The Multidimensional Capital–Growth Nexus: A Comparative Cross-Regional Panel Data Analysis

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ABSTRACT: Economic growth depends on the accumulation and productive use of physical, human, social, and natural capital. This study investigates the relationship between these forms of capital and real GDP per worker across economies in South Asia, South-East Asia, Latin America, South-East Europe, and Africa during 1990–2017. Grounded in the Cobb–Douglas production function, the study employs a quantitative panel-data approach to examine the effects of capital indicators on regional economic growth, including variations and interactions between physical and social capital. Data were obtained from the World Development Indicators, Penn World Table, and International Country Risk Guide. Physical capital was measured through capital stock, human capital through the Human Capital Index, social capital through institutional indicators, and natural capital through natural resource depletion. The analysis employed descriptive statistics, cross-sectional dependence tests, panel unit-root tests, cointegration analysis, and Fully Modified Ordinary Least Squares (FMOLS) estimation. Findings indicate that physical and human capital have positive, significant associations with economic growth in South Asia, Latin America, and Africa. Social capital shows positive associations in South Asia and Latin America but is statistically insignificant in Africa. Natural resource depletion exhibits a negative, significant association in Latin America and a positive relationship in Africa. Interaction results suggest that institutional conditions strengthen the relationship between physical capital and economic performance in South-East Asia and South-East Europe. However, long-run relationships vary across regions. The findings emphasize investment in physical and human capital, institutional improvement, and sustainable resource management to support economic strategies, while acknowledging measurement limitations and non-causal interpretations.

KEYWORDS: Economic Growth, Physical Capital, Human Capital, Social Capital, Natural-Resource Depletion, GDP per Worker, Panel-Data Analysis

Pages: 10 – 24
Volume: 5
Issue: 10 (October 2026)

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Cite this Article: Jamil, Z., Anjum, S., & Farooq, M. U. (2026). The Multidimensional Capital–Growth Nexus: A Comparative Cross-Regional Panel Data Analysis. *The Regional Tribune, 5*(10), 10-24. https://doi.org/10.55737/trt/v-x.459

Introduction

Economic growth is affected by different types of capital that promote productivity and national prosperity. While traditional growth theories emphasize physical investment, labor force, and technological progress, differences in economic performance can also reflect human abilities, social relations, institutional environments, and natural resources. Physical capital is built to power production using machines, devices, buildings, and infrastructure. Human capital, which includes education, knowledge, and competence, can improve productivity and innovation (Schultz, 1961). Natural capital include, land, forests, minerals, and energy support economic activity, although depletion of resources may threaten long-term sustainability.

These forms of capital are interconnected rather than independent. Physical investment can result in higher returns if the workers have the relevant skills, while economic activities are performed in a socially and institutionally positive environment. Similarly, natural resources can support production, but long-term benefits depend on sustainable management. This study analyses the relationships between physical, human, social and natural capital and output per worker in selected economies within South Asia, South-East Asia, Latin America, South-East Europe and Africa based on panel data for 1990-2017. It also investigates whether physical capital interacts with selected social capital proxies. The aim is to improve the understanding of the relationships of economic performance with a number of regions, by incorporating these dimensions into a common empirical framework.

Objectives of the Study

1. To estimate the relationships between physical, human, social, and natural capital indicators and economic output per worker in selected economies.
2. To examine whether these relationships differ across the regional groups included in the study.
3. To investigate whether physical capital and the social-capital proxy interact in their relationship with economic output per worker.

Literature Review

Economic growth is influenced by human capability, institutional conditions, and natural resources, and not only by physical investment. Physical, human, social, and institutional factors were identified by the literature as important factors that can have an impact on productivity and long-term economic performance, as well as natural capital. However, across countries, depending on their economic structure, policies and development, can lead to differences in their impact.

Human Capital

Human capital means individual knowledge, education, skills, and competencies. The development of education and skills can enhance labour productivity, promote technological progress and support economic development. A significant relationship between educational qualification and economic growth across countries has been found by Barro (1991). Similarly, Mankiw et al. (1992) emphasized human capital's role in clarifying cross-country income disparities apart from physical capital. These findings show that investment in education and skills can increase the economy's productive capacity.

Physical Capital

Physical capital consists of machines, buildings, and infrastructure that support manufacturing. Gross Fixed Capital Formation (GFCF) is used as an indirect measure of physical capital investments. Mankiw et al. (1992) have shown

the importance of physical capital accumulation to explain differences in economic growth across countries. However, investment and growth in relationship between are not always the same since investment's efficiency is also dependent on productivity, technology, and resource allocation.

Social and Institutional Capital

Social and institutional capital includes social relations, trust, governance mechanisms, legal systems, and institutional quality, which affect economic activity. Effective institutions can promote investment, protect property rights, and enhance resource allocation. Mauro (1995) mentioned that corruption had a negative impact on investment and economic growth. Political instability was identified by Mo (2001) as a crucial channel that can interfere with economic efficiency through corruption. The studies show that institutional quality constitutes an important consideration when considering the relationship between the formation of capital and economic growth.

