

INFRASTRUCTURE GAPS, CAPITAL FORMATION AND SUSTAINABLE DEVELOPMENT GOAL (SDG) SCORES IN SOUTH ASIA

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ABSTRACT

Infrastructure indicators for South Asia reveal huge gaps in access and usage despite rising investments. Maldives, Sri Lanka have fewer gaps while Pakistan, Afghanistan have the largest gaps. The persisting infrastructure gaps despite stable growth and rising investment does have impact on sustainable growth. The paper analyzes the relationship between Infrastructure investment and sustainable development scores. The panel regression approach with random effects assesses the impact of gross fixed capital formation, government capital expenditure, per capita GDP growth, bank credit allocation and tax revenues on sustainable development scores from 2000 to 2022. The results show that improvements in the sustainable development goal scores are negatively impacted by gross fixed capital formation, bank credit allocation and growth in gross domestic product. However, per capita GDP growth, government capital expenditure and tax revenues creates a positive impact. The demand of infrastructure is expected to increase with urbanisation and GDP growth.

Mobilisation of domestic savings into infrastructure investment is still very rigid in Asian countries and at the same time capital market imperfections depressed the return for foreign capital or foreign currency accumulation. Government expenditure remains the key financing option. The study argues for the government's funding of infrastructure provisioning than promoting public-private partnerships.

Keywords: Infrastructure gaps, infrastructure investment, panel regression, SDGs, South Asia.

INTRODUCTION:

Development policies have increasingly focused on achieving enhancing infrastructure provision for achieving the Sustainable Development Agenda 2030 in recent years (Kumar, 2019) (Filho et al, 2022), measured through 169 indicators. The Sustainable Development Goals (SDG) encompasses three important pillars: economy, environment and society, with infrastructure being the core strength of these pillars. SDG 9 focuses on building resilient infrastructure for inclusive and sustainable industrialisation. SDG 11 targets

inclusive, sustainable, safe, and resilient human settlements and cities. Moreover, SDG 5 (Gender Equality), SDG 6 (Clean Water & Sanitation), SDG 7 (Affordable & Clean Energy), and SDG 17 (Partnerships for the Goals), revolve directly around infrastructure availability and adequacy. Lower SDG scores for South Asian Countries reflect upon the infrastructure gaps.

There is an urgent need to step up infrastructure investment of \$3.7 trillion (4.1 percent of global annual GDP) between 2017-2035. 54 percent of this investment is required for Asia (IMF, 2020). It has further projected an investment shortfall of \$5.5 trillion. The highest investment gaps are for water supply and energy in South Asia, dominated by India and Bangladesh. Infrastructure is a significant determinant for Asian economy's growth but at the same time consistent economic growth created enormous pressure on Asia's transport, energy, and communications infrastructure. Gradually, it becomes the biggest bottleneck for growth, competitiveness, and poverty reduction. Infrastructure¹ is a prerequisite (as an explicit goal and an implicit means) for attaining SDGs. However, infrastructure is highly dependent on investment, or the capital allocated for the infrastructure provisions. Along with infrastructure provisions, per capita availability, accessibility, and affordability of infrastructure services are equally critical for developing regions like South Asia, given the low per capita

income levels and incomplete markets. Governments, therefore, are the essential source for infrastructure financing and provisioning (Kumar, 2019) (GI Hub, 2020). Public expenditure to GDP (GE/GDP) ratio is considered as the most suitable proxy for government demand for infrastructure (Aschauer, 1993). So, the countries with a higher ratio of GE/GDP will have a higher demand for infrastructure. With increasing government expenditure and international lending, infrastructure has gradually improved in South Asia. For instance, South Asia has one of the highest irrigated farmland (40 percent of the total cultivated area) in Asia. More than 70 percent of the intra-regional trade takes place through land transport. Similarly, electricity, ports, and railways have experienced phenomenal changes during the last two decades. This has resulted in a considerable rise in agricultural and industrial output and income and consumption levels. Further, expanding schools, hospitals, communication and financial infrastructure have resulted in increased productivity and improved living standards. Expansion of the banking institutions and communication has promoted economic activities and induced innovation and investment in these economies. Digitalization, mobile penetration, and internet connectivity are the recent additions to infrastructural facilities, enabling faster inclusion and higher productivity. Consistent enhancement of infrastructure is visible via increasing

real GDP and business sale revenues. Per capita availability is another indicator for increased investment in infrastructure, such as railways, roads, electricity, commercial and residential buildings, water supply and sanitation. Broadly, production, productivity and living standards are accelerating gradually across South Asian countries. Nevertheless, regional differences are wide due to infrastructure gaps. Therefore, infrastructure is the key determinant for inclusive and stable growth in South Asia.

In the last three decades public and private sector investments have significantly contributed toward infrastructure provision and availability. For instance, infrastructure investment increased from 4.7 per cent to 6.9 per cent of gross domestic product from 1973 to 2009 for South Asia. This increase, though, fluctuated but still managed to register a 47 percent increase. The infrastructure investment was dominated by investments in electricity and transport-related provisions. Consequently, private sector investment crowded in and rose upto 2.34 percent of gross domestic product during 2007-2012 for South Asia. Private sector infrastructure investments were again concentrated in the energy sector, indicating the crowding in effect of public investment as well as commercial and non-commercial energy demand in the South Asian region. The improvement in infrastructure can be explained in two ways. One is the increase in gross

value added in real terms and business activities. The second is per capita availability in terms of railways, roads, electricity, houses, commercial and noncommercial buildings, basic amenities and many more. Production, productivity and living standards are broadly accelerating across countries and within. Because of the limited capacity of investment financing in these countries, international SDG funding has gained significance for the region. Given the marginal improvements in SDG indicators in South Asia, international funding agencies are increasing their investment commitments. South Asia needs an additional 11.3 percent of GDP as an investment in infrastructure to move successfully towards the SDG Agenda 2030. The empirical literature survey on the relationship between infrastructure growth and development can be categorized into four different but interrelated dimensions.

