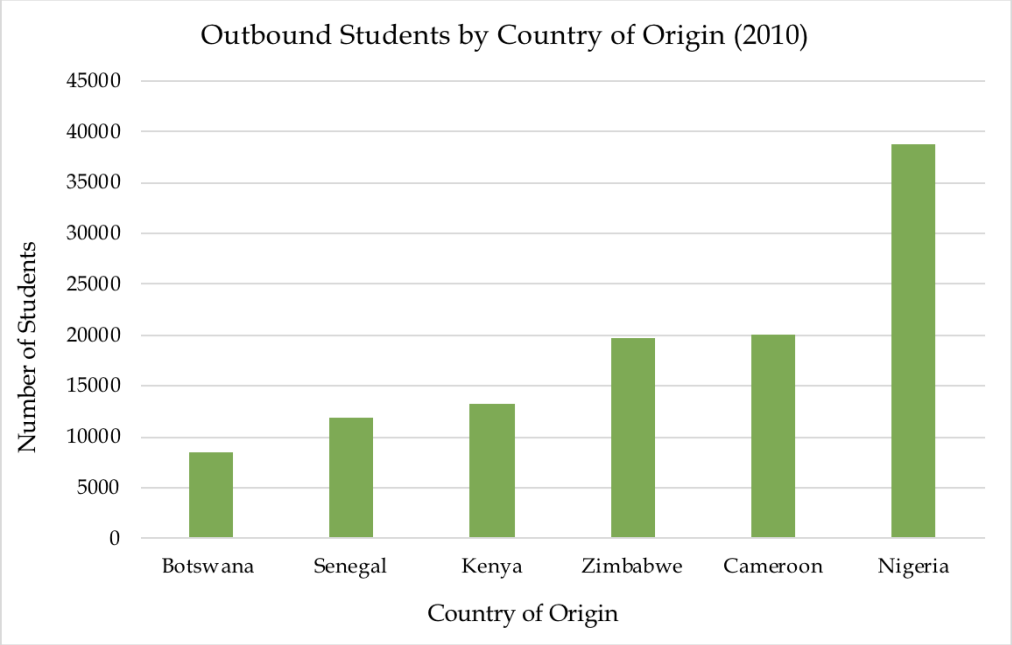
Studying this question from a more general perspective, Milligan, Moretti, and Oreopoulos (2003) use empirical evidence to find that education has positive effects on civic behavior in the US and UK. Although the study focuses on two developed countries with exceptional education systems, it supports that education leads to positive externalities. Besley and Reynal-Querol (2011) build on the work of Milligan, Moretti, and Oreopoulos (2003) and Jones and Olken (2005) to study whether educational attainment affects leadership quality and economic growth. They find evidence that a leader's education matters for economic growth, which lends credibility to the idea that an individual's education is an important element helping to explain differences in policy outcomes (Jones & Olken, 2005; Besley & Reynal-Querol, 2011).

In another study, Besley and Reynal-Querol (2001) use a fixed effects model to estimate whether democracies select more educated leaders and find robust evidence in favor of their hypothesis. Their research is based on the theory that education is strongly correlated with earnings, skills, civic engagement and leadership quality, which supports the idea that education impacts government quality and policy-making (Jones & Olken 2005; Besley & Reynal-Querol, 2011). However, these studies on leaders' education look primarily at developed countries that have advanced education systems with greater education equality. Accordingly, the field would benefit from research focusing on leaders from developing countries that take into account the effects of leaders receiving their education abroad in more developed countries.

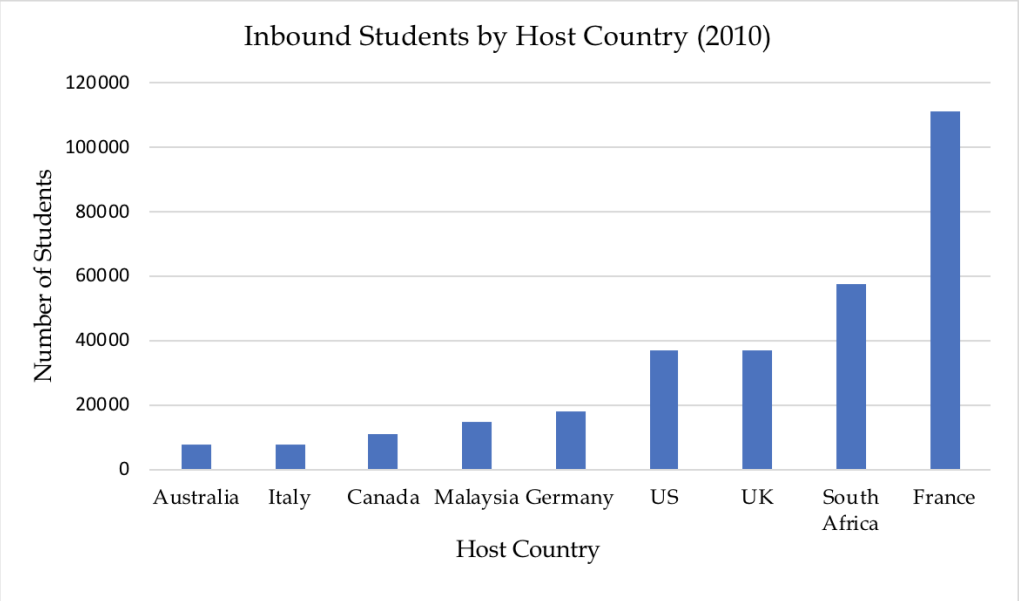
2.5 Do Foreign-Educated Leaders Change How Governments Invest in Education?

Based on the existing literature and specific examples, I have established that both leadership and leaders' education influence government policies towards education. However, the literature also supports the idea that receiving higher education abroad has significant impacts on both a personal and national level. With 40.3 percent of sub-Saharan African leaders receiving their education abroad

(Constant et Tien. 21, 2010), and growing numbers of students leaving sub-Saharan Africa to study in France, the U.K. and the U.S., there is a need to better understand how this impacts government spending and the development of the education system within sub-Saharan African countries.



Graph 1 - Source: Own elaboration using UNESCO data (2013)



Graph 2 - Source: Own elaboration using UNESCO data (2013)

Experiences such as studying in a foreign country are difficult to research because of their complexity and the range of factors involved, such as choice of program, country, duration, and university. Even so, the literature has found significant evidence showing that receiving education outside of one's own country has lasting individual and societal impacts. Paige et al.'s survey results from 6,391 study abroad students revealed increased levels of global engagement (civic engagement, knowledge production, philanthropy, social entrepreneurship and voluntary simplicity) and 87 percent of respondents reported that study abroad influences later educational experiences and career choices (Paige et al. 2009). Surveys also show that after one year abroad, 98 percent of participants report increased self-confidence, and 97 percent report a lasting impact on worldview (Dwyer & Peters, 2004).[3] These results uphold the intuitive assumption that foreign study would have lasting impacts on decision-making and opportunities later in life, which supports the theory that leaders who receive their education abroad would make decisions differently than those who receive their education within sub-Saharan Africa.

The literature also studies country-level impacts of foreign-educated leaders. Constant et al. (2010) use a conditional quantile regression of 40 African countries to show that foreign-educated repatriates are more likely to promote democracy, market-liberalizing reforms, and higher quality of government (Constant et al. 2010, Besley & Reynal-Querol, 2005). Foreign education is also a significant determinant of foreign direct investment inflows because of the role of social capital, networks, connections built by leaders during their time abroad (Constant et al. 2010). Based on the literature outlined so far, the intuitive assumption would be that foreign-educated leaders positively impact public spending on education in their home countries.

