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Alternative Variables for Geography and Institutional Structure: European Colonies and an Evaluation of sub-Saharan African Countries*

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Abstract

To explain the main reasons for the differences in economic development among countries, in the main model of this study, we use the malaria index as an instrumental variable to describe the sub-Saharan African countries. In addition, we use the indigenous population density in 1500 and the settler mortality rate as substitutes for each other in different model identifications to demonstrate the settlement conditions in the former European colonial countries, and we use the identity of colonizers to explain today's institutional performance. According to the main model, where we use the two-stage least squares method, the geography of sub-Saharan Africa and institutional structure determine

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the differences in economic development significantly. In both cases, the coefficients of these variables remain statistically significant, despite minor changes. In addition, estimates of coefficients are the most unbiased estimators among studies using a similar sample. The results of the main model also remained unchanged despite the alternative measures of institutional structure and geography.

Keywords: economic development, malaria index, sub-Saharan Africa, geography, institutional structure
JEL Classification: I15, O5, O10

1. Introduction

Economists have been discussing the reasons for economic development differences between societies for a long time and want to clarify this topic. The classical view has emphasized that division of labor and specialization level are the main reasons behind income differences, and the Neoclassical view has stressed the differences between labor-capital-technology variables in the production function.[1] However, considering the economic performance of the countries, the literature has observed that the relatively desirable level of division of labor and specialization, the amount of capital stock, and even the level of technology can be formed under certain conditions. Additionally, some events and facts prepare the ground for them. This structure, which forms the framework and "habitat" of economic activity, is at least as important as economic activity (North, 1991). These conditions are geography and the written and unwritten rules created to achieve

[1] The economic literature is rich in terms of explanations for the differences in economic development among societies. We summarize this literature as follows: The process that started with Smith's attention (Smith, 2016) to the level of division of labor and specialization continued with the contributions of Malthus (1872), Ricardo (1955) and Schumpeter (2010). In the Neoclassical growth models, where the economic development problem is perceived as a growth problem and explanations are made, technological change plays a key role in the long-term sustained growth and development. One of the neoclassical growth models, Harrod-Domar, Solow and AK, accepted technological change externally; Romer and Aghion-Howitt models tried to explain how technological development emerged.

economically desirable results in the economic development of the ability of social and individual economic behaviors to direct decision units.

According to the idea of geographical determinism, different levels of economic development have been observed for different people in the course of history. This difference has been due to the different nature of the geographies inhabited by the people and the differences between the division of labor and the level of specialization and the level of isolation caused by this geographical difference (Montesquieu, 1989, p. 234; Khaldun, 2013, p. 261-262; Diamond, 1998).

Another approach thought to prepare the necessary conditions for economic development is the nature of the institutional structure constructed by society and created to achieve desired results of the society, explaining the whole of written and unwritten rules (North, 1981; Bednar & Page, 2018, p. 82). Barro (1991) demonstrated that institutional factors are critical determinants of economic performance, even when controlled by private and public sector investments. Even if different measures are applied to the institutional structure in the following years, the positive and significant effect on economic development remains valid (Knack & Keefer, 1995; Hall & Jones, 1999; Efendic, Pugh, & Adnett, 2011; Law, Lim, & Ismail, 2013; Bennett, Faria, Gwartney, & Morales, 2017).

Differences of opinion are also observed among people who think that the differences in economic development cannot be explained by the capital stock level and technology level of the countries, or that these do not seem sufficient. Some economists have emphasized the unique aspect of determining the economic development of geography, and others have drawn attention to the superior aspect of the institutional structure in determining economic development. The focus of the discussions in this paper is on the sample used, the way the model is identified, and the economic indicators used to describe the variables. At this point, the main research problem of this study is to clarify whether the economic development differences are determined by geography or institutional structure or both. To describe the geography, tropical climate features and unique characteristics of sub-Saharan Africa is used. The rule of law index created by the World Bank is used to depict the institutional structure. Due to the problem of endogeneity, the malaria index is an instrumental variable for sub-Saharan Africa. For the institutional structure, population density and settler mortality rates in colonies in 1500 are used interchangeably in different models.

As indicated by the results of our main model, the main contribution of this paper is that the common, statistically significant effect of geography and institutional structure on economic development remains permanent when the most appropriate explanatory and instrumental variables are used for geography and institutional structure. The analysis results do not change when alternative measures of these fundamental determinants are used.

In Section 2, these elements are discussed respectively, and the reasons for the choices made in this study regarding this multidimensional preference problem are presented. In Section 3, the results of the analysis are included. In Section 4, the importance and limits of the analysis results are discussed. In the final section, the extent to which the results of the analysis are successful in explaining the differences in the level of economic development, and the aspects of the analysis that motivate further research are emphasized.

2. Theoretical framework for determinants of economic development and model identification

2.1. Sample Selection

The institutional structure, unlike geography, seems to be related to the material welfare level of societies. The social structure, namely, public policies and the institutional structure formed by society, is largely shaped by income level (Hall & Jones, 1999). A natural consequence of this situation is the problem of heterogeneity, in which relatively small samples show significant differences between observation values. The endogeneity problem caused by the heterogeneity problem makes it difficult to distinguish what determines the differences in economic development (Heckman & Robb, 1986; Manski & Pepper, 2000). Therefore, the external impact between the institutional structure and the wealth levels of the countries should be demonstrated.