Theoretical Framework for infrastructure as exogenous and endogenous factor:

The provision of infrastructure is regarded critical for development by policymakers as well as academics. There available literature can be classified into three groups. First, the stock of physical infrastructure is explained as the major determinant for growth and productivity. Second, the stock of gross fixed capital formation is considered more significant and a proxy for the stock of physical infrastructure. Third where annual

flows of investment and government capital expenditure is taken as the major determinant for infrastructure. The endogenous growth theory framework is used to explain the relationship between infrastructure and growth (Canning & Pedroni, 2004) (Straub, 2008) (Calderón & Servén, 2014). The simple model is explained as $g_i = \alpha y_i + \beta K_i + Z_i \gamma + v_i$, where g is the per capita real GDP growth of country i , K is the infrastructure stock or investment, Z is the vector of covariates or other explanatory variables and v is the random error term (Straub, 2008). The model used in the other two studies is $Y_t = A_t + K_t \alpha + G_t \beta + L_t (1 - \alpha - \beta)$ where K is the infrastructure capital stock and G is the non-infrastructure capital stock. The researchers have established the long-term significant growth effect but with a reduced welfare effect and less significant short-term effects. In the empirical estimations, all studies have used a large panel data set with 20-30 years of timeframe. It also includes regressors for controlling the infrastructure quantity and quality. GMM estimators are used to account for the endogeneity. The two important results from the studies include a robust impact of stock of infrastructure assets on growth along with a reduction in inequality. extended Barro's Model has been extended to include public and private capital. For infrastructure investment, current consumption is sacrificed for future consumption because public investment takes time to become productive. Moreover, infrastructure development

needs both capital and repetitive (current) expenditure, for instance, to build and maintain roads respectively (Tsoukis & Miller, 2003) (Ghosh & Mourmouras, 2004). The above framework has been examined by considering the stock of public capital and the flow of non-investment spending simultaneously. The previous results prevail; the growth maximization level of public investment is greater than the welfare maximizing level of capital expenditure. Stock of infrastructure assets as well as flow of infrastructure expenditure have been alternatively used in the models. It has been established that availability of infrastructure is more closely related to the stock of assets rather than flow of infrastructure related expenditure. For instance, the stock of public highways has a more pronounced relation to road transport (availability of transport infrastructure) in contrast to the effect of annual spending on road construction. Multiple approaches have been employed to assess the impact like cross- country and time-series regression using macroeconomic data to micro-level studies analyzing the effect of infrastructure provision on incomes of the poor of the rural areas. Meta analysis of 123 meta-observations, have been conducted to examine the robustness of the evidence regarding the impact of fiscal policy on growth (Nijkamp & Poot, 2003). Five fiscal policy areas are considered: general government consumption, tax rates, education expenditure, defence, and public infrastructure. Several

meta-analytical techniques are applied, including descriptive statistics, contingency table analysis and rough set analysis. On balance, the evidence for a positive impact of conventional fiscal policy on growth is rather weak, but the commonly identified importance of education and infrastructure is confirmed. These mentioned studies provide an extensive literature review of the available empirical estimations in different settings. Further, use an ordered probit model have been performed for investigating changes in the probability of finding negative, positive, and insignificant impacts (Elburz et al., 2016). The total data base consists of 912 observations from 42 studies conducted between 1995 and 2014. The meta-analytical results show that study characteristics do matter for the magnitude and sign of the variables concerned. The study finds that type of infrastructure, research methodology, time span, type of infrastructure measure, and geographical scale affect the outcomes of the primary studies. Studies that take into account interregional, interstate and interprovincial relations have a higher chance of finding negative effects, which gives an idea about the spillover effects of these investments. In contrast, some characteristics like output measure and selection of a particular sector appear to have no effect on obtaining positive, negative or insignificant outcomes. The findings of this study offer new insights to policy makers on the variation in empirical results regarding the relationship

between public investment infrastructure and regional growth.

Infrastructure, government expenditure and inequality:

There have been attempts to assess the impact of public investment on inequality. Income inequality proves to be an obstruction in growth, and enhanced provision of productive public services contributes to growth. If these services are provisioned in a heterogenous fashion across individual households then it influences the income distribution further, impacting growth positively indirectly. Due to lesser access to private alternatives, provision of public infrastructure is more advantageous to the poor. Private sector participation in infrastructure not only impacts employment status, but also affects public revenues and expenditures. It tends to abolish the subsidies provided to infrastructure services and generation of revenues. Thereafter, the impact on inequality depends on management of increased fiscal resources. If the enhanced fiscal space is utilized in bringing about an improvement in the efficiency and coverage of public service provision, be it infrastructure or non-infrastructure then income inequality might decline. It has also been argued that elimination of subsidies on infrastructure utilisation might lead to higher prices with the increased participation of the private sector, these providers may charge higher connection fees than public providers, and they may even be sceptical about functioning in poorer

areas (Estache et al., 2002). Therefore, handing over infrastructure services to private sector makes it unaffordable to lower income groups. Although such an outcome depends on the complete design of the reforms and private participation might also lead to enhanced access by the poor (Calderon & Servén, 2014). According to an estimate by World Economic Forum, about 14% of GDP is invested in infrastructure, even then with rising world population, increased pace of urbanization and development and emergence of outdated infrastructure, this level of investment is not enough (WEF, 2020) (WEF, 2022). This rate of investment is going to exacerbate the gap between projected infrastructure spending and the actual amount of investment required to suffice the infrastructure needs of the world. The estimated gap would be reaching the figures of \$15 trillion by 2040.

