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Determinants of health and education in Latin America

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Abstract. This paper discusses the determinants of health and education in Latin America, a region which we define as consisting of the following twenty countries: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Suriname, Uruguay, and Venezuela. Health and education are integral factors to the productive capability and overall well-being of individuals. Therefore the factors that contribute to health and education lay the foundation for long-term economic growth that is distributed equitably throughout every socioeconomic stratum. There are a myriad of factors that contribute to the levels of health and the quality of education experienced by individuals living in Latin America; the determinants of health will be organized such that they fall into economic, social and historical, environmental, and biological categories, while the determinants of education will be broken down into student-side, school-level, and system-wide or macro variables. Using a panel of the twenty Latin American countries previously listed, this paper will discuss possible influences of health and education status as well as the nature of that influence; the paper will then proceed to discern between statistically significant and statistically insignificant factors. The paper will conclude with a discussion of possible statistical flaws that could result in biased conclusions.
Keywords. Health, Education, Latin America, HIV, Panel data.
JEL. I15, I25, C33.

1. Introduction

For Latin American countries, student learning is a critical challenge, thus outlining the most significant problems that the educational framework in the region must resolve would prove useful. Latin American countries are among the lowest performers on international assessments of student ability; next, countries in the region have a high proportion of students achieving significantly below the minimum threshold of skill level in all subjects; further, substantial gaps in achievement across students point to high inequality in the learning outcomes of students from different socioeconomic and ethnic backgrounds. Not only do poor and minority students have an overwhelmingly greater probability of achieving lower scores than students of higher socioeconomic status, but perhaps more alarming is the fact that the most advantaged students in Latin America experience lower scores than the average student in developed countries (Portillo, 2012). Clearly, the entire region is struggling with the education challenge. According to

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the World Bank, Latin America continues to be one of the most inequitable regions in the world; this region is characterized by low social spending and in many Latin American nations aid is untargeted (LACRB, 2012). That is to say, wealthy and impoverished populations have an equal right to partake in social spending, and this does little to nothing to alleviate the poverty burden and fails to ameliorate health and education concerns.

While Latin American countries have expanded access to primary and secondary education, they have been sliding further and further behind other middle and high income countries. For example, in 1960 the proportion of adults that had completed upper secondary education was seven percent in Latin America and about eleven percent in East Asia, but by the early 2000s that gap expanded to eighteen percent in Latin American and forty-four percent in East Asia (Portillo, 2012).

A quality of education is contingent upon many inputs and the complex interaction of those inputs. That is to say, there is no universally-held education production function in which specific amounts of inputs yield a specified output. These factors can range from the availability of textbooks within a school, to the level of education of a child's parents, to the demographic composition of a classroom, to the verbal ability of the teacher. In rural communities, the agricultural calendar has a substantial impact on student enrollment and thus student learning outcomes (UNESCO , 2012). As previously stated, the determinants of education will be organized such that they fall under student-level, school-level, or system-wide categories. Student-level determinants will be widely defined; these variables will include family effects such as the educational background of parents, total family income, and whether they live in a rural or urban setting. School level data will include teacher characteristics such as years of education and experience, and we will discuss pay level. Further, school-level variables will also attempt to describe the overall conditions and organization of the school by examining the availability of textbooks, the language spoken within the school, and the accessibility of the school. An attempt will be made to examine possible peer effects by determining the percentage of students within a school that continue to secondary and tertiary levels of education. Macro or system-level variables will include the amount of public and private spending on education as a percentage of each country's GDP. In an attempt to discern between productive and unproductive funding allocations, there will be a discussion of any restrictions or specifications that dictate how government funding must be allocated. In addition, government policies on child labor will be examined in an effort to determine their effect on the education of children.

For Latin American countries, economic growth also hinges up0n the overall health level of the population. Difficulties include the persistence of high infant and maternal mortality rates; respiratory and diarrheal diseases; noncommunicable chronic diseases; infections that are largely preventable if the appropriate vaccinations are available; inadequate food and drug safety protocols; and a brain drain of health personnel which serves to undermine the region's efforts to improve health standards. The variables that will be studied will be broken down into economic, social, environmental, and biological factors. Economic determinants will be defined as the amount of money that is spent on public and private healthcare, and a general summary of healthcare policy trends in Latin America will be reviewed. Also beneath this category, employment, income, and the sector in which an individual works will be explored. Social and historical determinants will include the level of inequality within the country, as well as the level of education as measured by the literacy rate and the average years of schooling. Environmental factors could include the availability of water, the effects of climate change and natural disasters, the quality of sanitation facilities, as well as working and living conditions. Biological determinants will include birth defects as well as gender (Bliss, 2009).

