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ESTABLISHING THE EFFECT OF CHANGE IN PERCENTAGE OF PUBLIC HEALTH EXPENDITURE ON LIFE EXPECTANCY IN A COUNTRY

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ABSTRACT

It's every country's desire to increase its citizens' life expectancy. One of the popular approaches to achieving this goal is increasing public health expenditure. This study sought to establish the effect of a change in percentage of public health expenditure (relative to total government expenditure) on life expectancy in a country. It employed panel data analysis using first differences. The results indicate that at a 10% level of significance, a one percentage point increase in the percentage of public health expenditure is associated with a 0.088 year increment in life expectancy, controlling for changes in log GDP and level of education. Additionally, prevalence of undernourishment and the percentage of the population with access to an improved water source were shown to be mechanisms through which increment of public health expenditure operates to increase life expectancy. Improved water sources were found to be a superior mechanism.

Keywords: Public Health, Gross Domestic Product, Undernourishment, Expectancy, Health

1. TOPIC AND METHODOLOGY

1.1 Topic

Establishing the effect of change in percentage of public health expenditure (relative to total government expenditure) on life expectancy in a country.

1.2 Question

To what extent does a country's life expectancy depend on its public health expenditure as a percentage of total government expenditure?

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1.3 Empirical Strategy

The analysis focuses on establishing the effect of change in percentage public health expenditure on life expectancy of a country, controlling for changes in Gross Domestic Product and level of education.

The study uses panel data on relevant indicators from 177 countries for the years 2000 and 2010.

First, the analysis establishes the relationship between the independent variables and the dependent variable by running a cross-sectional regression of life expectancy on all the independent variables in 2010.

Subsequently, panel data analysis using first differences is done to establish the effect of change in percentage public health expenditure on life expectancy. This effect is not expected to be causal since public health expenditure percentages were not randomly assigned to countries, implying that there might be omitted variable bias.
The population models for period 1 (2000) and period 2 (2010) are:

$$Y_{i1} = B_o + B_1 X_{i1} + a_i + e_{i1}$$
$$Y_{i2} = B_o + \delta_o + B_1 X_{i2} + a_i + e_{i2}$$
$$Y_{i1} - Y_{i2} = \delta_o + B_1(X_{i2} - X_{i1}) + (e_{i2} - e_{i1})$$
$$\Delta Y = \delta_o + B_1 \Delta X + \Delta e$$

Where:

- Y represents life expectancy and X represents the key independent variable, percentage of public health expenditure relative total government spending.
- a_i represents unobserved variables that are time invariant and e_i represents other unobserved variables. *Bias due to the a_i's is eliminated.*

Other control variables whose differences were included in the regression are log GDP and average years of education. These are correlated with both life expectancy and percentage of public health expenditure and so their omission would lead to bias in the model's estimates.

Extra regressions were run to establish whether prevalence of undernourishment and percentage of population with access to an improved water source are mechanisms through which percentage of public health expenditure operates to influence life expectancy of a country.

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2.0 SUMMARY STATISTICS

Table 1: Variable Descriptions

Variable	Description
Life expectancy 2	Life Expectancy at birth - 2010
Health expenditure 2	Public health expenditure (% of government expenditure) - 2010
Log GDP 2	Log of 2010 GDP
Education 2	Average years of education in 2010
Undernourishment 2	prevalence of undernourishment (% of population) in 2010
Water access 2	%age of population with access to improved water source in 2010
Life expectancy diff	Change in life expectancy (2000 to 2010)
Health expenditure diff	Change in percentage of public health expenditure (2000 to 2010)
Log GDP diff	Change in Log GDP (2000 to 2010)
Education diff	Change in average years of education (2000 to 2010)
Undernourishment diff	Change in prevalence of undernourishment (2000 to 2010)
Water access diff	Change in % of population with access to improved water source (2000 to 2010)

