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What are the factors associated with longer life expectancy across low- and middle-income economies in Africa and South Asia?

I. Abstract

The study aims to explore the factors associated with longer life expectancy across low- and middle-income economies in Africa and South Asia based on the World Bank data from 2009 to 2019. The goal of the research is to find the factors that policymakers in the countries of interest should focus on, depending on the location and economic status of the country.

Our results show that higher HIV incidence and child mortality, lower access to sanitation services, and lower GDP per capita have a significant negative impact on life expectancy in African and South Asian countries. We recommend that low-income countries should particularly focus on reducing the HIV rate. We refrain from giving specific recommendations based on the location of the country due to the limited data availability for South Asia. Finally, we suggest that international aid from development agencies might be useful for increasing life expectancy in developing countries, thanks to its potential indirect effects on improving the healthcare sector in these countries.

II. Introduction

In both developed and developing countries, life expectancy has been used not only as an indicator of mortality but also as an economic development indicator. Life expectancy has increased dramatically over the past few decades. Demographic studies indicate that no country

in the world had a life expectancy longer than 40 years in the 19th century, and the entire world was living in extreme poverty (Roser et al. 2013). There has been an opposite trend in global poverty rates and life expectancy. The World Bank indicates that only 9.2% of the world's population lives in extreme poverty today, living on less than $2.15 per day (World Bank: 2022). At the same time, a significant increase in life expectancy has occurred with the decline in poverty rates, ranging from 30-40 years in the 19th century to 45-85 years in 2005 (Riley:2005). Countries with low life expectancy tend to be in extreme poverty. However, the poorest countries in the world are not necessarily the ones with the lowest life expectancy. Additionally, economic growth does not necessarily translate into high life expectancy growth today. Some countries, for example in Sub-Saharan Africa, with the fastest growing economies, are experiencing a decrease in life expectancy (Shahbaz et al.2015)

This study examines the factors associated with higher life expectancy in low- and middle-income countries in Africa and South Asia based on recent data collected from 2009 through 2019. Since a number of studies have been using data collected in the past decades, it is important to use novel data to examine what relevant factors determine life expectancy today, which will help in deciding what pertinent factors to prioritize. Our goal is to determine the relevant policies to improve longevity in low- and middle-income countries in those regions.

III. Literature Review

Several recent studies have found that the factors determining life expectancy vary across regions and economies, as well as over time. Studies that are devoted to assessing possible determinants of life expectancy in the second half of the 20th century have indicated that socioeconomic factors play a significant role in determining life expectancy (Peston 1975, 1975, 1980; Kakwani: 1993; Grosse and Aufiey: 1989). Factors like income, education, health care

spending and input, access to safe drinking water, nutritional outcome, as well as the geographic location of a country have been appearing to be statistically significant determinants of life expectancy in developing countries.

In the past few decades, income has received a lot of attention as a major life expectancy indicator. This is due to how countries, particularly developed ones, have invested in social sectors like education. Those changes have led to lower poverty levels, better literacy rates, improved sanitation, easier access to water, and better nutrition, all of which have led to longer life expectancy (Shawhbaz et al:2015). The World Bank shows that there is a strong relationship between the absolute level of income, measured in GDP per capita, and longevity by reporting that income per capita increases life expectancy, especially in developing countries (World Bank:2003). A cross-national comparative study done by Anand and Ravallion found a very significant relationship between GNP and life expectancy (Anand & Ravallion: 1993). Subramanian et al. add that poverty among societies is mostly related to poor health of the society (Subramanian et al: 2002). Additionally, Wilkinson studied the nonlinear relationship between longevity and economic growth. He found that the relationship between life expectancy and income disappears after achieving a threshold of per capita income. Further, an increase in income has a zero effect on life expectancy (Wilkinson:1996).

