

# Relationship between Social Sector Expenditure and Human Development Outcomes: A Cross-Country Analysis

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February, 2025

## Abstract

A comprehensive evaluation of human development requires a multidimensional approach. This study examines the relationship between government social sector expenditure and two human development dimensions (education and health), measured by expected years of schooling and infant mortality rate as key indicators. Using panel fixed effects, the results show that increased social sector spending improves education outcome and significantly reduces infant mortality, underscoring its pivotal role in human capital development. These findings emphasize the necessity of policies that enhance investments in both human and physical capital to foster long-term economic growth. Additionally, decentralized implementation strategies play a crucial role in fostering localized development and sustaining economic growth. These findings contribute to the broader discourse on the role of public expenditure in shaping long-term human development outcomes.

**Keywords:** Human development, Social sector expenditure, Education, Health, School attainment, Infant mortality rate, and Panel fixed effects.

**JEL Codes:** H51, H52, I15, I25.

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# 1. Introduction

Health and education are fundamental drivers of human development, requiring a multi-dimensional analytical framework to assess their determinants. Public social expenditure serves as a critical policy instrument in shaping key development indicators such as literacy rates, expected years of schooling, and infant mortality. While global initiatives, particularly the Sustainable Development Goals (SDGs), emphasize equitable access to health and education, persistent cross-country disparities raise concerns regarding the effectiveness of public investments in fostering human capital accumulation and reducing socioeconomic inequalities.

Education extends beyond its role in production, serving primarily to enhance human capability and expand individual choice. Sen (1999) argued that freedom should be central to development for two reasons. First, human progress is best measured by the expansion of freedoms. Second, development depends on individuals' capacity to act as free agents. While the first claim is widely accepted, if freedom is broadly defined to include freedom from deprivation—the second remains contested in mainstream economics.

A common argument for limiting public expenditures on education, healthcare, and social welfare is that low-income economies must prioritize growth before making such investments (Rostow, 1960). Sen challenges this view, demonstrating that high incomes alone do not ensure well-being, such as increased life expectancy. He argued that social sector expenditure can stimulate growth, particularly in labor-intensive sectors where developing economies hold a comparative advantage.

Sen also critiques the "Lee Thesis," which posits that restricting political and civil rights can foster economic development. Contrary to this claim, he contends that political freedoms are not merely eventual outcomes of growth but intrinsic to development. Moreover, freedom itself drives economic expansion by enabling participation, innovation, and accountability. Sen's perspective reframes development, emphasizing the reciprocal relationship between freedom and economic progress rather than treating growth as a prerequisite for welfare (O'Hearn, 2009).

A well-established body of literature underscores the positive relationship between social spending and welfare outcomes. However, the mechanisms through which fiscal allocations translate into improved human development remain a subject of debate. In particular, the extent to which fiscal decentralization, institutional quality, and regional economic disparities moderate these effects is not yet fully understood. Furthermore, cross-country heterogeneity in governance structures and budgetary priorities complicates evaluations of resource allocation efficiency. Addressing these gaps is essential for formulating evidence-based policies that enhance the effectiveness of social spending, improve

service delivery, and promote inclusive economic growth. A more granular understanding of these linkages can provide valuable insights for policymakers aiming to optimize public expenditure strategies in pursuit of sustainable development objectives.

This study empirically examines the relationship between social sector expenditure and human development indicators, emphasizing the extent to which public social spending influences expected years of schooling and infant mortality, as well as its cross-country relationship with public education and health expenditures and GNI per capita. By addressing gaps in the existing literature, this analysis contributes to policy discussions on the effectiveness of public investments in fostering long-term development outcomes.

This paper comprises six sections. The second reviews relevant literature, synthesizing insights from prior research. The third details the methodology, including data sources and empirical strategy. The fourth presents results, followed by a discussion in the fifth. The final section offers conclusions and policy implications.

## 2. Insights from Existing Literature

The relationship between social sector expenditure and economic growth remains a subject of extensive academic inquiry, with varying empirical findings across different economic contexts. A healthier workforce boosts productivity by reducing absenteeism and enhancing efficiency, while higher life expectancy incentivizes education and labor participation ([Bloom and Canning, 2000](#)). Longer lifespans also encourage retirement savings, fostering capital accumulation. However, India's social sector funding remains inadequate despite policy focus. [Kaur and Misra \(2003\)](#) examined education and health investments across 15 Indian states (1985–2001), finding stronger effects on elementary education in poorer regions, while insufficient health spending and infrastructure constraints limited improvements in infant mortality and inequality reduction.

[Estache et al. \(2007\)](#) analyzed public spending on education, health, and infrastructure, highlighting disparities in service delivery and efficiency. Increased defense expenditure in Nigeria (1970–2003) reduced allocations for education ([Adebiyi and Oladele, 2005](#)). Despite lower incomes, several EU nations approached U.S. welfare levels by balancing leisure, consumption, and life expectancy ([Jones and Klenow, 2016](#)). Healthcare spending improved life expectancy in 19 Caribbean nations, but education expenditure had no significant effect on school enrolment ([Craigwell et al., 2012](#)). Public expenditure convergence was absent among 17 EU countries (1990–2012), indicating persistent fiscal heterogeneity ([Apergis et al., 2013](#)).

Greenidge and Stanford (2007) analyze panel data (1994–2005) from 37 countries, finding that health expenditure, calorie intake, literacy, and urbanization significantly influence health status in Latin America and the Caribbean. Carter et al. (2013) found no statistically significant relationship between public social security spending and GDP per capita in Barbados, suggesting limited macroeconomic benefits. Within social protection frameworks, food assistance programs mitigate financial vulnerabilities, allowing households to allocate resources toward savings, investment, and technology adoption—key drivers of long-term growth (Lentz and Barrett, 2013).

School-feeding initiatives further enhance educational attainment by improving attendance, thereby strengthening labor market productivity. In the United States, social security expenditures exhibit a substantial multiplier effect, with each dollar spent generating nearly two dollars in output, primarily through demand stimulation and economic stabilization. This effect is particularly evident in unemployment benefits and other transfers that sustain consumption and economic activity (Koenig and Myles, 2013).

Using a Vector Error Correction Model (VECM), Pereira and Andraz (2015) found that higher public social security spending in 12 EU countries reduced economic output. Jaba et al. (2014) reported a positive link between health expenditure and life expectancy, with stronger effects in high-income countries. Similarly, Jalloh, Sam, and Fayissa (2018) showed that public health spending lowered infant mortality, particularly where institutional quality was higher, underscoring the role of governance in health outcomes.

Sinha et al. (2018) identified a bidirectional relationship wherein defense spending fosters economic growth in developed nations but hinders it in developing countries. In the SAARC region, Mahapatra et al. (2018) found a positive effect, highlighting regional disparities. For India, Mukhopadhyay et al. (2018) used time series analysis to establish a significant link between defense expenditure and growth, whereas in China, the relationship was statistically insignificant. These findings underscore the heterogeneity in the economic consequences of military spending (Sinha et al., 2018; Mahapatra et al., 2018).

Beyond the defense sector, human development remains central to economic progress, with quality of life, well-being, and access to social services shaping economic participation through improved health, education, and governance. Social-sector spending has been shown to significantly enhance Human Development Index growth across Indian states, underscoring the role of targeted public investment (Das et al., 2021).

Public expenditures on education and health positively influence schooling years and life expectancy over time (Paliova et al., 2019). Additionally, GDP growth, health and education spending, and industrialization contribute to lower under-5 mortality in developing countries (Islam et al., 2023).

These literature insights collectively underscore the multifaceted linkages between public expenditure, economic growth, and human development, warranting further investigation into context-specific policy implications.

## 3. Methodology

### 3.1. Data Sources

For this study, we utilized data from two sources: 1. [World Development Indicators \(WDI\) database](#) and 2. [Global Data Lab](#). Our analysis examines the impact of public social spending on key development outcomes, specifically infant mortality and expected years of schooling.

To ensure a comprehensive assessment, we constructed a panel dataset covering 187 countries over the period 2000–2022, incorporating both quantitative and qualitative indicators. The selection of variables and methodological approach align with previous empirical studies in this domain, facilitating comparability and robustness in our findings.

### 3.2. Empirical Strategy

To examine the relationship between government expenditure on education and health and key development indicators, expected years of schooling and infant mortality, we employ a panel fixed effects (FE) model. This methodology accounts for time-invariant unobserved heterogeneity, thereby mitigating potential biases arising from omitted variables that remain constant over time. By exploiting within-entity variation, the FE model provides refined estimates of the association between changes in government expenditure and development outcomes.

However, the validity of the FE estimator in capturing causal effects relies on a key identification assumption, namely, that changes in government expenditure are exogenous to time-varying unobserved factors influencing education and health outcomes. This assumption (Wooldridge, 2020) is often difficult to justify empirically, as fiscal allocations may respond endogenously to contemporaneous economic conditions or unobserved policy shifts. As a result, while the FE model enhances inference by controlling for time-invariant

confounders, it does not fully address concerns related to reverse causality, measurement error, or omitted time-varying factors.

Given these limitations, we interpret our estimated coefficients as adjusted correlations rather than definitive causal effects. The findings underscore significant within-country associations between government expenditure and key development indicators, yet caution is warranted in drawing strong policy inferences solely based on these estimates.

To address endogeneity concerns while recognizing the limitations of lagged instruments, we present the Panel IV-FE model in the appendix as a supplementary analysis rather than a primary identification strategy. While [Angrist and Krueger \(2001\)](#) caution against mechanical use of lagged instruments, we employ them as an alternative robustness check rather than a definitive causal estimator. Given the policy relevance of our study, we report these results alongside the primary panel FE estimates for comparison, while emphasizing that our main conclusions rely on the panel FE model, consistent with identification concerns in prior literature.

### 3.2.1. Panel Fixed Effects Model

The study employs a two-way fixed effects (TWFE) model with unbalanced panel data to account for unobserved heterogeneity, controlling for both country-specific, time-invariant factors and year-specific cross-sectional variations ([Imai & Kim, 2021](#)). This methodological approach ensures a robust examination of the relationship between public social spending and human development outcomes while capturing both temporal and country-level dynamics.

Two distinct regression models are estimated: Model 1 assesses educational outcomes using expected years of schooling as the dependent variable, whereas Model 2 evaluates health outcomes based on the infant mortality rate (IMR). This dual-framework approach facilitates a comprehensive analysis of sector-specific impacts, offering valuable insights into the effectiveness of public social spending in enhancing education and health outcomes.

The econometric specifications are outlined as follows:

$$Y_{eit} = \delta_i + \lambda_t + \beta_0 X_{eit} + \beta_1 Z_{it} + \mu_{it}, \quad i = 1, \dots, N, \quad t = 1, \dots, T \quad (1)$$

$$Y_{hit} = \delta_i + \lambda_t + \beta_0 X_{hit} + \beta_1 Z_{it} + \mu_{it}, \quad i = 1, \dots, N, \quad t = 1, \dots, T \quad (2)$$

where  $Y_{eit}$  denotes the educational outcome, measured as expected years of schooling, and  $Y_{hit}$  represents the health outcome, proxied by the infant mortality rate. The key explanatory variables include public expenditure on education ( $X_{eit}$ ) and health ( $X_{hit}$ ),

both expressed as a percentage of GDP. The vector of control variables,  $Z_{it}$ , includes GDP per capita (PPP, constant 2021 international dollars), the Gini coefficient, the age dependency ratio, the prevalence of undernourishment, population growth, research and development expenditure, and military expenditure, all expressed as percentages where applicable (Refer Table A1 for further details).

The model incorporates country fixed effects ( $\delta_i$ ) to control for time-invariant heterogeneity across countries and time fixed effects ( $\lambda_t$ ) to account for common macroeconomic shocks and global trends. The error term,  $\mu_{it}$ , is assumed to be independently and identically distributed.