2. Health, Education, and Economic Growth

These regressions can also be analyzed from a developmental perspective because health and education are the components of human capital. Human capital, in turn, is the nucleus of development economics. Due to the fact that development economics takes a holistic approach to the development process, indicators of quality of life, health and education are considered to illustrate the overall economic advancement of a country. These indicators are used to determine whether or not a nation or a regions growth is sustainable.

By definition, sustainable economic growth is balanced and equitable, and the most effective channel through which this can be achieved is via improvements in the health and education of individuals.

In fact, the field of development economics articulates the idea that economic growth is not the primary aim of economic activity and policy, but instead is simply a means to achieve the end of greater human happiness and development. This premise is a direct outgrowth of Amareta Sen's "Capabilities" Approach, which argues that the capability to function defines the difference between a poor and non-poor individual; being sufficiently nourished, free of disease, able to interact with the community at large created self-respect, happiness, and therefore greater productivity. In other words, economic growth and human development function within the same virtuous cycle, in which economic growth allows for greater human development, including better health services, education services, employment opportunities, stronger democracy, and increased environmental protection. These enhanced living conditions create an optimal environment for increased economic activity, resulting in more qualified labor, greater technological innovation, and better management.

In fact, Sen's "Capabilities" Approach influenced the UN's Human Development Index, which rates the level of economic development through measuring income, health, and education indicators. Each of these indicators is weighted equally by one-third. However, the education component is divided into two parts, with the adult literacy rate making up 2/9 of the overall HDI score and mean years of schooling making up 1/9 of the overall index. The income indicator is aimed at measuring the overall standard of living for the citizens of a country, and is measured by real GDP per capita in PPP dollars. The health indicator is measured by life expectancy at birth; this measures the average number of years a child born in any given year will live if the living conditions within that year prevail for the rest of the child's life.

Health and education are not only integral components of the measurement of the development level of an economy, but they are contributing factors to the productivity of the economy.

Human capital, which is defined as deliberately accumulated investment in training and education, is the end result of human development. This creates a more productive, innovative labor force that is both more adept to use advanced machinery, and can create new ideas and new methods that shape economic activity. According to Lucas in Econometrica, human capital is the main engine of growth; in fact, on page 254 he states that the long run growth of physical capital and of every country's output is equal to the growth rate of human capital. He continues, arguing that each country's income level will be "proportional to its initial human capital, not only in the long run but all along the equilibrium path." (Lucas, 1993). It is through this channel that improvements of health and education in Latin America will improve other facets of life, alleviating the burden of poverty and increasing the overall standard of living of the region.

As a result of the importance of the development of human capital through investments in education and health, the factors which influence both health and education will be examined.

3. Health Considerations

Although it is difficult to find a comprehensive qualitative measure for health, we have chosen to use life expectancy as our independent variable. In Latin America overall life expectancy is 72 years. Since 1980, life expectancy in Latin America has increased in a linear fashion. Of all developing regions, Latin America has the lowest under-5 mortality rate of 31 deaths for every 1,000 children per year; however, this is still a high number relative to developed nations. Optimistically, the under-5 mortality rate continues to decline in Latin America and the Caribbean, and the prevalence of undernourishment is 10%, which is significantly below the average of the developing regions (CSDH, 2009).

Our first dependent variable in the health regression is the level of expenditure on health as a percentage of GDP. Increases in health expenditure are viewed as having a positive effect on life expectancy through the improvement of the infrastructure of health systems. Public health systems include public health departments, hospitals, clinics, office doctors, and paramedics. These expenditures on health provide both mental and economic benefits. These mental benefits come from increased happiness, productivity, and therefore increased feelings of self-worth that accompany the relief of pain and the curing of ailments. The economic benefits of increased expenditures come from the aforementioned increase in productivity that yields economic gains (Stanford, & Greenidge , 2012).