While life expectancy has been increasing thanks to improvements in socio-economic determinants of health, the same is not true for all regions. Riley (2005) examined regional historical life expectancy data between 1800 and 2001 and found that life expectancy has increased at different rates across the regions (Riley:2005). Life expectancy in a region like Africa has been growing at a slower rate compared to regions like Europe and the Americas (Riley:2005). This can be attributed to the lagging economic development in many African

countries. Moreover, Kabir's study (2008) explored socioeconomic determinants of life expectancy in developing countries using multiple regression and probit models of aggregated and disaggregated level data. He found that the variables traditionally considered to be significant determinants of life expectancy in previous studies of the 20th century may not necessarily increase life expectancy in developing countries. Instead, the geographic location of a country and physician/population ratio are significant determinants in his study (Kabir:2008). This conclusion has also been made by Shen and Williamson (1997).

Some regions have higher mortality rates than others due to various reasons beyond economic status. For example, in African and Asian regions, infectious diseases are still the leading cause of death, especially in children below 5 years of age (MacLennan:2014). The high infant mortality due to infectious diseases like malaria, diarrhoeal diseases, and other deaths caused by AIDS and security issues explain Africa's life expectancy disadvantage. In 2020, Sub-Saharan Africa accounted for about 95% of all cases of malaria and 96% of all malaria deaths, with about 80% of these deaths reported in children under the age of 5 (Oladipo et al. 2022). This makes Africa have the highest incidence of mortality caused by infectious diseases, exacerbated by a lack of the capacity to manufacture vaccines that are essential to reduce mortality, improve life expectancy, and promote economic growth (Makenga et al:2019).

Various studies on life expectancy have been conducted over time based on different data sources gathered during times when most of the countries studied were dealing with political conflicts, civil wars, recovering from global recessions, etc. Our study uses recent data from 2009 to 2019, a period between the Global Recession of 2008 and the COVID-19 pandemic, to assess what factors are the most relevant in improving life expectancy for low-income and middle-income economies in Africa and South Asia.

IV. Economic and Econometric Models

The primary goal of this paper is to investigate what determinants of life expectancy tend to matter the most in developing countries (low-income and middle-income economies) across two regions (Africa and South Asia). We consider life expectancy (LE) as a function of economic factors (E) and non-economic factors (NE). The relationship can be studied using the following models:

$LE = f(E, NE)$ (1) Life expectancy as a function of economic and non-economic factors

$Y = \beta_0 + \sum_{J=1}^{k} \beta_j X_k$ (2) Economic Model

$Y = \beta_0 + \sum_{J=1}^{k} \beta_j X_k + u$ (3) Econometric Model

$\widehat{Y} = \widehat{\beta_0} + \sum_{J=1}^{k} \widehat{\beta_j} X_k + \widehat{u}$ (4) Sample Regression Model

$Y_{it} = \beta_0 + \sum_{j=1}^{k} \beta_j X_{itk} + \delta V_i + u_{it}$ (5) $\rightarrow Y_{it} = \alpha_i + \sum_{j=1}^{k} \beta_j X_{itk} + u_{it}$ (5) Country-Fixed Effects Regression Model

$Y_{it} = \alpha_i + \lambda_t + \sum_{j=1}^{k} \beta_j X_{itk} + u_{it} \rightarrow Y_{it} = \alpha_i + \delta_t \Lambda_{ti} + \sum_{j=1}^{k} \beta_j X_{itk} + u_{it}$ (6) Country- and Time-Fixed Effects Regression Model

Equation 1 shows the life expectancy (LE) as a function of all the factors that can be grouped into Economic factors (E) and Non-Economic factors (NE). Our study uses economic factors such as GDP per capita, net official flows of aid from UNDP, net official flows of aid from UNICEF, labor force participation rate, and a dummy variable for the economic status of a country. For non-economic factors, we use variables like HIV cases, Hepatitis B vaccination, the

percentage of the population using at least basic sanitation services, the mortality rate for children under 5 years old, and a regional dummy variable.

The Second equation is the general economic model of that relation. Y is life expectancy (LE), which is equal to the intercept plus the sum of X variables, each multiplied by its coefficient. X represents the economic factors and non-economic factors, combined. K is the number of our variables, and J represents the number of the variable coefficients. The list of factors affecting life expectancy cannot be exhaustive. It includes some factors that can be measurable and observable and others that cannot.

