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Scaling Up Quality Infrastructure Investment in South Asia

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Abstract

South Asia needs large infrastructure investments to achieve its development goals, and public investment can also support the Covid-19 recovery. Regression estimates that account for the quantity and quality of investment suggest that public infrastructure was a key driver of productivity growth in South Asia. Going forward, higher public infrastructure spending can raise growth, but its benefits depend on how it is financed and managed. Model simulations show 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. However, the optimal choice also depends on available fiscal space, taxation capacity, implementation risks, and public investment efficiency. To reap the most benefits from higher infrastructure investment, South Asian countries need to manage fiscal risks carefully, including from PPPs and state-owned enterprises, and improve public investment efficiency.

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A. Introduction

South Asia needs large investments in infrastructure to achieve its development goals, and public investment can provide support for the Covid-19 recovery. Public investment projects can be an important tool to promote employment and economic activity in the near term to support the recovery. Over the medium-term, public investment is essential to raise productivity, achieve the Sustainable Development Goals (SDGs), and build a resilient economy.

South Asia needs to scale up and improve the quality of its public infrastructure investment. Countries in the region have made important progress expanding their infrastructure network, including on utilities, transportation, telecommunications, and health. However, the quantity and quality of infrastructure remains below that of emerging market peers in Asia. Panel regression estimates suggest that infrastructure development has been a key driver of productivity growth in South Asia over the last decades. Going forward, growth could be significantly increased by upgrading both the quantity and quality of infrastructure.

Higher government spending on infrastructure can raise growth, but its benefits depend on how it is financed and managed. Covid-19 has exacerbated previous challenges to the financing of an infrastructure push as countries in the region are now facing higher debt to GDP, tax revenue shortfalls, and in some cases higher sovereign spreads. At the same time, there may be limits on the availability of concessional financing given the increased demand for resources worldwide because of Covid-19. Countries therefore need to look at the trade-offs and risks involved in the different financing options at hand including raising taxes, raising debt, or expanding reliance on private sector financing through public-private partnerships (PPPs). Model simulations using the IMF's Flexible System of Global Models (FSGM) applied to selected countries in the region show that tax financing, concessional lending, or PPP financing are more advantageous than government borrowing through financial markets because they support growth while containing the impact on public debt. While PPPs might seem more appealing than the other forms of financing infrastructure investment, implementation may entail additional costs. Therefore growth payoffs are feasible only if projects are well-designed and well-implemented to be highly efficient. Moreover, PPPs pose important fiscal risks. The simulation results also show that the optimal financing choice is country specific and depends on available fiscal space, taxation capacity, and the efficiency of the public sector investment.

To reap the most benefits from higher infrastructure investment, South Asian countries will need to manage fiscal risks carefully and improve public investment efficiency. A larger share of infrastructure projects in South Asia are implemented by state-owned enterprises (SOEs) than by general government entities, while PPPs remain limited. Although these alternatives for infrastructure provision (PPPs or SOEs) can provide

significant benefits, including greater efficiency of spending, they also entail significant risks that need to be addressed. In particular, countries need to take steps to accurately estimate and monitor associated fiscal costs and ensure transparency and accountability of PPP and SOE investment. In addition, countries in South Asia need to take action to increase the efficiency of public investment in order to get greater growth payoffs from additional public infrastructure spending. Improvements are needed in public investment management, and in particular in the practices of project appraisal and selection, maintenance funding, and multiyear budgeting.

The paper is organized as follows. Section B takes stock of infrastructure needs in South Asia by type of infrastructure, looking at both quantity and quality. Section C analyzes the trade-offs involved with different financing options. Section D looks at the role of public-private partnerships and state-owned enterprises in implementing infrastructure spending in South Asia, outlining measures to mitigate related risks. Section E underscores the role of public investment management in raising public investment efficiency, drawing on lessons from public investment management assessments (PIMAs) carried out in the region. Section F concludes.

B. Infrastructure Needs in South Asia

Infrastructure plays a vital role for sustained economic growth. Infrastructure investment can boost growth by raising productivity. Several studies have found significant total factor productivity effects of infrastructure in Asian economies (Nishimizu and Hulten 1978; Hsieh 1999; Hulten et al. 2006). The role of public investment is especially relevant in the current context of the Covid-19 shock. As countries develop their strategy for the recovery, public investment projects can be an important tool to support near-term employment and economic activity (IMF, 2020a; IMF, 2020b). Public investment has been found to have a higher fiscal multiplier than other type of spending, implying a stronger boost to aggregate demand (Abiad et al., 2016).