## 4. Results

This section provides the relationship between government expenditures and human development outcomes. Table 1 summarizes key variables, while Figures 1 to 4 illustrate distributions of education and health indicators. Figures 5 to 10 depict expenditure-outcome trends across time and regions. Panel fixed effect estimates in Tables 2 and 3 quantify these associations, providing a rigorous assessment of expenditure impacts on human development outcomes.

### 4.1. Characteristics of Human Development Outcomes and Selected Variables

Table 1 presents descriptive statistics on human development outcomes and selected control variables. Government expenditure on health and education (% of GDP) varies, with education receiving a higher share than health. GDP per capita (PPP) exhibits substantial disparities, indicating significant income inequality. The Gini coefficient ranges from 0.03 to 0.66, reflecting diverse inequality levels. The age dependency ratio fluctuates considerably, highlighting varying demographic pressures. Prevalence of undernourishment remains high in some countries, underscoring severe food security challenges. Population growth rates are highly heterogeneous, with some nations experiencing rapid expansion while others face stagnation. Research and development (R&D) expenditure as a share of GDP remains low on average, suggesting limited emphasis on innovation. Military expenditure also varies widely, with some countries allocating significantly higher budgets. These fiscal and social disparities illustrate structural differences in economic and human development across nations, emphasizing the need for targeted policy interventions to address inequality, demographic shifts, and food security concerns.

**Table 1:** Summary statistics of human development outcomes and selected variables

Variable	Observations	Mean	Std. Dev.	Min	Max
Expected years of schooling (Years)	4,458	12.57	3.15	1.8	18
Infant mortality rate (per 1,000 live births)	4,434	15.39	12.45	0.70	62.70
Government expenditure on education (% of GDP)	4,277	4.43	2.31	0.00	29.61
Government expenditure on health (% of GDP)	4,372	3.28	2.39	0.00	22.25
GDP per capita, PPP (constant 2021 international \$)	4,318	21,406	23,571	711	1,45,591
Gini coefficient	3,000	0.23	0.14	0.03	0.66
Age dependency ratio (% of working-age population)	4,458	61.49	18.38	17.30	111.21
Prevalence of undernourishment (% of population)	3,944	11.31	11.32	1.90	71.70
Population growth (annual %)	4,458	1.51	1.47	0.00	22.74
Research and development expenditure (% of GDP)	3,057	0.82	0.93	0.00	5.71
Military expenditure (% of GDP)	3,800	2.24	3.73	0.00	86.04

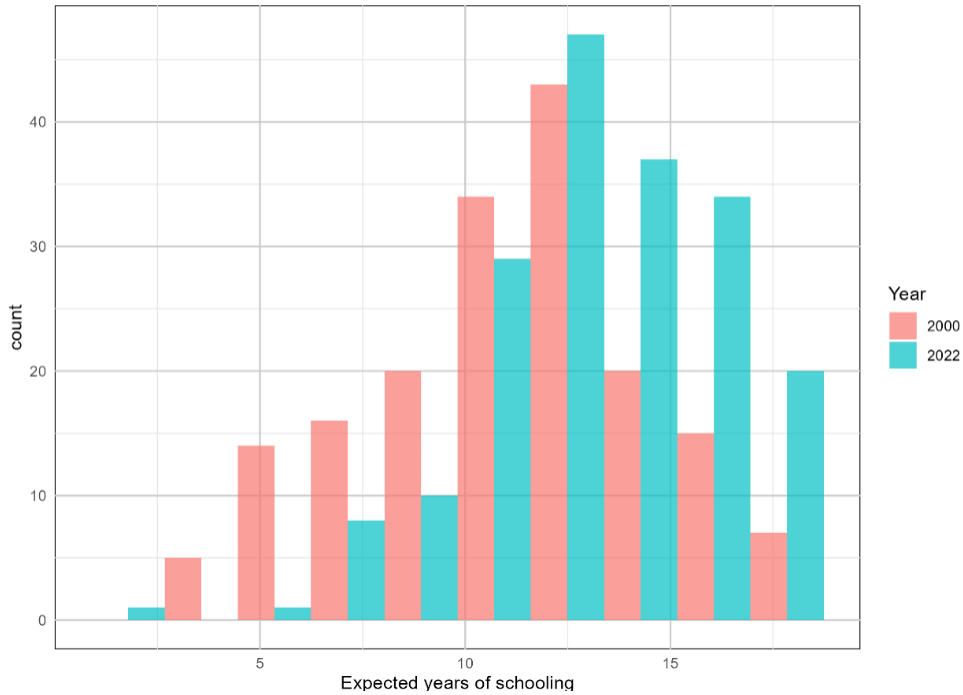


Figure : 1(a). Distribution of education outcome across years (Expected years of schooling)

**Source:** Prepared by author using WDI data.

Figure 1(a) depicts expected years of schooling for 2000 and 2022, while Figure 1(b) shows cross-country distributions for both years. The rightward shift in the distribution indicates a general increase in schooling years over time. The higher concentration of observations in the upper schooling categories in 2022 suggests notable improvements in educational access and attainment, reflecting progress in global efforts to expand educational opportunities.

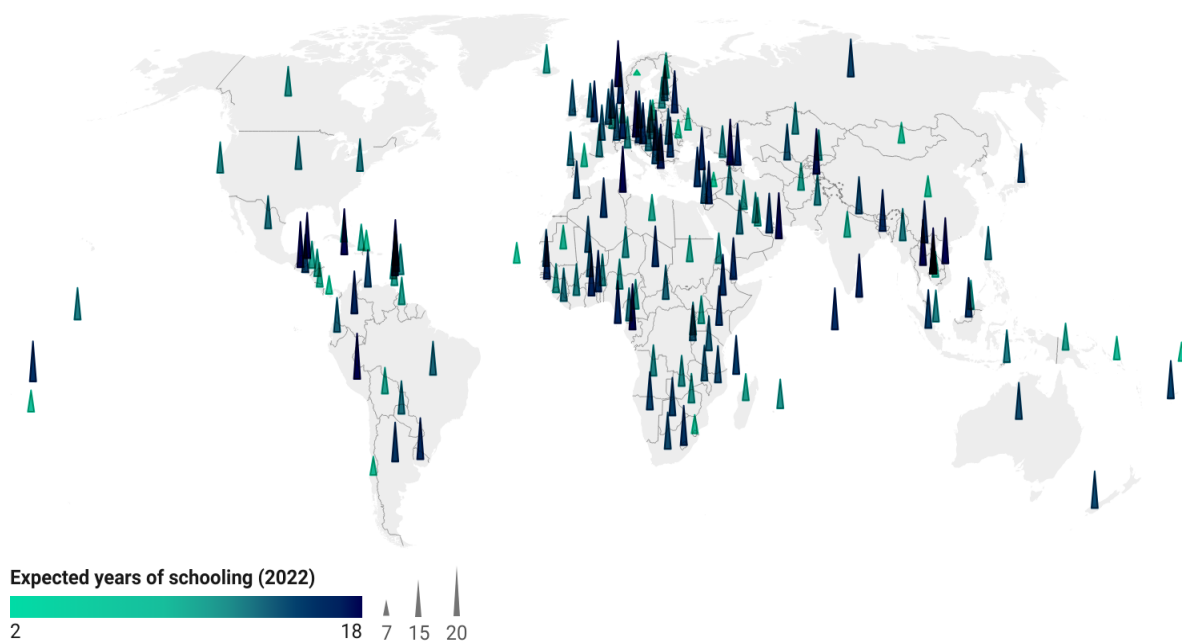
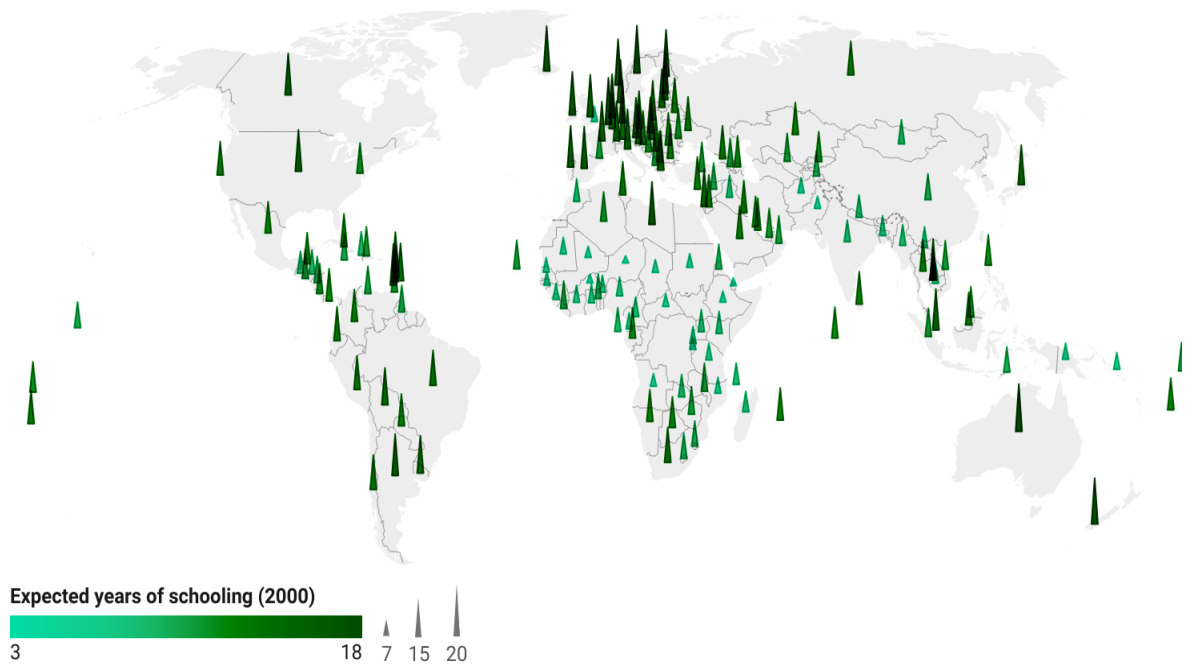


Figure : 1(b). Distribution of education outcome across countries and years (Expected years of schooling)

**Source:** Prepared by author using WDI data.

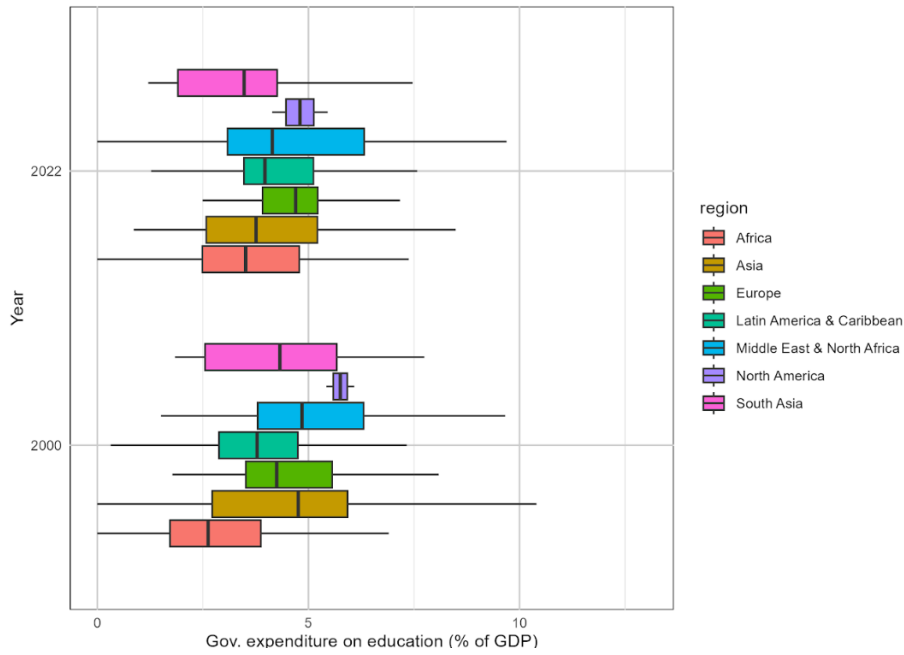
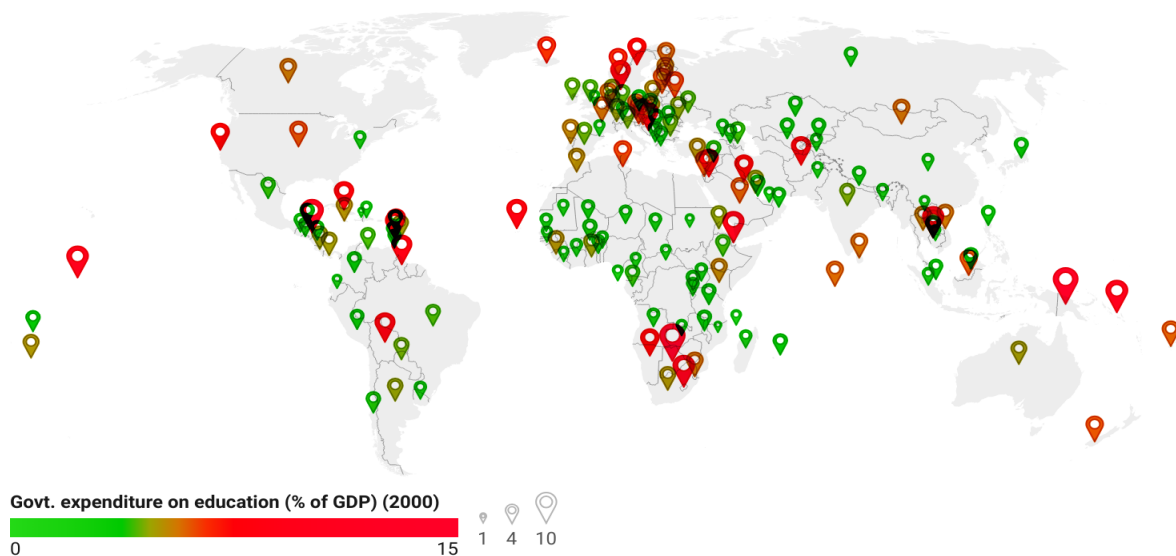


