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Abstract

Purpose – Investment in human development is considered a means of improving the quality of life and sustaining economic growth in the Caribbean. The purpose of this paper is to assess the efficacy of public spending on health care and education by evaluating the life expectancy and school enrolment rates of these countries.

Design/methodology/approach – Using a data set containing 19 Caribbean countries over the period 1995 to 2007 for health care and 1980 to 2009 for education, a Panel Ordinary Least Squares model was employed.

Findings – The results revealed that health expenditure has a significant positive effect on health status, while spending on education has no appreciable influence on either primary or secondary school enrolment.

Originality/value – Unlike previous Caribbean research, the paper explores a variable for quality in the education system, that is, the pupil-teacher ratio. It also seeks to update the existing Caribbean literature by employing data from 1980 to 2009.

Keywords Caribbean, Government policy, Public finance, Public spending, Education, Health care, Panel OLS

Paper type Research paper

1. Introduction

Many studies undertaken on both developed and developing countries have indicated that efficient and sufficient government resource allocation on education and health encourages human development and economic growth as well as lessens the poverty burden (Schultz, 1961; Barro and Lee, 1997; Swaroop, 1996; Gupta *et al.*, 2004; Psacharopoulos and Patrinos, 2002). However, despite the Millennium Development Goals emphasizing the achievement of universal primary education, reduction in child mortality rates, improvement of maternal health and decreasing the prevalence of HIV/AIDS, malaria and other diseases (United Nations, 2000) few papers (Swaroop, 1996; Greenidge and Stanford, 2007; Griffith, 2001; Moore, 2006) have evaluated the effects of government expenditure on education and health care in the Caribbean.

JEL classification – I00, I15, I21

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This is surprising given that public expenditure on education and health care is immense in the Caribbean (Tables AI and AII); over the period 1995-2007, the average amount of money spent on health care was 11 percent of total government expenditure and 15 percent for education for the time span 1980-2009. These amounts spent on education and healthcare in the Caribbean are comparable to those spent by the governments of highly developed countries like Canada which spent an average of 16 percent of total government expenditure on health care for the period 1995-2007 and 14 percent on education between 1980 and 2009, the USA which spent 18 and 15 percent on health care and education, respectively. While the UK government disbursed 15 percent on health care and 12 percent on education for the same periods[1]. Hence, the returns gained from this expending should be recognized in order to decipher the value-added to the country of such spending. Effective public expenditure on education and health care in the Caribbean is imperative as resources are limited and economic growth is necessary to sustain economic development, and thus improve standards of living and human development.

This paper purports to determine the impact of government expenditure on health status and education attainment in 19 Caribbean countries for the period 1995-2009 using the panel ordinary least squares estimating method. Unlike previous Caribbean research it explores a variable for quality in the education system, that is, the pupil-teacher ratio (Mehrotra, 1998). It also seeks to update the existing Caribbean literature by employing data from 1980 to 2009.

The study is structured as follows. Section 2 reviews the literature on the efficacy of public spending on health care and education. Section 3 contains the empirical model and data, the subsequent segment comprises of the estimation procedure and results. This is followed by the conclusion and policy implications.

2. Literature review

2.1 Health

2.1.1 Developed and developing countries. Schultz (1961), one of the forerunners of investment in human capital, says that this capital has been the basis of the faster growth rate in Western societies. Therefore, without the use of empirics, he proposes that investment in direct expenditure on health is necessary to achieve economic growth through improving productivity.

Anand and Ravallion (1993) with a sample of 86 developing countries utilized a graph of life expectancy against consumption per capita to investigate the correlation between human development (life expectancy at birth) and aggregate affluence (gross national product). The relationship is interpreted in three ways. The first is that the public provision of essential goods and services like health care leads to improved social outcomes. The second view holds that economic growth is directly responsible; as average incomes rise people can purchase relevant social goods and services which enhance health and nutrition, lower mortality rates and expand life expectancy. It also revealed that economic growth only matters if used to finance suitable public services which suggest economic growth leads to better provision of social services. The final explanation is that social outcomes are strengthened once the income poverty is reduced. Another main discovery of their research is that the positive correlation across countries between life expectancy and affluence disappears as soon as the incidence of poverty and public spending on health are controlled.