Infrastructure investments generate either positive or negative externalities or even both and it depends on the affected party. This makes exclusion of the non-payers difficult. Not only this, the determination of a single price which showcases the economic effects of the service provided becomes tough. Also, there is difficulty in collection of payments that are proportional to the usage of services. These features prove that infrastructure services have properties of public goods and therefore these are required to be provided by the public sector. These services turn out to be advantageous to the poor and therefore generates positive externalities and strengthens the role of

public sector. These externalities and the poverty of consumers of the service make operative user fees a distant dream. This necessitates the involvement of public sector, but poor countries lack infrastructure revenue raising capacity and are characterized with less developed financial markets. The public infrastructure policy cannot be assigned a decisive role due to network effects and coverage characteristics. The feature atypical of infrastructure projects such as scale and long-time horizon also point towards involvement of public sector. These features highlight the concerns in financing infrastructure investments and the crucial role of development of well-functioning financial market to support infrastructure investment. Specifically, bond market with long-term bonds in local currency tend to facilitate international financial intermediation by easing risks involved in foreign exchange. Restrained public sector budget outline the importance of crowding in the private sector. This is easier in infrastructure sectors such as telecommunication than in others. Infrastructure is associated with market failures. The construction and operation of infrastructure facilities is associated with significant economies of scale. Larger infrastructure facilities are cheaper on a per unit of output basis than the analogous smaller infrastructural facilities. Also, infrastructure facilities are capital intensive as a massive amount of investment as compared to their annual output and/or to the amount of labour needed for their operation. This capital

intensity generally is responsible for the economies of scale of such facilities. The provision of infrastructure once made, lasts for generations, although this very feature is possessed by several residential and commercial facilities as well. These services tend to serve broad public goals. In some cases, these services are purely public goods and as such are characterized with positive externalities. Therefore, increased number of individuals can be benefitted at a very low or even no additional resource cost. This availing of services by greater number of individuals doesn't contribute to reduction in the benefit expropriated by others. It is not even possible to exclude anyone from availing the benefit of these services (Walter, 2016).

Recent Literature on Infrastructure gaps, efficiency and financing:

The effects of infrastructure development on growth and income distribution has been the recent focus in theoretical literature (Straub, 2008) (Claderon and Servén, 2014). The theoretical literature has employed a variety of analytical settings regarding the drivers of income growth, the degree to which infrastructure represents a public or a private good, and the extent of market distortions, notably in capital markets. In turn, the empirical literature has used various econometric methodologies on time-series and cross-section macro and microeconomic data to test for the effects of infrastructure development.

However, these empirical tests face challenging issues of measurement, identification, and heterogeneity. Overall, the literature finds positive effects of infrastructure development on income growth and, more tentatively, on distributive equity. Still, the precise mechanisms through which these effects accrue, and their full impact on welfare, remain relatively unexplored. The positive and negative effects of infrastructure and the interdependencies between infrastructure sectors is another important aspect of investigation (Thacker et.al., 2019). Because infrastructure either directly or indirectly influences the attainment of all of the Sustainable Development Goals (SDGs), including 72% of the targets, policymakers need to establish long-term visions for sustainable national infrastructure systems, informed by the SDGs. Investment in infrastructure is at an all-time high globally, thus an ever-increasing number of decisions are being made now that will lock-in patterns of development for future generations. Although for the developing countries these investments are motivated by the desire to increase economic productivity and employment (IMF, 2020). More importantly, efficiency and productivity impact of public investment on growth conditional upon the infrastructure governance has been emphasized by several authors. Even if the level of public spending is similar, the availability of physical

infrastructure differs because of the efficiency differences of per unit expenditures. Further, with the accumulation of physical infrastructure productivity outcomes can differ because of the quality.

Empirical studies investigating the impact of public expenditure on infrastructure, its adequacy and efficiency is extremely sparse, mainly due to the lack of information on patterns of infrastructure expenditures (Foster et.al., 2023). Using the World Bank's BOOST database (it only includes Afghanistan from South Asia), this study attempts to disaggregate infrastructure spending trends and patterns for a large sample of more than 70 developing countries covering 2010-18. It further explores expenditure by sector for roads as well as electricity, into two categories of operating and capital expenditure. The study finds that on-budget expenditure on infrastructure has been low both in absolute and relative terms, as well as declining over time. There is evidence that low-income countries, despite lower spending envelopes, attach greater priority to public investment and infrastructure spending than their middle-income counterparts. Econometric analysis suggests that infrastructure spending in low- and middle- income countries has been historically procyclical, although to a lesser degree than total expenditure. In the transport sector, road funds are shown to play a substantial role in funding road maintenance, appearing to improve the adequacy of funding, while attenuating pronounced capital

biases in road sector spending, but there is little evidence of efficiency improvement over time.