To capture all the factors associated with life expectancy, we use an econometric model, equation 3, which includes the error term "u". This is a regression function that shows the change in life expectancy given variables Xs. Due to data limitations, we use a sample regression model to study the relationship between Xs and Y based on sample data sets. We then use the OLS regression model, equation 4, to estimate the impact of our variables on life expectancy in low- and middle-income countries in Africa and South Asia. Because we are using panel data from 2009-2019, to rely on the OLS model is to ignore the potential to account for fixed effects. Not controlling for them would result in omitted variable bias. The solution to that is to use fixed-effects regression models in our study, equation 5, where α_i are unobserved time-invariant heterogeneities across the countries, i=1,…,29 countries, used in our research. Our goal is to estimate β_j, the effect on Y_i of a change in X_i, holding α_i constant. We also include time-fixed effects, in addition to country-fixed effects. Equation 6 is our complete model, where we control both time- and country-fixed effects to assess changes in life expectancy over the course of our time period.

V. Data and Sources

The data used for our project is a panel dataset downloaded from the World Development Indicators section on the World Bank Open Data website. We chose to use this data source because it contains comprehensive information about the countries we wanted to focus on in our research. Additionally, we were specifically looking for a longitudinal dataset that would allow us to control for fixed effects in our regression models and have a larger sample size.

Our dataset includes 319 observations. Each observation represents a country in a specific year from 2009 to 2019. The years were chosen based on the assumption that the Global Financial Crisis of 2007-2008 and the COVID-19 Pandemic that started in 2020 might have influenced life expectancy across the countries. Therefore, we decided to focus on the time period between these two events. Our data contains information about 29 countries in Africa and South Asia. Due to the availability of data for the life expectancy factors we wanted to explore, the only South Asian countries in our dataset are Afghanistan, Bangladesh, India, and Sri Lanka. The other 25 countries are located in Africa, mostly in Sub-Saharan Africa, except Algeria. All countries included in our data are defined as low- or middle-income economies by the World Bank. One of the problems encountered was that the World Bank's classification of countries' economic status changed throughout the years for some of our countries of interest. We solved this issue by analyzing the classification from 2009 to 2019 and assigning a country the economic status it had for the majority of these years. For example, Bangladesh was classified as a low-income economy in 2009-2013 and as a low-middle-income economy in 2014-2019. Therefore, in our data, Bangladesh belongs to the middle-income category.

The left-hand side variable we focused on is life expectancy at birth, measured in years. To start with, we wanted to see how varied the life expectancy is in the dataset for different

groups of countries to be able to make judgments about the economic significance of various variables later in our research. The summary statistics of life expectancy are presented in Figure 1. The average life expectancy in the sample is equal to 61 years, however, its variation is quite large, with the lowest life expectancy at 44 years and the highest at over 76 years. Moreover, we noted that the middle-income economies have the highest variation of life expectancy compared to other groups we looked at. Additionally, we found that the mean life expectancy is higher for countries in South Asia and middle-income economies compared to the countries in Africa and low-income economies, respectively. Again, it is important to underline that the sample size of African countries is much larger than that of South Asian countries. So, the summary statistics for countries in Africa might be more representative and informative of the region as a whole.

VI. Estimated Models

We decided to estimate five regression models. We focused on the following independent variables: natural logarithm of GDP per capita (current US$), mortality rate under 5 (per 1,000 live births), net official flows from UNICEF (thousands of current US$), net official flows from UNDP (thousands of current US$), the incidence of HIV (per 1,000 uninfected population), immunization rate against Hepatitis B (% of one-year-old children), percentage of the population using at least basic sanitation services, and labor force participation rate (% of total population ages 15+). We encountered a few issues with our initial dataset, however, we resolved them through several steps. First, we decided to drop the variables that described the immunization rates against DPT and measles, since they were highly correlated with each other and the immunization against Hepatitis B (Figure 2). Including all of these variables in our models would result in less reliable results, therefore we decided to keep just one of them. The decision to keep the Hepatitis B immunization rate was arbitrary. We followed the same procedure for the

mortality rate for children under 5 and infants (Figure 3) and decided to use the mortality rate for children under 5 in our models. Second, we took a natural logarithm of GDP per capita, since it is generally assumed that it is growing exponentially rather than linearly. Last, we transformed the net flows from UNICEF and UNDP from current US dollars to thousands of current US dollars to make the estimated coefficients more legible.