Distinct from Anand and Ravallion (1993) and Carrin and Politi (1995) establish that even though gross national product per capita is an important determinant of health status it does not control it. With the use of a 40 country sample for the years 1985-1990 they study the influence of poverty reduction and public health expenditure on health status in developing countries. The research uses a regression estimate with health status, captured by life expectancy, infant mortality and under-five mortality as the dependent variables and public health expenditure to gross national product ratio, incidence of total absolute poverty and gross national product per capita as the independent variables. The results indicate that gross national product per capita is positive and highly related with health status while the reduction of poverty is directly associated to health. Public health expenditure is found not to be statistically significant as it may be inefficient or not a good measure of government efforts to finance basic health care.

Using the two stage least squares method on 50 developing and transition countries it was concluded by Gupta *et al.* (2004) that government spending on health care strengthens a country's health status. Accordingly, the authors stipulated that policy makers need to assign resources in health care liberally and efficiently to advance economic growth and strengthen the well-being of the poor. They found that health care is also affected positively by per capita income, urbanization, adult literacy, access to sanitation and water and private spending.

In order to assess the social outcomes of government spending on health status, Rajkumar and Swaroop (2007) uses annual data for 1990, 1997 and 2003 and an ordinary least square regression for 91 developed and developing countries. The results from the cross-section of countries indicated that public expenditure on health has a greater negative impact on child mortality in countries with good governance, high quality of bureaucracy and low corruption levels. Public spending on health care alone does not guarantee improved social outcomes, good quality governance tools such as well-functioning budget formulation, execution and monitoring are essential in order to produce a better health position.

2.1.2 Caribbean. Swaroop (1996) believes that admittance to basic health services is essential in the Caribbean, since it gives the poor the opportunity to gain from increased income, jobs and expansions in their productivity which attributes to enhanced economic growth. The outcome of the research also indicates that in Jamaica, a contraction in public expenditure on human development may not result in a low standard of living or reduced economic growth since it is likely that the private sector spending may account for the large increase in total health spending as happened between 1980 and 1994.

Greenidge and Stanford (2007), using panel data of 37 countries from 1994 to 2005 attempted to identify the variables that are statistically important in determining health status in Latin America and the Caribbean. The results imply that increases in health expenditure as a ratio of GDP, per capita calorie availability (calorie intake) and literacy rate and urbanization rate add to a population's health status as measured by life expectancy, while per capita carbon dioxide emissions reduce longevity.

2.2 Education

2.2.1 Developed and developing countries. According to Schultz (1961), access to education plays a crucial role in equipping persons with opportunities that shape their

character and develop their personal, economic, social cultural and cultural status. This is demonstrated by education's progressive influence on health; income, family structure and political participation (Caribbean Development Bank, 2010).

Mingat and Tan (1998) believe that education is important to a country's social and economic life. They find that low-income countries generally lag behind high-income countries on most measures of education attainment. The authors try to establish the reasons for this lag (rich countries' advantage in education) by examining the relation between per capita gross national product and several indicators of educational development using a data sample of 125 developing and developed countries in 1993. The results indicate that ceteris paribus, reaching the same coverage in primary education puts twice as heavy a resource burden on the poorest countries as it does on the richest countries. The data illustrated that literacy rate increases with the per capita gross national product from 50 percent in countries at $200 in per capita gross national product in 1993 to an almost universal literacy by the time the per capita gross national product is greater than $10,000. Relative to the allocation of resources to education, the data submits that rich and poor countries allocate the same share of resources to education. From this conclusion the inference can be made that income per capita may have a greater influence on education attainment than public expenditure.