Countries in South Asia need more and higher-quality infrastructure to achieve their development goals. Accelerating sustainable infrastructure development is identified as a key priority area to achieve the Sustainable Developmental Goals, as countries in South Asia often lag in terms of basic infrastructure (UN Economic and Social Commission for Asia and the Pacific, 2017). Closing existing gaps in infrastructure has the potential to boost growth and alleviate poverty in the region (Andrés et al., 2013).

Countries in South Asia have made important progress expanding their infrastructure network, but have not yet matched peers in the rest of Asia in terms of both quantity and quality. Figure 2.1 illustrates that physical infrastructure quantity—such as electricity generation capacity, road connectivity, and internet access—has increased significantly in all countries in the region, and more than doubled in most cases. Figure 2.2 shows the

improvement across all countries in access to water and sanitation infrastructure, used as a proxy for health care infrastructure, which is at the center of countries' ability to deal with the Covid-19 outbreak. While starting from a rather low level, infrastructure in the region still falls short of the average among the emerging market (EM) and advanced economies (AE) in the region. Moreover, to get a more complete picture of the state of infrastructure in South Asia, it is important to also look at the quality of infrastructure. The indicators in Figures 2.1. and 2.2 suggest that infrastructure quality in South Asian countries is low compared to Asian EMs in most cases:

- *Electricity:* Despite the increase in the last two decades, electricity generation capacity in most South Asian countries remains low compared to regional peers, except for Bhutan where electricity is its main export. Supply of electricity is often unreliable due to chronic shortages (Singh et al., 2015), and this is considered as one of main constraints to potential growth (World Bank, 2018). The quality of electricity provision services, as proxied by the efficiency in transmission and distribution, is also somewhat lower in South Asian countries than Asian EMs.

- *Transportation:* Road connectivity, measured by the length of road per area, is poor in most South Asian countries, with the exception of India (which has one of the largest road networks in the world). The quality of roads, as measured by the share of paved roads, is relatively low and has deteriorated in some countries.

- *Telecommunication:* The penetration of telecommunication has been dramatic in the last two decades. Even with such an increase, however, internet access and data capacity in most South Asian countries are still low compared to regional peers.

- *Health:* Access to water, especially safely managed water, is not universal in several countries in South Asia. Even in countries that provide greater access to basic water, a much smaller share of the population has access to safely managed water that is free of pathogens and elevated levels of toxic substances.

The cross-country empirical analysis shows that both quantity and quality of infrastructure matter for growth. The growth benefit of improving infrastructure is empirically assessed based on a regression analysis using a panel of 80 countries for the period of 1990–2017. The analysis estimates an aggregate production function augmented with physical infrastructure variables, following the approach in Calderon and Servén (2004 and 2008).[2] The analysis extends the approach of Calderón and Servén by also taking into

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[2] The empirical analysis uses physical measures of infrastructure rather than monetary ones such as public expenditure. Public expenditure tends to be less accurate as it is affected by efficiency and government procurement practices and does not reflect the increasing private sector participation in infrastructure development. Further, the analysis focuses on power, transportation, and telecommunications as these factors

account the quality aspect of infrastructure, in addition to quantity (see Annex for details on the methodology).[3] The results confirm that infrastructure expansion in quantity makes a significant contribution to productivity growth (Table 2.1, columns 1 to 4). Moreover, for any given quantity, improving quality would also yield a significant additional boost to growth (Table 2.1, columns 5 to 8).

The regression analysis suggests that infrastructure development has been a driver of productivity growth in South Asia over the last decades. Based on the regression estimates in Table 2.1, productivity growth can be decomposed into its contributing factors to quantify the contribution of infrastructure expansion and quality improvement.[4] The decomposition shows that about one-third of productivity growth in the last two decades can be attributed to infrastructure development (Figure 2.3). The expansion in the quantity of infrastructure has been an important driver, especially the explosive penetration of the internet. Quality improvement also explains some of the productivity growth, in particular internet data capacity and the efficiency in electricity service provision.