Thus, an instrumental variable, which is largely related to the variable with which the instrument has a weak relationship with the variable to be explained, is appropriate. The suitability of settlement conditions has been demonstrated by the mortality rates of European settlers (Acemoglu, Johnson, & Robinson, 2001) and the density of indigenous populations in 1500 who resided in that area (Acemoglu et al., 2002). Although the data for deaths in settlers includes 80 countries, data on the population density in 1500 cover many more countries. Thus, this study is based on the countries that have settler mortality rates comparable to the literature on this subject. Therefore, we used a sample of 79 countries. This larger sample set makes the coefficient estimates of the variables more effective.[2]

2.2. Economic Development

To demonstrate the level of economic development, 2014 GDP per capita is used. Another variable used to determine the level of economic development is the annual growth rate of countries; however, growth rates must be extended over many years because some countries cannot be reached, and in recent years, growth rates have remained low in developed countries compared with other countries. Additionally, economic development indicates the increasing share of high value-added products in total production and the improvements in the social and economic conditions of society (Gillis, Perkins, Roemer, & Snodgrass, 1992, p. 6-9; Han & Kaya, 2008, p. 2-4). Therefore, a static approach seems more appropriate than a dynamic perspective.[3] In this study, per capita income level is used to show the level of economic development. Table 1 presents the names, abbreviations, explanations, and sources of the variables.

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[2] In the original article, Acemoglu et al. (2001) used a sample of 64 countries. However, the settler mortality rates data cover 81 countries. In this study, we include the country group of Barbados, Belize, Benin, Central African Fed., Chad, Fiji, Guinea-Bissau, Korea Rebublic, Lao Pdr, Liberia, Mauritania, Mauritius, Myanmar, Rwanda, and Suriname, Thailand. Acemoglu et al. (2001) used Zaire in the sample. However, 2014 GDP data is not included in the WGI database of this country. Because the high standard errors of coefficient estimators cause biased estimators, a larger sample is used in this study. Using a similar sample group, Acemoglu et al. (2002, p. 1386), Rodrik et al. (2004, p. 31-32), Bennett et al. (2017, p. 510) have found larger standard errors than the standard errors of Models 1 and 2 in Table 5, which are our main models.

[3] According to the WGI dataset, the average growth rate in the 30-year period between the high-income countries group (1989-2018), mostly classified as developed countries, is 2.21. The average growth rate for the middle-, low-, upper-middle-, and lower-middle-, income groups is 4.45, 3.67, 4.35, and 4.82, respectively.Therefore, using growth rate data to measure the level of economic development may be misleading.

Table 1: Variable descriptions and data sources

Variable	Abbreviation	Descriptions	Sources
2014 log GDP per capita	log GDP	Natural logarithm of per capita income based on purchasing power parity in 2014.	World Bank(2017a)
Sub-Saharan Africa Dummy	SSA	It equals 1 if the country is a sub-Saharan African country, and 0 if the country is in other regions.	United Nations Economic and Social Council (2017)
Rule of law	Rule	An index value indicating the degree to which a desirable business and trade environment is achieved in favor of economic development. It takes values between -2.5 and +2.5, an increase in value indicates improvement in institutional quality.	World Bank (2017b)
Land in Tropics	Tropics	The ratio of the portion of the countries between the Capricorn and the tropical crab to the total area. It takes values between 0 and 1. A value of 1 indicates that all the territory of the country is located in the tropical region.	Gallup, Sachs, and Mellinger (1999), ESRI (2017)
Malaria Index	Malaria	Takes values between 0 and 1. A value of 1 indicates that the entire population of the country is at high risk; and simultaneously, all of the cases in which the disease occurs are of plasmodium falciparum; and a value of 0 indicates that malaria does not pose a serious threat to the country.	World Health Organization (2017)
Log Mortality rate	Mortality	Natural logarithm of mortality in 1000 settlers per 1000 years in old European colonies.	Acemoglu et al., (2001)
Standardized log population density	Population	Standardized value of the natural logarithm of the population density of 1500 in colonial countries by using the formula. Population= $[x_i-\bar{x}] / \sigma_x)$ where x_i = log is population density in 1500; $\bar{x}$ and σ_x are the mean and standard error of the data, respectively.	Acemoglu et al., (2002)
British colony dummy	British	Dummy variable for British colony countries. If the colony is an English colony, 1 is equal to 0 otherwise.	Klerman, Mahoney, Spamann, and Weinstein (2011)
Common effect of Population with British	British* Population	Variable for the standardized population density in British colonies in 1500.	Stated above.

Common effect of British with Mortality	British* Mortality	Variable for the natural logarithm of the mortality rate in British colonies.	Stated above.
Economic Freedom of World Index	EFW	Published by the Frase Institute in 2014, the Economic Freedom of World (EFW) Index comprises size of government, legal system & property rights, sound money, freedom to trade internationally, regulation, and other factors.	Fraser Institute (2017)

2.3. Geography

Although geography is a broad concept, in some studies, geography is depicted by distance from the equator. As individuals move closer to the equator, living conditions worsen due to the high temperatures, endemic diseases, and other adverse climatic factors. This situation causes the societies residing in these regions to be economically underdeveloped (Acemoglu et al., 2001; Rodrik, Subramanian & Trebbi, 2004). For the sample group used in this study, the positive correlation between the distance to the equator and per capita income level in 2014 is shown in Figure 1.