Gupta *et al.* (2004), cited above, find that government spending on education aids in the attainment of education. Accordingly, the authors stipulate that policy makers need to assign resources in education liberally and efficiently to advance economic growth and improve the well-being of the poor. However, they acknowledge that though public spending is necessary to increase education attainment, the marginal costs of expanding education are substantial. They also show that education attainment is also directly affected by per capita income, urbanization, adult literacy, access to sanitation and water and private spending.

Baldacci *et al.* (2003) uses a covariance structure model for 94 developing countries for the period 1996 to 1998 to evaluate the effectiveness of government expenditure on education. The results of the study signify that public spending on education alone does not improve social outcomes and adult illiteracy and gender inequality worsen social outcomes. They suggest the removal of these unfavorable social conditions in addition to public spending to accelerate human development.

de Mello and Pisu (2009) estimate the social production function for 5,591 Brazilian municipalities with the use of structural equation models with latent variables. While the results point out that government spending affects education positively, they find that income is the central determinant of education's product. The findings also reveal that empirical analysis should not focus solely on public expenditure on education but should include spending on non-education programmes as they are pertinent to educational outcomes.

2.2.2 Caribbean. Swaroop (1996) surveyed the Caribbean Group for Cooperation in Economic Development countries[2] from 1981 until 1995 and found that a more in-depth assessment of government resource allocation between primary and tertiary levels of education is necessary to make inferences about the benefit incidence, noting that the probability of obtaining university education is higher for secondary school graduates from high-income than low-income families.

Griffith (2001) posits that educational attainment leads to efficiency in resource utilization resulting in higher productivity and increased income levels but market

determined allocation may cause a skewness in income levels of the populous thereby contributing to further unevenness in income distribution. Similar to Judson (1998) and Psacharopoulos and Patrinos (2002), she recognizes education as an investment good and calculates the rate of return at different levels of education in Barbados. She uses an extended Mincerian approach in a household survey data of 3,000 individuals for 1999 to compute the rates of return to investment in education. The results indicate that secondary education is more highly rewarded than primary and tertiary is more highly rewarded than both. The private rate of return to education in Barbados ranges from 4.8 to 8.0 percent so for every dollar spent (of income forgone) on secondary education, there is a return of 4.8 to 8.0 percent. The results for university education suggest that for every dollar of forgone income the return to that level of education is between 12.8 and 20.9 percent.

Moore (2006) believes that education attainment is essential as it has an impact on economic output. His findings suggest that an increase in the number of household university graduates in Barbados would cause a fall in poverty levels and an increase in the standard of living of Barbadians. Using an estimated production function, with real gross domestic product as the dependent variable and the level of technology, quality-adjusted capital stock and quality-adjusted labour input as its independent variables, he found that a 1 percent augment in quality-adjusted labour causes an expansion in output growth of an estimated 0.5 of a percentage point and a 1 percent increase in quality-adjusted capital boosts output growth by 0.3 of a percentage point.

3. Model specification and data

3.1 Model

3.1.1 Health. The equation used to capture the effectiveness of government expenditure on health care can be modeled as follows:

$$H_{it} = \alpha_{it} + \beta_1 X_{it} + \beta_2 Z_{it} + \beta_3 Y_{it} + \varepsilon_{it} \tag{1}$$

where H_{it} is health care, proxied by life expectancy at birth, X_{it} is a vector of investment variables comprising of public expenditure spent on health as a percentage of total government expenditure, income per capita and adult literacy, Z_{it} is a vector of accessibility indicators composed of urban population as a percent of total population, carbon dioxide emissions and percent of population with access to improved sanitation facilities and water sources and Y_{it} is an immunization vector that consists of DPT[3] and measles. The indices $i = 1, \ldots, N$ countries and $t = 1, \ldots, T$ time periods.