Our social variable is the adult literacy rate, which is indicative of an individual's level of education. Greenidge and Sanford contend that increased education has a positive effect on health status because it increases job and income security, and thus by extension it improves the overall health of the individual. It can be inferred from there that increased education can also improve the working environment of laborers, and they are exposed to less hazard at the workplace than their uneducated counterparts. In addition, they may work hours that are more favorable and allow them to fully rest and take care of themselves.

Another channel through which increased education can have a positive effect on an individual's overall health is the increase in a mother's education. An increase in both a mother's education allows her to have access to the information and resources that will improve the quality of life for her child. First, it may increase her income and thus increase the number of calories per day that the child receives. Next, it increases her awareness and ability to learn about programs that are beneficial for her family. Finally, it allows her to allocate her financial resources productively, and in ways that benefit the future of her children (Todaro & Smith, 2011).

The environmental variables that are included in the regression are urbanization and per capita CO2 emissions. Many families seek to gain employment in the urban sector in an effort to achieve higher wages and an improved standard of living relative to the agricultural sector. We expected to find that CO2 emissions would have a negative effect on longevity due to health complications that are associated with the inhalation of toxins.

However, there are both positive and negative potential effects of urbanization on longevity. In urban areas, there is easier access to healthcare facilities relative to rural areas, however urban environments in Latin America are often overpopulated and lack proper sanitation, clean water, and have higher concentrations of airborne chemicals. In addition, the transfer of disease from person to person occurs at a much faster rate due to the high density of the population in urban areas.

The biological factor that was included was the prevalence of HIV throughout the population. HIV is classified as one of the three major scourges in developing countries. 95 percent of deaths related to HIV/ AIDS occur in the developing world, with women representing the majority of individuals infected. In 2009 the World Health Organization estimated that there were 2 million adults and children living with HIV/AIDS, 170,000 new cases that year, and 77,000 deaths that year due to HIV/AIDS. Clearly, this has a strongly negative effect on longevity, and increased education on the transmission of HIV as well as providing contraceptives and

increased medical assistance could improve longevity in Latin America (Bliss, 2009).

4. Education Considerations

Problematically, Latin American workers have an average of 4.8 years of education, compared with 6 years for their Asian counterparts, and a total of one third of Latin American students must repeat a grade or drop out before the sixth grade. Only one half of primary school graduates in Latin America go on to finish their studies, compared with a remarkable 95 percent completion rate in Asian countries such as Malaysia and Korea. These high levels of school desertion are in part due to the economic structure of Latin American countries; children of school age are forced to leave school prematurely in order to resume work in the agricultural sector, where their labor cannot be spared for the sake of a future return on an investment in education. Statistically, only ten percent of students in the bottom two quintiles of the income distribution continue their studies through the ninth year (Portillo, 2012).

Advantageously, however, Latin American countries do not exhibit the wide gap in educational achievement across genders. According to World Bank statistics, adult literacy for males and females is 91% and 89%, respectively (LACRB, 2012).

Looking at students in school in Peru, El Salvador, and Colombia, the average number of hours worked during the school is twenty hours per week, and many students must leave school entirely during the harvest season.

Thus, the major constraints that inhibit a child from attending school in Latin America are economic in nature; the income of their family is partially dependent on the labor of the child. The amount of schooling that is demanded is a function of four variables: wages, the probability of finding modern-sector employment, the direct costs of education, the indirect costs of education, and a vector of other variables that includes cultural traditions, gender, social status, the education of parents, and the size of the family (Portillo, 2012).

The most binding constraint to education in Latin America is the opportunity cost of education, which is equal to the cost of the labor of a child. There are a number of approaches that focus on the reduction of child labor and increasing student enrollment. The first approach recommends targeting poverty rather than directly addressing the child labor difficulty; this is espoused by the World Bank (Todaro & Smith, 2011). An alternative approach seeks to incentivize school attendance of children by giving parents incentives to send their children to school; an example of this approach is the PROGRESA Program in Mexico. This program provides cash transfers for families that send their children to school, and it specifically targets poor households. Studies suggest that PROGRESA transfers reduced the number of households beneath the poverty line by approximately ten percent, with the depth of poverty reduced by a significant thirty percent. Even better, there is research that indicates that PROGRESA has had a positive enrollment effect for *both boys and girls,* thus assisting in the reduction of the education- gender gap. Statistically, the enrollment rate for boys increased by 1.07 percent, and for girls, it increased by 1.45 percent. The secondary school level brought even larger gains in the enrollment increase, with values ranging from a 7.2-9.3% increase for girls and 3.5-5.8% for boys. The study also found that students begin their schooling earlier in their lives and experience lower drop-out rates. Therefore, the results also show reduced labor-market participation of PROGRESA targeted children; however, these reductions were only seen for boys. The reductions were considerable, with a 15-25% reduction (IFPRI). This policy must continue being studied, but it appears to be an effective way of improving education in Mexico through targeting poverty (IFPRI, 2012).