The models' results are demonstrated in Figure 4. All regressions are estimated with the 'robust' option in Stata to account for the fact that our data might be heteroscedastic and obtain unbiased standard errors. The first model is an ordinary least squares (OLS) regression.

(1) $life\_exp = \beta_0 + \beta_1 ln\_gdpcap + \beta_2 mort\_under5 + \beta_3 unicef\_thdol + \beta_4 undp\_thdol + \beta_5 hiv + \beta_6 im\_hepb3 + \beta_7 san\_access + \beta_8 lfpr + \beta_9 A + \beta_{10} low + u$

This regression is the least informative one in our research because it has the highest chance of omitted variable bias occurrence since it disregards the fact that we have longitudinal data that has the potential to allow us to control for entity- and time-fixed effects.

The next four models were all fixed-effects models with different variations. Model 2 is equivalent to the OLS model, however, it accounts for country-fixed effects. In this model, the binary variables indicating the region and economic status of the country - A and low, respectively - are dropped because they are constant for each country over time.

(2) $life\_exp_{it} = \beta_0 + \alpha_i + \beta_1 ln\_gdpcap_{it} + \beta_2 mort\_under5_{it} + \beta_3 unicef\_thdol_{it} + \beta_4 undp\_thdol_{it} + \beta_5 hiv_{it} + \beta_6 im\_hepb3_{it} + \beta_7 san\_access_{it} + \beta_8 lfpr_{it} + u_{it}$

Model 3 adds to Model 2 by including the regional controls for certain independent variables by introducing interaction variables into the model. Using interaction variables allowed us to have a cross-regional comparison element for our research, even when the binary regional variable itself would be dropped due to the nature of the fixed-effects model. The interaction

variables we introduced in this model were chosen based on the statistical significance of independent variables in Model 2. Only the variables that were found statistically significant in the previous model were added as interaction variables in Model 3.

(3) $life\_exp_{it} = \beta_0 + \alpha_i + \beta_1 ln\_gdpcap_{it} + \beta_2 mort\_under5_{it} + \beta_3 unicef\_thdol_{it} + \beta_4 undp\_thdol_{it} + \beta_5 hiv_{it} + \beta_6 im\_hepb3_{it} + \beta_7 san\_access_{it} + \beta_8 lfpr_{it} + \beta_9 lngdpcap\_A_{it} + \beta_{10} mort\_A_{it} + \beta_{11} hiv\_A_{it} + \beta_{12} san\_A_{it} + u_{it}$

Similarly to Model 3, Model 4 expands on Model 2 by including the income-level controls for independent variables.

(4) $life\_exp_{it} = \beta_0 + \alpha_i + \beta_1 ln\_gdpcap_{it} + \beta_2 mort\_under5_{it} + \beta_3 unicef\_thdol_{it} + \beta_4 undp\_thdol_{it} + \beta_5 hiv_{it} + \beta_6 im\_hepb3_{it} + \beta_7 san\_access_{it} + \beta_8 lfpr_{it} + \beta_9 lngdpcap\_low_{it} + \beta_{10} mort\_low_{it} + \beta_{11} hiv\_low_{it} + \beta_{12} san\_low_{it} + u_{it}$

Finally, Model 5 controls for both country- and time-fixed effects to control for omitted variables that change over time but affect all countries equally.