However, a contrasting theory suggests that leaders who receive their education abroad might actually invest *less* in education at home. Scholars have found that when issues are removed from view there is a lack of acknowledgment of the problem. Thus, there is a subjective "poverty blindness" which describes the tendency to remain unaware of issues not experienced subjectively, making it easier to ignore or disregard them (William et Geoff, 52, 2014). Furthermore, as the studies by Constant et al. (2010) and Besley & Reynal – Querol (2005) show, leaders might become more outward-oriented in terms of their development strategies. Extrapolating these findings and relating them to educational experiences, it could also be the case that when leaders receive their higher education entirely outside of sub-Saharan Africa, they do not experience the education system in their home country, in particular, higher education. Therefore, as leaders, they devote less attention and investment into the education system compared to leaders who receive their education within sub-Saharan Africa and have first-hand knowledge of the system's weaknesses. For example, Rwanda's President Paul Kagame cites his experience of attending a school in Uganda and Rwanda without proper books,

[3] The Institute for the International Education of Students (IES), surveyed 3,400 alumni from all IES study abroad programs from 1950 to 1999.

inadequate buildings and understaffed teachers as a motivating force behind ensuring education access for all Rwandan citizens (Kagame, 2007). If he had not directly experienced his country's education system, could this have changed his determination to prioritize Rwanda's national education?

2.6 Research Questions and Hypotheses

The following research questions and hypotheses will be examined based on the literature review and theoretical framework outlined thus far:

Q1: What is the impact of sub-Saharan African leaders receiving higher education outside of sub-Saharan Africa on government spending into education in their home countries?

The following hypotheses are formed based on the research question:

Hypothesis 1: In a comparison of sub-Saharan African countries between 1979 and 2016, countries where leaders receive their higher education outside of sub-Saharan Africa will allocate higher spending on public education as a percent of GDP compared to countries where leaders do not study outside of sub-Saharan Africa.

Hypothesis 2: In a comparison of sub-Saharan African countries between 1979 and 2016, countries where leaders receive their higher education outside of sub-Saharan Africa will allocate less spending on public education as a percent of GDP compared to countries where leaders do not study outside of sub-Saharan Africa.

3. OPERATIONALIZATION

To assess whether foreign-educated leaders are associated with differences in education spending, I apply two statistical models; a one-way fixed effects model, and a two-way fixed effects model. The one-way fixed effects allow me to control for unmeasurable factors across the different units of comparison, in this case, leaders. It also allows for different baseline levels of the dependent variable, in this case, education spending as a percentage of GDP. The two-way fixed effects model allows for fixed effects in time as well as units. For example, some countries might have had higher or lower investment into education because of unmeasurable factors at a certain point in time due to economic conditions, such as the 2008 global financial crisis. Fixed effects models are more useful for this analysis than an OLS estimation because I assume there is a correlation between time-invariant unobserved variables and the dependent variable; this might include individual preferences for choosing to go abroad or not, cultural differences, or language, which could affect both the dependent and independent variables.

In performing a statistical analysis on sub-Saharan Africa, one of the main challenges is dealing with missing data. To work around the problem of an incomplete dataset, I use the Amelia II program for multiple imputation of data.[4] The one-way and two-way fixed effects models using the imputed dataset are presented alongside a one-way fixed effects model using the original dataset.

3.2 Data Collection

The core data used for this research is an original dataset recording where sub-Saharan African leaders received their higher education between 1979 and 2016. The time frame was selected to ensure that the majority of countries were in the post-colonial period of their history. The sample includes 42 mainland sub-Saharan African countries, counting Madagascar, for a total sample size of 1,558. The data on leader education was collected using biographical information from the Library of Congress, and when information was not available, it was obtained using Wikipedia and double checked using additional sources. I then constructed a dichotomous variable, coding leader education as "1" for leaders who received any higher education outside of sub-Saharan Africa, and as "0" if a leader received no higher education outside of sub-Saharan Africa.

The dependent variable used for the analysis is total government investment into education as a percent of GDP by local, regional and central governments for each country-year between 1979 and 2016, which was obtained using the QoG Standard Dataset.[5] While this was the most complete dataset available for sub-Saharan country data, missing data still presented a significant problem, which I try to correct for by using multiple imputation.

To take into account other independent variables described by the literature as having a potential causative effect on education spending, I use eight control variables. To account for income differences between countries, I control for gross national income per capita in current US dollars based on the World Bank's Atlas method.[6] To control for corruption, I use the Study Hive for Economic Research and Public Policy Analysis' (SHERPPA) Bayesian Corruption Indicator, which ranges from 0 and 100, with 100 corresponding to a high level of corruption.[7] To control for political

[4] Amelia II draws imputations of the missing values using an expectation-maximization with bootstrapping algorithm. The algorithm uses an expectation-maximization algorithm on multiple bootstrapped samples of the original incomplete data to draw values of the complete-data parameters. The algorithm then draws imputed values from each set of bootstrapped parameters, replacing the missing values with these draws (Honaker et al, 3, 2011).

[5] Teorell, Jan, Stefan Dahlberg, Sören Holmberg, Bo Rothstein, Anna Khomenko & Richard Svensson. 2017. The Quality of Government Standard Dataset, version Jan17. University of Gothenburg: The Quality of Government Institute.

[6] The World Bank Atlas method of conversions helps smooth fluctuations in prices and exchange rates, which is useful for economies with volatile currencies.

[7] I use the BCI instead of the more commonly used CPI because the BCI is a more reliable way to compare corruption between countries over time (Standaert, 2015), and for sub-Saharan Africa this is an important consideration since many of the countries experience persistent levels of corruption.

stability, I use the Worldwide Governance Indicators estimate, which measures perceptions of the likelihood a government in power will be destabilized or overthrown by unconstitutional or violent means with measurement ranging from -2.5 to 2.5, with 2.5 representing high levels of stability (World Bank, 2016). To control for differences in population between countries, I use the World Development Indicators data for total population estimates for each country-year. World Development Indicator data is also used for the GINI index to control for inequality, where a value of 0 represents absolute equality and a value of 100 absolute inequality. As a control for official development assistance to sub-Saharan Africa, I use the World Bank's data on total yearly overseas aid as a percent of GDP. To take sub-Saharan Africa's European colonial history into account, I control for each country's colonizer using dummy variables as follows: 1 = British, 2 = French, 3 = Portuguese, 4 = Belgian, 5 = Spanish, 6 = German, 7 = None [8]. Lastly, I use the Ethno-Linguistic Fractionalization (ELF) measure to control for ethnic fractionalization, which reflects the likelihood that two people chosen at random will come from different ethnic groups.

The following chart predicts the direction of the relationship between the independent variables and government spending on education:

Control Variable	**Predicted Direction of Relationship**
GNI per capita (Atlas method, current US$)	Positive
Bayesian corruption index	Negative
Colonial history	Positive/Negative
Political stability	Positive
Population size	Negative
Development Aid	Positive
Inequality (GINI)	Negative
Ethnic Diversity	Negative

Table 1: Predicted direction of relationship between independent and dependent variables

[8] The UNHCR's Map of Colonial Rule and Independence was used to collect Colonial history data (2000).

3.3 Sample Characteristics

The tables below provide a summary of the main independent variables used in the analysis of H1 and H2. Table 2 shows the descriptive statistics based on the original dataset before imputing missing data. There is a significant amount of missing values for the dependent variable, the GINI index, and the variable measuring political stability. To correct for this, I imputed the missing data using Amelia II. The descriptive statistics based on the new imputed dataset are shown in table 3.