In terms of the a priori signs of the explanatory variables, many studies have indicated that government spending on health care is pertinent for health enhancement and human development (especially for those who have lower incomes) and consequently economic growth (Schultz, 1961; Anand and Ravallion, 1993; Swaroop, 1996; Gupta *et al.*, 2004). Therefore, it is expected to have a direct association with life expectancy. Income per capita measured by gross domestic product per capita (purchasing power parity) suggests that as household income increases, a country's health position should improve. If people have more disposable income then they will have the capacity to personally invest more in health care and caloric intake per capita may increase which improves health status (Greenidge and Stanford, 2007). Thus, a priori the coefficient on income per capita is positive. For adult literacy, many studies show that a positive relationship exists between adult literacy and life expectancy.

Evidence has suggested that schooling contributes to longevity by allowing persons to read and understand the essential information for healthy living[4] (Grossman, 1972; Berger and Leigh, 1989).

With respect to the accessibility variables, increased access to sanitation facilities and water creates a more salubrious environment thus improving health status (Gupta *et al.*, 2004). Deprived access to sanitation and water promote the spread of health problems like hepatitis and diarrheal diseases like cholera and a weakened immune system (World Health Organisation (WHO, 2011)). Evidence has suggested that water-poor and sanitation facility deprived communities are typically simultaneously economically poor. This variable is expected to be positively related to life expectancy. With respect to urbanization, defined as the percent of the entire population existing in urban areas, it is believed that in such areas access to health facilities is much easier than rural areas (Greenidge and Stanford, 2007) and related to improved health status (Schultz, 1993). Though, Thornton (2002) states that urban areas are characteristically polluted with carbon dioxide emissions (metric tons per capita) and thus have negative effects on health expectancy. Consequently, the relationship between urbanization and health expectancy depend on the overall effect of pollution. Urbanization is expected to be positively related to life expectancy and carbon dioxide emissions should be negatively related.

Concerning the immunization indicators, vaccination from the diphtheria, pertussis (whooping cough) and tetanus. DPT and measles diseases should increase an individual's life expectancy, assuming other factors remain constant.

3.1.2 Education. The education regressions are modeled as follows:

$$E_{itj} = \alpha_{itj} + \beta_1 X_{itj} + \beta_2 Z_{itj} + \beta_3 Y_{itj} + \beta_4 A_{itj} + \varepsilon_{itj} \quad (2)$$

where E_{it} is education attainment for j enrollment where j is primary and secondary percentage gross school enrollment, respectively. X_{it} represents a vector of investment variables consisting of public expenditure spent on education as a percentage of total government expenditure, income per capita and adult literacy; Z_{it} is an accessibility indicator measured by urban population as a percent of total population; Y_{it} is a quality variable proxied by pupil-teacher ratio and A_{it} represents the school aged population. The indexes i and t are as defined above and j represents the different levels of education- primary and secondary.

In terms of the partial derivatives, the amount of money government spends on education (construction of schools and provision of teachers) should have a positive effect on education attainment. As income per capita rise the relative cost of enrolling children into school is decreased indicating that increasing incomes should expand school enrollment. Parents incur direct and indirect costs when they send their children to school which include uniforms, supplies, transportation and the forgone income of the child's work in the labour market (McEwan, 1999). In addition, if education is a normal good, at higher income levels the demand for education will augment (Gupta *et al.*, 2002). If persons in the household are literate or acknowledge the importance of literacy, then the significance placed on education attainment will be higher. This suggests a positive relationship between literacy and school enrollment.