Developing Countries, Asia and Infrastructure Gaps:

A survey of studies on the economics of infrastructure in developing countries highlight huge gaps and investment shortfalls (Stone, 2008). Energy, transport, telecommunications, water and sanitation are considered. The survey covers two main set of issues: the linkages between infrastructure and economic growth (at the economy-wide, regional and sectoral level) and the composition, sequencing and efficiency of alternative infrastructure investments, including the arbitrage between new investments and maintenance expenditures; OPEX and CAPEX, and public versus private investment. Infrastructure provision has been shown to aid in reducing time, improving productivity, reducing inequality and poverty and improving employment prospects. The developing region is characterized with low level growth, dense population, poor performance in education and health parameters. Therefore, to tap the potential of this region there is a requirement to give an impetus for infrastructure investment. The demand of infrastructure is expected to get spurred in this region as majority of the population resides in rural areas, and with passage of time there will be urbanization which in turn would be highlighting the requirement of

increased public expenditure on infrastructure. Infrastructure is significantly related to per capita GDP. The divergence in quality and availability of infrastructure among different countries is responsible for their different levels of productivity. Lack of infrastructure causes productivity inefficiency. It is evident from several instances, as improper facilitation of transport and telecommunication hamper access to markets and interactions with clients thereby increasing input costs, similarly unavailability of proper electricity networks makes investments subject to volatility of voltage and frequent power-cuts, which further force manufacturers to invest in support system like power-generators. Therefore, to tap the potential of this region there is a requirement to give an impetus of infrastructure investment (Straub and Akiko, 2011). The efficacy of transport infrastructure in facilitating economic prosperity stems from Adam Smith's Wealth of Nations. The development of infrastructure enables in easier access of productive opportunities to poor and raises the value of their assets. Their human capital can also be enhanced by improving their health and education parameters with the help of infrastructure provision. Overall, it plays a key role in integration of individuals and households into social and economic life, through the access to infrastructure services like electricity, roads, safe water, and sanitation (World Bank, 2012) (ADB, 2009) (ADB, 2017). Infrastructure

development utilized a high share of the fiscal stimulus granted during global crisis of 2007-08, the developing and emerging economies deployed 40% of the stimulus to infrastructure spending, while advanced economies deployed 21% of the package to infrastructure (TEIUL, 2021). During the Covid-19 pandemic, the fiscal stimulus was initially diverted more towards health but gradually shifted back to energy and digitalisation.

South Asian Region faces significant challenges, including uneven economic growth, slow urbanization, rapid population expansion, and severe infrastructure gaps (Biller et al., 2013) (Andrés, et al, 2014) (Biller et al., 2014). Despite high economic growth rates, the region lags in urban development, with many South Asian countries ranking poorly in living standards. Addressing the infrastructure deficit in South Asia requires substantial investments, ranging from 6.6% to 9.9% of the GDP of 2010 annually. However, given limited financial resources, countries in the region must prioritize whether to focus on immediate needs or medium-term goals. They can seek external assistance and consider restructuring their current infrastructure approaches. Assessing the infrastructure deficit involves evaluating the quality and efficiency of existing infrastructure, determining access rates, and establishing targets in line with sustainable development goals. Infrastructure demand is dynamic and varies across South Asian and East

Pacific regions. Access to infrastructure exhibits significant disparities, with some South Asian nations performing well in certain sectors while others lag. Even within countries, there are discrepancies in infrastructure provision among districts. Prioritizing infrastructure investments is crucial, given the limited funding sources. These investments can be categorized as public, private, or public-private partnerships (PPPs). Infrastructure investment in South Asia has varied over time, with fluctuations in sectors like electricity and more stable investments in transport, water, sanitation, and irrigation. India plays a dominant role in infrastructure investment in the region, particularly in the energy sector. Energy, telecom, and transport sectors have attracted substantial private and foreign investment. A set of panel regressions for South Asia reveal that tax financing, concessional lending, or private sector financing through public private partnerships (PPPs) are more advantageous than government borrowing through financial markets because they support growth while containing the impact on public debt (Bizimina et.al., 2021). South Asia needs large infrastructure investments to achieve its development goals, and public investment can also support the Covid-19 recovery. At the same time quantity and quality of investment both needs careful management. Infrastructure investment has a strong (at least 1.5 times greater) multiplier impact on economic growth (Andres, et al 2014). Infrastructure investment can

play a key role in supporting economic recovery and stability, however simply investing in infrastructure is insufficient. It needs to be the right kind of infrastructure that has transformative outcomes for the people and the planet (GI Hub, 2020). The recent literature and empirical estimations on infrastructure impact and financing with reference to the SDG goals confirms the positive relationship between the two (Filho et al., 2020) (Filho, et al, 2022). These studies highlight the need to study the region-specific impact of infrastructure investment impact on SDG goals progress in order to assess the future financing needs.

The brief literature review reveals that despite the advocacy of higher public investment for sustainable development goals, there are a smaller number of studies exploring the effect of

fixed investment and government capital expenditure flows on the SDG scores. Moreover, the studies analyzing South Asia have focused more on the poverty and income inequality challenges as compared to infrastructure gaps and infrastructure financing. This paper aims to investigate the impact of gross fixed capital formation (as a proxy of infrastructure investment) on SDG scores for eight South Asian countries. To analyze the impact, the paper first presents a discussion on infrastructure gaps in south Asia and the disparities in terms of selected development indicators. This paper hypothesizes a

positive relationship impact of public investment (gross fixed capital formation and government capital expenditures as proxies for infrastructure investment) on SDG scores for South Asian countries. Further this results in a positive impact of GDP growth and per capita GDP growth on SDG scores. This paper would be an important contribution to the scarce literature available on infrastructure and sustainable development financing gaps in South Asia. Firstly, it presents a status of infrastructure gaps measured through eight important parameters of infrastructure which affect the sustainable development goals excluding climate change and environmental damage. Secondly, It estimates the impact of fixed capital formation and GDP growth on SDG scores for South Asia.