Table 2: Summary Statistics

Variable	n	Obs	Mean	Std. Dev.	Min	Max
Life expectancy 2	177	177	70.181	8.568	47.533	83.160
Health expenditure 2	177	177	11.620	4.428	1.774	28.992
Log GDP 2	174	177	9.084	1.226	6.412	11.737
Education 2	135	177	8.051	3.104	1.240	13.420
Undernourishment 2	111	177	14.887	11.166	5.000	51.700
Water access 2	173	177	87.049	15.453	39.100	100.00
Life expectancy diff	177	177	3.467	2.466	-0.762	14.705
Health expenditure diff	177	177	1.044	3.521	-10.525	11.142
Log GDP diff	173	177	0.259	0.248	-0.584	1.275
Education diff	135	177	1.008	0.617	-0.330	3.130
Undernourishment diff	111	177	-5.722	7.140	-32.200	8.800
Water access diff	173	177	4.635	5.512	-7.100	22.600

Notes: *Variables with missing values were adjusted to avoid loss of data points in the regressions.* ***n*** *is the actual number observations before adjustment for missing values and* ***Obs*** *is the adjusted number of observations. The variables with a "2" extension are derived from period 2 (2010) and the variables with a "diff" extension represent the difference in the relevant variable in period 2 (2010) and period 1 (2000).*

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Data source: *World Bank and Barro-Lee databases*

3. ANALYSIS

3.1 Cross-sectional analysis

Table 3: Cross-sectional regressions of life expectancy on independent variables in 2010 (Establishing the relationship between life expectancy and the independent variables)

Dependent Variable: Life Expectancy at birth in 2010

Control Variables	Main Control Variables	Inclusion of Mechanism 1	Inclusion of Mechanism 2
Health expenditure 2	0.267***	0.239***	0.170**
	(0.0871)	(0.0861)	(0.0835)
Log GDP 2	4.531***	3.827***	3.197***
	(4.837)	(5.290)	(5.367)
Education 2	0.569***	0.581***	0.387**
	(0.194)	(0.195)	(0.185)
Undernourishment 2		-0.142***	
		(0.0465)	
Water access 2			0.184***
			(0.0348)
Constant	21.26***	29.57***	19.93***
	(3.277)	(4.162)	(3.091)
Observations	177	177	177
R-squared	0.679	0.697	0.724

Notes: *Standard errors are in parentheses. *** represents p<0.01, ** represents p<0.05, and * represents p<0.1. The regressions were run with dummy variables corresponding to missing values for each control variable. The results from the dummy variables are not reported because they are irrelevant to the core analysis.*

Data source: *World Bank and Barro-Lee databases*

Interpretations:

Main Control Variables: As expected, the main independent variable, Health expenditure 2 (percentage of public health expenditure in 2010), is positively correlated with life expectancy in 2010. The other control variables (Education 2 and Log GDP 2) are also positively correlated

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with life expectancy. All coefficients are statistically significant at a 1% level.

Inclusion of Mechanism 1: This represents addition of the variable Undernourishment 2 (percentage prevalence of under-nourishment in 2010) to the regression. As expected this variable has a negative coefficient i.e. less undernourishment is associated with a higher life expectancy. It is statistically significant at a 1% level. The addition of this variable to the regression reduces the coefficient on "Health expenditure 2" from 0.267 to 0.239, implying that it is negatively correlated with Health expenditure 2 as well. i.e. more public expenditure is associated with less undernourishment.

Inclusion of Mechanism 2: This represents addition of the variable Water access 2 (percentage of population with access to improved water source in 2010). As expected this variable has a positive coefficient i.e. a larger percentage of the population with access to an improved water source is associated with higher life expectancy. The coefficient on this variable is statistically significant at a 1% level. Its addition to the regression reduces the coefficient on "Health expenditure 2" from 0.267 to 0.170, implying that there is positive correlation between Health expenditure 2 and Water access 2. i.e. more public health expenditure is associated with a higher percentage of the population having access to an improved water source.