In urban areas access to education is relatively better (Plank, 1987) and the transportation costs may also be lower so enrollment in urban areas will be higher (Gupta *et al.*, 2002). The lower the pupil-teacher ratio the more attention each child

receives and the more effective individual teachers can be. If households believe that the pupil-teacher ratio is too high and thus ineffective for educating then they may utilize private school, home-schooling or make their children get jobs. As a result, the coefficient of this is expected to be negatively signed. However, the decrease in this ratio necessitates an increase in public education expenditure. Additionally, Mingat and Tan (1998) found that a reduction in this variable has a small impact on student learning and has a long run effect of lowering levels of education attainment levels. It is expensive and difficult to increase enrollment rates when the population is relatively young (Mingat and Tan, 1992). Gupta *et al.* (2002) postulate that a high incidence of young people (population aged 0-14) should have a negative a priori coefficient. Infant mortality also reduces the school aged population and is negatively related to school enrollment as if the number of infants who die annually is high then the school enrollment will be low at the time those infants would have been school age.

3.2 Data

The data used comprises of annual observations from 19 Caribbean countries[5] over the period 1995-2007 for health and 1980-2009 for both education regressions. This information was collected from the World Bank, The United Nations Educational, Scientific and Cultural Organization (UNESCO) database, Trading Economics, the Caribbean Development Bank Social and Economic Indicators Report 1996-2006, Penn World Table, Economic Commission for Latin America and the Caribbean (ECLAC) and the WHO.

Public health expenditure consists of recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations) and social (or compulsory) health insurance funds. Adult literacy rate is the percentage of people ages 15 and above who can, with understanding, read and write a short, simple statement on their everyday life (The World Bank, 2011a, b). Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring (The World Bank, 2011a, b). DPT refers to a combination of vaccines that fight against three infectious diseases: diphtheria, pertussis (whooping cough) and tetanus. Primary gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Primary education provides children with basic reading, writing, and mathematics skills along with an elementary understanding of such subjects as history, geography, natural science, social science, art, and music. Secondary gross enrollment ratio is defined in the same way however secondary education completes the provision of basic education that began at the primary level, and aims at laying the foundations for lifelong learning and human development, by offering more subject- or skill-oriented instruction using more specialized teachers. Public expenditure on education consists of current and capital expenditure and includes government spending on educational institutions (both public and private), education administration as well as subsidies for private entities (students or households and other private entities). The total school pupil-teacher ratio is the number of pupils enrolled in primary and secondary school divided by the number of primary and secondary school teachers (regardless of their teaching assignment).

The infant mortality rate is the number of infants dying before reaching one year of age, per 1,000 live births in a given year. The income variable is measured by gross domestic product per capita (purchasing power parity).

The descriptive summary statistics for the regressors, regressands and expenditure variables are given in Table AI. For all the Caribbean countries the pupil-teacher ratio for both primary and secondary schools has been steadily declining over the time period as well as income per capita, infant mortality and population 0-14. While adult literacy rate, immunization for DPT and measles, and life expectancy are trending upwards. Enrollment rates have also been generally expanding across the Caribbean. Improved access to water and sanitation has been mostly constant from 1995 to 2009 with the percentage of access to water ranging from 83 to 100 and 80 to 100 percent of the population having access to sanitation facilities. In both cases Haiti is the outlier with an increase over the period from 47 to 63 percent access to improved water source and shrinkage over the same period from 26 to 17 percent in improved access to sanitation facilities. The average public spending on health care in the Caribbean is 10.89 percent of total government expenditure with a maximum of 23.58 percent for Haiti and a minimum of 3.52 percent for Jamaica. Most of the countries exhibit decreased public spending on health care over the time period; however Trinidad and Tobago, Bahamas and Guyana have upward trending government expending. Barbados, Dominica and Dominican Republic all have constant spending fluctuating around means of 12, 9.8 and 11.6, respectively, with corresponding standard deviations of 0.76, 1.87 and 2.05.

The data in general had several gaps, sometimes for five year time periods for some countries. As a result the number of observations over which the health and education regressions were estimated totaled 53 and 45, well short of a possible maximum of 247 and 570, respectively. This insufficiency will obviously affect the unbiasedness, the consistency and efficiency of the results from the models.