Figure : 2(a). Distribution of government expenditure on education across regions and years

**Source:** Prepared by author using WDI data.

Figure 2(a) presents regional government education expenditure (% of GDP) for 2000 and 2022, while Figure 2(b) shows country-level patterns over time. The data reveal a general upward trend in education spending over time across some regions, while North America shows a declining trend yet reported a highest median value among seven regions in 2022. The expansion of inter-quartile ranges in several regions indicates increasing disparities in education investment, reflecting differences in policy priorities and fiscal capacities among countries.



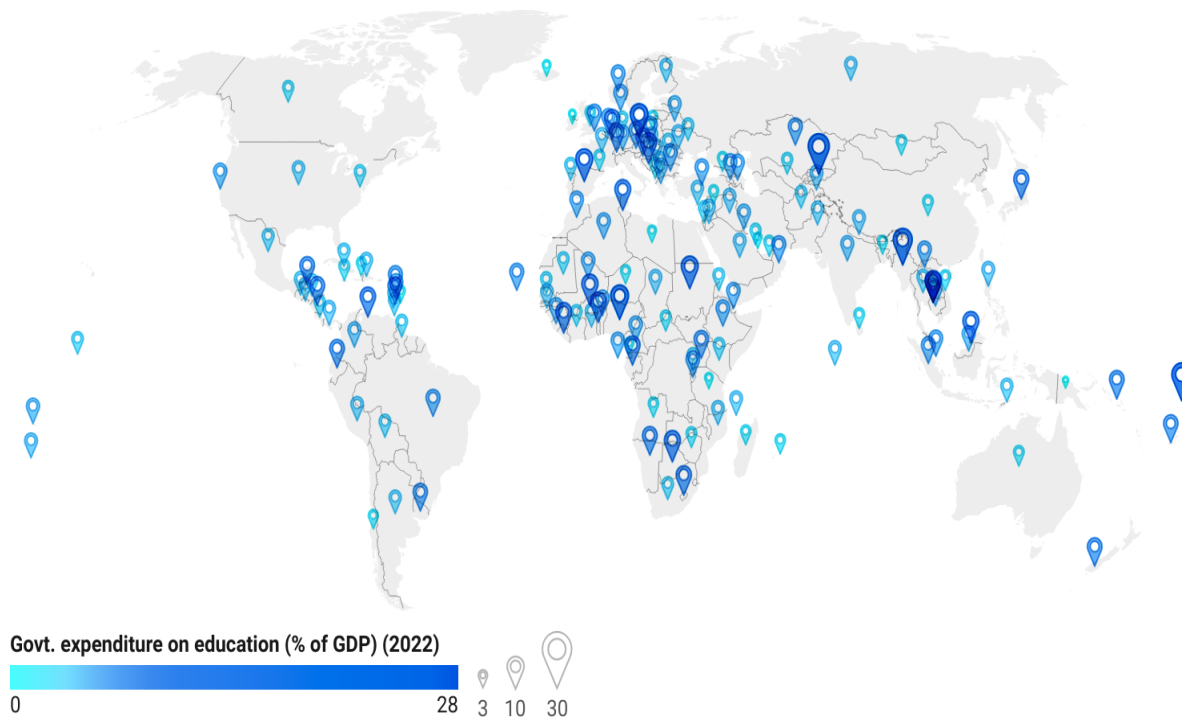


Figure : 2(b). Distribution of government expenditure on education across countries and years

Source: Prepared by author using WDI data.

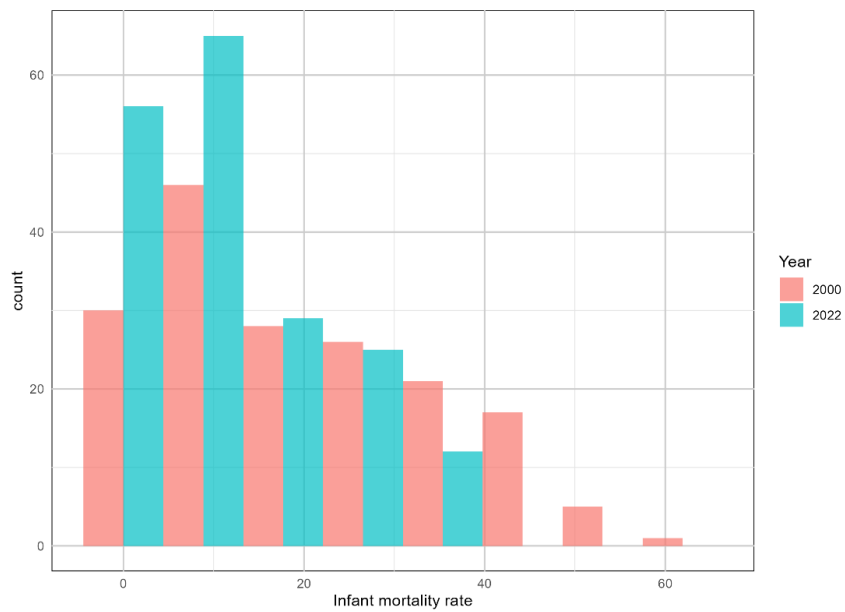


Figure : 3(a). Distribution of health outcome across years (Infant mortality rate)

Source: Prepared by author using WDI data.

Figure 3(a) illustrates infant mortality rate distribution over two years, while Figure 3(b) shows variations across countries and years. The observed decline in higher mortality rate categories in 2022 indicates notable progress in reducing infant deaths. However, the persistence of mortality cases in certain regions underscores ongoing disparities in health-care access. These findings highlight the need for sustained public health investments to further mitigate infant mortality.

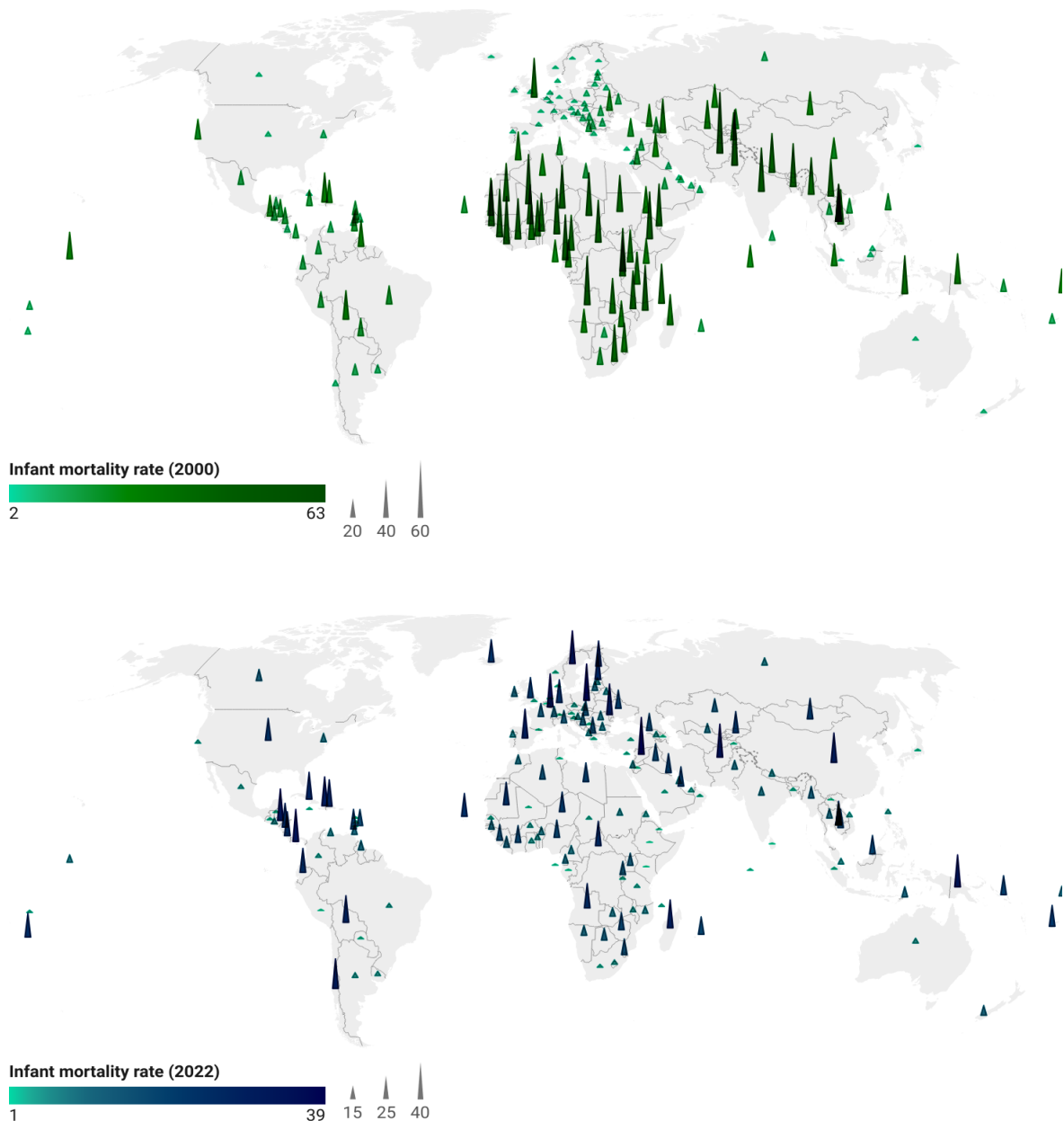


Figure : 3(b). Distribution of health outcome across countries and years (Infant mortality rate)

**Source:** Prepared by author using WDI data.

Figure 4(a) shows patterns of government health expenditure (% of GDP) by region over time, while Figure 4(b) presents country-level patterns. A significant upward trend is evident, particularly in Europe and Asia, indicating a growing public commitment to healthcare. However, persistent regional disparities in expenditure levels highlight structural differences in welfare policies. While some economies have substantially increased their healthcare budgets, others continue to allocate a relatively lower share of GDP to health, suggesting heterogeneity in policy priorities and fiscal capacity.