(5) $life\_exp_{it} = \beta_0 + \alpha_i + \beta_1 ln\_gdpcap_{it} + \beta_2 mort\_under5_{it} + \beta_3 unicef\_thdol_{it} + \beta_4 undp\_thdol_{it} + \beta_5 hiv_{it} + \beta_6 im\_hepb3_{it} + \beta_7 san\_access_{it} + \beta_8 lfpr_{it} + \delta_2 2010 + \ldots + \delta_{10} 2019 + u_{it}$

VII. Results of Hypothesis Testing

For the reasons explained above, we do not think the results of hypothesis testing for Model 1 are very useful for our research. However, they are useful for comparing the results of this model with the outcomes of the others. We would just like to note that all independent variables used in Model 1 were found statistically significant at a 1% significance level, with the exception of the vaccination rate against Hepatitis B, which is statistically significant at a 5% level of significance. The results of Model 2 which controls for country-fixed effects differ greatly from the first model. In this regression, the estimated coefficients on mortality under-5,

HIV rate, and access to sanitation services are statistically significant at a 1% significance level. The incidence of HIV and mortality under-5 are predicted to have a negative correlation with life expectancy while access to sanitation has a positive correlation with it, all else constant. The HIV rate variable is found to have the most economically significant effect on life expectancy: a one-unit increase in HIV incidence for 1,000 uninfected population is predicted to decrease the life expectancy by 0.865 years - or, equivalently, a bit over 10 months - on average, holding everything else constant and controlling for country-fixed effects. Additionally, the natural logarithm of GDP per capita is statistically significant at a 10% significance level and is estimated to have a positive correlation with life expectancy, ceteris paribus.

Analyzing Model 3, we noted a few interesting changes compared to Model 2. First, unlike in the previous model, net flows from UNDP were found to be statistically significant at a 1% significance level. However, we would like to underline that this variable does not seem to have an economically significant effect on life expectancy. Net flows from UNDP are measured in thousands of current US dollars in the model. Therefore, we could interpret the coefficient on this variable as follows: a one million dollar increase in net UNDP flows is predicted to increase life expectancy just by 0.074 years - around 0.9 of a month - ceteris paribus and controlling for entity-fixed effects. Because we do not consider this variable economically significant, we decided to not include an interaction term between it and the regional control variable in our regression. Second, we found the coefficient on the HIV incidence variable unexpected. We assumed that the HIV incidence would have a greater effect in Africa, but from our model, it appears that South Asian countries are affected by an increase in HIV rate more negatively. Moreover, the coefficient on this variable is very large. Looking at the results, one unit increase in HIV incidence is predicted to decrease life expectancy by 27.5 years in South Asia and by 0.9

years in Africa. The coefficient numerical value for South Asia does not seem to be realistic, which probably is influenced by the small sample size of South Asian countries. Finally, we were surprised to see that access to sanitation was not statistically significant in this model. We conducted a joint significance test for this variable and its interaction term with the regional control variable and did not find statistical significance at any conventional significance level either (Figure 5). Additionally, we decided to conduct a joint significance test for the mortality rate variable and its interaction term with the regional variable since the estimated coefficient on the interaction term was not statistically significant, and we found that these variables are jointly significant (Figure 6).

Analyzing the results of Model 4, we would like to note that controlling for income variations for certain variables through the interaction terms demonstrated that low-income economies are predicted to experience more negative impacts of higher HIV rate and less positive impacts of higher access to sanitation on life expectancy compared to middle-income countries, holding everything else constant. Similarly to Model 3, while the net flows from UNDP are statistically significant, their economic significance is low. Moreover, for this model, we conducted two joint significance tests as well and concluded that while mortality under-5 and its interaction term with the binary income indicator are jointly significant, the natural logarithm of GDP per capita and its interaction variable with the same binary indicator are not (Figure 7 and Figure 8). And, as in other models, the HIV incidence has the highest economic significance: one unit increase in this variable is predicted to decrease life expectancy by 0.723 years - 8.7 months - for middle-income countries and by 1.2 years for low-income countries. Finally, controlling for time-fixed effects in Model 5, we saw a positive association between moving forward one year and having a longer estimated life expectancy. Every new year is consistently

associated with a higher value of life expectancy, ceteris paribus. These results are both statistically and economically significant. In this last regression, however, the variables describing access to sanitation services and the natural logarithm of GDP per capita were not found statistically significant.