Between 1979 and 2016 total government education expenditure across the countries in the sample averaged 4.2 percent of GDP in the original dataset, and 4.0 percent based on the imputed dataset. The standard deviation of government spending is 2.7 percent in both samples. Considering the minimum value is .7 percent, and a maximum value of 44.3 percent, the standard deviation of 2.7 percent indicates the data is widely spread. Based on the available data, the Democratic Republic of Congo had the lowest levels of government spending on education; between 1984 and 1986 spending averaged only .79 percent of GDP per capita. Zimbabwe had the highest levels of government spending, with 44.4 percent of GDP invested into education in 1994, and 22.3 percent in 1992, making it an outlier relative to other sub-Saharan African countries terms of education spending.

Gross national income per capita averaged 993.8 in current USD. Of course, this variable increased steadily over time, particularly in Equatorial Guinea where the GNI per capita grew from $120 in 1982, to a peak of $14,130 in 2008. On the other hand, Liberia's GNI per capita fell from $520 in 1979 to $370 in 2016. These examples underline the variation across countries, and based on the literature, we would expect countries with a higher per capita GNI to invest more in education.

The corruption index ranges from 0 to 100, with an increase in the index corresponding to a rise in the level of corruption. For comparison, New Zealand has the world's lowest level of corruption, with an index score of 15.4. Somalia ranks as the world's most corrupt country, with a score of 70.9 (Standaert, 2015). Between 1979-2016, the average rate of corruption in sub-Saharan Africa was 55.6. Rwanda was the least corrupt country during this period with an average score of 29.83, followed by Botswana with a score of 36.54. The most corrupt countries were Guinea Bissau (64.31), Equatorial Guinea (67.55) and the Democratic Republic of Congo (66.5). It is also interesting to note that there is a statistically significant negative correlation between corruption and government spending on education with a Spearman correlation coefficient of -0.30, and with at a 0.01 significance level.[9]

Although the variable for political stability was missing a significant number of values (921 out of 1,558), based on available data the average level of stability for the sample was -0.6, with highest

[9] Correlation matrix: appendix table 7

levels of instability in the Democratic Republic of Congo, Central African Republic, Sudan, and Burundi; and the most stability in Botswana, Namibia, and Benin.

In terms of population size, the average population was 15.5 million for 1979-2016. However, this is misleading because there is a very large variation across time and countries. Sub-Saharan Africa's least populous country, Equatorial Guinea, had a population of 247,078 in 1979, which grew to 1.2 million in 2016; Nigeria's population increased from nearly 55 million in 1979 to 186 million people by 2016, making Nigeria sub-Saharan Africa's most populous country.

In terms of ethnic fractionalization, it is perhaps not surprising that the average fractionalization for sub-Saharan Africa is 0.70 given the continent's colonial history and arbitrary borders. According to the ELF index, this represents a 70 percent chance that two individuals chosen at random within a country will not share certain characteristics, such as language or ethnicity. Swaziland has the lowest rates of ethnic fractionalization over time, as well as Lesotho, Burundi, Rwanda, Equatorial Guinea, Zimbabwe, and Botswana. On the other hand, Uganda, Liberia, Madagascar, the DRC, Congo, and Cameroon, to name a few, have very high levels of fractionalization.

Finally, the Gini coefficient measuring inequality was removed from the analysis because 1,415 observations were missing out of 1,558, and multiple imputation with such a high degree of missing data would have provided unreliable results.

Descriptive statistics

Statistic	N	Mean	St. Dev.	Min	Max
Year	1,558	1,997.5	11.0	1,979	2,016
Leader Edu	1,372	0.5	0.5	0	1
Gov Spending Edu	615	4.2	2.7	0.7	44.3
GNIpc	1,471	993.8	1,590.0	80	14,130
GINI	143	45.1	8.4	28.9	65.8
Corruption	1,111	55.6	7.5	28.4	69.0
Political Stability	637	-0.6	0.9	-3.0	1.2
Population	1,554	15,459,491.0	22,668,635.0	247,078	185,989,640
Foreign Aid	1,330	12.1	13.0	-0.2	181.1
Ethnic Fractionalisation	1,441	0.7	0.2	0.1	0.9

Table 2: Descriptive statistics with original dataset

Descriptive statistics - Imputed Data

Statistic	N	Mean	St. Dev.	Min	Max
Year	1,558	1,997.5	11.0	1,979	2,016
Leader Edu	1,558	0.5	0.5	0	1
Gov Spending Edu	1,558	4.0	2.7	-6.5	44.3
GNIpc	1,558	974.8	1,577.4	-2,928.9	14,130.0
GINI	1,558	43.9	12.2	-5.2	97.9
Corruption	1,558	55.2	7.7	26.4	71.7
Political Stability	1,558	-0.5	0.8	-3.0	4.6
Population	1,558	15,477,897.0	22,649,764.0	247,078.0	185,989,640.0
Foreign Aid	1,558	12.2	12.7	-24.4	181.1
Ethnic Fractionalisation	1,558	0.7	0.2	0.1	1.1

Table 3: Descriptive statistics with imputed dataset

3.4 Assessment of Potential Measurement Errors

One of the main challenges with this research is dealing with endogeneity resulting from omitted variables and measurement error. Systematic observational errors could be potentially problematic when estimating the dependent variable, government spending on education as a percentage of GDP because governments often have different national budgetary reporting standards. This makes fiscal data less reliable, especially in sub-Saharan Africa where countries may omit or misreport government spending due to a lack of accounting, accountability or corrupt practices (Lopes, 2002).

Omitted variable bias could also produce biased estimates of the coefficient on the dependent variable. This might be the case with omitted variables correlated with both the dependent variable (government spending on education) and the independent variable (whether or not a leader receives education abroad). For example, expenditures on scholarships represent 55 percent of the total budget in Francophone sub-Saharan Africa, and 15 percent in English speaking Africa (Segrera, 24, 2012). Furthermore, the President's office rather than the Ministry of Education is often in charge of the scholarship budget (Rose, 92, 2016). Because foreign degrees are viewed as more prestigious, high levels of corruption or elite privilege mean the scholarships could be used to fund international study for elites. Consequently, this could create an upward bias on both the independent and dependent variables. However, no publically available data details yearly scholarship expenditures, or recipients, making it difficult to correct for this bias.

Another consideration when working with panel data is omitted variable bias resulting from unobserved variables, such as culture or geography, as well as variables that change over time but not across countries; regulations, international agreements, and institutional factors. To overcome this problem, I use fixed effects models which allow me to remove the effects of country and time-invariant characteristics, and control for the average differences across countries, so I can make

within-group comparisons and better assess the net effect of leader education on governments' education spending (Torres, 2007). However, for fixed effects models to be more reliable, it is generally recommended to have variation of the independent variable within each group. In this case, the independent variable reflects where leaders for each country-year received their education. In sub-Saharan Africa, many country leaders have ruled for several decades, which means that for a number of countries there is insufficient within-variable variation.[10] A more comprehensive study could allow for increased independent variable variation by recording the total combined years of foreign education of top leaders within a government instead of only the President's education.

Finally, I encountered a challenge in dealing with missing data for a significant number of observations. For example, the dependent variable, government expenditure on education as a percentage of GDP, is missing 943 observations, and the GINI coefficient is missing 1,415 observations[11]. I attempted to correct for this by using the Amelia II program for multiple imputation. Even so, comparing the descriptive statistics between the original and imputed data, the range for the values of GNI per capita, overseas aid and government expenditure on education vary significantly; the imputed dataset contains more extreme minimum values, which could affect the regression estimates, and as mentioned before, the Gini coefficient as a measure of inequality had to be removed from the analysis because of missing data, and this could also create a bias in the results. However, since levels of inequality are relatively time-invariant, these effects will partially be captured by the fixed effect models.