Upgrading infrastructure quantity and quality would entail a large ramp up in spending and improvement in spending efficiency. Studies have found that the South Asia region would need to invest between 5 and 10 percent of GDP per year in order to reach the infrastructure level required to meet increasing demand and deliver healthy growth (Andrés et al., 2014; Asian Development Bank, 2017, Vu et al., 2020).[5] Given the large costs and its lumpy nature, the growth benefits will depend crucially on how additional infrastructure spending is financed and how it is managed.

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have been found to be among the most important for growth, and their data are more widely available. Health indicators are not included in the empirical analysis because of lack of adequate data availability.

[3] To capture the quantity and quality of infrastructure, aggregate synthetic indices are used rather than including individual measures of different types of infrastructure. Various estimation methods are considered, including the GMM estimation developed by Arellano and Bond (1991) to alleviate the endogeneity issue and bias stemming from the correlation between the lagged dependent variable and fixed effects in the error term.

[4] Note that better infrastructure would also enable faster industrialization, which the regression analysis revealed as another important contributing factor enabling a growth leap among lower-middle income economies.

[5] In the past, Andrés et al. (2014) estimated the investment needs between 6.6 and 9.9 percent of GDP per year for the period of 2011-20. More recently, ADB (2017) estimated infrastructure investment needs for South Asia at 7.6 percent of GDP for the period of 2016-2030 as a baseline, and up to 8.8 percent once accounting for climate mitigation and adaptation. Vu et al. (2020) found that the Asia Pacific region needs to invest about 5 percent of GDP to achieve SDGs, with large needs especially in road infrastructure.

**Figure 2.1. South Asia: Infrastructure Quantity and Quality: 1990-2015**

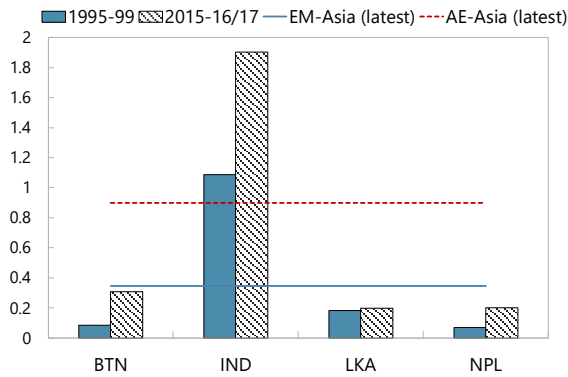**Electricity Generating Capacity**
(Megawatt per 1000 workers)

■ 1995-99 ▨ 2015-16 ── EM-Asia (latest) ---- AE-Asia (latest)
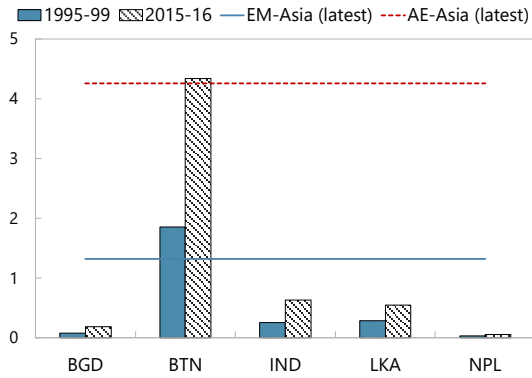
Electricity Provision Service Quality
(Electricity transmitted & distributed to consumers in % of total production)

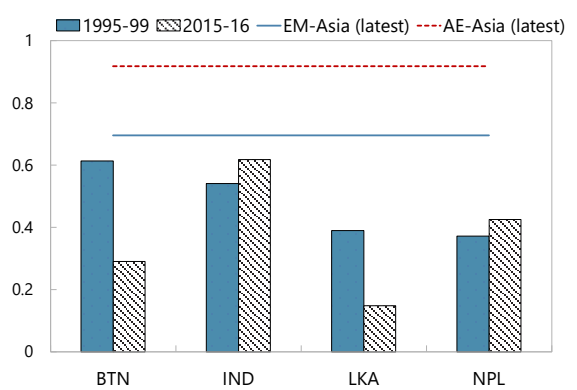■ 1995-99 ▨ 2010-14 1/ ── EM-Asia (2014) ---- AE-Asia (2014)