VIII. Results Interpretation and Policy

The results from our study show that, as initially assumed, not all the factors impact life expectancy the same. The goal of the study was to identify the current factors that governments and policymakers should treat first when it comes to improving the life expectancy of their citizens. We found variables like HIV incidence, access to sanitation, and child mortality rate to be the main factors that policymakers in both regions and economies should focus on. The results from the 4 different models show that improving sanitation and lowering the HIV case rate and child mortality rate would significantly increase life expectancy overall in our countries of interest. Additionally, HIV incidence in lower-income economies has a higher negative impact on life expectancy than in middle-income ones. Therefore, policymakers in low-income economies should pay particular attention to this indicator. Due to the imbalance of regional observations in our dataset, it is hard to make special recommendations for individual regions in our study.

We would advise governments and policymakers in the countries we studied to emphasize reducing HIV and other infectious disease incidences since they are one of the leading causes of mortality among children under five in Africa and South Asia– another important factor of life expectancy. In addition to putting an emphasis on improving the public health sector, economic development plans that aim to increase GDP per capita should be prioritized as well. We assume that an increase in GDP per capita would lead to greater access to sanitation,

which, in turn, can reduce diarrhoeal diseases, resulting in lower child mortality. Finally, since the developing countries in our dataset might not have enough financial resources to address all those issues, international communities and organizations should increase their support in economic and public health development in those countries. Even though the aid flows from various development agencies were not found economically significant in our research, we believe their funding, including funding from other agencies and organizations like the World Bank, might indirectly contribute to life expectancy. That would enable developing countries to build more comprehensive healthcare services and create educational materials about HIV.

IX. Conclusions

The paper examines what factors are most important in determining life expectancy in low- and middle-income countries in Africa and South Asia. We use longitudinal data from 29 countries between 2009 and 2019 to run five different models, one OLS and four fixed-effects regressions. The variables that we found significant are GDP per capita, HIV rate, access to sanitation services, and mortality rate of children under 5 years old. Higher access to sanitation and GDP per capita, and lower HIV and mortality rates are associated with higher life expectancy in the countries studied on average. The result is backed by MacLenna's reports that infectious diseases cause the highest infant mortality in Africa and South Asia, which negatively affects life expectancy. Our results are also complemented by Makenga et al. 's 2019 report, where they showed that a lack of economic capacity to improve citizens' well-being exacerbates the incidence of mortality caused by infectious diseases, including HIV, in low-income countries. To increase the life expectancy of their citizens, all countries, regardless of region or economic status, need to focus on improving public health sectors to reduce infectious diseases like HIV and infant mortality. In addition, improving the public health sector and sanitation should be

done simultaneously with improving economic and social well-being, especially in the low-income countries, to effectively increase life expectancy.

X. Appendix

Figure 1: Life Expectancy Summary

Variables	(1) N	(2) Mean	(3) SD	(4) Min	(5) Max
life_exp (overall)	319	61.153	5.945	44.034	76.474
life_exp (A == 1)	275	59.913	5.148	44.034	76.474
life_exp (SA == 1)	44	68.9025	4.601	60.364	76.008
life_exp (low == 1)	132	58.915	3.329	49.196	65.882
life_exp (middle == 1)	187	62.733	6.823	44.034	76.474

Figure 2: Immunization Rates Correlation Coefficients

	im_hepb3	im_dpt	im_measles
im_hepb3	1.000		
im_dpt	0.966	1.000	
im_measles	0.891	0.931	1.000

