Jurnal Ekonomi dan Bisnis Airlangga
p-ISSN : 2338-2686 e-ISSN : 2597-4564
Available online at https://e-journal.unair.ac.id/JEBA
Volume 35, No.1, December - May 2025
Page 37 – 48
doi: 10.20473/jeba.V35I12025.37-48

CAPITAL FORMATION AND HEALTH OUTCOMES IN MIDDLE-INCOME COUNTRIES

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ARTICLE HISTORY

Received:
23 November 2024
Revised
01 March 2025
Accepted:
25 April 2025
Online available:
28 May 2025

Keywords:
Capital Formation, Health Outcomes, Middle-Income Countries, SGMM

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ABSTRACT

Introduction: Understanding how much a country's health system spends on infrastructure, machinery, and types of equipment is crucial for policymaking and analysis. Although health systems continue to be labor-intensive, capital has been increasingly important in producing health services in recent decades. Considering the growing importance of diagnostic and therapeutic types of equipment, as well as the recent rise of information, computers, and technology in healthcare services being capital intensive, hence, it is imperative to determine the impacts of capital formation on health outcomes in middle-income countries.
Methods: The study used the World Bank rating, from 2000 to 2023. The system generalized method of moments (SGMM) was adopted to account for endogeneity. The World Development Indicators (WDI), and World Governance Indicators (WGI) data were used. The model's validity was assessed using the AR (1) and the AR (2) tests, while the instrumental variables were validated using Sargan and Hansen tests. Inferences were drawn using a 5% threshold of significance.
Results: Results showed that capital formation confirmed a crowd-out relationship between morbidity rates and crude death, while life expectancy has a positive relationship with capital formation in middle-income countries. Life expectancy has a positive relationship and is statistically significant at a 5% level.
Conclusion and suggestion: Therefore, the study recommended that middle-income countries must generate savings and investments through individual savings or government policy to improve their healthcare system since countries with a high level of household savings can accumulate funds and produce capital goods faster.

INTRODUCTION

Policymaking and research both depend on knowing how much a nation's health system spends on various forms of equipment, machinery, and infrastructure. Health systems continue to be labor-intensive, but in recent decades, capital has played a bigger role in the delivery of healthcare services. Economic development is essentially related to an increase in per capita. As a result, capital formation appears as an important part of economic growth through the productivity of quality healthcare delivery. This study attempts to find generic solutions to capital formation challenges in economically low-middle-income countries. Supplementary circumstances essential for economic advancement are related to good healthcare delivery, which promotes economic growth. Given the growing importance of diagnostic and therapeutic equipment, as well as the recent rise of information, computers, and technology in capital-intensive healthcare services, it is imperative to understand the effects of capital formation on health outcomes in middle-income countries.

The stock of assets added to or flowing into the capital stock via investments is known as capital. Therefore, the entire stock of products owned by producers, the net stock of foreign financial claims, and housing and other durable physical assets owned by individuals and governments are all considered to be part of capital formation. Fewer of the classical schools and Keynes's arguments apply to low- and middle-income economies. These nations are faced with a severe shortage of capital, and neither excessive saving nor a discrepancy between income and consumption pose a threat. A "circular constellation of forces tending to act and react upon one another in such a way as to keep a poor country in a state of poverty" is implied by the possibility of a "vicious circle of poverty" (Howitt, 2005).

In many nations, low productivity which is also a result of low investment, is closely linked to low income. The only way to break the cycle of poverty in low-income nations appears to boost investment and capital formation through sufficient healthcare delivery among the workforce.

The likelihood of falling ill is higher for the impoverished. Being ill has a negative impact on production, which makes poverty worse. Access to health services is impacted by poverty. Being poor also makes it more difficult to pay for medical treatment. Poorer health outcomes are more common in low-income countries than in other economic and social groupings and maternal, infant, and child mortality rates are greater in these nations. Poor health has consequences beyond physical pain and suffering; it impairs learning, reduces returns on human capital, and limits the environment for entrepreneurial and creative activity. Poor health imposes enormous economic consequences on individuals, households, and society.

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A country cannot achieve high levels of economic growth if its population suffers from high child and maternal mortality, widespread disease in the workforce, and a short life expectancy. The economic status of an individual, community, or country is related to the health of the individual or its people. A low-income economy has features such as poor housing, insufficient food and nutrition, insufficient water supply, insufficient environmental sanitation, a low level of education, and a low cost of healthcare. As a result, this study looked into how capital formation affects health outcomes in several middle-income countries.