Because of the beneficial results of policies such as the PROGRESA, which is indicative of increased government spending, we predicted that expenditures as a percentage of GDP would have a positive effect on the independent education variable, or the primary completion rate.

Another determinant of education in Latin America is the level of education of the child's parents, particularly the mother. Increasing the level of education of a child's mother increases the productivity of the woman; assuming that her earnings are linked to her level of productivity, this will increase the overall income of the family and reduce the need for child labor, thus increasing the likelihood that her child will receive more years of education. Greater education of the mother also results in greatly improved child health and nutrition. The healthier the child, the more able the child is to absorb the benefits of schooling, as the child will be more alert while at school, and will not miss school due to illness or injury. In addition, a higher level of education achieved by a mother will allow her to recognize the long-term advantages of the education of her children.

The other dependent variable used in the regression was the student to teacher ratio; we predicted that a greater student to teacher ratio (more students to fewer teachers) would have a negative effect on the primary completion rate. The essay "Latin America Gets Poor Reading Marks" asserts that the heart of Latin America's education and perhaps even of its economic dilemma is the low quality of its education. Many teachers in Latin America are paid a low salary and usually must take another job; thus less of their time and energy is allocated towards the education of their students. Furthermore, public schools in Latin America require fewer in-class hours than private schools with 500-800 hours required for public schools and 1,000 hours required for private schools. Thus, the poorest students who attend the public schools not only have teachers who are underinvested in their learning process, but they have fewer in-class hours than relatively wealthier students who can afford to attend private school; thus poor students receive fewer hours of schooling, and the hours they receive are generally lower in quality (Portillo, 2012).

There are other teacher and classroom effects that play an integral role in the education of a child. In Latin America there is a prevalent indigenous population that bears the brunt of poverty, inequality, and social exclusion. If Latin Americans are serious about reducing inequality in the region, issues such as student-teacher language barriers must be addressed. Furthermore, the elimination of cultural barriers between students and teachers be beneficial to the learning outcomes and overall educational efficacy.

Another factor that we believed would affect education outcomes is urbanization. We were unsure whether urbanization would have a positive or negative effect on education outcomes. The effect of urbanization could be positive because an urban setting increases the accessibility of educational facilities including schools, libraries, and any museums or cultural attractions. Furthermore, if the probability of attaining a job in the urban sector is a contributing factor to increased demand for education, then students in urban environments will have increased demand for education because they are in a location that increases their chances of working in the rural sector.

However, urbanization could have a negative effect. According to World Bank statistics, countries in Central America experience on average 14, 257 deaths per year to violent crime, most of which is concentrated in major cities. This social unrest and upheaval could have a negative effect on the completion of primary school, as it may put strain on students and increase drop-out rates. Furthermore, the increased CO2 emissions that accompany urbanization could also have a negative effect on the students' health and impair their ability to learn and increase the number of days they do not attend class due to illness (Stanford, & Greenidge, 2012).

5. Econometrics Analysis

Our guiding questions for our research paper are: How do economic, social, biological, and environmental factors explain the health status in Latin America? And how do economic and environmental variables affect education? For the econometrics analysis of our research, we selected a sample group of 21 countries

based on their geographical location in Central and South America (Lin, 2012). The data was collected using the online databases from the World Book Group (2012). Due to the lack of empirical, data we chose to drop French Guiana from our sample. The remaining 20 countries include: Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Surname, Uruguay, and Venezuela. In order to include a large number of observations in our data set, we have chosen to examine the health and education levels in these Latin American nations from 1995-2009. Since we are working with multiple countries over a time span of 15 years, we will be working with panel data. The effect that economic, social, biological, and environmental factors have on health, as well as the effect that economic and environmental factors have on education will be examined after our regression analysis.