4. Results

The econometric software program used for this research was econometric views (E-Views). All three regressions were estimated using panel data analysis mainly to improve on the degrees of freedom since there were 19 cross-section and ten time series, too small for either cross-section or time series methods. The data was not only short but contained several structural breaks. Therefore, use of panel unit root tests – Levin *et al.* (2002) and Im *et al.* (2003), the augmented Dickey Fuller (ADF) Fisher χ^2 (Dickey and Fuller, 1979) and the Phillips-Perron (PP) Fisher χ^2 (Phillips and Perron, 1988) – was utilized to confirm the non-scientific visual analysis of the series plots. Improved sanitation facilities, life expectancy, carbon dioxide emissions, immunization DPT and immunization measles, adult literacy, urbanization, primary school enrollment and government expenditure on education are stationary in levels, while the remaining variables appear to be integrated of order zero [I (0)] but with structural breaks. These results are not reported but are available on request. They imply that panel OLS provides consistent estimates for the three models above.

4.1 The health equation

The adjusted R^2 of the health regression is 75.8 percent. This indicates that the regressors fit the models fairly well. From Table AII, except for immunization

for measles, income per capita, urbanization and improved access to sanitation facilities all the remaining variables in the health model are significant at the 10 percent level. The findings show, as was expected, that improved access to water, immunization for DPT and public expenditure on health increases longevity. These results are similar to Gupta *et al.* (2002) and Greenidge and Stanford (2007). A 1 percent rise in better access to clean water sources augments life expectancy by 0.26 percent, which is logical since water is needed to carry out bodily functions such as regulating temperature and transporting nutrients. The significance of immunization for DPT shows that spending on preventative methods is necessary to achieve improved health status in the Caribbean which is in accordance with the views of Sahn and Bernier (1993) and Pradhan (1996). The outcome of the regression imply that increased expenditure on health care, the variable of interest, increases life expectancy, a growth of 1 percent in public spending on health care raises life expectancy by 0.04 percent. On the other hand, Greenidge and Stanford (2007) found that a 1 percent increase in public spending led to a 0.4 percent improvement in longevity.

4.2 The education equation

The adjusted R^2 of the primary education regression is 82.9 (Table AIII). Infant mortality, adult literacy and income per capita are all significant at the 1 percent level. The coefficient on income per capita is contrary to the a priori belief of a positive relation to school enrollments in the Caribbean while the parameters on adult literacy and infant mortality are in agreement with the theory mentioned in the methodology. However, the urbanization rate, pupil-teacher ratio, percent of the population 0-14 and public expenditure are statistically insignificant. This insignificance of the education expenditure variable may be a consequence of the government spending a majority of the money on secondary and tertiary education. The greater the portion of resources devoted to tertiary education relative to primary education, the lesser the primary and secondary enrollment rates (Baldacci *et al.*, 2003). Another source of this insignificant relationship between expenditure and school enrollments may be that most of the expenditure budget is devoted to salaries and wages rather than supplies and equipment for pupils (Swaroop, 1996; Mingat and Tan, 1998; Anand and Ravallion, 1993).

In relation to the secondary regression seen in Table AIII the adjusted R^2 is 94.9 percent. Except for literacy and the pupil-teacher ratio all the other variables – infant mortality, income per capita, urbanization, population aged 0 to 14 and government expenditure – are insignificant. The insignificance of the education expenditure variable may be an outcome of the government disbursing a bulk of the capital on tertiary education. The larger the fraction of resources devoted to tertiary education relative to primary education, the lesser the primary and secondary enrollment rates (Baldacci *et al.*, 2003). In addition, this insignificant relationship between expenditure and secondary school enrollments may be a result of majority of the expenditure account being allocated to salaries and wages instead of the materials and tools necessary for students to enroll on school such as buildings and furniture (Swaroop, 1996; Mingat and Tan, 1998; Anand and Ravallion, 1993).

5. Conclusion and policy implications

The concluding of many papers is that public expenditure on education and health care is necessary to attain human development and other benefits such as economic growth.