Natural Capital

Natural capital consists of natural resources, such as mineral resources, forests, agricultural lands, and energy for economic production. While resource abundance can generate revenue and sustain investment, dependence on natural resources does not necessarily guarantee economic growth's sustainability. Sachs and Warner (1995), who studied 97 developing countries, reported a negative relationship between natural resource abundance and economic growth. Gylfason (2001) highlighted that excessive dependence on resources could weaken investment in education and in human capital. These findings show that the contribution of natural resources depends in part on how resource revenues are effectively managed and invested in productive activities.

Synthesis

Overall, the literature suggests that physical, human, social, and institutional natural capital can grow through various but interlinked mechanisms, influenced by economic activity. Physical capital helps production capacity, human capital improves the quality of work, the institutional conditions shape the efficiency of economic activities, and the natural capital provides essential resources for production. The direction and extent of these relationships, however, may vary from country to country and period to period. The study of these four forms of capital within a common empirical framework can therefore enable a broader understanding of their individual contributions to economic growth across countries and regions.

Theoretical Framework

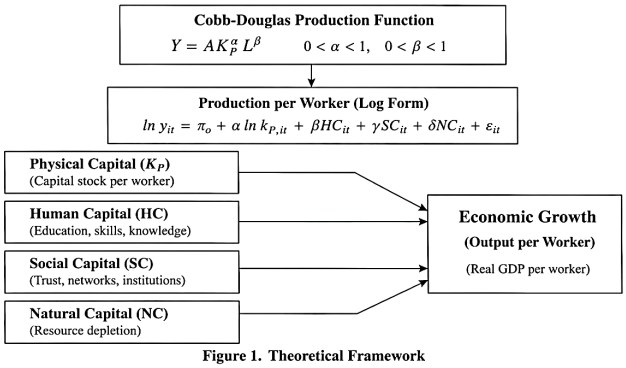


Figure 1. Theoretical Framework

$$GDP_{it} = \pi_o + \alpha K_{P,it} + \beta HC_{it} + \gamma SC_{it} + \delta NRD_{it} + \varepsilon_{it}$$

GDP	= Gross Domestic Product	SC	= Social Capital
HC	= Human Capital	NRD	= Natural Resource Depletion
K_s	= Capital stock per worker	ε_{it}	= Error term

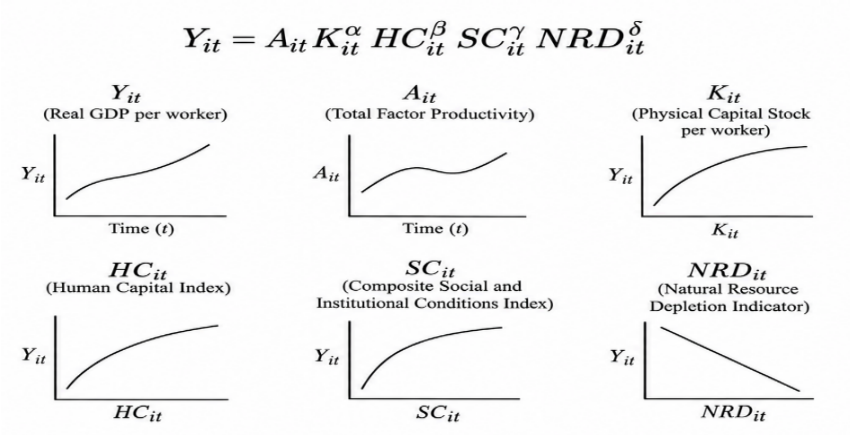
Methodology

This study reviewed four forms of capital from relationship between: (Physical Capital, Human Capital, Social Capital and Natural Capital, and economic performance in selected countries during the 1990 - 2017 period. The Cobb-Douglas production function is based on its theoretical basis and was originally developed by Cobb and Douglas (1928) to explain economic performance as far as productive inputs are concerned. In the traditional Cobb-Douglas production function, physical capital and workforce are seen primarily as the most important determinants of production. Economic growth is, however, also influenced by the development of human capital, social and institutional conditions, and the availability of natural resources. This study expands the traditional production framework with the incorporation of human capital, social capital, institutional indicators, and the depletion of natural resources in the analysis. This broader approach offers the opportunity to examine the relationship of different forms of capital to economic production. The study follows a quantitative panel data approach, which was followed over several years with observations of selected countries. Empirical analysis focuses on the relationship between selected capital measures and real GDP per worker to estimate their contribution to economic development.

Theoretical Production Function

The extended production function is specified as:

$$Y_{it} = A_{it} K_{it}^{\alpha} HC_{it}^{\beta} SC_{it}^{\gamma} NRD_{it}^{\delta}$$



$$\ln(Y_{it}) = \beta_0 + \beta_1 \ln(K_{it}) + \beta_2 \ln(HC_{it}) + \beta_3 SC_{it} + \beta_4 NRD_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

$\ln(Y_{it})$ = log real GDP per worker

$\ln(K_{it})$ = log physical capital stock per worker

$\ln(HC_{it})$ = log human capital index

SC_{it} = composite social-capital proxy

NRD_{it} = natural resource depletion

μ_i = country-specific effect

λ_t = year-specific effect

ε_{it} = error term

Description of Variables and Data Sources

In this study, secondary data were adopted from the World Development Indicators (WDI) 1990 - 2017, the Penn World Table (PWT), and the International Country Risk Guide (ICRG). The variables include economic indicators, physical capital, human capital, institutional and socio-economic conditions, as well as depletion of natural resources.