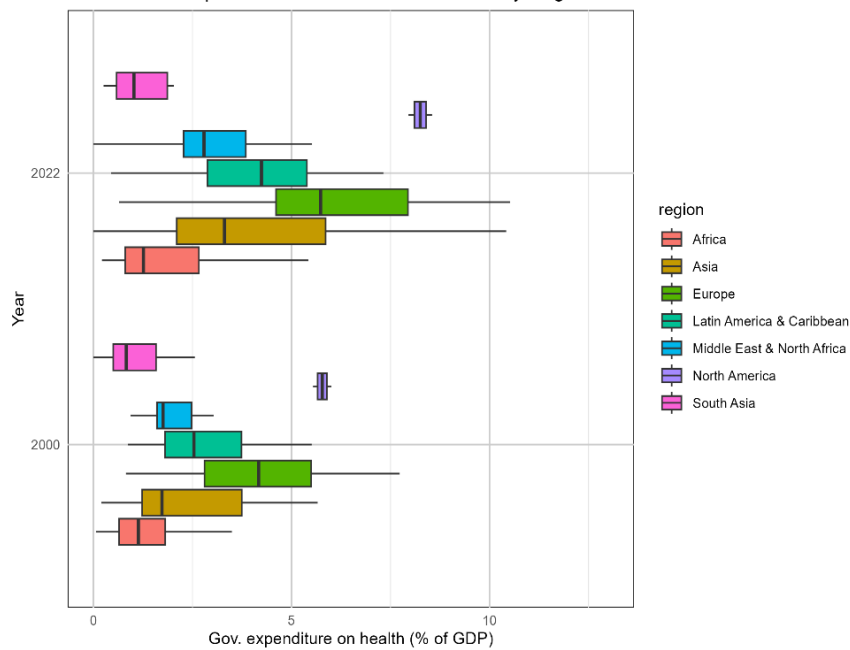
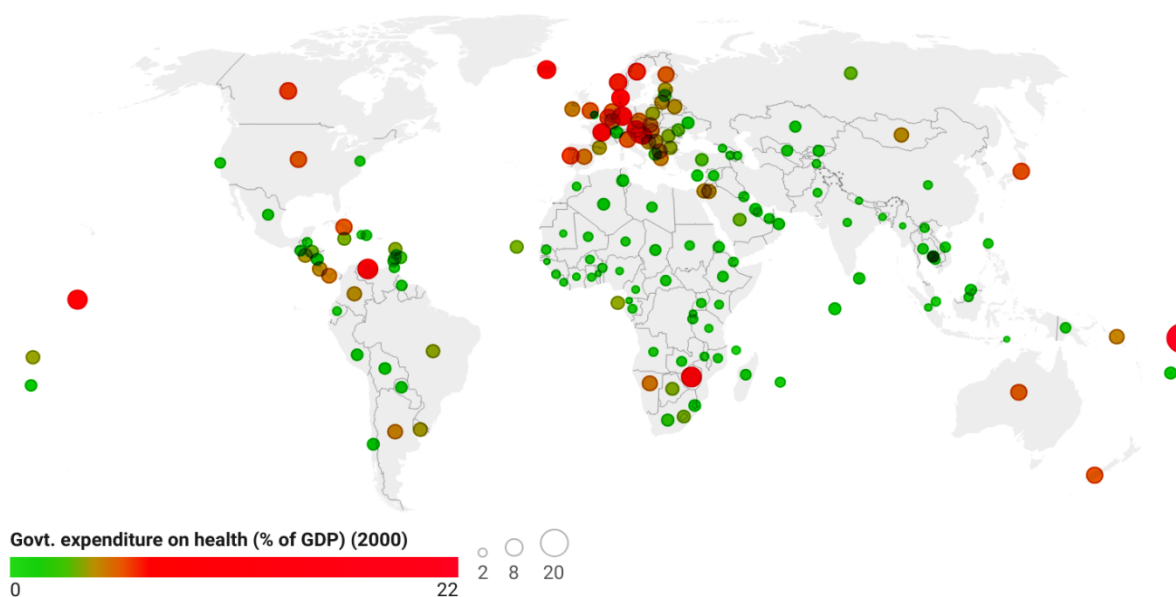


Figure : 4(a). Distribution of government expenditure on health across regions and years  
**Source:** Prepared by author using WDI data.



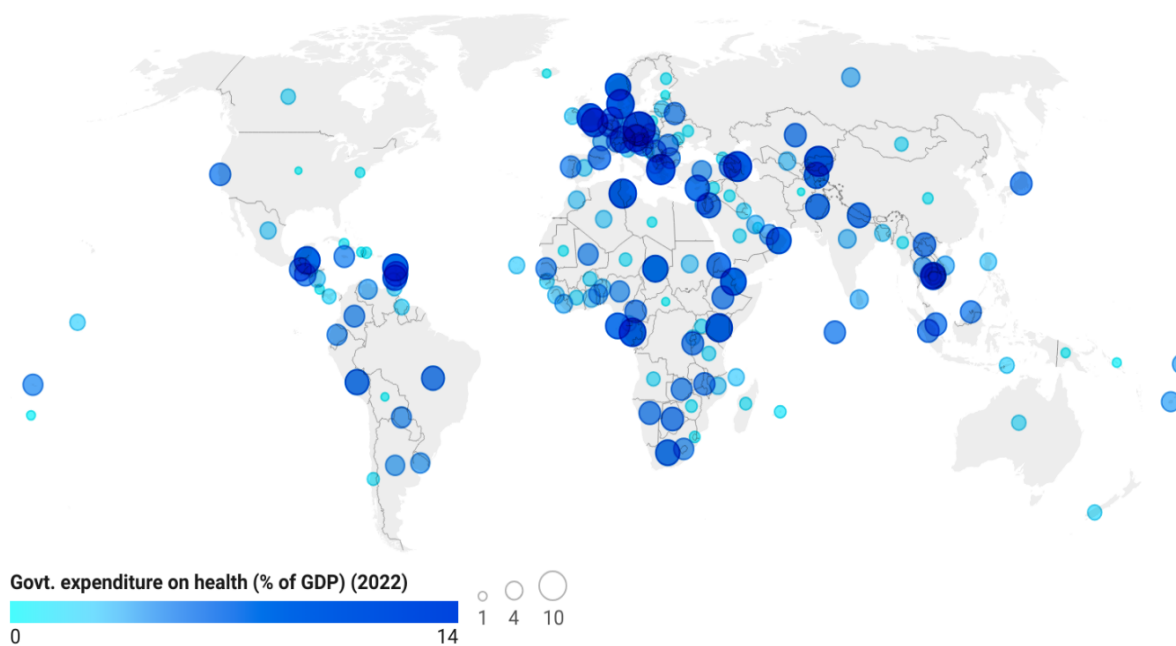


Figure : 4(b). Distribution of government expenditure on health across countries and years

**Source:** Prepared by author using WDI data.

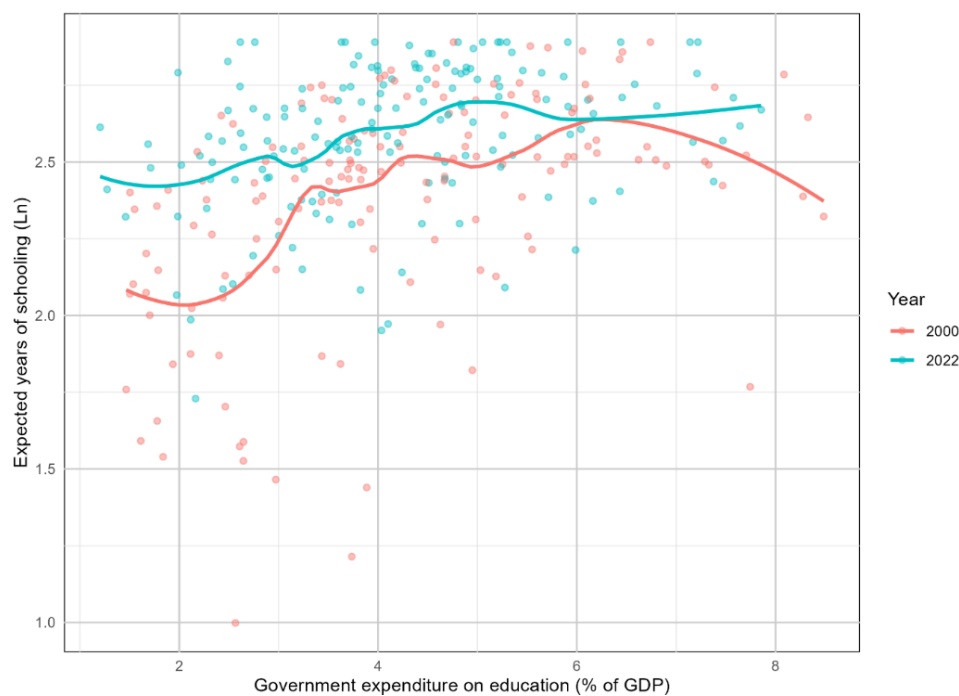


Figure : 5. Relationship between education outcomes and government expenditure on education in 2000 and 2022

**Source:** Prepared by author using WDI data.

Figure 5 examines the relationship between government education expenditure (% of GDP) and expected years of schooling in 2000 and 2022. The results reveal a positive association, with higher spending linked to increased schooling years. However, the 2022 curve stabilizes at higher expenditure levels, indicating diminishing marginal returns. This trend may reflect gains in efficiency, policy variations, or structural constraints. The findings highlight the need to complement financial investment with targeted reforms to enhance institutional effectiveness and educational quality.

Figure 6 presents the relationship between government health expenditure (% of GDP) and the mortality rate for 2000 and 2022. The analysis reveals a negative association, where higher public investment reduces mortality rates. However, the 2022 curve stabilizes at higher expenditure levels, indicating diminishing marginal returns. This trend may reflect improved healthcare efficiency, policy differences, or structural constraints. The findings highlight the need to complement increased spending with targeted reforms to enhance institutional effectiveness and healthcare quality.

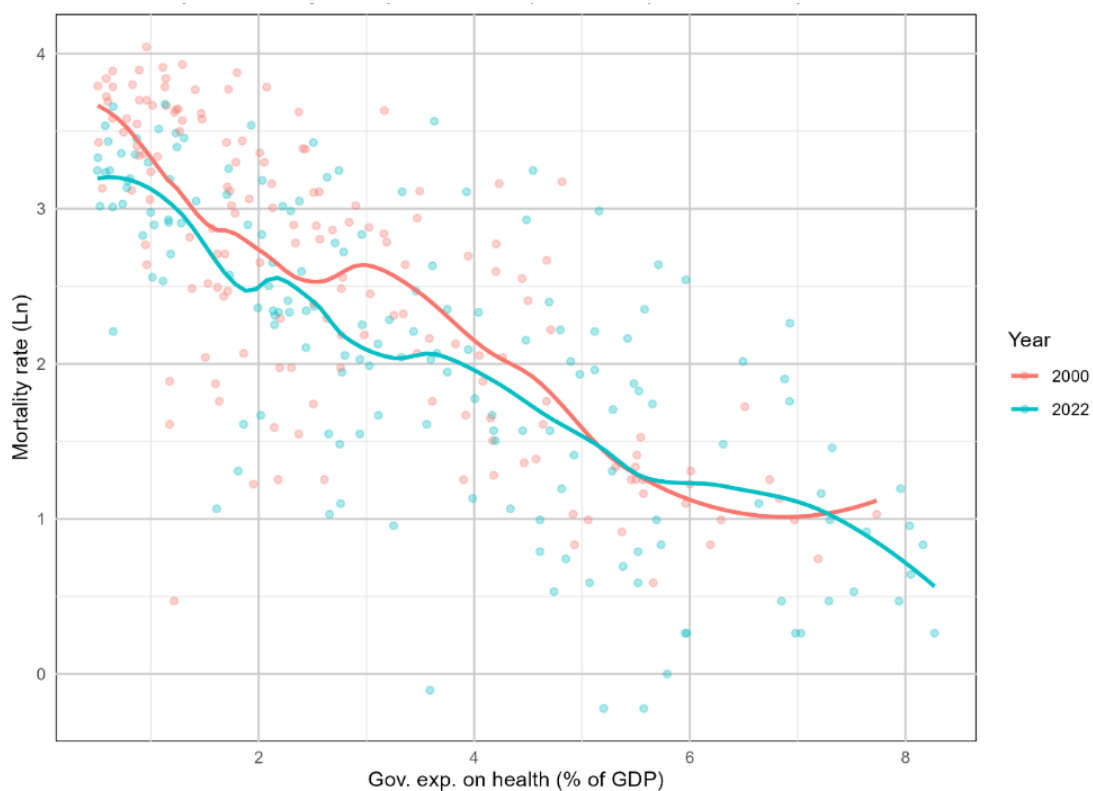


Figure : 6. Relationship between health outcomes and government expenditure on health in 2000 and 2022

**Source:** Prepared by author using WDI data.

Figure 7 illustrates the positive association between government education expenditure (as a percentage of GDP) and expected years of schooling, while revealing regional disparities. Higher expenditure corresponds with greater schooling years in Europe and North America, whereas Africa and South Asia exhibit lower levels. The Middle East/North Africa and Latin America show a moderate alignment with this trend. The observed heterogeneity suggests that institutional capacity and policy implementation mediate this relationship, highlighting the varying effectiveness of education policies across regions.