RESEARCH METHODS:

The variables selected for the paper are for two purposes. One, to analyze the development gaps and infrastructure gaps in eight south Asian countries. Second, to estimate the impact of capital formation and GDP growth on sustainable development scores during 2000-2022. Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. The development gaps are analyzed through three indices, viz, human development index, multidimensional poverty index and sustainable development index. For the first two indices' values have been used while for the third index, composite scores are used. The Human

development index (HDI) is a geometric mean-based summary measure of achievement in three major dimensions of human development, viz, per capita gross national income, life expectancy and mean years of schooling. Multidimensional Poverty index (MPI) is related to measurement of deprivations across 12 major indicators based on poverty, education, health and basic amenities. In case of HDI higher values (closer to 1.00) reflect higher level of human development, while in case of MPI lower values (closer to 0.0000) reflects lower poverty. The sustainable development index scores range between 0-100, higher score indicating higher development. The countries included in the SDG ranking are 193 UN member countries. Rankings and scores are inversely related for SDGs. These indicators capture various aspects of development and governance and reveal the standard of living for the countries along with the GDP per capita. Per capita GDP has been taken in current dollars to understand the effect of absolute income differences, while GDP at purchasing power parity reveal relative income differences. Moreover, per capita GDP growth and GDP growth are the two variables that help to understand the responsiveness of economic growth towards development status and living standards in the selected countries.

The infrastructure gaps have been explained by using eight indicators capturing the economic, social,

financial, and digital infrastructure gaps. Gross Fixed capital formation has been used as a proxy for infrastructure investment. This is due to insufficient infrastructure investment data for selected South Asian countries. Bank credit for infrastructure-related activities is also chosen to understand private sector investment. The share of urban population and GDP growth are the two major demand side variables for infrastructure. The major data source is the World Bank open data bank. Energy use per person in kilowatt/hour and Paved Roads (Density) Km/1002 km are representations of economic infrastructure. Safely managed Sanitation, Safely managed Drinking water, and Hospital beds per lakh population is taken as the representation of social infrastructure. Commercial Bank Branches per one lakh adults and the number of ATMs per lakh population are the representation of financial infrastructure. Lastly mobile density per 100 persons and the percentage of the population accessing Internet usage are the representation for digital infrastructure. The relationship between SDG scores (SDG) as a dependent variable and selected independent variables has been estimated by using the Panel regression approach. The independent variables are real GDP growth (GDPGR), per capita GDP growth (PCGDPGR), government capital expenditure (GCapex), gross fixed capital formation (LnGFCF) in constant \$, rate of urbanisation (Urban) gross fixed

capital formation as percent of GDP (GFCF/GDP) and Tax revenue as percent of GDP (Tax/GDP). log values of the variables are taken for the estimations. All the selected independent variables are found to be stationary at the first difference. The following Panel regression has been estimated in the paper:

$$\text{SDG Score}_{it} = \text{GDPGR}_{it} + \text{PCGDPGR}_{it} + \text{GCapex}_{it} + \text{GFCF}_{it} + \text{Urban}_{it} + \text{GFCF/GDP}_{it} + \text{Tax/GDP}_{it} + e_{it}.$$

e represents the error term. 'i' indicates the country and t indicates the time.

RESULTS:

South Asia is one of the regions with huge development gaps and the highest infrastructure gaps (UNESCAP, 2019) (TEIUL, 2019) (Asadullah et al., 2020). Moreover, rapid urbanization and migration have created a lot of pressure on the existing infrastructure leading to a decline in the quality of available infrastructure. In the last three decades, absolute poverty has been declining, and per capita income is rising along with per capita consumption across major categories, such as food, non-food, and services. However, development gaps in South Asia are visible through the rankings of the Human Development Index (HDI), Multi-dimensional Poverty Index (MPI) and Sustainable Development Goals (SDG) rankings. Two important observations in the case of South Asian countries are noteworthy. First, there is a similar pattern of human development index values and GDP growth. Second,

the increasing disparities in terms of gross fixed capital formation (the primary proxy variable for Infrastructure investment) and multidimensional poverty. The empirical evidence is increasingly indicating dissatisfactory quality and efficiency in the expanding infrastructure provisions in South Asia (UNESCAP, 2023). Figure 1 shows the growth in real GDP and gross fixed capital formation. Both values are expressed at constant prices. The growth rates are shown on the left Y axis. The right y axis presents the gross fixed capital formation as ratio to gross domestic product. In 2007 this ratio reached the highest level of 33.7 percent and gradually declined to 26.52 in 2019. Movements in gross fixed capital formation have been more volatile compared to GDP growth. The GDP growth ranged between two to 7 percent whereas gross fixed capital formation varied between -13 percent to 25.81 percent but largely they are positively correlated. Volatile fixed investment, as a proxy for infrastructure investment, has its implications for larger infrastructure gaps in South Asia (Andres et al, 2014b).