Gross Domestic Product per Worker

Gross domestic product (GDP) represents the monetary value of final goods and services produced within a country during a specified period. In this study, economic performance is measured by real GDP per worker, which represents the value of real economic output relative to the number of employed persons.

GDP Per Worker is Calculated as

REAL GDP PER WORKER CALCULATION

$$Y_{it} = \frac{RGDP_{it}}{EMP_{it}}$$

Y_{it} = Real GDP per worker
(Economic Output per Employed Person)

$RGDP_{it}$ = Real GDP
(Monetary Value, Inflation-Adjusted)

EMP_{it} = Total employment
(Number of Persons Employed)

GDP per worker is calculated as: Real GDP (RGDPit) divided by total employment (EMPit) for a given country (i) and year (t).
This measure differs from GDP per capita by using the employed population as the denominator.

Physical Capital

Physical capital includes productive assets used to manufacture goods and services, including machinery, equipment, buildings, transport infrastructure, and other production facilities. These assets boost economic activity, strengthen production capacity, and allow workers to function more efficiently. Capital stock is the accumulated value of the production assets available to the economy, as compared with gross fixed capital formation (GFCF), which measures capital investment over a specified period.

$$K_{it} = \frac{KS_{it}}{EMP_{it}}$$

K_{it} = physical capital stock per worker
KS_{it} = capital stock
EMP_{it} = total employment

Human Capital

Human capital means the knowledge, skills, and productive ability of each individual. Investment in education and learning can enhance workers' productivity, promote technology, and contribute to economic development; Schultz (1961) highlighted human capital investments. This study employed the Human Capital Index provided by the Penn World Table as a measure of human capital. This index reflects the degree of education and the expected impact of it. Human capital is projected to be positively associated with real GDP per worker because more experienced and qualified staff can take advantage of physical capital more effectively, launch new technologies, and increase productivity. Nevertheless, the scale of such a relationship may vary according to the quality of the education system, the labour market conditions and the degree to which the acquired competences are used productively.

Social Capital

Social capital is composed of social relations, trust, common norms, institutional conditions for the promotion of co-operation and collective action. It's difficult to measure, because none of the indicators reflects all of its measurements (Durlauf, 2002; Fukuyama, 2001; Grootaert & van Bastelaer, 2002). This study provides a framework for the implementation of social capital on the basis of a composite index based on the three ICRG indicators: law and order, socioeconomic conditions, and combating corruption. Variables are intended for institutional purposes and for economic performance and socio-economic conditions. These are indirect proxies, not comprehensive human trust measures or social networks.

Law and Order (LO): This indicator represents the power and impartiality of the law and its application. Economic terms and conditions may facilitate support for economic activities through rights protection and reduced uncertainty.

Socio-Economic Conditions (SEC): This indicator represents socio-economic Pressure with regard to the stability of the Government. Precise components and their directions must be established on the basis of the ICRG edition that was used in research.

Prevention of Corruption: This indicator is associated with institutional conditions. Reduction in corruption can make economic support more efficient by reducing resource misallocation uncertainties and institutional weaknesses.

$$X_{it}^{*} = \frac{X_{it} - X_{min}}{X_{max} - X_{min}}$$

positive direction normalization

$$X_{it}^{*} = \frac{X_{max} - X_{it}}{X_{max} - X_{min}}$$

reverse direction normalization

$$SC_{it} = \frac{LO_{it}^{*} + SEC_{it}^{*} + C_{it}^{*}}{3}$$

composite index calculation

Natural Capital

Natural capital is an ecological asset contributing to the economic production and well-being of humans, including forests, water, soil, minerals, energy, and environmental systems. In support of economic activities, such assets provide raw materials, energy, and ecosystem services. Daly (1994) underlined the importance of recognizing natural capital and environmental restrictions on growth. In this study, natural resource depletion (NRD) is used as an indirect indicator of natural capital pressure. The World Bank indicator Adjusted saving: depletion of natural resources (% of GNI) combines the depletion of selected forest, energy, and mineral resources, and expresses the resulting measure as a percentage of Gross National Income. Natural resource depletion is not a direct measure of the entire natural capital stock. In comparison to national income, it represents the depletion of certain resources. A higher value represents a greater measured depletion than GNI, provided the definitions and the indicator's coverage are applied. The anticipated nexus between natural resource depletion and economic production is potentially negative from the point of view of long-term sustainability, as depletion of resources can lead to a fall in resource wealth and environmental cost. The extraction activities can, however, increase current production and income, especially in resource-dependent economies. Hence, the calculation coefficient may be positive or negative, and its interpretation should differentiate between the output's short-term relationship and the impact of long-term sustainability.