1/ Data for Bhutan and Nepal refers to 2018.
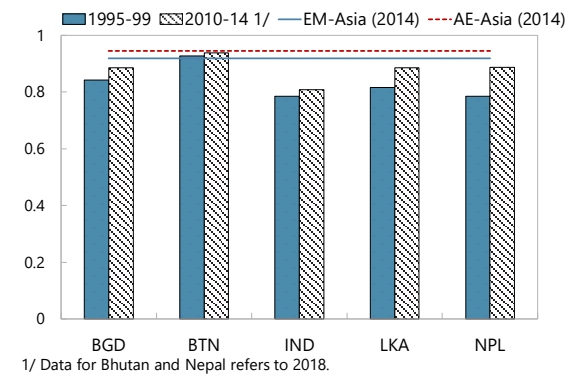
Road Length
(Kilometer per square kilometer of land area)

■ 1995-99 ▨ 2015-16/17 ── EM-Asia (latest) ---- AE-Asia (latest)

Road Quality
(Share of paved road to toal road length)

■ 1995-99 ▨ 2015-16 ── EM-Asia (latest) ---- AE-Asia (latest)

Internet Access
(Percent of households with internet access)

■ 1995-99 ▨ 2015-17 ── EM-Asia (latest) ---- AE-Asia (latest)
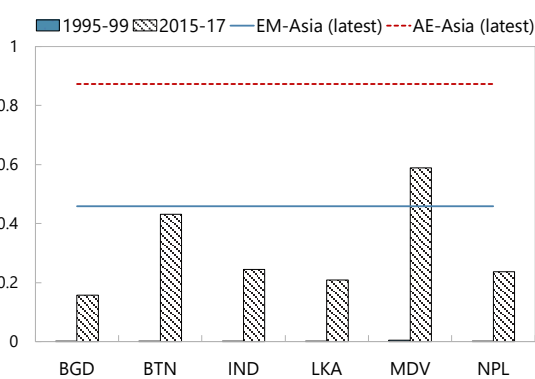
Internet Service Quality
(International internet bandwidth per user, bit/s, rescaled to 0-1)

■ 1995-99 ▨ 2015-17 ── EM-Asia (latest) ---- AE-Asia (latest)
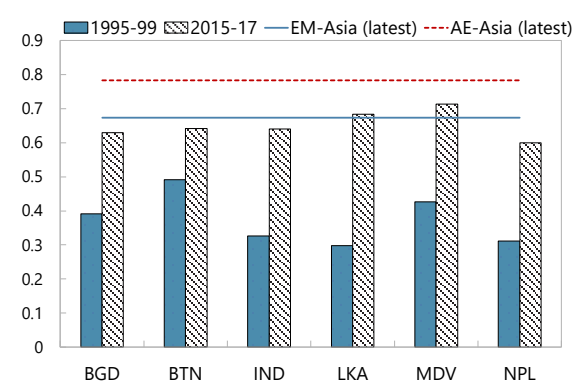
Sources: UN Energy Statistics, The World Bank, International Road Federation, International Telecommunication Union, Nepal Electricity Authority, and authors' calculations.

Note: EM-Asia refers to emerging market economies in Asia and AE-Asia refers to advanced economies in Asia, according to the IMF WEO categorization.

Figure 2.2. South Asia: Water and Sanitation Infrastructure: 2000-2017

Access to Water, At Least Basic
(Percent of population)

Access to Safely Managed Water
(Percent of population using improved water supplies)
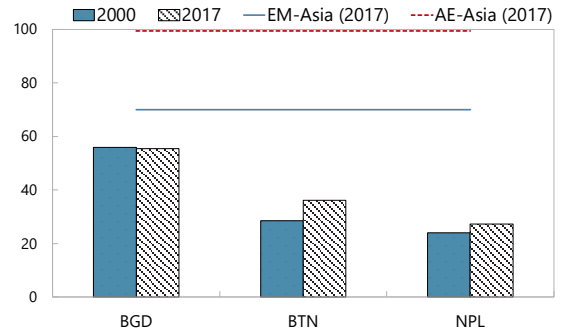
Sources: WHI and UNICEF Joint Monitoring Programme for Water Supply, Sanitation, and Hygiene, and author's calculations.