In our health regression, our dependent variable is life expectancy at birth because utilizing macro level data as opposed to micro level data has allowed us to avoid the subjectivity and costly implementation of micro level data analysis. Our first independent variable in our health regression is the amount of expenditure on health as a percent of GDP. We chose this variable because it includes the public and private expenditures on health in the economy. We predict that there will be a positive relationship between this variable and the life expectancy at birth. The social factor incorporated into our regression was the percentage of people, ages 15 and above, who are literate. This variable is called the adult literacy rate. We expect to find a positive relationship between education and health because education equips a person with knowledge and understanding to keep them healthy. We will also include environmental factors using the urbanization rate and per capita carbon dioxide emission. We expect that the urbanization rate could have either a positive or a negative effect on health. Our reasoning behind this is that although urbanization does provide a greater access to health facilities, urban areas could also lead to other factors, such as unsanitary living condition, that can adversely affect health. Therefore, the sign will impact that urbanization will have on health will depend on the net effect of these two factors (Stanford, & Greenidge, 2012). Although we would have ideally liked to include the prevalence of non-communicable diseases and HIV prevalence as independent variables in our regression, we were unable to incorporate them in our regression analysis due to the lack of data obtained. The model is represented below:

$$Life\ Expectancy\ Per\ Capita_{1995\text{-}2009} = \beta_0 + (\beta_1 \cdot Government\ Expenditures_{i,t}) + (\beta_2 \cdot Adult\ Literacy\ Rate_{i,t}) + (\beta_3 \cdot urbanization\ rate_{i,t}) + (\beta_4 \cdot Co2Emission\ Per\ Capita_{i,t})$$

When examining Education among these 20 countries, we have decided to run our regression focusing in on primary education in Latin America due to the accessibility of prevalent data found on the World Book Group. Our independent variable is the primary completion rate in each country. The expenditure on education as percent of GDP, the student-teacher ratio, the percent of teachers trained in primary education, and the urbanization rate are the independent variables. These variables were selected based on similar models presented among the literature review presented. The expenditure on education as percent of GDP is an economic factor that we expected to have a positive impact on education. Our reasoning behind this is that a higher expenditure on education would provide students with more educational resources, either directly or indirectly, which would have a positive impact on their completion rate. School and classroom characteristics play a key role in primary education (Wollf, n.d.). Therefore, having a higher ratio of students in the classroom should have a negative impact on the students' education because we believe that the low ratio would have a direct impact on student retention and primary completion. Additionally, we assume that having a higher percentage of trained teachers will have a positive impact on student education because the teachers are better more equipped to meet the

student's educational needs. The urbanization rate, an environmental factor, can have either a positive or negative impact on education. While urban areas do provide more accessible schools, these schools could also have a higher student-teacher ratio. The impact on education may be either positive or negative depending on the net effect of these two independent variables. The model is as follows:

$$\textit{Primary Completion Rate}_{1995\text{-}2009} = \beta_0 + (\beta_1 \cdot \textit{Expenditure on Education}_{i,t}) + (\beta_2 \cdot \textit{Student Teacher Ratio}_{i,t}) + (\beta_3 \cdot \textit{Percentage of trained teachers}_{1,t}) + (\beta_4 \cdot \textit{Urbanization Rate}_{i,t})$$

After determining what our model would look like, we decided to plot a scatter plot to gauge the trend of our independent variables which were life expectancy at birth and primary completion rate. The first scatter plot displays year on the x axis and life expectancy at birth on the Y axis.

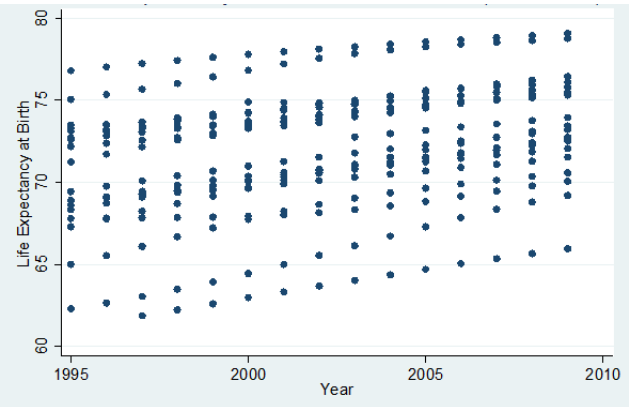

Figure 1. *Life Expectancy at birth in Latin America (1995-2009)*

The second scatter plot displays time on the x axis and % of relevant group on the Y axis.