The empirical study employs fixed-effect panel data, instrumental variables, and the system generalized method of moments (GMM), which combines equations in first differences and levels. The study emphasizes the need to distinguish between capital formation and health outcomes, as both have a substantial impact on growth. Hence, the paper is organized as follows.

Section 2 reviews the literature and explores the relationship between capital formation and health outcomes in low- and middle-income nations. Section 3 describes the theoretical model and data that were used. In Section 4, we examine the empirical influence of capital formation on health outcomes in low- and middle-income countries. Finally, Section 5 presents the key conclusion.

LITERATURE REVIEW

Several studies have been conducted on the human capital components of education and training, but there has been far less consideration of health as human capital (Becker, 2007). More specifically, most of the economics literature on health examines strategies to improve the delivery of healthcare services, forgetting that health status is embodied in people and, thus, should focus on the notion of human capital, which, in turn, promotes growth. Furthermore, this section reviews theoretical and empirical models that incorporate the impact of health on economic growth. It is not an exhaustive survey like those of Monterubbianesi (2014), Monterubbianesi et al. (2017), or Bloom et al. (2018). These revised models employ and emphasize various health measures; others emphasize the complementarity of tying health to education and other forms of human capital investment; and the vast majority believe that combating diseases and extending survival contributes to economic success without proper examination of capital influence in the production process.

The Relationship between Capital Formation and Health Outcomes in LMICs

The relationship between capital formation and health outcomes in low and middle-income countries (LMICs) is complex and multifaceted, involving direct and indirect pathways. Capital formation refers to the accumulation of physical, human, and financial capital in an economy it is a crucial driver of economic growth and development.

Improved health outcomes are both a goal and a determinant of economic development, affecting productivity, income levels, and quality of life.

In countries like Rwanda, significant investments in healthcare infrastructure, including hospitals, health centers, and the training of healthcare professionals, have led to remarkable improvements in health outcomes. For example, the country has seen dramatic reductions in maternal and child mortality rates over the past two decades.

In India, the Swachh Bharat Mission aimed at improving sanitation has had a direct impact on health outcomes by reducing the incidence of waterborne diseases. This program, representing a form of capital formation in sanitation infrastructure, has contributed to improved public health, showcasing the direct link between such investments and health improvements.

Economic growth resulting from broad-based capital formation enables governments and private entities in LMICs to allocate more resources to the health sector. In Vietnam, for example, rapid economic growth has been accompanied by increased public and private investment in health services, leading to improved access to healthcare for the population and better health outcomes.

Investment in education, a form of human capital formation, directly contributes to better health outcomes. An educated populace is more likely to make informed health choices, leading to lower rates of infectious diseases and better management of chronic conditions. In countries like Ghana, government and NGO investments in education have led to improved health literacy, which in turn has contributed to reductions in HIV/AIDS rates and improved maternal health.

Capital formation in technology can lead to innovations in healthcare delivery and treatment methods. In Kenya, the widespread use of mobile technology for health (mHealth) applications has improved access to health information and services, especially in rural areas. This has enhanced disease surveillance, patient monitoring, and access to health advice, thereby indirectly improving health outcomes.

Challenges and Considerations

While the relationship between capital formation and health outcomes is generally positive, it is important to note that the benefits may not be uniformly distributed across or within countries. Factors such as governance, corruption, economic policies, and social inequalities can influence the extent to which investments in capital formation translate into improved health outcomes. Furthermore, investments in one type of capital (for instance, physical infrastructure) without adequate attention to others (such as human capital or healthcare quality) may not yield the expected health improvements. Hence, capital formation plays a critical role in improving health outcomes in low- and middle-income countries.

The relationship between health and the majority of the macroeconomic variables depends on the dimension of health examined or the methodology used. Based on the theory of economic growth and expanding some of the existing models to incorporate health, Ehrlich and Lui (1991) used adult life expectancy as a proxy for health, whereas Kalemli-Ozcan et al. (2000) reflected health through life expectancy at birth. Although these studies use different measures, both find that higher health status is associated with higher education levels or investment in human capital, which leads to enhanced economic performance. Using growth accounting as a tool, Bloom and Canning (2003) also hold that health as a factor of human capital has a positive impact on income. Therefore, improvements in the population's health reduce poverty in a country or region, thus justifying investment in health. In a similar vein, Howitt (2005) applies the Schumpeterian growth theory and proposes a production function to analyze the impact of improvements in the health and skills of a country's population on economic growth. His conclusions support the arguments of authors such as Barro (1996) by demonstrating that healthier workers are more productive. In turn, these more productive workers generate higher revenues ready to finance investments in technology or improve the level of skills, creativity, and learning capacity in society as a whole, thus generating greater economic growth.