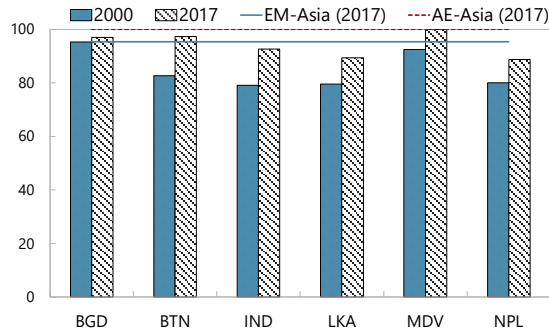**Figure 2.3. Contribution of Infrastructure Development to Productivity Growth**
(Between 1995-2000 and 2015-latest; Annualized average in percentage points)
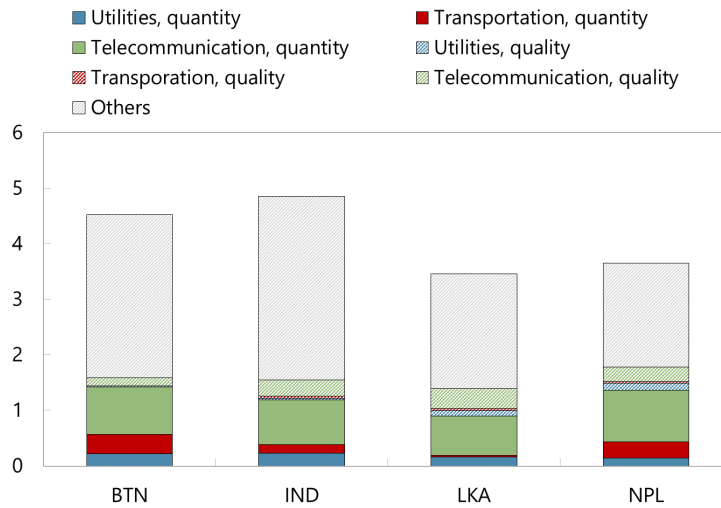
Source: Authors' estimates.

Notes: Calculation is based on the GMM regression estimates of productivity growth on infrastructure indices (Column 8, Table 2.1). The contribution of infrastructure quantity and quality indices is decomposed into three underlying infrastructure types based on their respective weights in constructing their first principal component.

Table 2.1. Infrastructure and Growth

Dependent variable: GDP per worker (log difference)	(1) Pooled OLS	(2) Panel with time effect	(3) Within estimator	(4) Difference GMM	(5) Pooled OLS	(6) Panel with time effect	(7) Within estimator	(8) Difference GMM
Lag. Output	-0.061***	-0.106***	-0.377***	-0.379***	-0.103***	-0.116***	-0.385***	-0.372***
	(0.010)	(0.015)	(0.033)	(0.077)	(0.012)	(0.016)	(0.051)	(0.122)
Education	0.043***	0.025	-0.023	-0.064	0.048***	0.046***	0.008	0.000
	(0.012)	(0.018)	(0.028)	(0.081)	(0.013)	(0.017)	(0.031)	(0.070)
Financial development	0.001	-0.013	-0.002	0.001	-0.000	-0.008	0.002	0.001
	(0.008)	(0.009)	(0.010)	(0.011)	(0.008)	(0.008)	(0.010)	(0.010)
Government burden	-0.024	-0.013	-0.054	0.007	-0.016	-0.013	-0.088*	-0.055
	(0.017)	(0.023)	(0.033)	(0.072)	(0.018)	(0.023)	(0.050)	(0.086)
Trade openness	-0.001	-0.009	-0.005	-0.017	-0.002	0.001	0.036	0.091
	(0.010)	(0.015)	(0.024)	(0.053)	(0.010)	(0.014)	(0.033)	(0.066)
Institutional quality	0.021	0.044	0.065	0.094	0.016	-0.037	-0.014	-0.061
	(0.046)	(0.055)	(0.069)	(0.165)	(0.056)	(0.064)	(0.093)	(0.196)
Inflation	0.003	-0.003	-0.007	-0.011	0.015	0.007	-0.000	0.025
	(0.008)	(0.008)	(0.009)	(0.019)	(0.009)	(0.010)	(0.012)	(0.020)
Modern sector share	-0.081	0.001	0.611***	0.271	0.389***	0.457***	0.696***	1.010**
	(0.067)	(0.083)	(0.181)	(0.522)	(0.100)	(0.125)	(0.223)	(0.446)
Terms of trade	0.013	0.010	-0.061***	-0.120**	0.005	0.015	-0.038	-0.048
	(0.022)	(0.021)	(0.022)	(0.051)	(0.027)	(0.023)	(0.026)	(0.046)
Terms of trade shocks	0.010	0.042	0.142*	0.190*	0.080	0.134	0.137	0.099
	(0.120)	(0.087)	(0.080)	(0.099)	(0.135)	(0.101)	(0.100)	(0.092)
Infrastructure Quantity	0.034***	0.068***	0.151***	0.216***	0.023**	0.042***	0.141***	0.155**
	(0.009)	(0.013)	(0.025)	(0.052)	(0.010)	(0.012)	(0.031)	(0.062)
Infrastructure Quality					0.023***	0.020**	0.031**	0.055**
					(0.007)	(0.008)	(0.013)	(0.025)
N. observations	367	367	367	270	249	249	249	161
N. countries		97	97	92		88	88	78
N. Instruments				54				47
Arellano-Bond test for AR(2)				0.10				0.27
Hansen test				0.24				0.42