3.5 H1 and H2 Regression Models

The first and second hypotheses ask whether governments, where leaders receive their higher education outside of sub-Saharan Africa, allocate more or less spending on public education as a percentage of GDP compared to governments where leaders do not study outside of sub-Saharan Africa. I construct the following linear models to analyze the hypotheses:

One-way fixed effects:

$$Education\ expenditure_{it} = \beta_1\, leaderedu_{it} + \beta_2 GNIpc_{it} + \beta_3 colhist_{it} + \beta_4 corruption_{it} + \beta_5 politicalstability_{it} + \beta_6 logpopulation_{it} + \beta_7 developmentaid_{it} + \beta_8 ethnicfractionalization_{it} + \propto_i + \nu_{it}$$

[10] Equatorial Guinea, Angola, Zimbabwe, Cameroon, Republic of Congo, Swaziland and Uganda have had the same Presidents in power for 30 years or more.

[11] Image 1 in the appendix shows a missingess map detailing the magnitude of missing data, which was most problematic for the variables related to the Gini coefficient, government spending on tertiary, secondary and primary education, total government spending on education as a percentage of GDP, political stability and corruption measures.

Two-way fixed effects:

$$Education\ expenditure_{it} = \alpha_1\, leaderedu_{it} + \alpha_2 GNIpc_{it} + \alpha_3 colhist_{it} + \alpha_4 corruption_{it} + \alpha_5 politicalstability_{it} + \alpha_6 logpopulation_{it} + \alpha_7 developmentaid_{it} + \alpha_8 ethnicfractionalization_{it} + \propto_i + \tau_t + \nu_{it}$$

Where time is indicated by *t* and countries by *i*. *Education expenditure* (as a percent of GDP) represents the dependent variable. *Leaderedu* is an independent dichotomous variable representing whether the leader in country *i* at time *t* had received their higher education outside of sub-Saharan Africa. Other independent observed variables for each country year period include; *GNIpc* for gross national income per capita; *colhist* representing the former colonizer; *corruption* as the Bayesian Corruption Index; *political stability* represents the likelihood the government in power will be destabilized or overthrow. The *population* variable takes the log of the total country population for each country-year; in order to run the multiple imputation and fixed effects models, population was transformed into a logarithmic variable to correct for a skewed distribution. *Developmentaid* controls for foreign aid as a percent of GDP, and *ethnicfractionalization* represents the ethnical diversity of each country.

For a fixed effect model, the error term ε_{it} divides into a fixed effect term $\propto_i$, and random error term ν_{it}. The fixed effect term captures time-invariant individual country factors to account for unobserved country heterogeneity (Voigt et al, 2006).

4. RESULTS & INTERPRETATION

To explore the first and second hypothesis, I use R Project for Statistical Computing to run a one-way and two-way fixed effects regression using both the original dataset, as well as a dataset with missing values filled in using multiple imputation to arrive at the following results[12]:

[12] Colonial history had to be used as an identification variable to perform the multiple imputation, which means it is excluded from the model.

4.1 H1 and H2 Regression Results and Interpretation

H1 & H2 Regression Results

	Dependent variable:		
	Government Expenditure Edu as % GDP		
	Without Imputation	Country FE	Country-Year FE
	(1)	(2)	(3)
leader_edu1	-0.188	-1.061***	-1.101***
	(0.157)	(0.142)	(0.145)
GNI_pc	0.0002*	0.0001	0.00004
	(0.0001)	(0.0001)	(0.0001)
bci_bci	-0.040	0.084***	0.082***
	(0.036)	(0.012)	(0.012)
wbgi_pse	-0.059	2.189***	2.206***
	(0.131)	(0.080)	(0.081)
total_population	0.00000***		
	(0.00000)		
ltotal_population		1.096***	0.404
		(0.185)	(0.566)
overseas_aid	0.014*	-0.013**	-0.013**
	(0.007)	(0.005)	(0.006)
al_ethnic		-7.294***	-7.335***
		(0.867)	(0.878)
Observations	321	1,558	1,558
R2	0.093	0.393	0.387
Adjusted R2	-0.044	0.373	0.351
F Statistic	4.732*** (df = 6; 278)	139.280*** (df = 7; 1509)	132.652*** (df = 7; 1472)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 4: H1, H2 Regression Results

As the results show, there is a substantial difference between using the original dataset with only 321 observations, and the imputed dataset with 1,558 observations. Based on the original dataset, there is no significant association between a leader receiving higher education abroad and government investment into education at home. However, both the one-way and two-way fixed effects models show a negative association between leader education and government spending on education. More specifically, the country fixed effects model shows that a leader receiving their education outside of sub-Saharan Africa is associated with a 1.061 percent decrease in government spending on education as a percent of GDP. For the country-year fixed effects model the value is -1.101. The standard errors of .142 and .145 respectively imply the results are highly statistically significant at a 0.01 level.

The coefficient on the variable representing corruption is also statistically significant in the country fixed effects and the country-year fixed effects models with p-values of 0.01. Both models return

similar results; 0.084 for country fixed effects, and 0.082 for country-year fixed effects. These values suggest that when a leader has received higher education abroad, a one unit increase along the corruption index is associated with about a 0.08 percent increase in government spending on education. While this is counterintuitive, when government spending on education increases, corrupt practices can divert funds, as described in the case of Uganda. Furthermore, countries with higher levels of corruption might be more likely to increase the education budget but use the funds to sponsor scholarships.

The coefficient measuring the effects of political stability is positive in both the fixed effects models as well. The one-way fixed effects model reports a value of 2.189 at a 0.01 significance level, which implies that when a leader has been educated abroad, a one unit increase in the measure of political stability is associated with a 2.189 percent increase in government spending on education. For the two-way fixed effects model, the coefficient is 2.206 at a 0.01 significance level as well, which also implies that holding other effects constant, when a leader has been educated abroad, a one unit increase in the measure of political stability is associated with a 2.206 percent increase in government spending on education.

The coefficient for official development assistance (overseas aid) is significant for all three models. However, the fixed effects model without imputation shows a positive result, at a 0.10 significance level, while the imputed models both show negative results at a 0.05 significance level. Since the literature on the effects of foreign aid on education is mixed, it is problematic to interpret which result would be more accurate in this case.

The estimate of the coefficient corresponding to ethnic fractionalization also shows a highly statistically significant result with a p-value of 0.01. The country fixed effects model shows that when a leader is educated abroad, a one unit increase in the measure of ethnic fractionalization is associated with a 7.29 percent decrease in government spending on education. Using country-year fixed effects obtains a similar result, a coefficient of -7.34 also at a 0.01 significance level. Although the literature would agree that ethnic fractionalization would have a negative impact on government education spending, this result seems quite extreme. It could be the case that in countries where leaders tend to go abroad there might be higher levels of fractionalization, but this would require a more careful study focusing on these two variables more in-depth.

Taking a look at the models overall, R2 for the country fixed effects model without multiple imputation suggests that the variables explain 9.3 percent of the variation in government spending on education. On the other hand, R2 for the country fixed effects model using imputed data increases to 39.3%. This show that the fixed effect model is substantially less robust when there are large amounts

of missing data. Even though both fixed effects models do show highly significant results, it is important to keep in mind that the values are estimates and not definite values.