Samek (2019) demonstrated an application for the UK in 2014 and calculated that, on average, if people who were ill were in good health, the UK economy would have had approximately 11% more human capital. Blázquez-Fernández et al. (2015) indicated that increased reproduction and lower investment in human and physical capital had a negative correlation with a higher probability of dying young, which has an adverse effect on income.

Lenhart (2019) investigated the effects of abrupt health shocks on labor and household income, job status, and hours worked by analyzing data from the British Household Panel Survey. The study demonstrates that abrupt health declines result in significant and long-lasting reductions in earnings, with the strongest effects being seen in males, higher-educated individuals, those in managerial positions, and those experiencing severe health shocks. These findings were obtained by estimating propensity score matching difference-in-differences models.

In light of the results from most of the studies analyzed in the literature, we can conclude that health improvements can be a fundamental factor for capital formation which in turn informs economic development. However, these studies failed to examine specifically capital as a catalyst to economic performance in the LMICs and as a comparative growth hypothesis amongst LMICs. Therefore, the novelty of the study is hinged on the aforementioned. Hence, this study examined the impact of capital

formation on health outcomes in LMICs, with a hypothesis that capital formation does not impact health outcomes in LMICs.

RESEARCH METHODS

The primary goal of this study is to incorporate capital formation and health outcomes into a well-defined aggregate production function to quantify the impact of capital formation on health outcomes. This work uses the macro-based technique of Weil (2001) and Bloom et al. (2019) to estimate a generalized aggregate production function that breaks down output into its components:

Data

This analysis employed annual panel data from ten LMICs (Chad, Ethiopia, Liberia, Madagascar, Lesotho, Morocco, Nigeria, Tanzania, and Zambia) from 2000 to 2023. The specified periods were determined by data availability and the World Bank classification of these countries. The variables used in this study are government spending on health (captured by domestic government spending on health), human capital accumulation (captured by government spending on education), capital formation (captured by gross fixed capital formation), and health outcomes (proxies for lifespan). The statistics were obtained from the Central Bank of Nigeria and the World Development Indicator database.

Model

In line with the study objective, the augmented Solow growth model was adopted to serve as the theoretical base for the empirical analysis. Hence, the theoretical model is specified as:

$$Y_{it} = K^{\beta}\ H^{\beta}\ AL^{1-\propto-\beta} \quad \text{.....(1)}$$

where

Y is aggregate output, K is physical capital, H is health outcomes, L is labor in the workforce, and A is technical efficiency. α and β are output elasticity parameters. Like the Solow growth model, A and L are assumed to grow at a constant rate g and n, respectively, and they are subject to diminishing return to scale given by 1> α + β. By transformation, Equation (1) becomes;

$$Ln\frac{Y}{L} = Ln\ A + g - \left(\frac{\alpha+\beta}{1-\alpha-\beta}\right) \ln(n+g+\delta) + \frac{\alpha}{1-\alpha-\beta} \ln(s_k) + \frac{\beta}{1-\alpha-\beta} \ln(s_n) \quad \text{.....(2)}$$

(s_k) and (s_n) are the investments or savings devoted to physical capital accumulation and δ is the depreciation rate for physical capital.

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$Ln\ A = \propto_0 \frac{\alpha}{1-\alpha-\beta} = \propto_1 \frac{\alpha}{1-\alpha-\beta} \propto_2 \frac{\alpha}{1-\alpha-\beta} = \propto_2 {}^{Y}/_{L}$=y, g = 0 and (n+g+δ) = 0 .....(4)

Since the labor force, technology, and depreciation grow at a constant rate over time and output per worker. The model becomes;

$Lny = \propto_0 + \propto_1 \ Lns_k + + \propto_2 Lns_n$ .....(5)

Hence, the model is specified as;

$ln\mathrm{HOC}_{it} = \varphi_1\ lnGFCF_{it} + \varphi_2\ lnGEH_{it} + \varphi_3\ ln\mathrm{WP}_{it} + U_{it}$ .....(6)

where

the subscript i = 1… N represents each country's identity in the panel while t= 1…T denotes time and the elasticity of output per effective labor for each exogenous variable in the model. However, $\varphi_i\ is$ the country-specific fixed effect in the model, while U_{it} is a normally distributed error term. HOC is health outcomes, GFCF is gross fixed capital formation, WP is productivity of the working population, and GEH is health expenditure per workforce.