3.2 Analysis using first differences

Table 4: Regression of difference in life expectancy (2010-2000) on differences in control variables (Panel data analysis using first differences to establish impact of change in percentage public expenditure on life expectancy)

Dependent Variable: Change in Life Expectancy (2000 – 2010)

Control Variables	Main Control Variables	Inclusion of Mechanism 1	Inclusion of Mechanism 2
Health expenditure diff	0.0879*	0.0823*	0.0418
	(0.0528)	(0.0492)	(0.0506)
Log GDP diff	1.035	0.0431	0.329
	(0.762)	(0.737)	(0.726)
Education diff	-0.547	-0.445	-0.355
	(0.343)	(0.320)	(0.323)
Undernourishment diff		-0.124***	
		(0.0317)	
Water access diff			0.166***

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			(0.0330)
Constant	3.588***	3.549***	2.912***
	(0.448)	(0.455)	(0.442)
Observations	177	177	177
R-squared	0.046	0.182	0.175

Notes: *Standard errors are in parentheses. *** represents p<0.01, ** represents p<0.05, and * represents p<0.1. The regressions were run with dummy variables corresponding to missing values for each control variable. The results from the dummy variables are not reported because they are irrelevant to the core analysis.*

Data source: *World Bank and Barro-Lee databases*

Interpretations:

Main Interpretation: At a 10% level of significance, a one percentage point increase in the percentage of public health expenditure relative to total government spending is associated with a 0.088 year increment in life expectancy, controlling for changes in log GDP and level of education. This implies that if the country with the least percentage of public health expenditure increased its percentage to a value equal to that of the country with the highest percentage of public health expenditure (an increment of 27.22 percentage points), its life expectancy would be expected to increase by 2.39 years, holding changes in log GDP and level of education constant.

Mechanism 1: The -0.124 coefficient on "Undernourishment diff" (change in %age prevalence of undernourishment), is statistically significant at a 1% level. Addition of the variable to the regression reduces the coefficient on "Health expenditure diff" from 0.0879 to 0.0823. Therefore, we can conclude that change in prevalence of undernourishment is a mechanism through which changes in public health expenditure operate to influence life expectancy.

Mechanism 2: The 0.166 coefficient on "Water access diff" (change in percentage of population with access to an improved water source), is statistically significant at a 1% level. On addition of the variable to the regression, the coefficient on "Health expenditure diff" reduces from 0.0879 to 0.0418 and is no longer significant at the 10% level. Therefore, we can conclude that change in percentage of population with access to an improved water source is a strong mechanism through which changes in public health expenditure operate to influence life expectancy.

4. CONCLUSION

4.1 Results

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At a 10% level of significance, a one percentage point increase in the percentage of public health expenditure relative to total government spending is associated with a 0.088 year increment in life expectancy, controlling for changes in log GDP and level of education.

Prevalence of undernourishment and percentage of population with access to an improved water source are mechanisms through which changes in percentage of public health expenditure to total government spending operate to influence life expectancy of a country. Percentage of population with access to an improved water source is however a stronger mechanism than prevalence of undernourishment.

4.2 Limitations

This analysis eliminates bias from factors that affect both life expectancy and percentage of health expenditure but are time invariant (though different across countries) or change in the same way over time across countries.

However, it doesn't eliminate bias due to omission of factors that affect both life expectancy and percentage of public health expenditure, and vary differently across time and countries. Examples of such a factors include GDP and level of education, which were controlled for in the analysis, and others that were not controlled for like political climate. Political climate varies differently across time and countries and it can influence both life expectancy and the proportion of government's spending on public health, hence, it is a potential source of bias in the analysis.

Due to the potential presence of omitted variable bias, the results of the analysis can't be interpreted as causal but are considerably substantive since many of the potential sources of bias are eliminated.

5. DATA SOURCES

World Bank (World Development Indicators) http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators#

Barro-Lee Dataset http://www.barrolee.com/data/yrsch2.htm