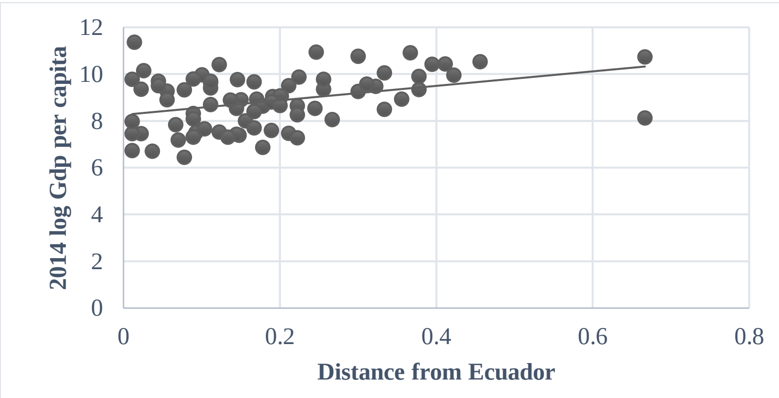
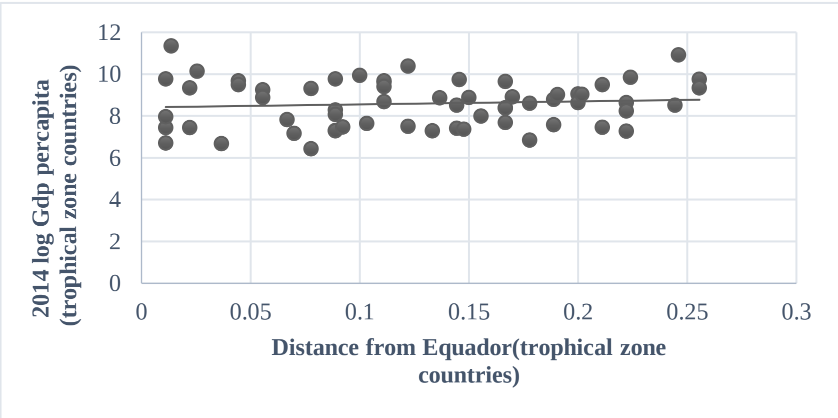


Figure 1: 2014 log GDP per capita and Distance from the Ecuador

However, the approach of distance to the equator to depict geography is insufficient and does not explain a broad concept such as geography. An alternative approach is to use climate zones as the main determinants of economic performance. In addition to adverse weather conditions, some types of diseases are commonly observed in the regions where tropical climate features prevail (Gallup, Sachs, & Mellinger, 1999; Gallup & Sachs, 2001; Masters & McMillan, 2001). Figure 2(a) shows the connection between per capita income and the distance from the equatorial circle of the countries located in the tropical zone. Figure 2(b) shows the relationship between per capita income and the distance from the equatorial circle in the temperate zone. The coefficient of the correlation between the distance to the equator and the income level decreased from 0.316 in Figure 1 to 0.092 in Figure 2(a) and 0.091 in Figure 2(b). Accordingly, the strong relationship in Figure 1 is not observed here.

(a)



(b)

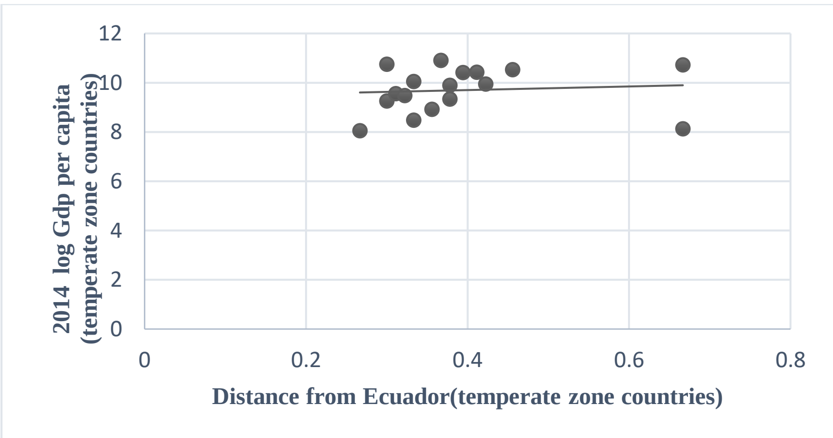


Figure 2: 2014 log GDP per capita and distance from Equator (tropical and temperate zone countries)

We observed no strong correlation between equator distance and per capita income level, and this seems to be substitutable because of the positive relationship between the tropical zone and per capita income level (Figure 3).

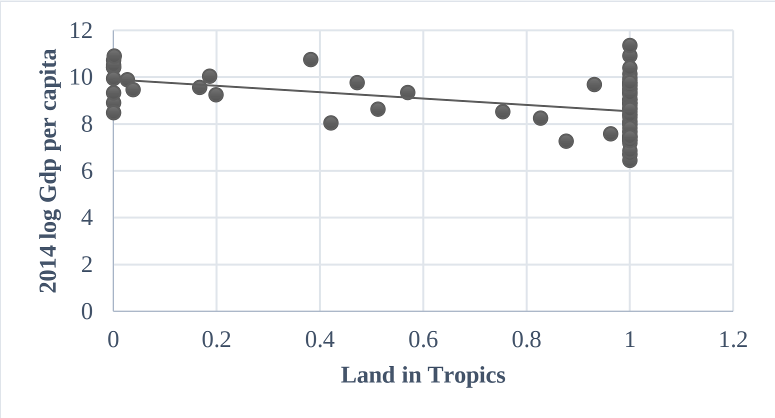


Figure 3. 2014 log GDP per capita and land in the Tropics

Another geographical determinant that cannot be measured by the mathematical location of countries is sub-Saharan Africa (SSA) geography. The SSA countries, characterized by disease, poverty, internal turmoil, and political instability, which threaten public health, are of particular importance when describing the geography (Diamond, 1998; La Porta et al., 1999; Béguın et al., 2011). This situation indicates that variables used for geography are insufficient to describe the negative effects of SSA geography. For this reason, a dummy used to describe the region is frequently included in variable models. However, in some studies, the dummy is not included in their main models; in these models, the dummy is a common explanatory variable, especially in measuring the sensitivity of the established model and have statistically significant coefficient values.[4] On average, countries in this region have lower incomes than in other parts of the world (Figure 4).