In panel data analysis, the generalized method of moment (GMM) is frequently employed as the dynamic panel estimator. Nonetheless, a great deal of empirical research has used GMM estimators to analyze macro panel data (Samargandi et al., 2013). Two factors, small N and significant T, make the GMM estimators prone to producing false results (Roodman, 2009). First, an erroneous autocorrelation test could be produced by a small N. Secondly, the number of instruments will increase in tandem with the data period. It impacts the validity of the Sargan test of over-identification restriction, hence the null hypothesis of instrument homogeneity is rejected by the Sargan test of over-identification limitation (Samargandi et al., 2013). We therefore doubt the dependability and consistency of the GMM results. Furthermore, the GMM approach assumes that the panel members have homogenous slope coefficients and ignores cross-sectional dependence (homogenous panel). For these reasons, the system GMM estimator is used in this study. Moment conditions for the model in levels and moment conditions for the model in first differences are combined to create the system GMM estimator for the dynamic panel data model. It is more recommended in this regard because it has been demonstrated to outperform the GMM estimator in the first differenced model for bias and root mean squared error.

RESULT AND ANALYSIS

Table 1. Unit root test results

Variables	Levin, Lin and Chu t*				Order	ADF - Fisher Chi-square				Order
	Level		1st Difference			Level		1st Difference		
	None	Constant	None	Constant		None	Constant	None	Constant	
HOC	-2.5378 (0.0011)**	-1.19543 (0.0022)**	-12.76122 (0.00212)**	0.41237 (0.42675)*	I(0)	32.61945 (0.00211)**	52.86234 (0.0027)**	27.72341 (0.0000)**	120.32765 (0.0000)**	I(0)
GFCF	-1.13542 (0.057243)**	0.54173 (0.63196)	-14,64783 (0.0067)*	10.6234 (2.54124)	I(1)	72.62134 (0.03825)**	49.64253 (0.3258)	243.1285 (0.0513)**	243.6397 (0.0011)**	I(1)
GEH	2.6533 (1.7342)	6.27831 (1.1533)	-13.3513 (0.0045)*	21.7634 (2.5342)	I(1)	31.3475 (0.6742)*	30.5412 (0.9265)	314.5342 (0.0525)**	321.2467 (0.0044)**	I(1)
WP	1.4236 (0.6132)	2.6354 (0.2111)	-14.5634 (0.0054)*	28.6213 (1.0040)	I(1)	51.6243 (0.3321)*	54.7632 (0.6016)	312.1324 (0.0532)**	132.1563 (0.0001)**	I(1)

Note: The unit root test findings are included in the analysis according to the integration sequence. As a result, although the I (1) series are differenced, the I (0) series are included in the model under analysis without being. Asymptotic normality is assumed when computing probability

**P<0.01 and **P<0.05 respectively*.

Source: Author's Compilation (2024)

Table 2. Empirical results of the system-GMM dynamic panel

Dependent Variable: Health Outcomes (HOC)			
Variables→	**Coefficients**	**t-statistics**	**P-values**
$\mathbf{HOC}_{it-1}$	0.2184	2.6438	0.0534**
D(GFCF)	-0.0604	-0.0584	0.0512**
D(GEH)	-1.3276	-0.4221	0.0643**
D(WP)	0.3422	0.1521	0.0047*
AR(1)	-0.22	0.0532	
AR(2)	-0.03	0.6366	
F-test of Joint Sig	7.105774	**Instrument rank**	4
J-statistic	432.0000	**Number of Obs**	354
Prob (J-statistic)		0.40000	

Source: Author's Compilation (2024)

Table 2 shows that the lagged dependent variable is positive and statistically significant at the 5% level. This indicates that the previous level of HOC contributes positively to explaining the current level of health outcomes in LMICs. Thus, a unit increase in previous HOC would result in a 23% increase in present HOC in LMICs. Hence, variation in HOC in LMICs is fuelled by the previous level of HOC. However, the coefficient of gross fixed capital formation (GFCF) is negative and statistically significant at a 5% level indicating that, in LMICs, a decrease in GFCF would translate to a 6.04 decrease in HOC in the LMICs. However, the results can also best explain the crowd-out effects of capital formation on health outcomes in low-middle-income countries. This result conforms to the study by Lenhart (2019) which states that sudden health declines lead to significant and persistent reductions in earnings. However, this study was not specifically on LMICs

Furthermore, the coefficient of government health expenditure is also negative and statistically significant at the 5% level, implying that as government health expenditure decreases, health outcomes decrease disproportionately which also implies a crowd-out impact. However, the growing population of the workforce has a positive and significant relationship with HOC in LMICs.