Table 1

Description and Data Sources of Variables

Variables	Abbreviations	Proxy for	Data Sources	Units of Variables
Gross Domestic Product per capita	GDP	Proxy for output per worker	WDI	Constant 2010 US $
Gross fixed capital formation	GFCF	Physical capital of a country	WDI	Constant 2010 US $
Law and order	LO	Proxy for social Capital	International Country Risk Guide ICRG, The PRS Group	Ranges from 1-6

Socio-economic conditions	SEC	Proxy for social Capital	The PRS Group/International Country Risk Guide(ICRG)	Ranges from 1.33-10.25
Corruption	C	Proxy for social Capital	International Country Risk Guide ICRG, The PRS Group	Ranges from 0-5
Human Capital Index	HC	Proxy for human Capital	Penn World Tables	Ranges from 1.33-3.33
Natural Resource Depletion	NRD	Proxy for natural capital	World Bank Wealth Accounts	% of GNI

Table 2

Variables, Expected Signs, and Theoretical Channels

Variables	Abbreviated in the Model as	Expected Signs	Channel
GDP	Y		Dependent variable
Capital stock per worker	K	+ve	Capital stock per worker ↑→Tools availability for workers ↑→Productivity → efficiency↑ →output/worker ↑
Human capital	HC	+ve	Education↑ →earnings ↑→ spending↑ ↑aggregate demand →output ↑
Social Capital	SC	+ve	↑law and order, → Control in corruption↑→ fair use of power→↑ socio economic conditions improve ↑ better economic conditions → output/worker↑
Natural Capital	NRD	-ve	Growth↑ →consumption of natural resources ↑→, pollution↑ long-term toxins →↑soil erosion ↑ → ↑ damage to nature↑ →environmental quality

Theoretical Model

This study examines the impact of four forms of capital on economic growth across 19 lower-middle-income countries using panel data.

Theoretical foundation: The Cobb–Douglas production function is used to explain the relationship between capital, labour, and economic output.

Physical capital (KP): Investment in machinery, equipment, and infrastructure.

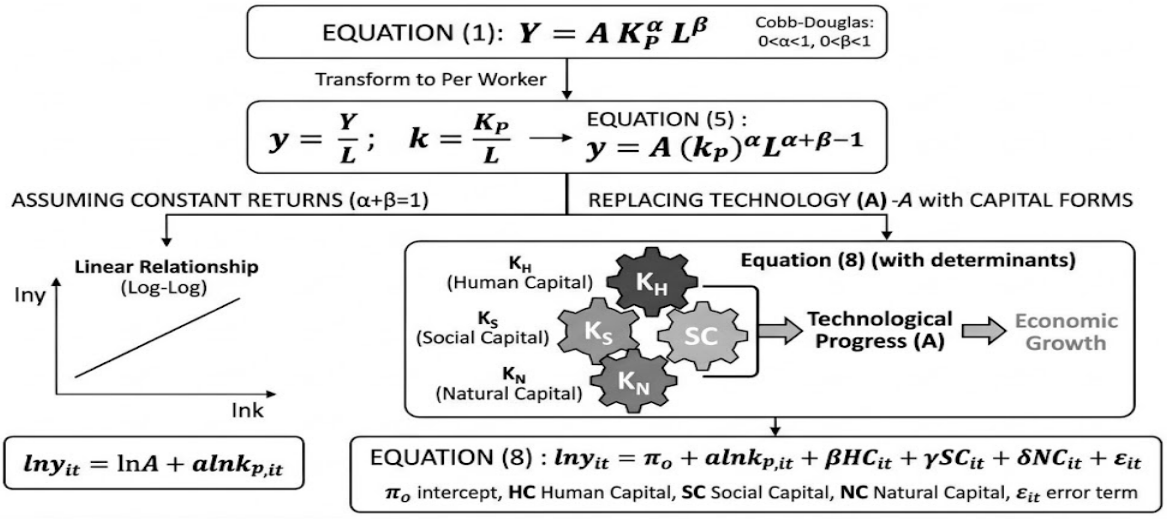
Human capital (HC): Education, knowledge, and skills.

Social and institutional capital (SC): Social conditions and institutional quality.

Natural capital (NC): Natural resources that contribute to economic production.

Dependent variable: Economic growth, measured through real GDP per worker.

Methodology: Panel data analysis examining the relationship between the four forms of capital and economic growth.



Empirical Model

Empirical model to examine economic growth using the Cobb-Douglas production function.

The general form of the model can be written as:

$output/worker = f(HC, ks, SC, NRD,)$

GDP = Gross Domestic Product

HC = Human Capital

Ks = capital stock per worker

SC= Social Capital

NRD= Natural Resource Depletion

In equation (9), GDP is the dependent variable taken as a proxy for economic growth.

Descriptive Statistics of all Variables of All Regions (1990-2017)

Table 3

Descriptive Statistics for South Asian Region

	GDP	GFCF	SC	HC	NRD	LABOR	Y	LNY	KS	K	LNK
Mean	382B	105B	3.074	2.395	1.863	131M	3263.904	7.960213	879B	2.57E+09	12.4926
Median	109B	21B	3.275	1.797	1.474	49M	2828.294	7.947428	263B	12399.22	9.425
Maximum	2,660B	861B	4.670	6.920	4.306	503M	9625.792	9.172201	7,220B	3.16E+10	24.1753
Minimum	21B	4B	0.000	1.000	0.615	7M	1222.507	7.108659	8B	2666.874	7.888662
Std. Dev.	596B	193B	0.828	1.368	1.040	169M	1842.625	0.500593	1,530B	6.58E+09	5.887035

Descriptive statistics show a highly heterogeneous region, with India having a considerable impact on regional resources for GDP, investment, and capital stock. Therefore, the average GDP of (US$382 billion) is significantly higher than the median of (US$109 billion), indicating that some large economies dominate the region. Average GDP per capita (US$3,263.9), which implies moderate differences in income between countries. Physical capital is also significant since gross fixed capital formation and capital stock reflect uneven investment and capital accumulation; therefore, a logarithmic transformation of the capital stock (LNK) is suitable for the reduction of skewness. Human capital mean is (2.395) with a standard deviation of (1.368), stressing significant differences in education, skills, and health, whereas social capital mean is (3.074) with a standard deviation of (0.828), making it the most homogeneous variable in the region.