The most important public goals are to use public expenditure to reduce poverty and aid in the creation of an enabling environment within which the privates sector can be an engine of growth (Swaroop, 1996). Most of the variables this model uses were chosen in accordance with previous literature. However, unlike most of the literature assessing the Caribbean, this model attempts to account for quality in interpreting education attainment.

Employing panel ordinary least squares for the health regression improved access to water, immunization for DPT, adult literacy and public expenditure on health are statistically significant at the 5 percent level and carbon dioxide emissions is significant at the 10 percent level. The former two have expected positive signs while the latter three have unanticipated ones. Nevertheless, these abnormalities can be explained. Carbon dioxide emissions positive relationship with health expectancy may reflect either a good health care system in the Caribbean and access to combative pollution medication or a lack of pollution in the Caribbean, both of which diminutions the impact of pollution on health significantly. The negative relationships between adult literacy and health and public expenditure and health may be due to the presence of very low-income countries in the sample which affects the skewness. Another alarming result is the insignificance of income per capita but this may be a result of disparities in the distribution of income.

Using the same method as in the health regression, infant mortality and adult literacy are statistically significant at the 5 percent level for both education regressions while total pupil-teacher ratios, income per capita is statistically significant at the 5 percent level for the primary regression and pupil-teacher ratio is so for the secondary regression. Infant mortality is negatively related to education attainment it reduces the number of school age children per year. Adult literacy's coefficient is positive; one reason for this is the more educated households are the more likely they will send their children to school. Moreover, a 1 percent growth in adult literacy causes a 0.4 percent rise in primary school enrollments and a 1.99 percent rise in secondary enrollments. Income per capita and public expenditure on education do not illustrate the results as prescribed by the literature; nevertheless these results can be justified. Income per capita is affected by the distribution of income and the effect of expenditure on primary and secondary rates depends on how resources are allocated among those levels and the tertiary level.

Several policy implications can be deduced from this research. These findings indicate that expenditure on health care is an important component of health status and government should provide sufficient and efficient funding for essential preventative care such as immunization for DPT. The statistical significance of better access to water sources urges government to invest in adequate drainage and sewerage systems, subsidise water rates for households and provide free easily accessible water facilities in lesser income communities.

To improve the educational system, government should allocate the money in a manner which benefits each level of education equitably. Since the education system is a hierarchy with primary on the bottom, secondary in the middle and tertiary at the top. Studies have suggested that more investment should be made at the primary level as the greatest returns to society are gained at this level. Psacharopoulos (1981) indicates that the tertiary education benefits the individual more than the society. Swaroop (1996) research revealed that it is more expensive to send one student to tertiary level education than to educate 33 students in primary school.

From the results it is seen that health and education are intertwined since an improvement in infant mortality increases school enrollments. Another positive impact on education from health is the healthier a person is, the longer their life expectancy and thus they can attempt more education levels. Thus, spending on one, positively affects the other. However, the presence in some countries of disparaging social conditions like high illiteracy rates and sizeable income disparities in the access to these public goods, reduce the effectiveness of public spending in guaranteeing better social consequences and healthier human development (Baldacci *et al.*, 2003). To ensure the effective of public spending on human development infrastructure needs to be set up in order to guarantee that it is easily accessible to the persons who cannot afford. For illustration, although primary education is of no cost in most Caribbean islands many low-income households cannot afford to send their children to school because of the direct and indirect costs associated with school enrollment. To lessen this occurrence and account for income inequality, government could allow free school enrollment based on financial need and offer subsidized privatized education for those households who can afford it. The financing once spent on those who could afford school can now be devoted to the educational costs of the less fortunate. This process could be utilized for all levels.