Robustness Results

Table 3. Pooled OLS result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HOC(-1)	0.3411	0.0257	13.2723	0.0257
GFCF	1.2575	0.6435	1.9541	0.6435
GEH	-0.4132	0.7965	-0.5187	0.7966
WP	-1.2436	0.7442	-1.6711	0.7441
C	2.4654	0.4765	3.5876	0.0000

Note: Significant at 5% level ** P > 0.05

Source: Author's Compilation (2024)

Table 4. Results of the fixed and random effects (within) regression

	Random Effects Estimates			Fixed Effects Estimates		
Variables	**Coefficients**	**t-statistics**	**P-values**	**Coefficients**	**t-statistics**	**P-values**
GFCF	0.3222	0.4231	0.7615	-1.4634	-1.5543	0.9415
GEH	0.7456	0.5765	1.2933	0.6342	1.5221	0.4167
WP	-1.1033	-0.6543	1.6862	0.4562	0.4275	1.0671
C	4.5342	5.2875	0.0000	5.686446	7.152744	0.0000
Hausman Test	**b(Fixed eff.)**	**B (Random eff.)**	**(b-B) Var(diff.)**		**Prob.**	
GFCF	0.4765	1.2763	0.3733		0.0000	
GEH	0.6343	1.991	0.3185		0.0030	
WP	0.9837	1.1346	0.8670		0.0019	
$Chi^2(3) = 22.7612$, $Prob>chi^2 = 0.0000$						
F-statistic (prob) 5.2316 (0.00243), R-squared =0.6411, Adj R =0.6367 Dw=1.4327				F-statistic (prob) =4.2766 (0.0000) R-squared=0.6143 Adj R= 1.6587 Dw=1.63416		

Source: Author's Compilation (2024)

The result of Hausman test in Table 4 suggests that the fixed effects model is the more appropriate model since the Hausman test probability value is less than the chosen 5% level of significance (Prob< 0.05).

To ascertain the findings in the objective of this study, the robustness test was done. According to Blundell et al. (1996), the robustness check and further validity test of the system GMM estimates can be done through pooled OLS and fixed effects estimation. They argued that additional detections of dynamic panel validity can be confirmed when the estimated coefficient of the lagged dependent variable lies between the values obtained from the fixed effect (FE) and pooled ordinary least squares (POLS) estimator. Hence, our results in Table 3 and Table 4 established that the estimated coefficient of the lagged dependent variable of the system GMM results stood between the values obtained from POLS) and the FE estimators (FE= 0.3733<sGMM=0.2184 < POLS= 0.3411).

CONCLUSION

This study examines the impact of capital formation on health outcomes in LMICs from 2000 to 2023. The study used annual panel data sourced from the World Bank Development Index (WDI) and the Statistical Bulletin. This relationship was estimated using the dynamic system generalized methods of moments (SGMM) and other confirmatory estimates such as the fixed effect panel, and pooled OLS. The findings from this study show

that capital formation exhibited a significant relationship with health outcomes in the LMICs considered during the study periods.

Hence, this study concluded that health outcomes in the LMICs are strategically capital formation-motivated, therefore rejecting the null hypothesis that capital formation does not have an impact on health outcomes in LMICs. Hence, the study recommends policies that ensure equitable access and address the broader determinants of capital formation and adequate healthcare delivery, such as encouraging domestic savings through policies that promote financial literacy, access to banking services, and incentivizing saving behavior, which channels funds into investment opportunities. Additionally, attracting FDI by offering incentives such as tax breaks, streamlined regulations, and political stability would inject capital into LMICs, fostering economic growth. Moreover, aid from international organizations and developed countries can supplement domestic resources, supporting infrastructure development, education, and healthcare, thus contributing to capital formation. Furthermore, supporting microfinance initiatives and small and medium-sized enterprises (SMEs) can mobilize capital from grassroots levels, empowering local businesses and communities. Finally, ensuring proper healthcare delivery policy would enhance skill development and human capital, which in turn drives productivity and innovation, contributing to overall capital formation.

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