Table 4

Descriptive Statistics for Southeast Asian Region

	GDP	GFCF	SC	HC	NRD	LABOR	Y	LNY	KS	K	LNK
Mean	312B	88B	4.102	2.413	3.095	45M	9045.737	8.945297	1,110B	7.63E+10	17.73831
Median	240B	69B	4.090	2.399	2.683	35M	6428.094	8.768395	1,080B	2.21E+10	17.52568
Maximum	1,090B	355B	6.000	2.970	9.054	129M	23650.56	10.07114	3,000B	2.98E+11	26.41919
Minimum	82B	18B	1.670	1.895	0.303	7M	3854.137	8.256902	204B	8961.138	9.100653
Std. Dev.	220B	73B	0.995	0.243	2.239	35M	5717.279	0.550903	685B	9.32E+10	7.932608

The descriptive statistics reveal significant differences in economic growth and capital-related indicators in the Southeast Asian region. The mean GDP is (312 billion) versus the median of (240 billion), which indicates that some observations with relatively high GDP may increase the mean. Gross Fixed Capital Formation (GFCF) averages (88 billion), with a standard deviation of (73 billion), indicating significant differences in physical investment. Human capital (HC) is the average (2.413), whereas social capital (SC) is the mean (4.102). Natural resource dependence (NRD) has an average value of (3.095) and a relatively high standard deviation of (2.239), which shows considerable variation in that indicator. Average labour force of about (45 million) people, including (35 million) people who are standard deviation, reflecting variations in the country's size. Real GDP for one employee (Y) has average value on (9,045.737), while average value is equal to (6,428.094). The average value of the log for one worker (LNY) is (8.945). The average cost of physical capital (K) is (76.3 billion), and the average value is the logarithmic measure (LNK) - 17.738.

Table 5

Descriptive Statistics for Latin American Region

	GDP	GFCF	SC	HC	NRD	LABOR	Y	LNY	KS	K	LNK
Mean	967B	187B	4.303	2.463	3.774	45M	22262.57	10.00119	2,380B	49024.27	10.74986
Median	942B	194B	4.222	2.496	2.895	43M	21798.5	9.989594	2,520B	52266.6	10.86406
Maximum	2,420B	517B	5.833	3.015	14.552	105M	30303.25	10.31901	6,140B	71303.91	11.17471
Minimum	79B	9B	3.000	1.717	0.697	5M	15452.3	9.645513	78B	15386.94	9.641274
Std. Dev.	708B	136B	0.825	0.336	2.945	33M	3173.342	0.136802	1,780B	13183.72	0.350427

The economic activities and capital measurements of the Latin American region show considerable variation a description of the statistical indicators. The average GDP was (967 billion), whereas the average was (942 billion), and the average standard deviation was (708 billion), a figure that marks substantial differences in economic size for observations. Gross Fixed Capital Formation (GFCF) has a mean value of (187 billion) and an SD of (136 billion), indicating substantial variation in physical investment across the selected economies. While the mean of human capital (HC) is (2.463), the average of Social capital (SC) is (4.303). Natural resource dependence (NRD) has a (3.774) average and standard deviation (2.945) means considerable variation in this case. The average labour force is estimated to be (45 million) people, with a standard deviation of (33 million). The actual GDP per worker (Y) is the mean (22,262.57) value and the median (21,798.5) value. The GDP average log per employee (LNY) is (10.001). The mean relative to the physical capital (KS) was (2,380 billion), while K averaged (49,024.27), and the logarithmic measure (LNK) averaged (10.750). Overall, results show substantial differences in economic size, physical investment, and natural resource dependence during the observation period.

Table 6

Descriptive Statistics for South East European Region

	GDP	GFCF	SC	HC	NRD	LABOR	Y	LNY	KS	K	LNK
Mean	199B	38B	4.039	3.068	1.297	8M	28435.08	10.08671	518B	83965.96	10.99608
Median	176B	30B	4.125	3.020	0.495	5M	25257.24	10.13677	396B	55311.47	10.92042
Maximum	601B	120B	5.860	4.670	5.000	18M	65702.55	11.09289	1,630B	322954.5	12.68527
Minimum	30B	2B	2.000	2.500	0.064	3M	7763.359	8.95717	70B	15971.95	9.678589
Std. Dev.	145B	30B	0.928	0.380	1.605	6M	16199.46	0.598515	406B	73891.38	0.825523