[4] Barro (1991), Sachs and Warner (1997), and Rodrik et al. (2004) have found negative coefficient estimates, showing the negative impact of this geography on economic development when dummies are used for sub-Saharan African countries.

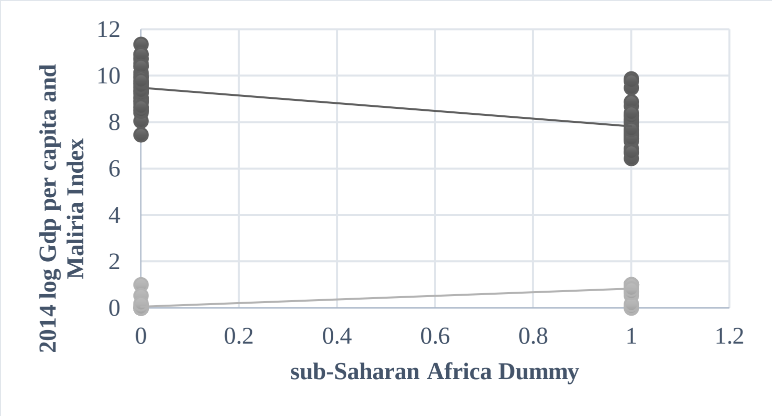


Figure 4: 2014 log GDP per capita and the Malaria Index for sub-Saharan African countries

Notes: This distribution chart shows the income level and the malaria index value compared with other regions in the SSA countries. It shows the upward trend of the malaria index, which is sloping positively and becomes dimmer, in SSA countries.

The relationship of causality with the fundamental determinants of economic development, such as the nature of the institutional structure and disease ecology, reveals the problem of simultaneity between income level and the dummy used for this geography. To solve this problem, using a dummy that does not involve income level and causality but depicts this group of countries is an appropriate method. This variable is used as the risk of exposure to a specific type of malaria disease, plasmodium falciparum, in the countries in this study. Figure 4 shows that the risk of malaria tends to be higher in SSA countries. Although some have argued that a country's level of income has a critical effect on the elimination of the disease (Acemoglu et al., 2001; Rodrik et al., 2004), the geographical distribution of the disease is remarkable. The risk of the disease is high in the tropical region compared with other parts of the world (WHO, 2015). Thus perhaps, the geographical and ecological reasons, rather than the economic conditions of the countries, are outweighed, and the disease becomes permanent in certain geographies. Thus, the risk of the disease is reduced by increasing growth rates over many years in geographic regions with other types of geography. (Gallup & Sachs, 2001; Kiszewski, Mellinger, Spielman, Malaney, Sachs, & Sachs, 2004; Okuneye & Gumel, 2017). This occurs because the number of disease-bearing vectors in excessively hot and humid regions is higher compared with other regions, and genetic variations are substantial over very short distances (Wolfe, Dunavan, & Diamond, 2007).

2.4. Institutional Framework

After specifying the use of a variable that includes a multidimensional description of geography, we identify proxy variables that reveal the nature of the institutional structure, another pillar of the model to be created. Different indicators are used in the economic literature to indicate and measure institutional quality.

The database called Economic Freedom of the World (EFW) is published by the Fraser Institute and used in this study because it measures many aspects of institutional quality (Hall & Jones, 1999; Acemoglu et al. 2001; Bennett et al., 2017). The rule of law index is a critical indicator of the institutional structure because it covers many other variables related to the institutional quality and makes significant use of other databases created to measure the quality of the institutional structure (Rodrik et al., 2004; Skaaning, 2010, p. 456-458). Table 2 shows the correlation between EFW, the rule of law index published by the World Bank, and per capita income level. The higher correlation is observed in the rule of law between the quality of the institutional structure. For these reasons, this index is used in this study to determine the institutional quality.

Table 2: Correlations between EFW, Rule of Law, and GDP per capita

2014 log GDP per capita	Rule of Law	EFW	
1	0.6957	0.4874	2014 log GDP per capita
	1	0.7595	Rule of Law
		1	EFW

It is highly correlated with the institutional structure because of this problem: the institutional structure determines the economic performance but affects the income level; thus, a variable with a low correlation to income level is necessary (Hall & Jones, 1999; Chong & Calderon, 2000). However, opinions differ in terms of determining the instrument for this variable. The policies of Europeans in the colonial process were determined by the settlement conditions. In the colonies where the population density was high and the Europeans faced a serious threat of death, they preferred to exploit resources instead of establishing European economic and political institutions (Acemoglu et al., 2001; Acemoglu et al., 2002). Due to the less-developed institutional structure in regions with high population density, economic performance has not developed sufficiently (Acemoglu et al., 2001).

Because the population density in 1500 has a very high variance, standardization is applied to this data with the formula $x^s=[(x_i-\bar{x})/\sigma_x]$, where x_i and x^s denote log population density in 1500 for colony i and its standardized value, respectively; $\bar{x}$ is mean of the data; and σ_x is the standard deviation of the data.[5] In 1500, the average per capita income level in the regions where the local population is high is limited (Figure 5[a]). Together with the regions with high population density, Acemoglu et al. (2001) expressed that the high mortality rates of European settlers caused the exploitation of resources and the lack of institutionalization in the old colonies. Figure 5(b) illustrates the negative correlation between settler mortality and the rule of law index. However, Albouy (2012) stated that the mortality data of European settlers is designed, in a sense, to provide the desired results; therefore, it has been an unsuitable instrument for institutional quality. Acemoglu et al. (2005), in contrast to Albouy's assertion, claimed that the data on the mortality rates among settlers are based on solid ground but that the data from the author are insufficiently elaborated and include arbitrary assessments; nevertheless, according to them, mortality data can be made more consistent by combining more sources with more realistic data. Because which institutional variable should be used it a controversial topic, we use both competing instruments in our model to explain the conditions for European settlers.