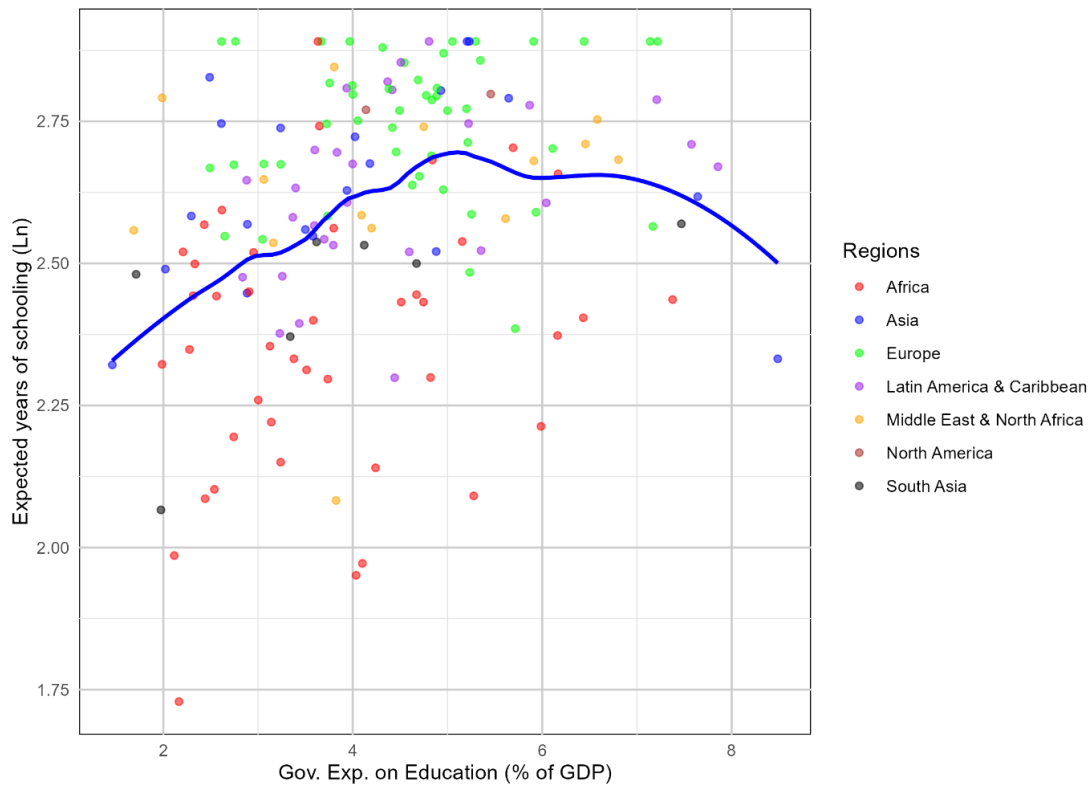


Figure : 7. Relationship between education outcome and government expenditure on education (Panel data from 2000 to 2022)

**Source:** Prepared by author using WDI data.

Figure 8 presents a negative association between government health expenditure (% of GDP) and mortality rates, with notable regional disparities. Higher expenditures correlate with lower mortality in Europe and Asia, while Africa and South Asia exhibit persistently high mortality despite public health spending. The Middle East/North Africa and Latin America show moderate alignment with this trend. The observed heterogeneity suggests that factors such as healthcare infrastructure, institutional capacity, and public health policies mediate this relationship, highlighting the varying effectiveness of health expenditure across regions.

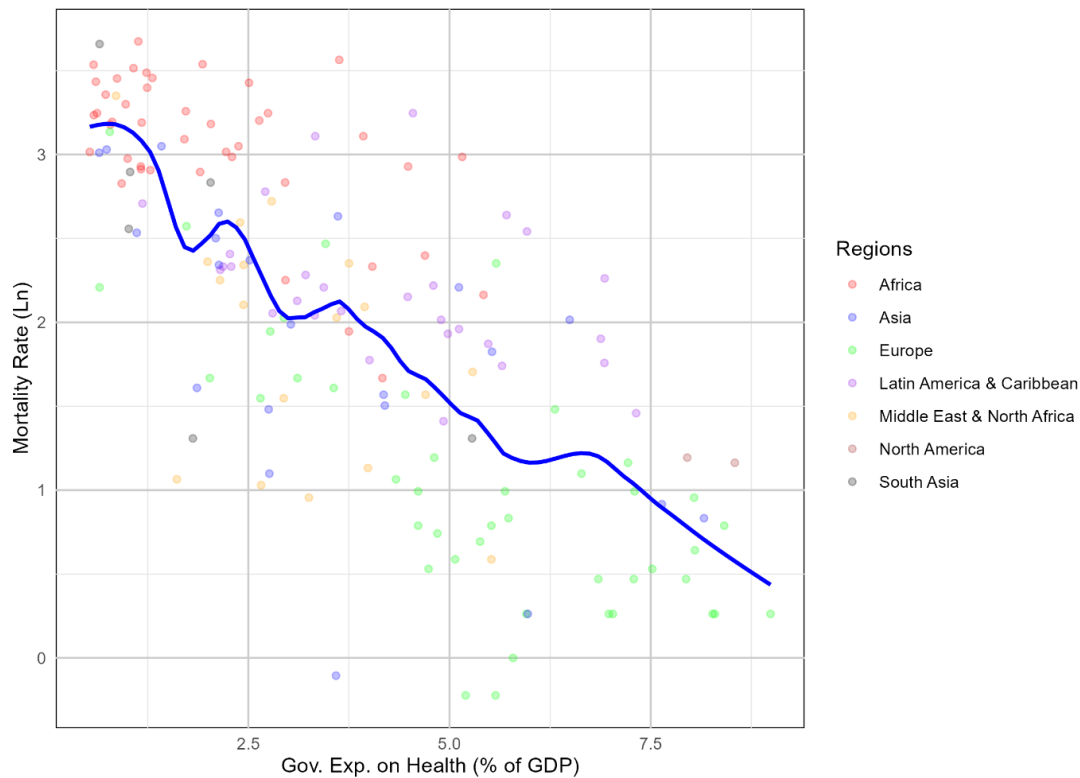


Figure : 8. Relationship between health outcome and government expenditure on health (Panel data from 2000 to 2022)

**Source:** Prepared by author using WDI data.

Figure 9 depicts the relationship between government education expenditure (as a percentage of GDP) and expected years of schooling across seven global regions. The association is positive but nonlinear, exhibiting diminishing marginal returns at higher expenditure levels. Regional disparities are evident, with Europe and Latin America displaying relatively stable patterns, while North America and South Asia show greater variability. In contrast, the association is weaker in regions such as the Middle East and North Africa, suggesting that additional factors influence the effectiveness of public education spending.

These findings highlight the role of structural and contextual conditions in shaping education outcomes, implying that beyond a certain threshold, increased expenditure alone may not yield proportional gains in schooling years. Understanding these regional differences is crucial for designing effective education policies that account for institutional and socioeconomic heterogeneity.

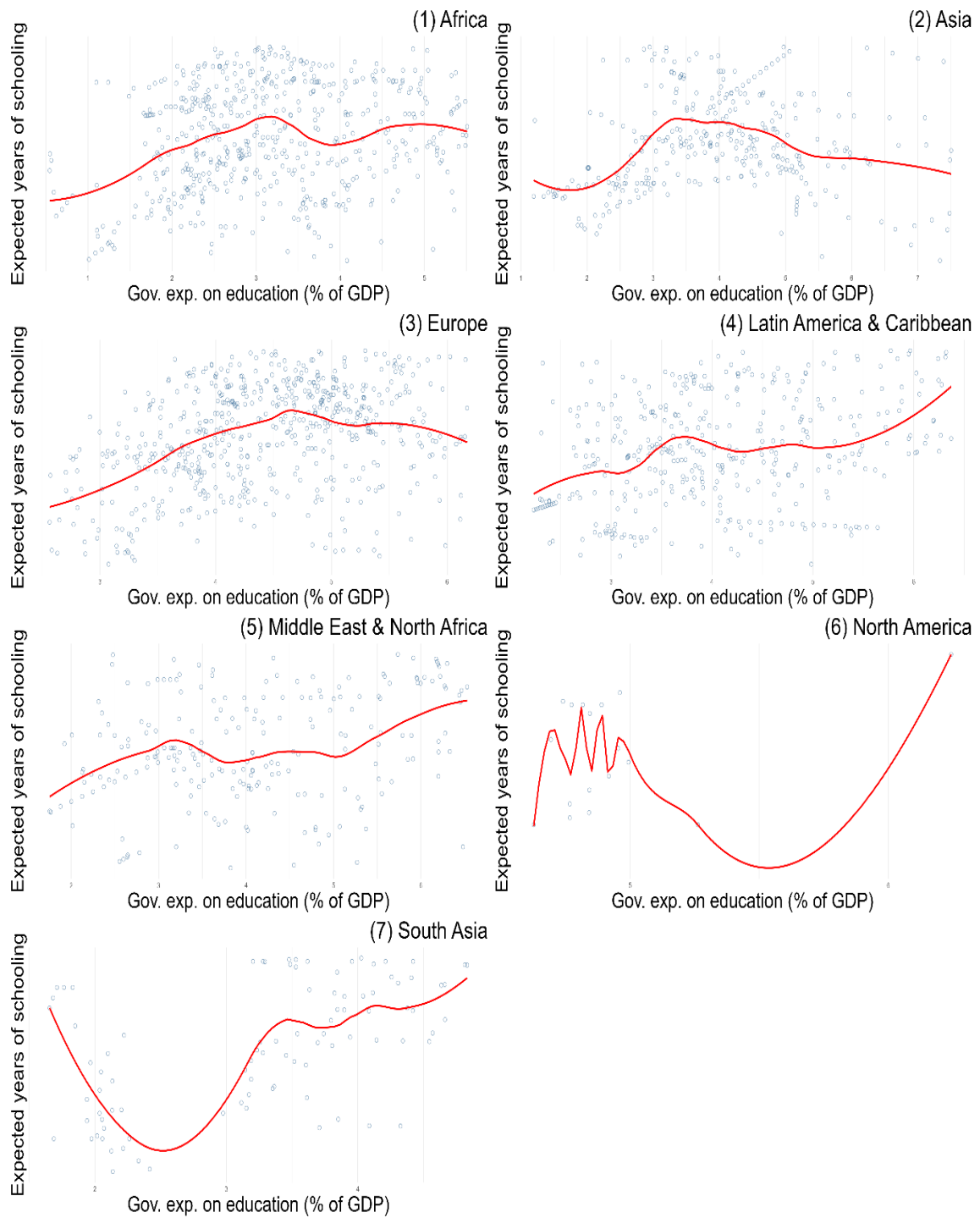


Figure : 9. Relationship between education outcome and government expenditure on education (Panel data across regions)

Source: Prepared by author using WDI data.