The descriptive statistics of the South East European surveys show a significant change in economic performance and the capital-related indicators. The average GDP is (199 billion), (SD = 145 billion), and exceeds the median of (176 billion), meaning that relatively high GDP levels can impact regional averages. The average Gross Fixed Capital Formation (GFCF) is (38 billion), (SD = 30 billion), which involves significant variation in physical investment. Social capital (SC) averages (4.039), (SD = 0.928), whereas human capital (HC) is on average (3.068), (SD = 0.380), which shows a bigger dispersion in social capital. Natural resource dependence (NRD) has a mean of (1.297) and a standard deviation of (1.605), suggesting substantial variation and possible right-Skewness. The real GDP per employee is, on average, (28,435.08) (SD = 16,199.46), while the average labour force is around (8 million) (SD = 6 million), reflecting the variation in economic productivity and the labour force. Capital-related indicators also present a significant dispersion, with KS showing an average of (518 billion) (SD = 406 billion), while K showing an average of 83,965.96 (SD = 73,891.38). The logarithmic measures, LNY and LNK, have means of (10.087) and (10.996), respectively. These differences indicate that all observations highlighted economic heterogeneity. Overall, the findings indicate a basis for analyzing the relationship between human capital, social capital, physical investment, natural resource dependence, and economic output per worker through panel data analysis.

Table 7

Descriptive Statistics for African Region

	GDP	GFCF	SC	HC	NRD	LABOR	Y	LNY	KS	K	LNK
Mean	161B	33B	3.242	2.080	7.308	16M	10222.39	8.968838	520B	36342.33	9.949599
Median	143B	28B	3.313	2.039	5.159	15M	10347.49	9.073516	472B	28638.96	10.26252
Maximum	427B	87B	5.330	2.800	25.547	31M	20316.26	9.919177	1,690B	139297.2	11.84437
Minimum	22B	2B	1.500	1.513	0.945	6M	2144.714	7.670761	18B	2092.994	7.646351
Std. Dev.	113B	25B	0.836	0.289	5.739	6M	6048.412	0.780066	398B	33202.25	1.225161

The average GDP is (161 billion), more than the median of (143 billion), which indicates that relatively high values could affect regional averages. Gross Fixed Capital Formation amounted to (33 billion) (SD = 25 billion) due to substantial physical differences in investment. Human capital (HC) has an average of (2.080) (SD = 0.289), while social capital (SC) has a mean of (3.242) (SD = 0.836), indicating a higher dispersion in social capital. Natural resource dependence (NRD) varies significantly according to the average 7.308 and 5.739 standard deviation. The average worker-working population amounts to around 16 million (SD = 6 million). Real GDP per employee (Y) means (10,222.39), while the logarithmic measure (LNY) has an average of (8.969 (SD = 0.780). The capital-related indicators also include substantial variation: KS has an average of 520 billion (SD = 398 billion), while K has an average of 36,342.33 (SD = 33,202.25), and LNK has an average of 9.950 (SD = 1.225). Such measures have a precise interpretation, depending on their definition and units. Overall, findings point to significant economic and capital-related heterogeneity in the African observations. The variation supports an additional panel data analysis of the relationships between human capital, social capital, physical investment, natural resource dependence, and the economic performance per worker.