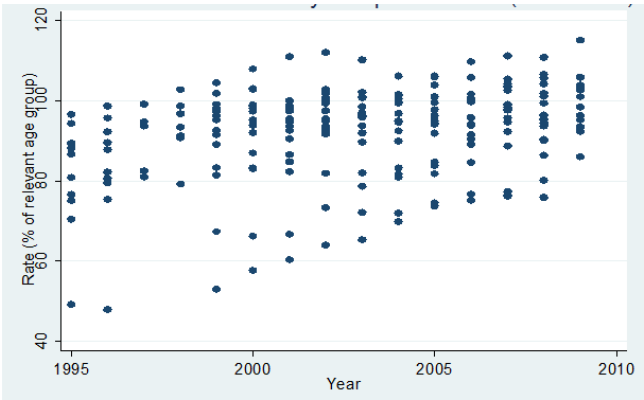

Figure 2. *Latin America total primary completion Rate (1995-2009)*

The trend in the scatter plots highlights that both life expectancy and total primary completion rate are positively correlated with time. In our regressions we controlled for time in order to determine the best fit model. We recognize that our data contains a time effect because each of the 20 countries is impacted by macroeconomic events that are common to all countries and are changing over time. However, there is also a cross-section effect because each of the variable is specific to each country and does not change over time. Taking this into account, we decided to use the fixed-effects model. We are interested in analyzing the

impact of the variables which vary overtime. With this model we examine the relationship between the predictor and the outcome within the country.

We started with our health regression. Our first regression included the five independent variables: government expenditure, adult literacy rate, urbanization rate, prevalence of HIV, and Co2 emission as shown below,

$$\textit{Life Expectancy Per Capita}_{1995\text{-}2009} = \beta_0 + (\beta_{1,\,1995\text{-}2009} \cdot \textit{Government Expenditures}) + (\beta_{2,\,1995\text{-}2009} \cdot \textit{Adult Literacy Rate}) + (\beta_{3,\,1995\text{-}2009} \cdot \textit{urbanization rate}) + (\beta_{4,\,1995\text{-}2009} \cdot \textit{Prevalence of HIV}) + (\beta_{5,\,1995\text{-}2009} \cdot \textit{Co2 Emission Per Capita})$$

The next four regressions tested three variables in order to determine the effects on the significance of the results. We started by omitting government expenditures, followed by the literacy rate, urbanization rate, and finally Co2. As we varied our independent variables, we observed that our data was unbalanced and the number of groups varied significantly form one Regression to another. If our data had been balanced, our regression should have resulted with 20 groups. However our lowest number of groups included was 10 and our highest was 18.

With the estimated sample data, it reads:

$$\textit{Life Expectancy Per Capita}_{i,t} = 67.48469 + (.0406822 \cdot \textit{Health Expenditure}_{i,t}) + (.0682667)$$
$$(.0460833 \cdot \textit{Adult Literacy Rate}_{i,t}) + (-.6816788 \cdot \textit{Urbanization rate}_{i,t}) - (.5441807 \cdot \textit{Co2 Emission Per Capita}_{i,t}) + (.0206485) \quad (.213154) \quad (.4129515)$$

In order to analyze our health regression further, we will also need to examine the individual coefficients of each regression. The coefficient of health expenditure as a percent of GDP is expected to increase life expectancy per capita. We found, however, that the coefficient on expenditure on health is statistically insignificant. The coefficient of adult literacy rate is statistically significant and the positive sign on the coefficient is what were expected. We predicted that more expenditure on health would lead to a higher life expectancy because people would be more informed and conscious about their health. We found that as adult literacy rate increases across time by one unit, expected life expectancy at birth increased by .0460833 years.