Figure 10 illustrates the relationship between government health expenditure (% of GDP) and infant mortality rates across seven global regions. A negative association is evident, though nonlinear, with diminishing returns at higher expenditure levels. Regional disparities are notable: Europe, Africa and Latin America show stable declines, whereas North America and South Asia exhibit greater variability. In regions like the Middle East and North Africa, the association is weaker. These results indicate that structural and contextual factors shape the effectiveness of public health investment, beyond expenditure alone. These findings underscore the significance of regional context in determining the effectiveness of health investments.

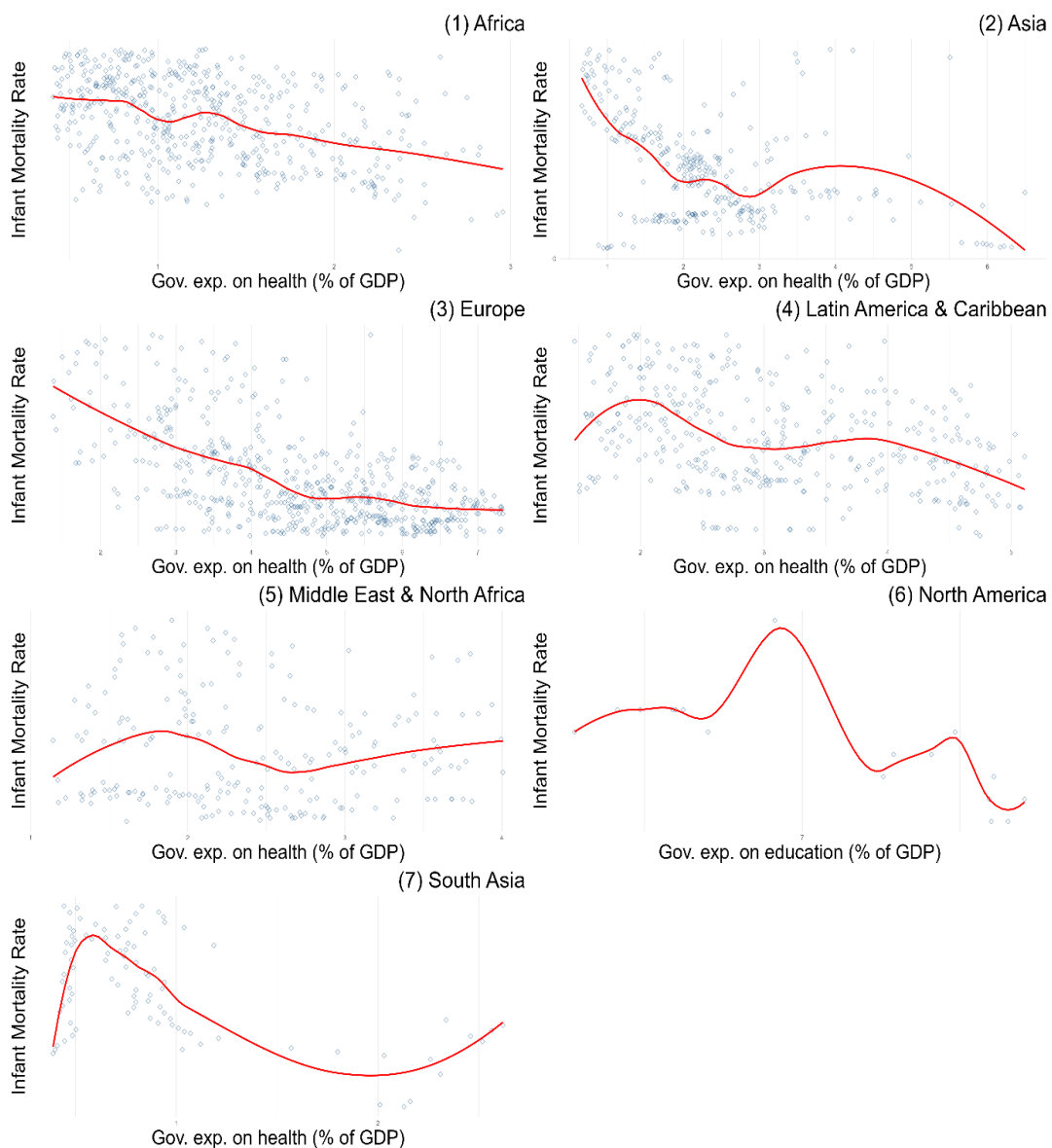


Figure : 10. Relationship between health outcome and government expenditure on health (Panel data across regions)

**Source:** Prepared by author using WDI data.

## 4.2. Panel fixed effects estimation

### 4.2.1. Education outcome estimates

Table 2 presents the panel fixed effects (FE) estimation results assessing the impact of government education expenditure and socio-economic factors on expected years of schooling, while accounting for regional heterogeneity. The estimated coefficients indicate the association between government expenditure on education and key development indicators, interpreted as adjusted correlations rather than causal effects.

In the cross-sectional models for 2000 and 2022, the coefficients are small and statistically insignificant, suggesting no clear relationship in these specific years. However, in the fixed effects (FE) and two-way fixed effects (TWFE) specifications, the coefficients are positive and statistically significant in certain cases. The country fixed effects models (Columns 3 and 5) yield significant positive estimates, implying that, within countries, higher education expenditure is correlated with improved development outcomes. The TWFE models (Columns 4 and 6) show mixed results, with some estimates losing statistical significance. These findings suggest that while increased expenditure on education is generally associated with better outcomes, time-varying factors may influence the results, highlighting the limitations of causal inference. Policy implications should be drawn with caution, considering potential endogeneity and omitted variables.

The findings indicate that government education expenditure (% of GDP) is positively significant in certain specifications, suggesting that higher public investment enhances educational outcomes. GDP per capita remains positively significant across models, reinforcing the role of economic prosperity in improving educational access through enhanced infrastructure and affordability. The Gini coefficient exhibits a negative and significant association with schooling years, highlighting the adverse impact of income inequality on educational attainment. Additionally, the age dependency ratio, prevalence of undernourishment, and population growth exert negative effects, underscoring the constraints imposed by economic and demographic pressures. Conversely, research and development (R&D) expenditure is positively significant, suggesting that investment in knowledge creation contributes to long-term educational improvements.

Regional disparities emerge in the analysis (Table 2, Model 1 & 2), with Europe and North America exhibiting higher expected schooling years, while South Asia and the Middle East report comparatively lower levels. The adjusted R-squared improves with the inclusion of additional controls, indicating a stronger model fit. Overall, the results underscore the critical roles of economic growth, targeted education spending, and inequality reduction in fostering improvements in educational outcomes.

Table 2. Expected years of schooling (log) and government spending – Panel FE estimates

Model	(1)	(2)	(3)	(4)	(5)	(6)
Variables	2000	2022	Country FE	TWFE	Country FE	TWFE
Government expenditure on education (% of GDP)	0.013 (0.013)	-0.001 (0.005)	0.006*** (0.002)	-0.001 (0.002)	0.019*** (0.002)	0.014*** (0.002)
GDP per capita, PPP (constant 2021 international \$)	-	-	0.000*** (0.000)	-0.000*** (0.000)	0.000*** (0.000)	-0.000*** (0.000)
Gini coefficient	-	-	-	-	-1.004*** (0.076)	-0.466*** (0.075)
Age dependency ratio (% of working-age population)	-	-	-	-	-0.002*** (0.000)	0.002*** (0.001)
Prevalence of undernourishment (% of population)	-	-	-	-	-0.003*** (0.001)	-0.002*** (0.001)
Population growth (annual %)	-	-	-	-	-0.018*** (0.005)	-0.019*** (0.005)
Research and development expenditure (% of GDP)	-	-	-	-	0.025*** (0.009)	0.009 (0.009)
Military expenditure (% of GDP)	-	-	-	-	-0.003 (0.002)	-0.006*** (0.002)
Asia	0.405*** (0.080)	0.258*** (0.047)	-	-	-	-
Europe	0.633*** (0.061)	0.396*** (0.039)	-	-	-	-
Latin America & Caribbean	0.491*** (0.064)	0.276*** (0.044)	-	-	-	-
Middle East & North Africa	0.329*** (0.103)	0.207*** (0.066)	-	-	-	-
North America	0.749*** (0.064)	0.434*** (0.036)	-	-	-	-
South Asia	0.095 (0.136)	0.108 (0.068)	-	-	-	-
Constant	1.930*** (0.068)	2.353*** (0.040)	2.357*** (0.014)	2.582*** (0.010)	2.703*** (0.031)	2.446*** (0.033)
Country FE	No	No	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	No	Yes
F Value	63.05***	29.83***	83.94***	51.75***	204.20***	22.07***
Adjusted R-squared	0.458	0.389	0.861	0.924	0.911	0.929
Observations	169	179	4,136	4,136	1,656	1,656

*Note:* Values in parentheses indicate robust standard errors. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. Africa is the base category.

#### 4.2.2. Health outcome estimates

Table 3 presents the results of the fixed effects (FE) estimation model, which examines the relationship between government health expenditure and the socio-economic determinants of infant mortality (log-transformed). The estimated coefficients capture the association between government health expenditure and key development indicators, interpreted as adjusted correlations rather than causal effects.

In the cross-sectional models for 2000 and 2022, the coefficients are negative, with the 2022 estimate achieving statistical significance, indicating a stronger negative association in the later period. In the fixed effects (FE) and two-way fixed effects (TWFE) specifications, the coefficients remain negative and statistically significant in most cases. The country fixed effects models (Columns 3 and 5) suggest a persistent negative correlation, implying that within-country variations in health expenditure are associated with lower values of the dependent variable. The TWFE models (Columns 4 and 6) yield smaller negative coefficients, with some estimates losing statistical significance, suggesting that time-varying factors influence the observed relationship. These findings highlight the need for cautious interpretation, as potential endogeneity and omitted variable bias may affect the estimates, limiting strong policy inferences.

The findings indicate that government health expenditure as a percentage of GDP is negatively and significantly associated with infant mortality, suggesting that increased public investment in healthcare contributes to lower mortality rates. Similarly, GDP per capita exhibits a negative and significant relationship, reinforcing the notion that higher income levels facilitate improved health outcomes through enhanced access to healthcare services.

The Gini coefficient, by contrast, is positively significant, indicating that greater income inequality exacerbates infant mortality, likely due to disparities in healthcare accessibility and quality. Additionally, variables such as the age dependency ratio, prevalence of undernourishment, and population growth demonstrate negative effects, suggesting that demographic and economic constraints hinder progress in reducing infant mortality. Notably, research and development (R&D) expenditure is positively significant, implying that while technological advancements contribute to long-term healthcare improvements, immediate reductions in infant mortality may require direct health interventions.

Regional disparities are evident (Table 3, Models 1 and 2), with Europe and North America exhibiting the lowest infant mortality rates, whereas South Asia reported the highest value. The adjusted R-squared improves across models as additional controls are incorporated, indicating a stronger model fit. These results underscore the critical role of public health investments, economic growth, and policies aimed at mitigating income inequality in effectively reducing infant mortality.