Table-1 & 2 exhibits the pattern of development and infrastructure gaps in South Asia. Sri Lanka and Maldives have achieved the human Development index value higher than the Asia average. Maldives due to the higher income levels and Sri Lanka due to higher levels of educational attainments and life expectancy rates. Then Bhutan, Bangladesh, India, and Nepal remain

below the Asia average with wide inter-country and intra-country differences. Maldives in South Asia is an exceptional case with low development gaps and low infrastructure gaps because tourism is the engine of growth creating all positive externalities for development and infrastructure. However, in the last 10 years, the country has had a higher burden of child mortality, malnutrition, debt liabilities, inflation, and corruption. Sri Lanka is the second country in the South Asian region with the lowest levels of deprivation and development gaps again mainly due to the second highest per capita income levels. Since the onset of the COVID-19 pandemic crisis, Nepal, India, and Sri Lanka have experienced a gradual increase in multidimensional poverty mainly because of increasing malnutrition, and decreasing availability of housing, water, sanitation and cooking fuel. For these three countries, macroeconomic stability challenges act as a compromising factor for the development agenda. The biggest challenge for Bhutan and Bangladesh in terms of multidimensional poverty is the years of schooling and housing. Pakistan and Afghanistan have the highest poverty in terms of malnutrition, schooling, and housing. however, there is an emphasis on the shift in poverty gravity center from South Asia to Africa, but the challenges have increased (Luo and Xu, 2018) (Kumar, 2019) (Cheraghlou et al, 2024). The need for a resilient and sustainable poverty reduction is

propagated because of the growth shocks as well as intra-country risks

Table1
Development gaps in South Asia

Countries/ Regions	HDI in 2021	Population Density per sq km	GDP per capita in current \$	Per capita GDP in PPP \$	Per capita GDP in PPP \$	Per capita GDP growth
Afghanistan	0.478	0.272 63.06	390	1673.96	-22.9	na
Bangladesh	0.661	0.101 1315.1	2820	6958.82	6.0	7.19
Bhutan	0.666	-- 20.52	3040	12036.36	3.4	4.08
India	0.633	0.069 476.65	2380	7873.53	6.3	7.00
Maldives	0.747	0.003 1745.99	11030	22739.18	11.8	41.75
Nepal	0.602	0.074 213.1	1340	4488.71	3.8	5.61
Pakistan	0.544	0.198 305.92	1580	6105.31	4.2	6.19
Sri Lanka	0.782	0.011 352.93	3610	11405.42	-7.9	-7.82
Asia	0.749	0.091 150.30	9952.2	18818.8	3.1	na

	Mobile density per 100	Energy use per person kw/hour	Safely managed Sanitatio n	Safely manage d Drinkin g water	Paved Roads (Density) Km/100 ² km	Banks Branch per 1lakh adults	Hospit al Beds per 10000	Internet usage
AFG	57	677	56	30	51 (5)	1.9	3.9	na
BANG	105	2912	59 (31)	59	30 (250)	9	7.95	6.10
BHT	95	27785	78 (51)	73	62	20.9	17.4	0.41
IND	81	7143	78 (51)	na	67 (204)	14.6	5.3	1.66
MALD	137	17669	100	na	na	13.8	na	11.78
NPL	127	1608	80 (52)	16	31 (54)	22.3	3	4.35
PAK	82	4243	71	51	70 (30)	10.4	6.3	1.14
SLK	143	4348	95	47	15 (174)	17.4	41.5	8.31
South Asia	83.82	565.32	75.46	93.08	na	14.58	0.58	2.75
East Asia	129.81	2124.82	93.53	96.54	na	9.65	4.51	31.75
World	108.02	1905.85	80.6	91.14	na	11.18	2.88	18.42

Table: 3 Panel Regression Results for SDG Score determinants in South Asia

Independent Variables	Coefficient	Std. Error	t-stats
C	3.440978*	0.109912	31.30666
GDPGR	-0.066746**	0.035798	-1.864493
PCGDPGR	0.062055*	0.023243	2.669819
GCapex	0.055812*	0.020360	2.741336
Ln GFCF	-0.062402*	0.019747	-3.160024
Urban	0.172599*	0.030120	5.730447
GFCF/GDP	-0.044444	0.029816	-1.490597
Tax/GDP	0.219189*	0.022225	9.862074
Adjusted R ²	0.700308		
No. of observations	100		
Log likelihood	133.9343		
F-statistic	26.70431		
Prob(F-statistic)	0.000000		
Durbin Watson stat	3.223064		

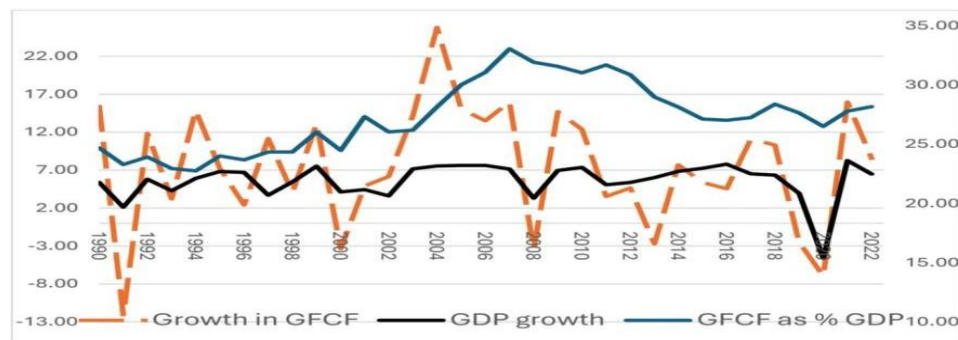


Figure-1: Fixed Capital Formation and GDP Growth in South Asia

Figure 1: Fixed Capital Formation and GDP Growth in South Asia

Table-3 presents the results of the panel regression. The relationship between SDG scores as a dependent variable and