Based on the results for the country and country-year fixed effects, I cannot reject the null hypothesis for H1 that leaders receiving their higher education outside of sub-Saharan Africa are associated with higher levels of education spending relative to leaders who receive their higher education within sub-Saharan Africa, but I can reject the null hypothesis for H2 in favor of the alternative hypothesis that countries, where leaders receive their higher education outside of sub-Saharan Africa, will allocate less spending on public education as percent of GDP compared to countries where leaders do not study outside of sub-Saharan Africa.

5. DISCUSSION & CONCLUSIONS

5.1 Recommendations For Future Research

What stood out the most while conducting this research is the amount of missing data for sub-Saharan Africa, especially prior to 1998. This was the biggest challenge and weakness in performing this study. Even though the Amelia II program helps correct for this, any research based on data with a high percentage of missing values will not capture the most accurate measurements. However, given the need to better understand sub-Saharan Africa's progress and obstacles in developing its education system, it is also important to figure out the best way to work around missing data.

For future research, I would recommend constructing the independent variable by measuring the total years of foreign education among leaders, which might allow for a simpler way to compare how differences in the amount of foreign education impact government policy. Furthermore, although private education was not a focus of this study, it is an important topic when looking at education trends in sub-Saharan Africa. In particular, it would be beneficial to research how private education influences the decision between going abroad for higher education or staying at home, and how the proliferation of investment into private education affects government spending.

Another potential question to keep in mind is the role of scholarships. As previously discussed, scholarships make up a large part of education budgets, and in countries with higher levels of corruption or inequality, scholarships might amount to a larger portion of the education budget, which is then allocated based on connections rather than merit. However, to date, there is no data available on scholarship distributions. It would also be useful to take into account the rural-urban divide in sub-Saharan African; urban groups tend to have more years of university schooling (Stasavage, 345) and future research could examine whether countries where leaders receive their higher education outside of sub-Saharan Africa invest differently by education level relative to countries where leaders do not study outside of sub-Saharan Africa.

To study this topic from a qualitative perspective, future studies could focus an in-depth analysis on a specific country, such as Nigeria, Cameroon or Zimbabwe, to better understand to what extent large numbers of students going abroad affects education or other cultural aspects in their home countries.

Finally, another topic which deserves further study is the effect of foreign study on gender equality. In particular, whether studying and living in environments characterized by higher levels of gender equality positively affects gender inclusion once students return to their home countries.

5.2 Significance and Conclusion

In our globalized era, it is easy to overlook the long-term impact transnational experiences and foreign education have on individuals, and how this affects leaders once they are in power. In sub-Saharan Africa, modernizing the education system represents an enormous challenge and very often it takes decisive and strong leadership to understand the value education brings, and to direct government reforms and policies. As the research shows, the resolve to prioritize education often comes from a leader's own experience.

In sub-Saharan Africa, four out of ten leaders receive their higher education abroad. Most do so out of necessity, or opportunity. Regardless of the reasons behind choosing to go abroad, the question most people don't ask is, what effect does this trend have locally? While a study with a wider scope could look at the entire population within a country, I limited my study to the people who would have the most influence to assess whether the experience of studying in a more economically developed country with superior education systems has positive or negative impacts on how leaders approach education in their home countries. The results of the study find that leaders receiving their higher education outside of sub-Saharan Africa is associated with decreased government education expenditure within their home country. Although this would be the counter-intuitive finding, it is supported by the literature as a possible outcome. It might be the case that those who have the possibility of going abroad come from higher socio-economic groups, and therefore are less aware of the needs of the public education system, and international experiences create a more outward-facing development strategy.

To conclude, the research provides a better understanding of how leaders are influenced by their own educational experiences and how this might translate into differences in governments' education policies. While the results do not provide a conclusive explanation as to why it might be the case that leaders who go aboard invest less into public education at home, it does provide compelling evidence that the impacts could be greater than previously acknowledged.