Table 3. Infant mortality (log) and government spending – Panel FE estimates

Model	(1)	(2)	(3)	(4)	(5)	(6)
Variables	2000	2022	Country FE	TWFE	Country FE	TWFE
Government expenditure on health (% of GDP)	-0.098 (0.064)	-0.161*** (0.029)	-0.077*** (0.009)	-0.017*** (0.005)	-0.057*** (0.009)	-0.017** (0.008)
GDP per capita, PPP (constant 2021 international \$)	-	-	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
Gini coefficient	-	-	-	-	1.612*** (0.129)	0.159 (0.135)
Age dependency ratio (% of working-age population)	-	-	-	-	0.002* (0.001)	-0.006*** (0.001)
Prevalence of undernourishment (% of population)	-	-	-	-	0.003*** (0.001)	0.002*** (0.001)
Population growth (annual %)	-	-	-	-	-0.007 (0.010)	-0.022** (0.009)
Research and development expenditure (% of GDP)	-	-	-	-	0.064** (0.026)	0.113*** (0.025)
Military expenditure (% of GDP)	-	-	-	-	-0.011*** (0.001)	-0.003** (0.001)
Asia	-0.887*** (0.202)	-0.825*** (0.173)	-	-	-	-
Europe	-1.484*** (0.211)	-1.427*** (0.167)	-	-	-	-
Latin America & Caribbean	-0.799*** (0.130)	-0.460*** (0.116)	-	-	-	-
Middle East & North Africa	-0.889*** (0.176)	-0.963*** (0.162)	-	-	-	-
North America	-1.703*** (0.284)	-0.871*** (0.199)	-	-	-	-
South Asia	-0.029 (0.213)	-0.507** (0.248)	-	-	-	-
Constant	3.687*** (0.110)	3.382*** (0.070)	3.064*** (0.038)	2.526*** (0.025)	2.961*** (0.078)	3.348*** (0.078)
Country FE	No	No	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	No	Yes
F Value	118.10***	219.00***	204.40***	42.78***	357.80***	30.99***
Adjusted R-squared	0.541	0.679	0.959	0.978	0.946	0.958
Observations	173	183	4,256	4,256	1,727	1,727

*Note:* Values in parentheses indicate robust standard errors. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. Africa is the base category.

## 5. Discussion of Findings

Graphical evidence reveals a nonlinear relationship, where higher social sector spending improves outcomes but with diminishing returns at elevated levels. Strong institutions enhance spending efficiency, while weaker economies struggle to convert fiscal outlays into measurable human development gains. A positive but nonlinear association between education expenditure and expected years of schooling, with diminishing marginal returns at higher investment levels. The negative relationship between health expenditure and infant mortality underscores the role of public health investments.

Regional disparities persist, with higher educational outcomes in Europe and North America, while income inequality remains a barrier. Similarly, health expenditure reduces infant mortality, though structural inefficiencies in weaker economies limit effectiveness. Capital-intensive investments yield sustainable improvements, whereas short-term expenditures show limited impact.

Fixed effects models indicate a positive association between government education expenditure (% of GDP) and schooling years, suggesting that sustained public investment enhances educational access and quality. However, two-way fixed effects (TWFE) estimates vary across specifications, reflecting the role of unobserved time-varying factors in shaping human capital outcomes such as policy shifts and external shocks. GDP per capita consistently supports educational outcomes, while income inequality and demographic pressures hinder progress, highlighting the need for complementary policies.

In health, government health expenditure (% of GDP) is negatively associated with infant mortality, indicating improved healthcare outcomes. Yet, TWFE models reveal sensitivity to time-varying confounders, limiting causal interpretation. GDP per capita reinforces this relationship, while income inequality exacerbates disparities. Findings align with prior evidence but underscore residual endogeneity concerns.

## 6. Conclusions

This study analyses the relationship between social sector expenditure and human development outcomes, focusing on government spending on education and health as key determinants of expected years of schooling and infant mortality, respectively. Expected years of schooling (EYS) represents human capital accumulation ([Barro 2001](#)), reflecting long-term education returns, while infant mortality rate (IMR) indicates health system efficacy ([Cutler et al., 2006](#)). Both are policy-sensitive, minimizing behavioural confounding, and align with SDGs 3 and 4, making them suitable for evaluating development policies.

The present study employed a panel fixed effects (FE) model with an unbalanced panel dataset encompassing 187 countries from 2000 to 2022, offering a comprehensive cross-country analysis of the impact of public investment on human development outcomes. The findings underscore the critical role of public investment in shaping education and health outcomes. Increased government expenditure on education is positively associated with higher expected years of schooling, while greater health expenditure is linked to lower infant mortality rates. Economic growth, measured by GDP per capita, enhances access to education and healthcare. However, income inequality, captured by the Gini coefficient, adversely affects schooling and correlates positively with infant mortality, indicating that unequal resource distribution limits human capital development and worsens health outcomes.

Regional disparities highlight structural inequities, with lower-income regions exhibiting weaker education and health outcomes. While research and development expenditures contribute to long-term improvements, immediate gains require targeted policy interventions. These results emphasize the need for integrated strategies that combine sustained public investment, economic growth, and redistributive policies to address socio-economic disparities. Strengthening education and healthcare systems through equitable, evidence-based interventions remains essential for advancing human capital development and improving well-being, particularly in resource-constrained economies.

These findings underscore the need for a nuanced approach to public expenditure allocation, balancing the quantity and quality of spending. The effectiveness of social sector investments depends on institutional efficiency, governance quality, and demographic dynamics. Countries with strong institutional capacity achieve higher social returns per unit of expenditure, while governance constraints lead to inefficiencies, leakages, and weaker development multipliers.

From a policy perspective, sustained improvements in human development require strategic fiscal planning. Low- and middle-income economies should prioritize targeted investments in education and healthcare infrastructure while implementing governance reforms to enhance expenditure efficiency. Strengthening revenue mobilization through progressive taxation and reducing inefficiencies in public service delivery are critical for long-term development. Future research should integrate macroeconomic factors such as inflation, labor markets, and demographic shifts to better understand human development outcomes. Fiscal policies must be designed with a long-term perspective, ensuring dynamic expenditure priorities that adapt to evolving development needs.

## Acknowledgment

I sincerely acknowledge Professor Vikram Dayal for his invaluable guidance and constructive feedback on this seminar paper. I also appreciate the insightful comments from faculty at the IES section, Institute of Economic Growth (IEG). Finally, I thank my batchmates for their suggestions and encouragement. All errors remain my own.

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## Appendix

Table A1. Selected Human Development Outcomes and Variable Definitions

Variable	Definition (as per WDI)	Unit
Expected years of schooling	The number of years a child of school entrance age can expect to spend in education, assuming current enrollment rates remain unchanged throughout the child's life.	Years
Infant mortality rate	The number of infants dying before reaching one year of age, per 1,000 live births in a given year.	Per 1,000 live births
Government expenditure on education	Total general government expenditure on education as a percentage of GDP, including spending on schools, universities, and other public education institutions.	% of GDP
Government health expenditure	Total public expenditure on health as a percentage of GDP, including spending on hospitals, medical services, and preventive healthcare.	% of GDP
GDP per capita, PPP (constant 2021 international \$)	Gross domestic product per capita adjusted for purchasing power parity (PPP) in constant 2021 international dollars.	Constant 2021 international \$
Gini coefficient	A measure of income inequality within a country, ranging from 0 (perfect equality) to 1 (perfect inequality).	Index (0 to 1)
Age dependency ratio	The ratio of dependents (people younger than 15 or older than 64) to the working-age population (ages 15-64), expressed as a percentage.	% of working-age population
Prevalence of undernourishment	The percentage of the population whose food intake is insufficient to meet dietary energy requirements continuously.	% of population
Population growth	The annual percentage increase in population, accounting for births, deaths, and net migration.	Annual %
Research and development expenditure	The total expenditure on research and development (R&D) as a percentage of GDP, including spending by governments, universities, and private enterprises.	% of GDP
Military expenditure	Total government spending on military forces, including salaries, operations, arms purchases, and infrastructure, expressed as a percentage of GDP.	% of GDP

# 1. Panel Instrumental Variable Fixed Effects (IV-FE) Model

The panel fixed effects model accounts for time-invariant unobserved heterogeneity, capturing within-entity variations. However, government expenditure on education and health may be endogenous due to reverse causality or omitted variables. To address this, we employ a panel instrumental variable (IV) approach, using an exogenous instrument to identify causal relationships. The first-stage equation predicts government expenditure, while the second-stage estimates its effect on outcomes such as expected years of schooling and infant mortality.

The model ensures identification by leveraging an instrument correlated with expenditure but exogenous to the outcome equation's error term. Our instrumental variables (IVs) consist of lagged values of selected control variables. The development economics literature widely employs lagged endogenous variables as instruments for their contemporaneous counterparts in static models (Angrist & Krueger, 2001; Jetter & Parmeter, 2018; Takeshima et al., 2024). The panel IVFE-GMM estimation is implemented in accordance with the specified equation model, utilizing the `'xtivreg2'` command in STATA.

**Stage 1:**

$$X_{e,it} = \alpha_0 + \alpha_1 IV_{it} + \alpha_2 X'_{it} + \delta_i + \lambda_t + \varepsilon_{it} \quad \text{Eq. (3a)} \quad (3)$$

**Stage 2:**

$$Y_{e,it} = \beta_0 + \beta_1 \hat{X}_{e,it} + \beta_2 X'_i + \delta_i + \lambda_t + \varepsilon_{it} \quad \text{Eq. (3b)} \quad (4)$$

**Stage 1:**

$$X_{h,it} = \alpha_0 + \alpha_1 IV_{it} + \alpha_2 X'_{it} + \delta_i + \lambda_t + \varepsilon_{it} \quad \text{Eq. (4a)} \quad (5)$$

**Stage 2:**

$$Y_{h,it} = \beta_0 + \beta_1 \hat{X}_{h,it} + \beta_2 X'_i + \delta_i + \lambda_t + \varepsilon_{it} \quad \text{Eq. (4b)} \quad (6)$$

Where,  $X'_{it}$  represents a set of control variables same as above model. IV represents instrumental variables (i.e. lagged values of selected control variables). The key explanatory variables include government spending on education ( $X_e$ ) and health ( $X_h$ ), both expressed as a percentage of GDP. Country-specific effects ( $\delta_i$ ) and time-fixed effects ( $\lambda_t$ ) are included to account for unobserved heterogeneity across countries and over time.

## 2. Panel instrumental variable fixed effects estimates (Robustness check)

### 2.1. Education outcome estimates

Table A2 presents the IVFE estimation results, addressing heterogeneity and endogeneity to ensure robust inferences on schooling years. Government education expenditure exhibits a positive and significant effect (0.007 in Model 1, 0.022 in Model 2), indicating that increased public investment directly enhances educational attainment. Similarly, GDP per capita is positively associated with schooling, suggesting that higher income levels facilitate better educational outcomes through improved infrastructure and lower opportunity costs.

Table A2. Expected years of schooling (log) and government spending – Panel IVFE estimates

Variables	Model - 1	Model - 2
Government expenditure on education (% of GDP)	0.007** (0.003)	0.022*** (0.003)
GDP per capita, PPP (constant 2021 international \$)	0.000*** (0.000)	0.000*** (0.000)
Gini coefficient		-0.940*** (0.077)
Age dependency ratio (% of working-age population)		-0.002*** (0.000)
Prevalence of undernourishment (% of population)		-0.003*** (0.001)
Population growth (annual %)		-0.027*** (0.008)
Research and development expenditure (% of GDP)		0.021** (0.009)
Military expenditure (% of GDP)		-0.005 (0.004)
Under-identification test (Kleibergen-Paap rk LM statistic)	306.50***	18.11***
Overidentification test (Sargan statistic)	0.000	0.000
Endogeneity test statistic (H0: Selected variables are exogenous)	16.24***	53.65***
F Value	74.97***	183.40***
R-squared	0.050	0.536
Observations	3,963	1,587

*Note:* Values in parentheses indicate robust standard errors. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

† The Chi-square test compares Sargan-Hansen statistics from endogenous and exogenous models, estimated using STATA's `xtivreg2` command. The test statistic is significant at the 1% level, supporting the endogeneity of selected variables.

In contrast, the Gini coefficient is negatively significant, implying that greater inequality constraints access to education, particularly for lower-income groups. The age dependency ratio and prevalence of undernourishment also exhibit negative associations, highlighting the adverse effects of economic burdens and poor nutrition on schooling. Population growth negatively influences education, suggesting that demographic pressures strain educational resources.