selected independent variables has been estimated by using the Panel regression approach. The independent variables

are GDP growth, per capita GDP growth, government capital expenditure (capex), gross fixed capital formation in constant \$, rate of urbanisation gross fixed capital formation as percent of GDP and Tax revenue as percent of GDP. All the selected independent variables are found to be stationary at the first difference. The Variance Inflation Factor test shows that all independent variables have a value lesser than 1 ($VIF < 1$) that is no multicollinearity. The model is significant and provides robust results. The Hausman Test indicates that the random effect model is significant. In contrast to the hypothesis, we find a significant negative impact of GDP growth and fixed capital formation on SDG scores in South Asia. The probable reason of this negative impact is the instability in growth and stagnant gross fixed capital formation. One of the positive and significant relationship emerged in the model is between government capital expenditures and SDG scores. In the South Asian countries more than 50 percent of the infrastructure financing as well as SDG financing is done by the Government. Similarly, tax revenues show a significant and positive impact on SDG scores indicating the need for larger fiscal reforms in these countries on the revenue side.

DISCUSSION:

South Asia is one of the regions with huge development gaps and the highest infrastructure gaps (UNESCAP, 2019) (TEIUL, 2019) (Asadullah et al., 2020).

Moreover, rapid urbanization and migration have created a lot of pressure on the existing infrastructure leading to a decline in the quality of available infrastructure. In the last three decades, absolute poverty has been declining, and per capita income is rising along with per capita consumption across major categories, such as food, non-food, and services. However, development gaps in South Asia are visible through the rankings of the Human Development Index (HDI), Multi-dimensional Poverty Index (MPI) and Sustainable Development Goals (SDG) rankings. Two important observations in the case of South Asian countries are noteworthy. First, there is a similar pattern

of human development index values and GDP growth. Second, the increasing disparities in terms of gross fixed capital formation (the primary proxy variable for Infrastructure investment) and multidimensional poverty. The empirical evidence is increasingly indicating dissatisfactory quality and efficiency in the expanding infrastructure provisions in South Asia (UNESCAP, 2023).

Infrastructure financing or investment gap has increased from 2.5 trillion USD to 4.5 trillion USD per year since 2014 estimates. The growing infrastructure and its financing gap are also explained as a “global capital flows paradox” (Summers, 2006) (Sungsup & Zhigang, 2018). This paradox has two dimensions, the first related to domestic capital outflows given low returns on

foreign exchange reserves and second related to shrinking fiscal space. Mobilisation of domestic savings into infrastructure investment is still very rigid in Asian countries and at the same time capital market imperfections depressed the return for foreign capital or foreign currency accumulation. Though in the recent years, there has been larger flows of international development fundings for projects related to water, electricity, roads, health and education but the inefficiencies and quality of infrastructure spending and infrastructure provisions is the biggest challenge for the South Asian countries.

Public expenditure on infrastructure is fundamental to crowd in private and foreign investment along with employment generation. Consistent public investment in infrastructure ensures significant social returns, accelerate productivity growth, and strengthen resilience to economic, social and environmental shocks. There have been various estimations regarding the infrastructure investment for SDGs. After the Covid-19 pandemic the required infrastructure investment has risen to \$4 trillion per year (around 4% of world GDP) from the previous estimate of \$ 2.5 trillion per year (UNCTAD, 2014) (UNCTAD, 2022). Further according to the International Renewable Energy Agency \$5.7 trillion (6% of global GDP) of investments are required at the global level by 2030, to control the greenhouse gases effect. Empirical research finding establish that aggregate investment and

development spending on health, education, sustainable infrastructure, agriculture, food and land use practices, and biodiversity would need to increase from 11.3 per cent of GDP in 2019 to 15.1 per cent in 2025 and 18.2 per cent in 2030 to reach the relevant SDGs. This amounts to additional spending of \$1.3 trillion by 2025 and \$3.5 trillion by 2030. While most new and additional investments are expected to come from the private sector, public funding would need to increase significantly from its current level to stimulate and crowd in private investment in the SDGs. Fiscal adjustments and expenditure cuts to fight inflation and improve debt sustainability could severely undermine the ability of developing countries to achieve the SDGs by 2030. The positive effects of public investment on long-term growth are particularly strong when there is a crowding in of private investment and when sectors with large infrastructure gaps and positive externalities, like education, digitalization and the green economy, are prioritized. Furthermore, in times of elevated uncertainty, strategic public investment plans may have even larger effects on output and private investment. By one estimate a total of US\$ 57 trillion is needed by 2030, or US\$

3.4 trillion per year, for infrastructure investment. Yet there is currently a finance gap to meet

this demand of US\$ 500 billion per year. Governments are therefore increasingly looking for mechanisms to close this gap, crowd-in private finance,

and improve efficiency and effectiveness of infrastructure projects. Innovative approaches to infrastructure finance and sustainable public procurement will be critical to their success.