Figure 3: Mortality Correlation Coefficients

	mort_under5	mort_inf
mort_under5	1	
mort_inf	0.973	1

Figure 4: Regression Models

Variables	(1) OLS	(2) Fixed Effects	(3) Fixed Effects	(4) Fixed Effects	(5) Fixed Effects
ln_gdpcap	1.012***	0.596*	3.186***	0.544	0.472
	(0.170)	(0.342)	(0.776)	(0.381)	(0.347)
mort_under5	-0.132***	-0.113***	-0.135***	-0.116***	-0.067***
	(0.005)	(0.007)	(0.012)	(0.012)	(0.014)
unicef_thdol	-0.0000326***	-7.55e-06	-0.0000143	-8.27e-06	-7.77e-06
	(9.40e-06)	(0.0000113)	(0.0000122)	(0.0000103)	(0.0000122)
undp_thdol	0.0001045***	0.0000357	0.0000744***	0.0000452*	0.0000485*
	(0.0000376)	(0.0000234)	(0.0000207)	(0.0000225)	(0.0000262)
hiv	-1.017***	-0.865***	-27.530**	-0.723***	-0.865***
	(0.037)	(0.112)	(11.570)	(0.127)	(0.094)
im_hepb3	0.016**	0.0000489	-0.008	-0.007	0.009
	(0.007)	(0.006)	(0.007)	(0.007)	(0.006)
san_access	0.062***	0.068***	0.008	0.103***	0.0272
	(0.008)	(0.021)	(0.020)	(0.035)	(0.026)
lfpr	0.033***	0.017	0.015	0.031	0.036
	(0.009)	(0.036)	(0.030)	(0.028)	(0.048)
A	-1.509***				
	(0.465)				
low	1.927***				
	(0.274)				
lngdpcap_A			-3.175***		
			(0.786)		
mort_A			0.014		
			(0.013)		
hiv_A			26.620**		
			(11.593)		
san_A			0.031		
			(0.027)		
lngdpcap_low				-0.241	
				(0.445)	

mort_low				0.004	
				(0.015)	
hiv_low				-0.441**	
				(0.170)	
san_low				-0.097**	
				(0.044)	
2010					0.349**
					(0.142)
2011					0.508**
					(0.192)
2012					0.684***
					(0.244)
2013					0.889***
					(0.309)
2014					1.065***
					(0.365)
2015					1.329***
					(0.418)
2016					1.605***
					(0.467)
2017					1.726***
					(0.492)
2018					1.737***
					(0.534)
2019					1.767***
					(0.572)
_cons	60.208***	63.054***	66.916***	63.397***	58.989***
	(1.701)	(4.018)	(2.333)	(2.993)	(5.006)
Observations	319	319	319	319	319

R-squared	0.928	0.9208 (within) 0.8959 (between) 0.8968 (overall)	0.9402 (within) 0.6524 (between) 0.6538 (overall)	0.9286 (within) 0.7256 (between) 0.7372 (overall)	0.9383 (within) 0.8773 (between) 0.8483 (overall
Country FE		Yes	Yes	Yes	Yes
Time FE					Yes

Dependent variable is life expectancy at birth in years.
Robust standard error in parenthesis.
***p<0.01, **p<0.05, *p<0.1

Figure 5: Joint Significance Test

```
( 1)  san_access = 0

( 2)  san_A = 0

      F(  2,    28) =    1.92

           Prob > F =    0.1660
```

Figure 6: Joint Significance Test

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( 1)  mort_under5 = 0

( 2)  mort_A = 0

      F(  2,    28) =  153.39

           Prob > F =    0.0000
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Figure 7: Joint Significance Test

```
( 1)  mort_under5 = 0

( 2)  mort_low = 0

      F(  2,    28) =  146.39

           Prob > F =    0.0000
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Figure 8: Joint Significance Test

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( 1)  ln_gdpcap = 0

( 2)  lngdpcap_low = 0

      F(  2,    28) =    1.76

           Prob > F =    0.1904
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XI. Brief Statement of Contributions

Liza worked on the following parts of the assignment: Abstract, Data and Sources, Estimated Models, Results of Hypothesis Testing, and Appendix. Noe worked on the Introduction, Literature Review, Economic and Econometric Models, Results Interpretation and Policy, and Conclusions. Both of us contributed to looking for the data, choosing the regressions to run that would be important for our project, and final editing of the paper.

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