Conversely, research and development expenditure positively impacts schooling, emphasizing the role of knowledge investments in strengthening human capital. Military expenditure remains statistically insignificant, indicating no direct effect on education. The significant under-identification test confirms instrument validity.

Overall, the findings underscore the importance of targeted public investment, income growth, and R&D in improving education, while inequality, economic dependency, malnutrition, and rapid population growth present key barriers to human capital development.

## **2.2. Health outcome estimates**

The IVFE estimation model in Table A3 examines the impact of government health expenditure and socio-economic determinants on infant mortality (log), addressing potential endogeneity concerns. The results indicate that higher public health expenditure (% of GDP) significantly reduces infant mortality, underscoring the importance of sustained investments in healthcare infrastructure, maternal care, and disease prevention. Similarly, GDP per capita exhibits a negative and significant effect, suggesting that wealthier economies experience lower infant mortality rates due to improved healthcare access and overall living standards.

Income inequality, measured by the Gini coefficient, is positively associated with infant mortality, highlighting disparities in healthcare access. Additionally, undernourishment prevalence and age dependency ratio positively affect infant mortality, reflecting the economic and nutritional burdens on vulnerable populations. Population growth, however, is negatively significant, suggesting that regions with higher birth rates may have benefited from healthcare improvements.

Unlike in education-related models, R&D expenditure is positively significant, implying that while innovation fosters long-term healthcare improvements, immediate mortality reductions rely on direct policy measures. The significant Kleibergen-Paap LM statistic confirms the validity of instrumental variables. Overall, the findings emphasize the need for integrated policies, including nutrition programs and equitable healthcare access, to achieve sustainable reductions in infant mortality.

Table A3. Infant mortality per 1000 births (log) and government spending – Panel  
IVFE estimates

Variables	Model - 1	Model - 2
Government expenditure on health (% of GDP)	-0.092*** (0.010)	-0.066*** (0.011)
GDP per capita, PPP (constant 2021 international \$)	-0.000*** (0.000)	-0.000*** (0.000)
Gini coefficient		1.599*** (0.136)
Age dependency ratio (% of working-age population)		0.002 (0.001)
Prevalence of undernourishment (% of population)		0.002** (0.001)
Population growth (annual %)		-0.026* (0.015)
Research and development expenditure (% of GDP)		0.070*** (0.025)
Military expenditure (% of GDP)		-0.012*** (0.003)
Under-identification test (Kleibergen-Paap rk LM statistic)	193.72***	24.21***
Overidentification test (Sargan statistic)	0.00	0.00
Endogeneity test statistic H0: Selected variables are exogenous	43.35***	106.21***
F Value	211.30***	333.10***
R-squared	0.295	0.649
Observations	4,078	1,655

*Note:* Values in parentheses indicate robust standard errors. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

† The Chi-square test compares Sargan-Hansen statistics from endogenous and exogenous models, estimated using STATA's `xtivreg2` command. The test statistic is significant at the 1% level, supporting the endogeneity of selected variables.

### 3. Summary of IV estimation findings

Table A2 evaluates expected years of schooling while addressing endogeneity through instrumental variables, yielding more precise estimates. Consistent with Table 2, government education expenditure remains positively significant, confirming that higher public investment enhances schooling outcomes. GDP per capita also retains its significance, reinforcing the link between income levels and education access. However, the Gini coefficient is negatively significant in Table A2 but absent in some models of Table 2, suggesting that inequality's adverse effect is stronger when endogeneity is accounted for. The larger

magnitude of government education expenditure's impact in Table A2 indicates that its effect is better captured when addressing causality concerns. Research and development expenditure remains significant, emphasizing its role in long-term educational progress. These findings underscore the importance of redistributive policies and sustained public investment in education to mitigate inequality and improve schooling outcomes.

Table A3 extends the infant mortality analysis using an instrumental variable fixed effects (IVFE) approach to address potential endogeneity. The results align with Table 3, confirming that government health expenditure significantly reduces infant mortality, while GDP per capita retains its negative significance, reinforcing the positive impact of income on health outcomes. A key distinction arises in the role of income inequality (Gini coefficient), which is significant in Table A3 but not in Table 3, suggesting that conventional fixed effects models may underestimate its adverse effects. Additionally, R&D expenditure remains positively significant, with a stronger magnitude in Table A3, implying its long-term benefits for mortality reduction. Overall, the IVFE estimates provide a more robust assessment, emphasizing the importance of public health spending, economic growth, and addressing healthcare inequalities for sustained improvements in infant survival.

## **4. Panel unit root tests and cointegration analysis in a fixed effects framework**

The Fisher-type unit root test, based on ADF tests, accounts for heterogeneity across 187 countries and ensures stationarity, preventing spurious regression in the two-way fixed effects (TWFE) model. To assess long-run relationships between government expenditure on education and health and the outcome variables, the Kao panel cointegration test is employed. While TWFE controls for time-invariant heterogeneity, it does not address non-stationarity or long-run equilibrium. The Kao test verifies the existence of a stable long-term relationship, ensuring that estimated effects in the TWFE model capture meaningful economic relationships rather than spurious correlations. Stationarity results are in Table A4 and A5, and cointegration test results are in Table A6 and A7.

The Fisher-type unit root test confirms stationarity for expected years of schooling, infant mortality rate, and government expenditure on education (% of GDP), as the P and Pm statistics reject the null hypothesis of unit roots at the 1 percent of significance level (See A4 & A5). However, government expenditure on education (% of GDP) yields insignificant results.

The Kao test confirms cointegration, with both the Dickey-Fuller and Augmented Dickey-Fuller test statistics significant at the 1 percent level, indicating a stable long-run relationship for education and health outcomes. These results suggest the existence of a long-term relationship between the variables (see Tables A6 and A7).

Table A4. Fisher-Type Unit Root Test for education  
(Based on Augmented Dickey-Fuller Tests)

<b>A. Expected years of schooling</b>			
Based on augmented Dickey-Fuller tests			
Ho: All panels contain unit roots		Number of panels	= 187
Ha: At least one panel is stationary		Avg. number of periods	= 23.84
AR parameter: Panel-specific		Asymptotics: T -> Infinity	
Panel means: Included			
Time trend: Included			
Drift term: Not included		ADF regressions: 1 lag	
		Statistic	p-value
Inverse chi-squared(374)	P	562.1544	0.0000
Inverse normal	Z	1.5710	0.9419
Inverse logit t(904)	L*	-0.5305	0.2980
Modified inv. chi-squared	Pm	6.8796	0.0000
P statistic requires number of panels to be finite. Other statistics are suitable for finite or infinite number of panels.			
<b>B. Government expenditure on education (% of GDP)</b>			
Based on augmented Dickey-Fuller tests			
Ho: All panels contain unit roots		Number of panels	= 180
Ha: At least one panel is stationary		Avg. number of periods	= 23.76
AR parameter: Panel-specific		Asymptotics: T -> Infinity	
Panel means: Included			
Time trend: Included			
Drift term: Not included		ADF regressions: 1 lag	
		Statistic	p-value
Inverse chi-squared(358)	P	425.1398	0.0084
Inverse normal	Z	0.0817	0.5326
Inverse logit t(879)	L*	-0.2128	0.4158
Modified inv. chi-squared	Pm	2.5091	0.0061
P statistic requires number of panels to be finite. Other statistics are suitable for finite or infinite number of panels.			

Table A5. Fisher-Type Unit Root Test for health  
(Based on Augmented Dickey-Fuller Tests)

**A. Infant mortality rate**

Based on augmented Dickey-Fuller tests

Ho: All panels contain unit roots                      Number of panels                      =    186  
Ha: At least one panel is stationary                      Avg. number of periods =    23.84

AR parameter: Panel-specific    Asymptotics: T -> Infinity  
Panel means: Included  
Time trend: Included  
Drift term: Not included    ADF regressions: 1 lag

		Statistic	p-value
Inverse chi-squared(372)	P	918.9021	0.0000
Inverse normal	Z	-6.2981	0.0000
Inverse logit t(904)	L*	-10.0365	0.0000
Modified inv. chi-squared	Pm	20.0504	0.0000

P statistic requires number of panels to be finite.  
Other statistics are suitable for finite or infinite number of panels.

**B. Government health expenditure (% of GDP)**

Based on augmented Dickey-Fuller tests

Ho: All panels contain unit roots                      Number of panels                      =    183  
Ha: At least one panel is stationary                      Avg. number of periods =    23.89

AR parameter: Panel-specific    Asymptotics: T -> Infinity  
Panel means: Included  
Time trend: Included  
Drift term: Not included    ADF regressions: 1 lag

		Statistic	p-value
Inverse chi-squared(366)	P	314.7613	0.9753
Inverse normal	Z	5.6721	1.0000
Inverse logit t(889)	L*	5.9833	1.0000
Modified inv. chi-squared	Pm	-1.8938	0.9709

P statistic requires number of panels to be finite.  
Other statistics are suitable for finite or infinite number of panels.

Table A6. Co-integration test results for education outcome

Kao test for cointegration

Ho: No cointegration	Number of panels	=	174
Ha: All panels are cointegrated	Avg. number of periods	=	21.782
Cointegrating vector: Same			
Panel means:	Included	Kernel:	Bartlett
Time trend:	Not included	Lags:	1.50 (Newey-West)
AR parameter:	Same	Augmented lags:	1
	Statistic		p-value
Modified Dickey-Fuller t	1.7270		0.0421
Dickey-Fuller t	-9.7130		0.0000
Augmented Dickey-Fuller t	-3.8818		0.0001
Unadjusted modified Dickey-Fuller t	4.1888		0.0000
Unadjusted Dickey-Fuller t	-8.0521		0.0000

Note: The same set of control variables used in Model 3 of Table 2 is applied in the co-integration analysis.

Kao test for cointegration

Ho: No cointegration	Number of panels	=	79
Ha: All panels are cointegrated	Avg. number of periods	=	19.215
Cointegrating vector: Same			
Panel means:	Included	Kernel:	Bartlett
Time trend:	Not included	Lags:	1.49 (Newey-West)
AR parameter:	Same	Augmented lags:	1
	Statistic		p-value
Modified Dickey-Fuller t	0.3345		0.3690
Dickey-Fuller t	-2.8470		0.0022
Augmented Dickey-Fuller t	-2.2910		0.0110
Unadjusted modified Dickey-Fuller t	2.3170		0.0103
Unadjusted Dickey-Fuller t	-1.4110		0.0791

Note: The same set of control variables used in Model 4 of Table 2 is applied in the co-integration analysis.

Table A7. Co-integration test results for health outcome

Kao test for cointegration			
Ho: No cointegration		Number of panels	= 178
Ha: All panels are cointegrated		Avg. number of periods	= 21.91
Cointegrating vector: Same			
Panel means:	Included	Kernel:	Bartlett
Time trend:	Not included	Lags:	1.50 (Newey-West)
AR parameter:	Same	Augmented lags:	1
		Statistic	p-value
Modified Dickey-Fuller t		7.0892	0.0000
Dickey-Fuller t		7.2716	0.0000
Augmented Dickey-Fuller t		6.1077	0.0000
Unadjusted modified Dickey-Fuller t		10.1654	0.0000
Unadjusted Dickey-Fuller t		12.1186	0.0000

Note: The same set of control variables used in Model 3 of Table 3 is applied in the co-integration analysis.

Kao test for cointegration			
Ho: No cointegration		Number of panels	= 81
Ha: All panels are cointegrated		Avg. number of periods	= 19.543
Cointegrating vector: Same			
Panel means:	Included	Kernel:	Bartlett
Time trend:	Not included	Lags:	1.51 (Newey-West)
AR parameter:	Same	Augmented lags:	1
		Statistic	p-value
Modified Dickey-Fuller t		4.6177	0.0000
Dickey-Fuller t		5.0388	0.0000
Augmented Dickey-Fuller t		2.6550	0.0040
Unadjusted modified Dickey-Fuller t		7.1064	0.0000
Unadjusted Dickey-Fuller t		9.0470	0.0000

Note: The same set of control variables used in Model 4 of Table 3 is applied in the co-integration analysis.