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APPENDIX

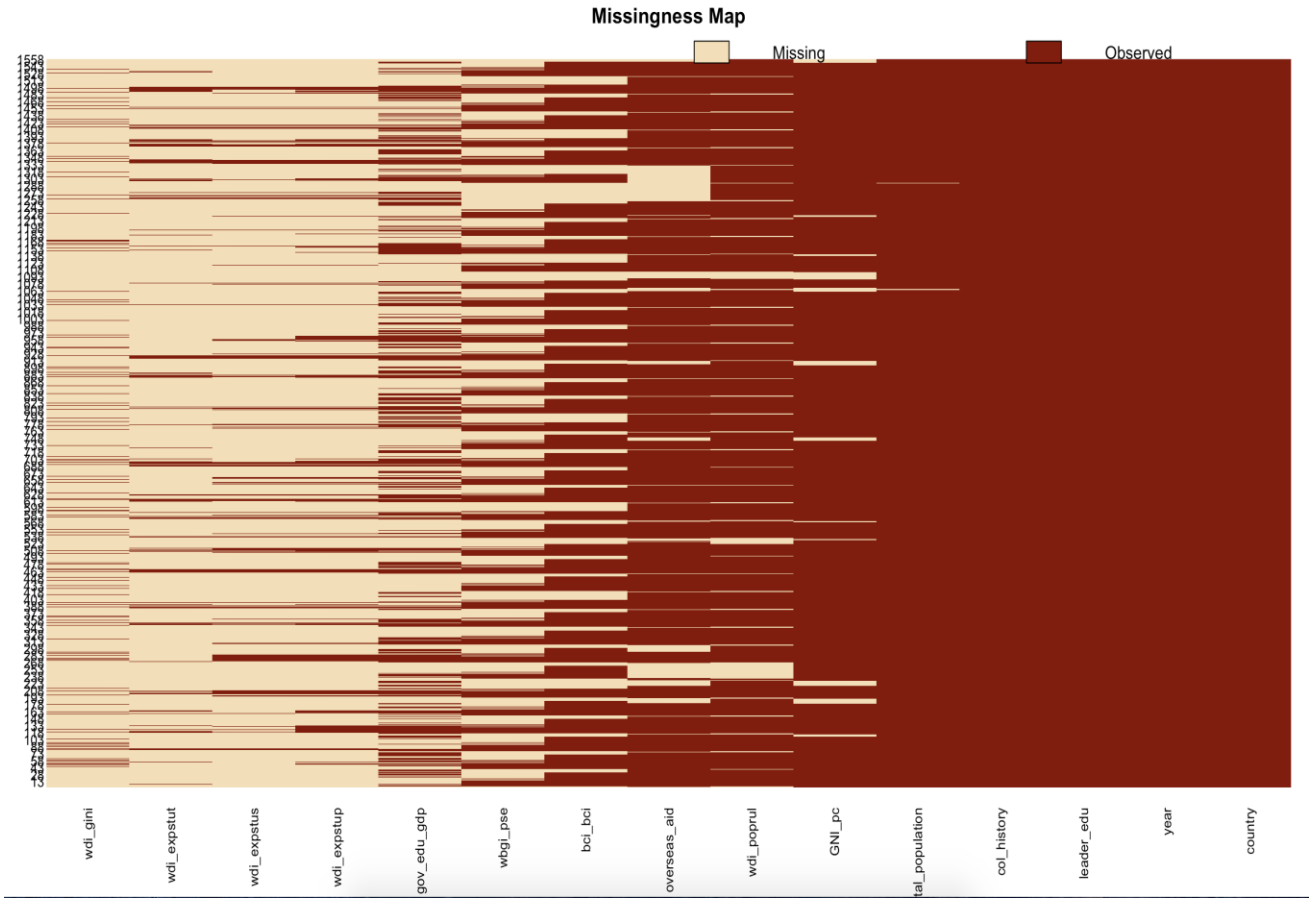


Chart 1: Missingness map

```
Oneway (individual) effect Within Model

Call:
plm(formula = gov_edu_gdp ~ leader_edu + GNI_pc + bci_bci + wbgi_pse +
    ltotal_population + overseas_aid + +al_ethnic, data = data1,
    effect = "individual", model = "within", index = c("country",
        "year"))

Unbalanced Panel: n = 42, T = 1-38, N = 1558

Residuals:
     Min.   1st Qu.    Median   3rd Qu.      Max.
-6.043406 -1.210890  0.020147  1.143378 21.774491

Coefficients:
                     Estimate  Std. Error t-value  Pr(>|t|)
leader_edu1       -1.0609e+00  1.4191e-01 -7.4763 1.290e-13 ***
GNI_pc             5.4065e-05  5.5005e-05  0.9829   0.32581
bci_bci            8.3851e-02  1.1613e-02  7.2207 8.171e-13 ***
wbgi_pse           2.1891e+00  8.0002e-02 27.3630 < 2.2e-16 ***
ltotal_population  1.0959e+00  1.8508e-01  5.9211 3.954e-09 ***
overseas_aid      -1.3112e-02  5.4940e-03 -2.3866   0.01713 *
al_ethnic         -7.2937e+00  8.6741e-01 -8.4086 < 2.2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    10502
Residual Sum of Squares: 6380.2
R-Squared:      0.3925
Adj. R-Squared: 0.37318
F-statistic: 139.28 on 7 and 1509 DF, p-value: < 2.22e-16
```

Table 6: H1 & H2: Summary of imputed country fixed effects model

```
Twoways effects Within Model

Call:
plm(formula = gov_edu_gdp ~ leader_edu + GNI_pc + bci_bci + wbgi_pse +
    ltotal_population + overseas_aid + al_ethnic, data = data1,
    effect = "twoways", model = "within", index = c("country",
        "year"))

Unbalanced Panel: n = 42, T = 1-38, N = 1558

Residuals:
    Min.  1st Qu.   Median  3rd Qu.     Max.
-6.11277 -1.19652  0.01479  1.11096 21.75464

Coefficients:
                    Estimate  Std. Error t-value  Pr(>|t|)
leader_edu1       -1.1005e+00  1.4460e-01 -7.6108 4.837e-14 ***
GNI_pc             4.4717e-05  5.7544e-05  0.7771   0.43723
bci_bci            8.1515e-02  1.1850e-02  6.8787 8.905e-12 ***
wbgi_pse           2.2056e+00  8.1377e-02 27.1038 < 2.2e-16 ***
ltotal_population  4.0429e-01  5.6569e-01  0.7147   0.47492
overseas_aid      -1.3217e-02  5.6958e-03 -2.3204   0.02046 *
al_ethnic         -7.3353e+00  8.7769e-01 -8.3576 < 2.2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    10189
Residual Sum of Squares: 6247.8
R-Squared:      0.38681
Adj. R-Squared: 0.3514
F-statistic: 132.652 on 7 and 1472 DF, p-value: < 2.22e-16
```

Table 7: H1&H2: Two-way fixed effects summary

	gov_edu_gdp	GNI_pc	wdi_gini	bci_bci	wbgi_pse	total_population	overseas_aid	wdi_poprul	al_ethnic	wdi_expstup	wdi_expstus	wdi_expstut
gov_edu_gdp	1.00	0.36	0.21	-0.30	0.15	0.00	-0.21	0.05	-0.40	0.71	0.35	0.26
GNI_pc	0.36	1.00	0.30	-0.03	0.41	-0.10	-0.68	-0.58	-0.11	0.14	-0.14	-0.47
wdi_gini	0.21	0.30	1.00	-0.31	0.30	-0.20	-0.16	-0.15	-0.09	-0.11	-0.10	0.06
bci_bci	-0.30	-0.03	-0.31	1.00	-0.49	0.21	-0.11	-0.07	0.38	-0.28	-0.07	-0.30
wbgi_pse	0.15	0.41	0.30	-0.49	1.00	-0.36	-0.16	-0.23	-0.33	0.14	0.04	-0.10
total_population	0.00	-0.10	-0.20	0.21	-0.36	1.00	-0.13	0.17	0.32	0.06	-0.29	-0.19
overseas_aid	-0.21	-0.68	-0.16	-0.11	-0.16	-0.13	1.00	0.36	-0.11	-0.10	0.25	0.35
wdi_poprul	0.05	-0.58	-0.15	-0.07	-0.23	0.17	0.36	1.00	-0.26	0.10	0.32	0.58
al_ethnic	-0.40	-0.11	-0.09	0.38	-0.33	0.32	-0.11	-0.26	1.00	-0.41	-0.63	-0.51
wdi_expstup	0.71	0.14	-0.11	-0.28	0.14	0.06	-0.10	0.10	-0.41	1.00	0.36	0.42
wdi_expstus	0.35	-0.14	-0.10	-0.07	0.04	-0.29	0.25	0.32	-0.63	0.36	1.00	0.51
wdi_expstut	0.26	-0.47	0.06	-0.30	-0.10	-0.19	0.35	0.58	-0.51	0.42	0.51	1.00