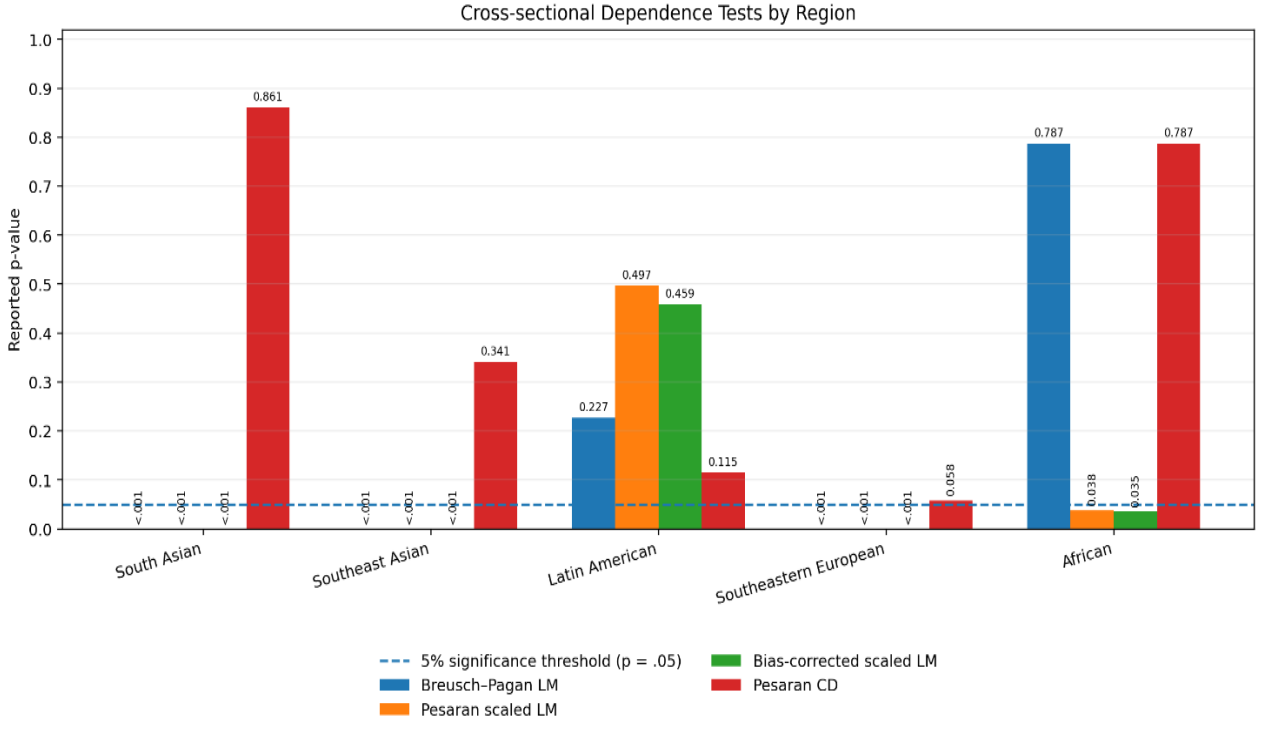
Cross-Sectional Dependence Test

The cross-sectional dependence tests were conducted to determine whether economic shocks or unobserved factors that hit one country were also linked to outcomes in other countries within the same regional panel. The results illustrated that the Pesaran CD test p-values were (0.861) for South Asia, (0.341) for South-East Asia, (0.115) for Latin America, 0.058) for South-Eastern Europe, and (0.787) for Africa. Since all five p-values are larger than 5%, the null hypothesis of cross-sectional independence cannot be rejected by reason of the Pesaran CD test.

Hypotheses for the Pesaran Test are

H0: No Cross-Sectional Dependence

H1: Cross-sectional dependence is present



Unit-Root Tests

Panel unit-root tests are used to determine whether variables are stationary or contain a unit root. In this study, the Levin, Lin, and Chu (LLC), Pesaran, and Shin (IPS), and ADF Fisher-type tests are used to examine the stationarity of variables across countries within each regional panel. The LLC test assumes a common autoregressive coefficient, whereas the IPS test allows this coefficient to vary across countries. The ADF Fisher test combines individual ADF test results and allows for heterogeneity across cross-sectional units. Country-level graphs are examined to identify possible trends and help select appropriate test specifications, including individual intercepts and time trends. The tests are then applied separately to each regional panel.

Hypotheses of the ADF Fisher-Type Test

- **H_0:** All cross-sectional units contain a unit root (non-stationary).
- **H_1:** At least one cross-sectional unit is stationary.

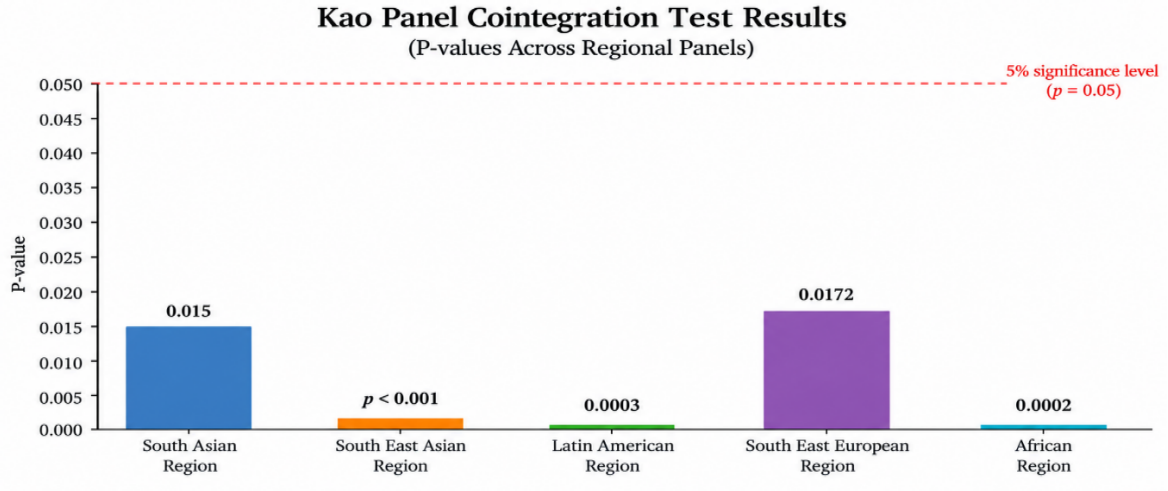
Table 8

Kao Panel Cointegration Test - Order of Integration

Regions	GDP/capita	LNK	HC	SC	NRD	Lnk*SC	SC*HC
South Asia	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
South-East Asia	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Latin America	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
South-East Europe	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
African	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)

Co-integration Test

The co-integration test is used to check whether the variables have a stable long-term relationship. The results of the Kao residual co-integration test show that the p-value is less than (0.05%). Therefore, the null hypothesis of no co-integration is rejected, indicating that a long-term relationship exists among the variables. It means that GDP per capita and independent variables such as physical capital (LNK), human capital (HC), social capital (SC), and natural-resource depletion (NRD) can move together in the long term. Co-integration does not necessarily mean that every independent variable has a statistically significant effect on GDP per capita.



Region	ADF Test Statistic	P-value
South Asian Region	-1.029520	0.015
South East Asian Region	5.322064	0.000 ($p < 0.001$)
Latin American Region	-3.475841	0.0003
South East European Region	-2.114888	0.0172
African Region	-3.537575	0.0002

Kao Panel Cointegration Test Results Across Regional Panels.