Notes

1. http://data.worldbank.org/indicator
2. These countries include: Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, St Kitts and Nevis, St Lucia, St Vincent and Grenadines, Suriname and Trinidad and Tobago.
3. Vaccination from the diphtheria, pertussis (whooping cough) and tetanus.
4. It should be noted that illiteracy does not mean a person's life expectancy would decrease.
5. These countries include Antigua and Barbuda, Aruba, The Bahamas, Barbados, Bermuda, Cayman Islands, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Puerto Rico, St Kitts and Nevis, St Vincent and The Grenadines, Trinidad and Tobago, Turks and Caicos and US Virgin Islands.

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Appendix

	Mean	Median	Maximum	Minimum	SD	Skewness	Kurtosis	Jarque-Bera
Education expenditure	15.55	17.54	22.16	0.89	4.64	−1.17	4.14	30.44
Health expenditure	11.36	11.49	17.92	3.52	2.94	−0.33	3.39	2.62
Income per capita	14,375.9	14,144.4	17,449.4	12,833.2	1,196.03	1.3	4.45	4.8
Percentage of urban population	31.98	31.82	34	30.54	1.18	0.33	1.81	1.01
Life expectancy	69.74	70.83	78.72	49	5.12	−1.67	6.96	136.33
CO_2	0.52	0.52	0.6	0.43	0.04	−0.37	3.27	0.34
Immunization (DPT)	98.31	99	99	95	1.25	−1.67	4.71	7.64
Immunization (measles)	97.46	99	99	93	2.33	−1.12	2.67	2.77
Improved access to sanitation facilities	95	95	95	95	0	NA	NA	NA
Improved access to water sources	91	91	91	91	0	NA	NA	NA
Infant mortality rate	16.26	15.72	22.32	11.61	3.46	0.34	1.91	0.9
Primary pupil-teacher ratio	23.66	21.99	55.38	8.25	7.95	1.15	4.76	42.55
Secondary pupil-teacher ratio	19.18	18.96	33.49	6.05	5.07	0.32	3.59	3.83
Gross primary school enrollment	105.22	104.33	139.79	46.3	13.75	−1.32	8.21	173.32
Gross secondary school enrollment	80.37	82.97	114.06	8.41	21.95	−1.23	4.7	45.35
Literacy	87.37	95.2	99.7	23.3	18.27	−2.15	7.03	416.95
Population aged 0-14	36.14	37.09	50.49	17.29	8	−0.24	2.22	23

Note: NA indicates the third and fourth moments of the distribution as well as the test statistic for normality could not be calculated for the improved access to sanitation facilities and water sources

Table AI. Summary descriptive statistics for the pooled data

Independent variable	Dependent variable: life expectancy at birth
Health expenditure to government expenditure ratio	0.034 (0.012)*
Improved water source (percentage of population with access)	0.255 (0.082)*
Immunization, DPT (percentage of children ages 12-23 months)	0.126 (0.061)**
Literacy rate, adult total (percentage of people ages 15 and above)	−0.198 (0.075)*
CO_2 emissions (metric tons per capita)	0.019 (0.011)**
Immunization, measles	−0.007 (0.095)
Improved sanitation facilities (percentage of population with access)	0.076 (0.054)
Urban population (percentage of total population)	0.059 (0.007)
Income per capita	−0.135 (0.012)

Table AII.
Results from the health regression

Independent variable	Dependent variable: primary school enrollment (gross %)	Dependent variable: secondary school enrollment (gross %)
Infant mortality	−0.078 (0.026)*	
Income per capita	−0.111 (0.015)*	0.031 (0.039)
Literacy rate, adult total (percentage of people ages 15 and above)	0.473 (0.084)*	1.99 (0.122)*
Pupil-teacher ratio	0.067 (0.048)	−0.184 (0.058)*
Urban population (percentage of total population)	0.023 (0.025)	−0.059 (0.048)
Population aged 0-14 (percentage of total population)	0.166 (0.218)	0.423 (0.399)
Public expenditure on education	0.052 (0.043)	−0.076 (0.056)

Table AIII.
Results from the education regression

Notes: Statistical significant at: *1, **5, and ***10 percent levels; all variables are logged; SE are in parenthesis

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