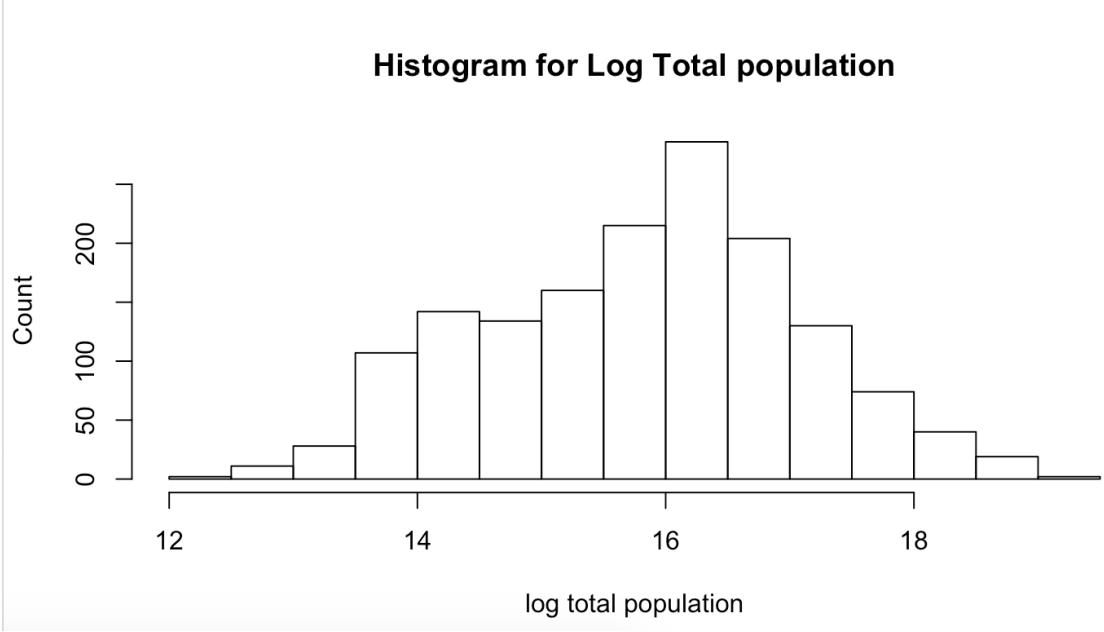
n

	gov_edu_gdp	GNI_pc	wdi_gini	bci_bci	wbgi_pse	total_population	overseas_aid	wdi_poprul	al_ethnic	wdi_expstup	wdi_expstus	wdi_expstut
gov_edu_gdp	615	601	70	509	352	615	567	600	602	219	162	146
GNI_pc	601	1471	142	1085	630	1469	1309	1350	1376	225	166	152
wdi_gini	70	142	143	131	87	143	138	143	142	33	26	21
bci_bci	509	1085	131	1111	637	1111	1038	1083	1075	220	161	146
wbgi_pse	352	630	87	637	637	637	604	624	624	197	142	136
total_population	615	1469	143	1111	637	1554	1330	1418	1439	226	167	152
overseas_aid	567	1309	138	1038	604	1330	1330	1284	1306	216	160	141
wdi_poprul	600	1350	143	1083	624	1418	1284	1418	1401	226	167	152
al_ethnic	602	1376	142	1075	624	1439	1306	1401	1441	226	167	152
wdi_expstup	219	225	33	220	197	226	216	226	226	226	165	138
wdi_expstus	162	166	26	161	142	167	160	167	167	165	167	113
wdi_expstut	146	152	21	146	136	152	141	152	152	138	113	152

P

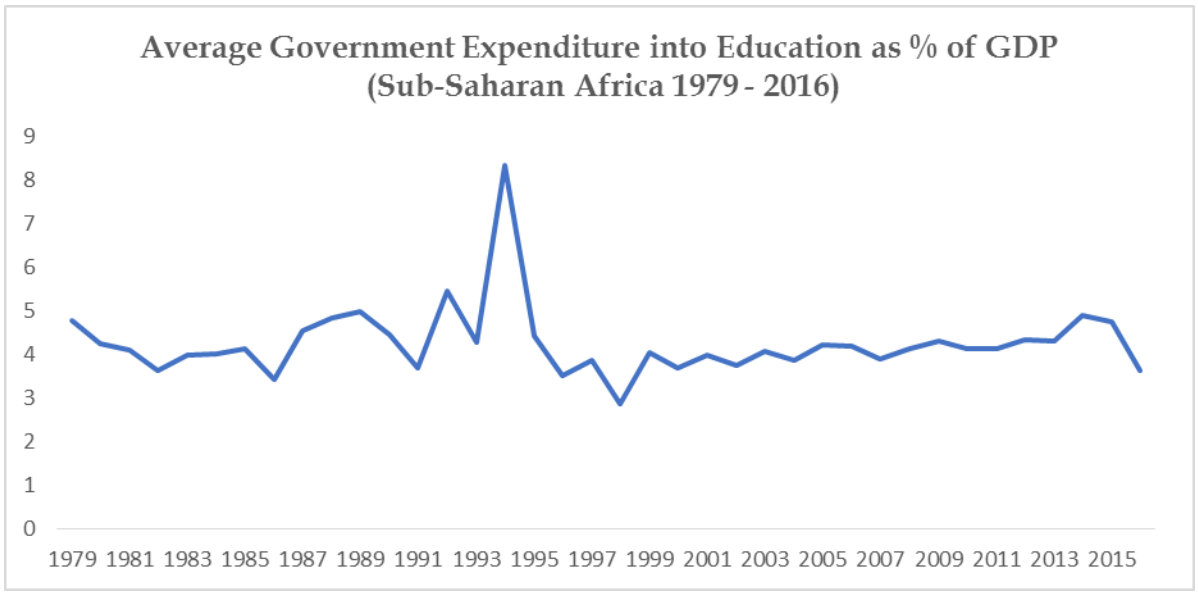
	gov_edu_gdp	GNI_pc	wdi_gini	bci_bci	wbgi_pse	total_population	overseas_aid	wdi_poprul	al_ethnic	wdi_expstup	wdi_expstus	wdi_expstut
gov_edu_gdp		0.0000	0.0847	0.0000	0.0039	0.9931	0.0000	0.2005	0.0000	0.0000	0.0000	0.0015
GNI_pc	0.0000		0.0002	0.3292	0.0000	0.0000	0.0000	0.0000	0.0000	0.0311	0.0647	0.0000
wdi_gini	0.0847	0.0002		0.0003	0.0041	0.0191	0.0576	0.0797	0.3084	0.5442	0.6146	0.7927
bci_bci	0.0000	0.3292	0.0003		0.0000	0.0000	0.0004	0.0170	0.0000	0.0000	0.3650	0.0002
wbgi_pse	0.0039	0.0000	0.0041	0.0000		0.0000	0.0001	0.0000	0.0000	0.0496	0.6534	0.2260
total_population	0.9931	0.0000	0.0191	0.0000	0.0000		0.0000	0.0000	0.0000	0.3836	0.0001	0.0218
overseas_aid	0.0000	0.0000	0.0576	0.0004	0.0001	0.0000		0.0000	0.0000	0.1574	0.0015	0.0000
wdi_poprul	0.2005	0.0000	0.0797	0.0170	0.0000	0.0000	0.0000		0.0000	0.1366	0.0000	0.0000
al_ethnic	0.0000	0.0000	0.3084	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000
wdi_expstup	0.0000	0.0311	0.5442	0.0000	0.0496	0.3836	0.1574	0.1366	0.0000		0.0000	0.0000
wdi_expstus	0.0000	0.0647	0.6146	0.3650	0.6534	0.0001	0.0015	0.0000	0.0000	0.0000		0.0000
wdi_expstut	0.0015	0.0000	0.7927	0.0002	0.2260	0.0218	0.0000	0.0000	0.0000	0.0000	0.0000	