We had anticipated that the urbanization rate could either have a positive or a negative impact on life expectancy. We found that the effect of urbanization rate is, unfortunately, statistically insignificant. The coefficient Co2 emission per capita is statistically insignificant as well. We predicted that more expenditure on health would lead to a negative impact on life expectancy because people would be adversely impacted by an increase in emissions. The regression R^2 value implies that 98.81% of life expectancy is modeled by government expenditure, adult literacy rate, urbanization rate, and Co2 emission per capita. This regression had the highest R^2 out of all of our models but this may be attributed to the fact that all of our variables are included in this regression.

It is important to note that imperfectmulticollinearity occurs when two or more repressors are highly correlated. Therefore, in the presence of imperfect multicollinearity the calculation of one of the coefficients would be imprecise. A potential problem that could have caused multicollinearity in our model is our data collection method. We were sampling over a limited range of values taken by some of the regressor in the model. Although this may still allow our estimators of the parameters to be the best linear unbiased estimator, we can still detect multicollinearity because the R^2 is higher than 0.9. This multicollinearity results in standard errors higher than expected. Consequently, it might explain why variables such as the health expenditure as a percent of GDP, Co2 emission per capita, and adult literacy rate are not statistically significant when we had expected them to be.

Similarly, despite the relatively high F-statistic a potential flaw with our model is the possibility of the presence of heteroskedacity, which occurs when the variance of the error term of the regression is not constant and in turn affects the standard error. When heteroskedacity occurs in a model many of the variables are not statistically significant.

Variables	Health Regression Trails				
	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5
Health Expenditures of GDP	0.0406822		0.1859812***	0.0051825	0.1215198
	(0.0682667)		-0.0324132	(0.0576233)	(0.0993533)
Adult Literacy Rate	-0.6816788**	0.0436314**		0.0712277*	0.0611537
	(0.2064850)	(0.0197947)		(0.0239074)	(0.0378483)
CO2 Emission Per Capital	-0.6816788***	-0.7028894***	-0.2493363*		0.5065954**
	(0.2131540)	(0.2055943)	(0.1372894)		(0.2478918)
Urbanization Rate of Total P	0.5441807	0.4310917	-0.7148957***	0.0116836	
	(0.4129515)	(0.3587950)	(0.1744936)	(0.3249610)	

Notes:***, ** and * denotes statistical significance at the 1%, 5% and 10% levels respectively. Numbers in round parentheses (.) are the robust standard errors.

Although our data may contain heteroskedacity, our model is still unbiased and consistent, however, it does not necessarily have the minimum variance and is not efficient. It is important to note that we may encounter simultaneous causality in our regressions. We believe that health might affect education and that education level may also affect health. Two potential solutions to our problem would be to either use an instrumental variables approach, a lagged specification, or a simultaneous equation model.

We ran a total of five education regressions and conducted a similar analysis to our previous health regression. Our first regression included the five independent variables: expenditure on education, student teacher ratio, percentage of trained teacher, and urbanization rate. The next five regressions tested four variables in order to determine the effects on the significance of the results. We started by omitting urbanization rate, followed by percentage of trained teacher, then student teacher ratio, and finally expenditure on education. We once again observed that our data was unbalanced due to the missing data primarily in our variables, percentage of trained teachers and student teacher ratio. The highest number of groups included was 18 and the worst was 16.

We also determined which of our regressions was the best model according to which one best answered our question. We based our decision based upon R^2 value, because it represents the mean-deviated regression. We found that the best model for our regression was one that took into account all of our variables. As a result, our model remains as follows:

$$\textit{Primary Completion Rate}_{1995\text{-}2009} = \beta_0 + (\beta_1 \cdot \textit{Expenditure on Education}_{i,t}) + (\beta_2 \cdot \textit{Student Teacher Ratio}_{i,t}) + (\beta_3 \cdot \textit{Percentage of trained teachers}_{I,t}) + (\beta_4 \cdot \textit{Urbanization Rate}_{I,t})$$

With the sample data, it reads:

$$\textit{Primary Completion Rate}_{1995\text{-}2009} = 170.7824 + (-.3493443 \cdot \textit{Expenditure on Education}_{i,t}) + (-.2630651 \cdot \textit{Student Teacher Ratio}_{i,t}) + (.205218 \cdot \textit{Trained teachers in Primary Education}_{i,t}) + (-1.566435 \cdot \textit{Urbanization Rate}_{i,t})$$

(50.41993) (.3358987) (.3451931) (.1351978) (.9503438)

The R^2 value indicates that 82.63% of life expectancy is modeled expenditure on education, student teacher ratio, percentage of trained teacher, and urbanization rate. The F-statistic confirms that all coefficients are jointly statistically significant.