In addition to the settlement conditions in the colonies, the identity of the colonizer is a critical factor in determining their institutional quality (La Porta et al., 1999; Klerman, Mahoney, Spamann, & Weinstein, 2011; Bennett et al., 2017). In the French colonies, indigenous people were under considerable political and economic pressure, and in the

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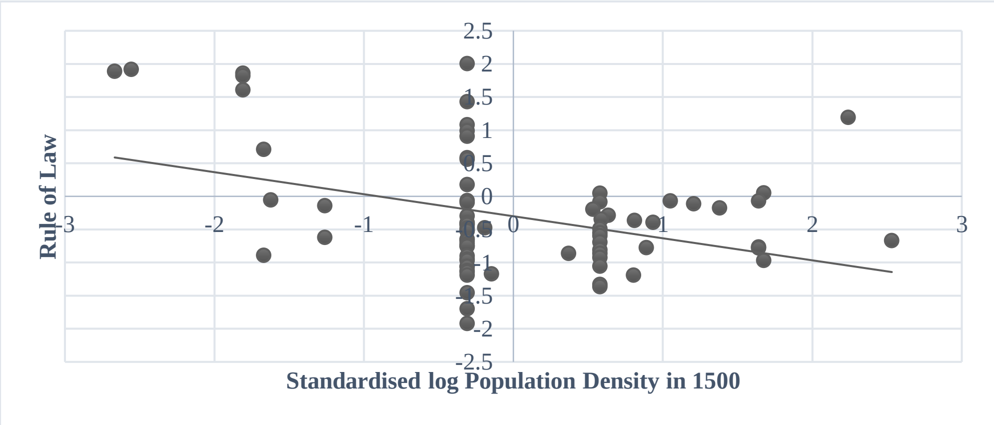
[5] Bennett et al. (2017) standardized the same data using the formula $x_s = 1-(x_i / x_{max})$ where x_s and x_i are the adjusted and nominal population densities in 1500 for colony i, respectively, and $x_{max} = \bar{x} + 0.25\sigma_x$. However, in this study, we use the formula $x_s = [(x_i-\bar{x}) / \sigma_x]$ in the standardization process because the values they found were a decreasing function of the data; therefore, the interpretation of the variable coefficients might be strange.

British colonies, this phenomenon was less common (Michelman, 1995; Lee & Schultz, 2012). Thus, British colonies have better economic performance than the other colonies (Bertoechi & Canova, 2002, p. 1859-1861). Figure 5(c) shows the rule of law index in British colonies and other colonies, and we observe that, compared with the other colonies, the colonies formed by England have a greater number of qualified institutions. Therefore, we include this variable as an instrumental variable in our model.

(a)



(b)

(c)

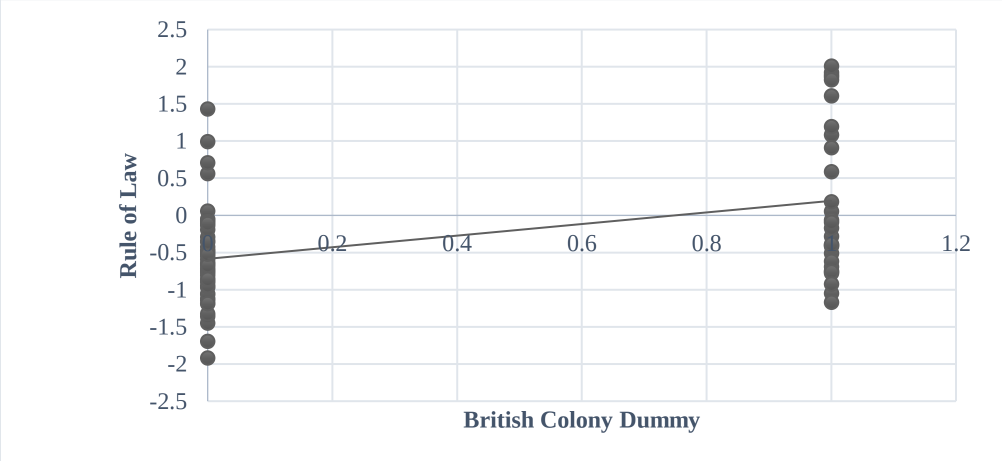


Figure 5: Rule of law and its instruments

3. Empirical results: regression analysis for the economic development determinants

3.1. Descriptive Statistics

Table 3 presents summary statistics of the variables used in the study. In the sample of 79 countries, the country with the highest income per capita is Singapore, with USD 85,227, and the country with the lowest income per capita is the Central African Republic, with USD 629. The highest rule of law index is New Zealand, with a value of 2.01, and Venezuela has the lowest value (-1.91). Additionally, 39% of the countries in the sample are in SSA, 18% are in Latin America, and 36% are in the former British colony. Egypt and Canada are the most and least densely populated countries in 1500. Canada is also one of the few populations of the country. Europeans experienced the highest mortality rates in Mali, and the lowest mortality rates were in Australia.