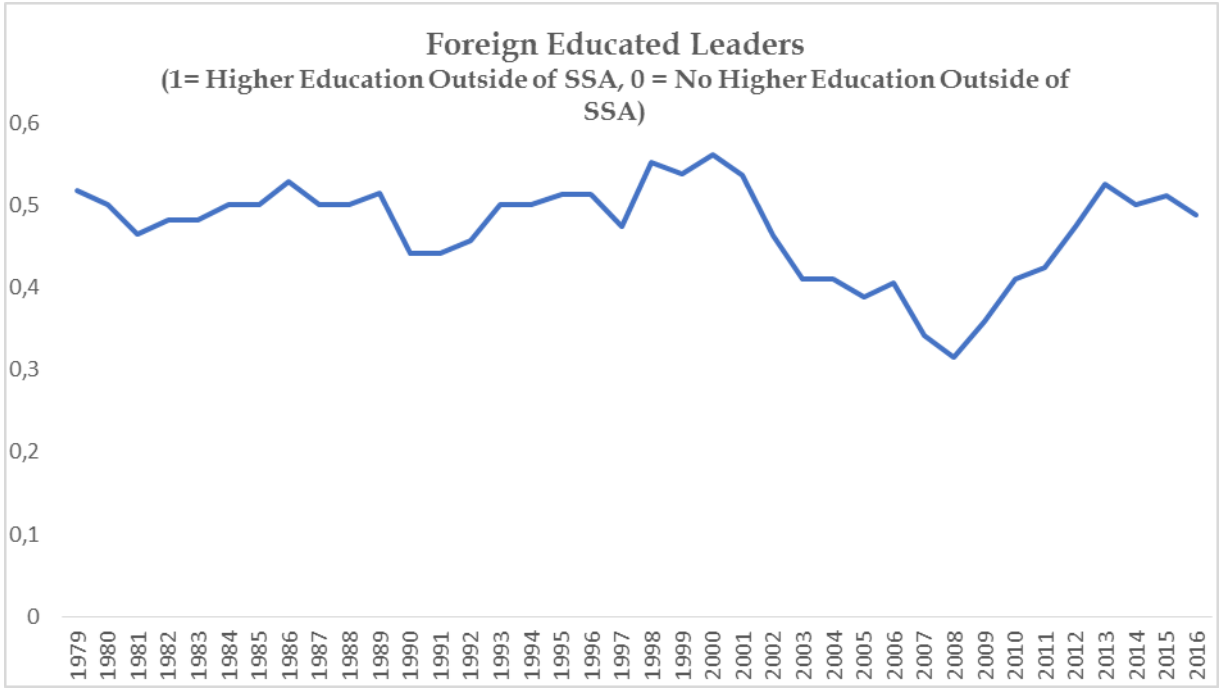
Table 8: Correlation matrix

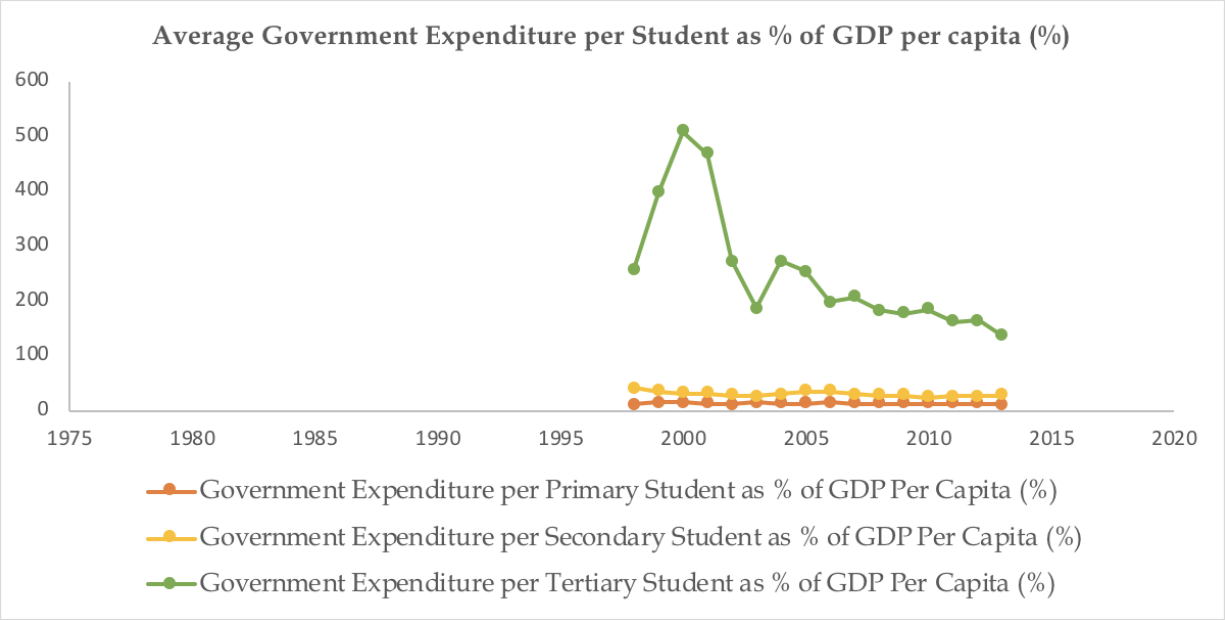


Graph 3: Histogram – log transformation of total population

Supplementary graphs:







Code used for analysis:

```
dat = read.csv("Thesis_dataset.csv", stringsAsFactors = FALSE)

models = list()

#convert to factor colonial history, 7 levels

dat$col_history = as.factor(dat$col_history)

# include only relevant variables

data<-dat[,c(1,2,3,4,7,8,9,10,12,13)]

# missingness map

missmap(data)

data$year = as.numeric(data$year)

data$country = as.factor(data$country)

data$GNI_pc = as.numeric(data$GNI_pc)

data$total_population = as.numeric(data$total_population)

library(ggplot2)

ggplot(data, aes(data$total_population)) +

 geom_histogram(breaks=seq(0, 200000000, by = 500000),

                +              alpha = .2) +

 labs(title="Histogram for Total population") +
```

```
  labs(x="total population", y="Count")


hist(data$total_population,main ="Histogram for Total population" ,
     xlab="total_population", ylab ="Count")


# log transform total population
data$ltotal_population<-log(data$total_population)


## roughly symmetric
ggplot(data, aes(data$ltotal_population)) +
  geom_histogram(breaks=seq(12, 20, by = 2),col='black',fill='white')+
  labs(title="Histogram for Log Total population") +
  labs(x="log total population", y="Count")
hist(data$ltotal_population,main ="Histogram for Log Total population" ,
     xlab="log total population", ylab ="Count")


# remove total population
data<-data[,-7]


## describe data type
str(data)
library(Hmisc)
dat$leader_edu <-as.factor(dat$leader_edu)
dat$GNI_pc<-as.numeric(dat$GNI_pc)
dat$total_population <-as.numeric(dat$total_population)
numeric <- dat[,c(4:11,13:16)]


## numerical variables are not highly correlated
corplot<-(corR <- rcorr(as.matrix(numeric), type="spearman", title = "Correlation Table"))


#impute missing data
```

```
dat_mi = amelia(dat, m = 3, ts = 'year', cs = 'country',noms='leader_edu',idvars='col_history',logs='total_population',p2s=0,amcheck=FALSE)

write.amelia(obj=dat_mi, separate=TRUE,file.stem="outputdata")

write.csv(data1, "imputedoutput.csv")

str(data1)

data1$leader_edu<-as.factor(data1$leader_edu)

data1$ltotal_population<-log(data1$total_population)


#model without imputation

rego.fe <- plm(gov_edu_gdp ~ leader_edu+bci_bci+wbgi_pse+ltotal_population+overseas_aid+

          + al_ethnic, data=data,index=c("country","year"),

         model="within",effect="individual")

stargazer(rego.fe, type="text",title = "FE Without Imputation"),out="table2.txt",df=FALSE, digits=4)


## country fixed effect

reg1.fe <- plm(gov_edu_gdp ~ leader_edu+GNI_pc+bci_bci+wbgi_pse+ltotal_population+overseas_aid+

          + al_ethnic, data=data1,index=c("country","year"),

         model="within",effect="individual")


## country and year fixed effects

reg2.fe<- plm(gov_edu_gdp ~ leader_edu+GNI_pc+bci_bci+wbgi_pse+ltotal_population+overseas_aid

        + al_ethnic, data=data1,index=c("country","year"),

        model="within",effect="twoways")


stargazer(rego.fe, reg1.fe, reg2.fe, type="text", title = "H1 & H2 Regression Results", column.labels=c("Without Imputation", "Country FE","Country-Year FE"), dep.var.labels=c("Government Expenditure Edu as % GDP"))

stargazer(data1, type = "text", title="Descriptive statistics", digits=1, out="table2.txt")


#Descriptive Stats

stargazer(data1[c("year","leader_edu","gov_edu_gdp","GNI_pc","wdi_gini","bci_bci","wbgi_pse","total_population","overseas_aid","al_ethnic")], type = "text",

      title="Descriptive statistics - Imputed Data", digits=1, out="table2.txt",covariate.labels=c("Year","Leader Edu","Gov Spending Edu","GNIpc","GINI","Corruption","Political Stability","Population","Foreign Aid","Ethnic Fractionalisation"))
```