In order to analyze our health regression further, we will also need to examine the individual coefficients of each regression. We had predicted that more

expenditure on education would lead to a higher primary completion rate because students would have more resources at their disposal. However, we found that the impact of expenditure on education as a percent of GDP has a statistically insignificant impact on Primary Completion Rate. A possible reason may be that increased government expenditure on education as a percent of GDP may not be properly allocated in order to have a direct impact on primary completion rate.

We found that the coefficient of Student Teacher Ratio is statistically insignificant. The coefficient of trained teacher ratio is .205218 which has a positive sign and it has a positive effect on primary completion rate which we expected and is significant at the 15% level of significance. We believed that as the percentage of trained teachers increased, the primary completion rate would decrease because the teachers would be better prepared to meet the students' educational needs. We found that as the trained teacher ratio increases across time by one unit, Primary Completion Rate decreases by .205218 years.

The coefficient of urbanization rate of the total population is -1.566435, whichis statistically significant and has a negative sign and it has a negative effect on primary completion rate. This supports our initial belief that the urbanization rate could potentially have a negative coefficient. We found that as the urbanization rate increases across time by one unit, primary completion rate decreases by -1.566435. We believed that as the urbanization rate varied across time, the sign of the regression might be either positive or negative.

Similarly to our health regression, a potential flaw that we have multicollinearity and heteroskedacity in our model. There is also the possibility that student teacher ratio and trained teachers and the primary education level could potentially have a simultaneous causality relationship. Similar to Table 1, Table 2 below displays the significance levels of each of the Regressions conducted in our analysis.

Variables	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5
Expendure on Public Education	-0.3493443		-0.240837	-0.0235097	-0.3287601
	0.3358987		0.299947	0.2144902	0.3543556
Student Teacher Ratio In Primar	-0.2630651	-0.3869753*		0.5319862***	-0.2615101
	0.3451931	0.2279911		0.1934906	0.3644114
Trained teachers inprimaryedu	0.205218	-0.1371135**	0.1742161		0.0973574
	0.1351978	0.0659728	0.1271178		0.1248929
Urbanization Rate of Total Po	-1.566435	1.10614**	-1.564455*	-0.2698548	
	0.9503438*	0.4446313	0.9369657	0.5689233	

Notes: ***, ** and * denotes statistical significance at the 1%, 5% and 10% levels respectively. Numbers in round parentheses (.) are the robust standard errors.

Despite the problematic errors found in our regression, we generally found that the relationship between the independent and dependent variables were as expected. A lot of our problems started when with the lack of data gathered for some of our variables. We then had a potential heteroskedacity, multicollinearity, and simultaneous causality issue to deal with. In order to correct for our errors, we could find instrumental variables for our simultaneous causality. To correct for multicollinearity we can increase the sample size, thus our R^2 would not be as high as it currently with both of our regressions. We must also regress our regression using robust to correct for our potential heteroskedacity problem. Another error that could be affecting both of our regressions is errors in the variables presented in the data. Although our data comes from a reliable source, the errors could originate with an inconsistency in how the organization gathered and recorded the data and we could have accidently downloaded the data onto our excel sheet and had an error occur then.

6. Conclusion

The majority our conclusions drawn from the regression were expected; although some of the regressors were not statistically significant, we found that flaw in our model could have provoked this outcome. A key finding in our paper was that we expected our regression to indicate a positive effect of government

expenditures as a percentage of GDP on both our health and education dependent variables. However, our regression did not show this. This could be due to the fact that government expenditures are not allocated to productive resources that yield meaningful increases in life expectancy and the primary completion rate; funds may not be accurately targeted towards populations that are most in need of increased resources, and only reach populations that already have access to adequate health and education services. Alternatively, increases in expenditures may be absorbed by rent-seeking behaviors. That is to say, funding may be lost in the shuffle of bureaucracy and do little to improve conditions of health and education on the ground level. Further investigation is necessary in regard to the mechanisms through which funding influences overall health and education; further research that aims to determine how financial resources can be allocated productively to make real improvements in health and education in the region would be extremely beneficial to the population of Latin America.

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