Table 3: Descriptive statistics

	Mean	Std. Dev.	Min.	Max.	N
log Gdp	8.82	1.16	6.44	11.35	79
SSA	0.39	0.49	0.00	1.00	79
Rule	-0.29	0.88	-1.91	2.00	79
EFW	6.55	1.02	3.28	9.00	79

Tropics	0.43	0.48	0.00	1.00	79
Malaria	0.35	0.44	0.00	1.00	79
British	0.36	0.48	0.00	1.00	79
Population	-0.01	0.98	-2.67	2.53	79
British*Population	-0.03	0.74	-2.67	2.24	79
Mortality	4.68	1.21	2.14	7.98	79
British*Mortality	1.52	2.20	0.00	7.60	79

3.2. OLS Results

Table 4 presents the OLS results. In the first model, African countries' qualitative explanatory variable is statistically significant at the 1% level. In Model 2, Tropics is significant at the 10% level and is negatively marked in line with expectations, and the SSA remains significant at 5%.

Table 4: OLS Regression Results

	(1)	(2)	(3)	(4)
SSA	−1.66***	−1.50***	−1.23***	−1.23***
	(0.19)	(0.20)	(0.17)	(0.17)
Rule			0.65***	0.64***
			(0.09)	(0.11)
Tropics		−0.59**	−0.07	−0.08
		(0.27)	(0.21)	(0.22)
British				0.05
				(0.16)
N	79	79	79	79
F-static	75,68		73,15	54,57
Adj. R-square	0.49	0.51	0.71	0.71

Notes: Dependent variable is the natural logarithm of per capita income based on purchasing power parity (World Bank, 2017a). SSA is a dummy variable describing sub-Saharan African countries; Rule is the index value of the rule of law of 2014 in the database of World Governance Indicators of the World Bank (2017b). Tropics cover the surface area of countries in the tropical region (Gallup et al., 1999). British is a dummy variable of British colonies that takes the value of 1 if the country in question is a British colony (Klerman et al., 2011). The expressions in parentheses show the robust standard errors of coefficient estimates. The *,

, and * symbols indicate significance levels of 1%, 5%, and 10%, respectively. Detailed explanations and sources of the variables are presented in Table 1.

In Model 3, Rule is included and is positive as expected; it is also statistically significant at the 1% level. In this model, SSA remains statistically significant, but Tropics is no longer statistically significant. In Model 4, the dummy of the British colonies was included, and as expected, British is positive but not statistically significant; the results and Model 3 remain essentially unchanged.

3.3. Two-Stage Least Squares (2SLS) Regression Results

Table 5 shows the main regression results. Panel A presents the 2SLS regression results; Panel B shows the first stage regression results. In Table 5, the OLS estimates are biased for all models, according to the Hausman test, at the 5% significance level. Moreover, considering the Sargan test results, we conclude that the instruments used for Models 1, 2, 3, 5, and 7 are valid. For Models 4 and 6, we conclude that all instruments are valid at the 10% significance level.

In Model 1, we use Population for the quality of the institutional structure, and in Model 2, we use Mortality as an instrument. In both of these models, the institutional structure has a positive effect on economic development and a statistically significant effect at the level of 1%. SSA remains negative and statistically significant; Tropics is not statistically significant. The first stage regression results show that where the rule of law is a dependent variable, the coefficient representing the British colonies is better than the coefficient representing the settlement conditions in the colonies in the first model, both quantitatively and qualitatively, in the second model. In Model 1, British and Rule are statistically significant at the 1% level, and Population is statistically significant at 5% level. In Model 2, although the coefficients of British and Mortality are statistically significant at 1% level, the coefficient of British is greater than that of Mortality in absolute value.

In Model 3, we include a British dummy as a dependent variable to evaluate the claim that the country that established the colony made this decision by considering the settlement conditions in the colonies. Because Acemoglu et al. (2001); Auer (2013); and

Ertan, Fiszbein, and Putterman (2016) have claimed that the settlement conditions in the colonies and the geography in which the colony is located significantly determined the British policy of colonization. However, as the first stage regression shows, the only statistically significant relationship is between Mortality and the identity of the colonizer at the 5% level.[6] In this model, as in the first two models, the coefficient estimates of SSA and Rule are statistically significant at the 1% level, with negative and positive signs, respectively. Therefore, even if the current institutional performance differences in colonies are the result of the colonization policy, our main results remain unchanged.

In Models 4 and 5, Population and Mortality and their common effects are included to explain the determinants of the institutional structure. As in Models 1, 2, and 3, the negative impact of the institutional structure and SSA on economic development is observed at the 1% significance level; coefficients of tropical climate characteristics are negative but not statistically significant. According to the first stage, British is statistically significant at 1%, Population*British at 5%, and Tropics at 5%. Notably, British*Population and British*Mortality are negative, although British is positive, as expected.

To address the negative impact of SSA geography on countries' economic performance, we use two countries: Guatemala and Burundi. In 2014 (PPP basis), Guatemala has a per capita income of USD 6603, and the income level of Burundi is USD 707. The countries' similarities are as follows: institutional performance, the rule of law index value (-0.68), tropical climate zone, and not British colonies. Geographically, Guatemala is a Latin American country, and Burundi is an SSA country. The malaria index is very low in Guatemala, and in Burundi, it is the highest value. Considering this situation, Burundi should earn 22% ($e^{-1.51}$) of Guatemala's income in SSA, according to Model 1 in Table 5, provided that other determinants of income are equal. According to Model 2, where Mortality is an instrument, Burundi should have 25% ($e^{-1.37}$) of Guatemala's income. Notably, Burundi accounts for 11% of Guatemala's income. Therefore, according to Model 1, 50% of the actual

[6] Population coefficients are not statistically significant even in the regressions that comprise only British and Population; British is a dependent variable, and Population is an independent variable.

income difference between Burundi and Guatemala, and according to Model 2, 44%, are due to the negative impact of SSA geography on economic development.