According to the McKinsey Global Institute Report, during 2016 - 2030, the world needs to invest about 3.8 percent of GDP, or an average of \$3.3 trillion a year, in economic infrastructure just to support expected rates of growth. Emerging economies account for some

60 percent of that need. But if the current trajectory of underinvestment continues, the world will fall short by roughly 11 percent, or \$350 billion a year. The size of the gap triples if we consider the additional investment required to meet the new UN Sustainable Development Goals. The highest investment gaps are for water supply and energy in South Asia, dominated by India and Bangladesh. Infrastructure is a significant determinant for Asian economy's growth but at the same time consistent economic growth created enormous pressure on Asia's transport, energy, and communications infrastructure. Gradually, it becomes the biggest bottleneck for growth, competitiveness, and poverty reduction. Greater regional collaborations for developing seamless connectivity among Asian countries with environmentally sustainable and greener infrastructure development remains an unfinished task (ADB, 2009). Given South Asia's diversity in terms of size, income

levels, population, natural resources, and access to both regional and global markets yet common development challenges, sub-regional infrastructure programs can help improve the SDG progress. McKinsey Global Institute's analysis suggests that increasing infrastructure investment by 1% of GDP could create substantial employment opportunities. According to the Boston Consulting group, infrastructure is a powerful vector for social and economic development, and its industry accounts for 6% of the global GDP and workforce. Government investment in infrastructure has an annual multiplier effect of 0.4 to 2.2 times GDP. Infrastructure can help create at least 10,000 total jobs for every \$1 billion invested. With these numbers in mind, governments can support the infrastructure industry not just for its own sake, but also as part of the larger pandemic recovery effort. Stimulus packages could be transformational even beyond the immediate crisis; they could address long-term infrastructure challenges (Castagnino et al., 2020). McKinsey Global Institute also estimates that enhancing infrastructure productivity can reduce spending requirements by 40%. While governments continue to stimulate infrastructure investments, there continues to be a multi-trillion-dollar financing gap due to the lack of bankable projects. Particularly in Asia-Pacific, demand far outweighs supply. The private sector will likely play a crucial role in filling these gaps, and multilateral banks should work together

to help create a suitable enabling environment by working with governments to scale up operations, streamline procedures, and deepen capital markets. Public procurement is instrumental in creating demand for innovative and sustainable infrastructure provisions. Because the public expenditure to GDP (GE/GDP) ratio is a proxy for government demand for infrastructure. So, the countries with a higher ratio of GE/GDP will have a higher demand for infrastructure. Consequently, this government expenditure-led demand will incentivise the industries and the private sector to make the production pattern efficient, sustainable, and cost-effective for infrastructure utilisation. In this framework, public infrastructure provisions take place through a predominantly PPP model. Regarding the SDGs, it is not only the allocation of infrastructure investment but the quality and efficiency along with the governance of infrastructure which creates significant progress for countries with higher population density. Therefore, this paper argues for integrated infrastructure development projects in South Asia.

CONCLUSION:

To sum up the paper it is emphasized that, in contrast to the proposed hypothesis, GDP growth and fixed capital formation have a significant negative impact on SDG scores in South Asia. One percent increase in GDP growth results in -6.6 percent change in the SDG scores. On the contrary one percent increase in per

capita GDP growth has a significant 6.2 percent positive impact on SDG scores. One percent increase in government capital expenditure and tax GDP ratio results in significant positive increase of 5.58 and 21.9 percent respectively. Similarly, the urbanisation ratio is positively impacting the SDG scores. The probable reason of the negative impact is the instability in GDP growth and stagnant gross fixed capital formation.

On the contrary, in South Asian countries more than 50 percent of the infrastructure financing as well as SDG financing is done by the Government. Further, positive impact of tax revenues indicate the need for larger fiscal reforms in these countries on the revenue side. The growing infrastructure and its financing gap are also explained as a “global capital flows paradox” (Summers, 2006) (Sungsup & Zhigang, 2018). The World Bank’s definition of infrastructure includes utilities (gas and electricity, water supply, telecommunications, sewerage, and waste collection and disposal), public works (roads and major dam and canal works for irrigation and drainage), and other transport sectors (railways, ports, waterways, and airports). OECD includes public works in a country, state or region, including roads, utility lines, and public buildings. The broadest definition includes real estate, oil and gas, and mining. In the recent decade real estate is becoming the highest investment sector. As the definition of infrastructure is expanding

the need for investment is rising but with weakening impact of development outcomes

The South Asian region is characterized with low level growth, dense population, lagging performance in education and health parameters. The demand of infrastructure is expected to increase with urbanisation and GDP growth. Mobilisation of domestic savings into infrastructure investment is still very rigid in Asian countries and at the same time capital market imperfections depressed the return for foreign capital or foreign currency accumulation. Though in the recent years, there has been larger flows of international development fundings for projects related to water, electricity, roads, health and education but the inefficiencies and quality of infrastructure spending and infrastructure provisions is the biggest challenge for the South Asian countries. In South Asia, the highest investment gaps are for water supply, roads and energy, dominated by India and Bangladesh (Cheraghlou, 2024). Infrastructure is a significant determinant for Asian economy's growth but at the same time consistent economic growth created enormous pressure on Asia's transport, energy, and communications infrastructure. Lack of Infrastructure is the biggest bottleneck for growth, competitiveness, and poverty reduction for South Asian countries. Given the South Asia's diversity, in terms of size, income levels, population, natural resources, and access to both regional and global

markets yet common development challenges, sub-regional infrastructure programs can help improve the SDG progress.

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