Table 9

Augmented Dickey-Fuller Test Equation (Dependent Variable: D (RESID)

Region	Variable	Coefficient	Std. Error	t-statistics	Prob.
South Asian Region	RESID(-1)	-0.108037	0.073716	-1.465579	0.1474
South East Asian Region	RESID(-1)	-0.231308	0.038760	-5.967719	0.0000
Latin American	RESID(-1)	-0.361531	0.099211	-3.644052	0.0005
South East European	RESID(-1)	-0.195524	0.078703	-2.484323	0.0157
African Region	RESID(-1)	-0.643616	0.195346	-3.294750	0.0031

The findings indicated that the long-run relationship between economic growth and the four forms of capital varies across the selected regions. In South Asia, the p-value is (0.1474), which is greater than (0.05), indicating that there is not enough evidence to confirm a long-run relationship among the variables. In South-East Asia, Latin America,

South-East Europe and Africa, provide statistically significant results suggesting that economic growth and capital's different types have a stable long-run relationship in these regions. The negative and significant coefficients mean that changes in long-run equilibrium over time are usually corrected, with an estimated rate of adjustment of (23.1%) in South-East Asia, (36.2 %) in Latin America, (19.6 %) in South-East Europe, and (64.4 %) in Africa per period. Africa shows the fastest adjustment, while South- East Europe shows the slowest among these four regions. Overall, the findings suggest that the relationship between capital and economic growth is stronger in four of the five regions studied, whereas the evidence for South Asia remains insufficient to establish a long-run equilibrium relationship.

Table 10

Results of FMOLS Estimates across Selected Regions

Variables	South Asian Region	Latin American Region	African Region
LNK	0.378*** (0.000)	0.433*** (0.000)	0.258*** (0.003)
HC	0.010** (0.033)	0.136*** (0.000)	0.157** (0.003)
SC	0.081** (0.040)	0.035** (0.003)	0.012 (0.059)
NRD	–0.030 (0.587)	–0.009*** (0.001)	0.097*** (0.007)

Note. Values are FMOLS coefficient estimates; p-values are reported in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.10. Significance stars have been adjusted to match the supplied p-values.

Interpretation of the Results

The FMOLS estimates that physical capital has a positive and statistically significant relationship with economic performance in all three regions. Its largest reported coefficient is in Latin America (0.433), followed by South Asia (0.378) and Africa (0.258). Human capital (HC) also has a positive and statistically significant coefficient in all three regions. The largest coefficient is observed in Africa (0.157), followed by Latin America (0.136), and South Asia (0.010). Social capital (SC) has a positive and statistically significant coefficient in South Asia (0.081) and Latin America (0.035). However, its coefficient in Africa (0.012) is not statistically significant at the 5% level because its p-value is (0.059). Natural-resource depletion (NRD) is not statistically significant in South Asia (p = 0.587). In Latin America, its coefficient is negative and statistically significant (–0.009, p = 0.001), whereas in Africa it is positive and statistically significant (0.097, p = 0.007). These results suggest that the relationship between natural-resource depletion and economic growth differs across regions.

Table 11

Results after Introducing Interaction Terms

Variables	South East Asian Region	South East European Region
Lnk	0.54**	0.46***
	(0.036)	(0.000)
HC	0.357***	0.21**
	(0.000)	(0.032)
SC	0.061*	0.16**
	(0.099)	(0.036)
NRD	**-0.0061**	-0.07***
	(0.399)	(0.001)
Lnk*SC	0.005**	0.046**
	(0.007)	(0.05)

Panel regression results show that physical capital and human capital have a positive relationship with GDP per worker in the South-East Asian and South-East European regions. Social capital has a positive relationship with both regions' economic output, although the intensity of statistical data differs. The relationship between physical capital and social capital is positive in both regions. Social capital may contribute to improving the relationship between physical capital and economic growth. The evidence is statistically higher in Southeast Asia, with a 5% significance limit on the Southeast European result. Natural resource depletion has negative, but statistically unimportant coefficients in Southeast Asia. Southeast Europe has negative and statistically significant coefficients that indicate the potentially negative relationship between resource depletion and long-term economic performance.

Conclusion

This study examined the relationships between physical, human, and social capital, and economic growth across five regions over the period 1990–2017. The findings indicate that physical and human capital play an important role in promoting economic development, although the contribution of social capital differs across regions. A positive relationship between physical and social capital was identified in South-East Asia and South-East Europe. However, no statistically significant interaction effects were observed in South Asia, Latin America, or Africa. Natural resource depletion also showed statistically significant relationships with economic growth in Latin America and South-East Europe. Overall, the findings emphasize the need for region-specific development strategies that promote investment in different forms of capital and encourage their effective utilization.

Limitations of the Study

The study has several limitations. Education may not be an adequate measure of human capital since the quality of education and practical skills vary from one country to another. The indicator of the depletion of natural resources does not cover all kinds of natural capital, including renewables, fisheries, and other environmental-related assets. Its significance and indicators vary from society to society; it is also hard to measure social capital. Finally, the study relates to selected countries between 1990 and 2017, so that the results may not apply to all economies or to recent periods.

Suggestions

- Governments should invest more in physical infrastructure, education of good quality, and skills development in order to boost productivity.
- Bangladesh and Pakistan must give priority to institutional reform in order to improve administration, transparency, and Public trust.
- Southeast Asian and Southeastern European countries should coordinate on physical investment.
- Countries should also encourage the sustainable management of resources to reduce environmental damage and to support economic development in the long term.

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