Next, we evaluate the two countries to understand the effects of the differences in institutional structure on economic development: Ghana and Liberia. Ghana's per capita income level in 2014 (PPP basis) is USD 4,032, and Liberia's is at USD 1,315. These two countries are located in SSA and the tropical zone. However, the rule of law index is 0.05224 for Ghana and 0.80579 for Liberia. For Ghana and Liberia, the malaria index is equal to 1, the highest value. Ghana is a British colony, and Liberia is not colonized. Both regions have an equal population density in 1500; however, Ghana has a slightly higher settler mortality rate. Considering the values in Table 5, when all other variables affecting the income level are equal for these two countries, the difference estimated for the rule of law index of two countries, according to the first stage in Model 1, is equal to 0.67, which is the coefficient of the British. The real difference is 0.85 (0.05 - (- 0.80)). According to Model 1, Ghana's per capita income level should be 2.11 ($e^{0.75}$) times higher than Liberia's income level. Notably, Ghana is 3.06 times richer than Liberia. When these results are considered, 69% of the income gap between these two countries, which are similar in terms of geographical characteristics, is due to the difference between their institutional structures. According to Model 2, the difference between the two countries' rule of law index value is 0.44; additionally, Ghana should be 1.72 ($e^{0.54}$) times richer than Liberia. Accordingly, 56% of the difference in economic development between these two countries, which are similar in terms of geographical characteristics, stems from the difference between the institutional performances of the two countries.

The analysis of the main results obtained in Models 1 and 2 to test the sensitivity of the EFW index is presented in Models 6 and 7. The EFW index is expressed as a more successful alternative in terms of measuring the quality of the institutional structure of countries (Acemoglu et al., 2001; Bennett et al., 2017). In Model 6, Population is used as the instrument for the institutional structure; in Model 7, Mortality is used. The results are largely similar, but there are minor differences compared with the results of Models 1 and 2 in Table 5. The coefficient estimates of EFW and SSA are statistically significant at the level of 1% in these three models, and the signs of these coefficients are positive and negative, respectively. In addition, Tropics is statistically significant in the second model at a level of 10% and in fourth model at the 5% level. When Rule is a dependent variable in the first stage regressions, British is statistically significant at 1% level in both models. In Model 6 only, Population is statistically significant at the level of 10%.

Model 8 uses a sample excluding neo-European countries to test the validity of the results of the main model. In Model 8, although the neo-Europes are excluded from the sample, no significant difference is observed in the second stage results. If the first stage regressions of this model are examined, only British is effective on the institutional structure. As in the models in Table 5, the statistically strong relationship between Malaria and SSA is maintained in Models 1 and 2.

Table 5: Main 2SLS results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Second Stage Regression Results (Log Gdp is the dependent variable)								
SSA	−1.37***	−1.48***	−1.41***	−1.41***	−1.50***	−1.31***	−1.44***	−1.24***
	(0.19)	(0.18)	(0.35)	(0.18)	(0.17)	(0.29)	(0.27)	(0.25)
Rule	0.88***	0.64***	1.29***	0.79***	0.61***			1.16***
	(0.14)	(0.14)	(0.30)	(0.12)	(0.14)			(0.27)
Tropics	0.22	0.03	0.52	0.15	0.01	−0.44	−0.44*	0.04
	(0.23)	(0.22)	(0.43)	(0.23)	(0.22)	(0.28)	(0.25)	(0.28)
British			−1.49					
			(1.04)					
EFW						0.74***	0.57***	
						(0.16)	(0.18)	

Panel B: First Stage Regression Results for Endogenous Variables (SSA, Rule, British, and EFW)

	(1)		(2)		(3)			(4)		(5)		(6)		(7)		(8)	
Dependent Variable	Rule	SSA	Rule	SSA	British	Rule	SSA	Rule	SSA	Rule	SSA	EFW	SSA	EFW	SSA	Rule	SSA
Malaria	−0.23	0.92***	0.15	0.94***	0.16	0.24	0.94***	−0.28	0.92***	−0.02	0.93***	−0.43	0.92***	−0.23	0.94***	−0.28	0.93***
	(0.20)	(0.06)	(0.27)	(0.12)	(0.17)	(0.25)	(0.11)	(0.20)	(0.08)	(0.31)	(0.14)	(0.26)	(0.08)	(0.35)	(0.12)	(0.21)	(0.06)
British	0.67***	0.04	0.53***	0.04				0.65***	0.04	2.07***	0.11	0.80***	0.04	0.73***	0.04	0.53***	0.05
	(0.16)	(0.06)	(0.16)	(0.07)				(0.16)	(0.06)	(0.65)	(0.41)	(0.20)	(0.06)	(0.20)	(0.07)	(0.17)	(0.07)
Population	-0.26**	-0.00			0.02	-0.20**	-0.00	-0.04	0.00			-0.19*	-0.00			-0.17	-0.01
	(0.10)	(0.01)			(0.05)	(0.10)	(0.01)	(0.11)	(0.02)			(0.10)	(0.01)			(0.12)	(0.03)
Mortality			−0.30***	-0.01	−0.18**	−0.33***	-0.01			−0.06	0.00			−0.17	-0.01		

			(0.10)	(0.04)	(0.07)	(0.11)	(0.04)			(0.13)	(0.09)			(0.12)	(0.04)		
British* Population								-0.36**	−0.01								
								(0.17)	(0.03)								
British* Mortality										−0.33**	−0.01						
										(0.12)	(0.07)						
Tropics	−0.78***	0.10	−0.58**	0.11	0.07	-0.59**	0.11	−0.71**	0.10	−0.56*	0.11	-0.01	0.10	0.11	0.11	−0.48	0.08
	(0.27)	(0.12)	(0.29)	(0.11)	(0.14)	(0.27)	(0.11)	(0.28)	(0.12)	(0.30)	(0.11)	(0.35)	(0.42)	(0.37)	(0.12)	(0.33)	(0.17)
N	79		79			79		79		79		77		77		75	
F-static	49.19		49.73			17.99		53.64		49.26		31.62		34.42		34.15	
Adj. R-square	0.70		0.70			0.49		0.71		0.71		0.53		0.55		0.65	
p(Hausman χ^2)	0,00		0.01			0.00		0,00		0.01		0.00		0.00		0.00	
p(Sargan Im)	0.11		0.71					0.09		0.85		0.04		0.52		0.03	

Notes: Table 5 shows the main regression results. The dependent variable is the natural logarithm of per capita income (PPP basis) in 2014 (World Bank, 2017a). Panel A presents the second stage regression results; Panel B contains the first stage regression results. SSA is the dummy variable describing sub-Saharan African countries; Rule is the index value of the rule of law of 2014 in the database of world governance indicators. Tropics is the surface area of the countries in the Tropics (Gallup et al., 1999). British is the dummy variable of British colonies that equals 0 if the country in question is a British colony or 0 otherwise (Klerman et al., 2011). In Models 6 and 7, the 2014 EFW index is used instead of the Rule of Law index to measure the quality of the institutional structure in all models. Because there is no EFW data for Lao, Pdr, and Sudan, the sample comprises 77 countries. Model 8 excludes from our main sample neo-European countries (the United States, Australia, Canada, and New Zealand). p (Hausman χ^2) shows that the p value of the null hypothesis is based on the hypothesis that OLS estimates are unbiased. p (Sargan Im) indicates the p value of the Sargan overidentification test based on the null hypothesis that all instruments are valid. The expressions shown in parentheses indicate the robust standard errors of coefficient estimates. The *, **, and *** symbols indicate significance levels of 1%, 5%, and 10%, respectively. Detailed explanations and sources of the variables are provided in Table 1.

4. Discussion of the results

In all models created in the study, the dummy presenting SSA countries maintains its significance at the level of 1%. This finding shows that the negative impact of this geography on economic development remains persistent. This piece of data provides insights into the reasons for the differences in economic development. However, intellectual curiosity regarding what is the underlying cause of this data in this geography increases once more.

When the institutional structure formed by individuals in a society directs the behavior of the economic decision units, comprising individuals, firms, and governments in a manner that contributes to economic development, useful results occur on behalf of society (North, 1981,1991; Hall & Jones, 1999; Acemoglu et al., 2001). The differences in institutional structure remain positive for economic development, despite different control variables and different measurements of institutional structure in our main model, because Rule, which shows the quality of institutional structure, is positive and statistically significant at 1% in all models. Therefore, for policymakers aiming to achieve economic development, the positive and statistically significant relationship of the institutional structure on economic development is a guide. Thus, policy designs that may adversely affect the institutional structure in the policy setting process can be eliminated. Similarly, when evaluating the success of the policies implemented, it becomes important to monitor the impact of the policy on the institutional structure.

5. Conclusion

The main reasons behind the differences in economic development have been a matter of curiosity. To clarify this issue, different approaches and the following models have been developed in the economic literature. In the models created to determine the fundamental causes of economic development differences, which proxy variables are used and how the model is created have led to different and sometimes conflicting results. To overcome this problem, we evaluated different concrete variables (proxies) and model identifications for geography and institutional structure.

In our main model, where the 2SLS method was used, we used the malaria index as an instrument for sub-Saharan African countries. In particular, we used the population density in 1500, the settler mortality data, and the dummy for British colonies as the instrument for the institutional quality differences observed in the colonies today. However, the accuracy of settler mortality data is controversial in the literature. For this reason, in the models we defined, we used the indigenous population density in 1500 and the settler mortality rates to explain institutional performance. However, our results remained essentially unchanged. When the tropical zone elements are controlled, according to the model results, we use the indigenous population density in 1500 as an instrument for institutional structure differences, and the countries in the SSA geography have an income level that is 25% that of the other parts of the world. Additionally, a one-point improvement in institutional quality increases per capita income by 0.88 log-points. According to the model results, we use the settler mortality data as an instrument for institutional structure differences, when the tropical climate is controlled, sub-Saharan African countries reach 23% of the income level of the other regions of the world, and a one-point increase in institutional quality increases the per capita income level by 0.64 log-points. In both models, the variable that denotes the tropical zone is not positive and statistically significant. Standard errors related to coefficient estimates in our main model in this study are lower compared with the standard errors in Acemoglu et al. (2002, p. 1386), Rodrik et al. (2004, p. 31-32), and Bennett et al. (2017, p. 510). Therefore, coefficient estimates in the main model appear to be relatively unbiased estimators of actual coefficient estimates.

In this study, the negative effects of SSA geography on economic development are emphasized; however, except for a few indicators, the factors that negatively affect the economic performance of this geography are not fully explained. The introduction of these elements would significantly help development policies in this region. The variables used to determine settlement conditions in the old European colonies should be made more coherent and holistic. This is critical to demonstrating the external impact of institutional performance differences.

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