Source: UN Energy Statistics, International Road Federation, and International Telecommunication Union, the World Bank, Barro and Lee (2013), International Country Risk Guide (ICRG) dataset, and IMF staff estimates

Note: Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, and * $p<0.1$. Country and period dummies and constants are not reported for brevity. Following the approach in in Calderon and Serven (2004), infrastructure quantity and quality refer to the synthesized aggregate indices constructed as the first principal component of the underlying physical measures of infrastructure quantity and quality of three types of utilities: electricity (generation capacity in Megawatt per 1000 workers and the share of electricity losses in transmission and distribution), road connectivity (length in Km per area and the share of paved roads), and telecommunication (the share of households with internet access and international internet bandwidth per user).

C. Trade-offs involved with different financing options

A big question is how to finance a ramp-up in public infrastructure spending. To improve the level and quality of infrastructure, and hence bolster potential growth, South Asian countries must decide between financing investment through increased taxation or debt, taking into consideration their macroeconomic effects. Given limited fiscal space to increase borrowing in many countries—which has been further eroded by the Covid-19 pandemic—as well as difficulties to mobilize revenues, consideration may also be given to greater use of private sector financing through public-private partnerships (PPPs).

Each of these financing options entails different trade-offs. In particular, countries need to ensure that the infrastructure investment push does not compromise fiscal sustainability that would jeopardize growth over the medium-term. This section analyzes the growth-debt trade-offs faced by South Asian countries using macro-model simulations for selected economies.

How to finance infrastructure investment

The macroeconomic effects of increasing public infrastructure investment in South Asia are evaluated using the IMF's Flexible System of Global Models (FSGM). [6] The FSGM is an annual, multi-region, general equilibrium model of the global economy combining both micro-founded and reduced formulations of various economic sectors. In the model, total consumption consists of both spending from households that can save and from those who can only consume out of current income (liquidity-constrained consumers). Firms produce goods and services using labor and their holdings of private capital. The government purchases final goods directly, including consumption and investment goods, and makes transfers to households, which it funds with various tax instruments. Monetary authorities set interest rates to achieve an inflation target in the medium term.

The FSGM is particularly well suited to analyze the macroeconomic effects of a government infrastructure push. Indeed, government investment, in addition to affecting aggregate demand directly, also cumulates into a public capital stock, raising the economy wide level of productivity. The accumulation of public investment into public capital varies from country to country, depending on the efficiency of public investment management. Moreover, the non-Ricardian dynamics of the model imply significant macroeconomic responses from fiscal policy both in the short term and long term. The simulations are

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[6] FSGM's theoretical structure and simulation properties are laid out in Andrle et al. (2015)

undertaken for four selected South Asian economies: India, Sri Lanka, Bangladesh, and the Maldives.[7]

The simulations assume a permanent increase in public investment of 1 percent of GDP phased in over five years, with varying financing options. Although the region has larger infrastructure needs (as indicated above), a 1 percent of GDP increase in public investment spending is used for simplicity and comparison across countries. Hence, the simulations show a conservative estimate of potential output gains.

The macroeconomic implications of an increase in public investment spending depend on how it is financed. The simulations explore four financing options:[8]

1. *Option 1: Tax financing through higher consumption tax.* The fiscal cost is financed by a budget-neutral reallocation of indirect tax revenue—equivalent to a VAT—towards public investment spending.[9] For this set of countries, a 1 percent of GDP increase in consumption tax would imply a hike in tax rate of about 1.4 to 1.7 percentage points.

2. *Option 2: Debt financing through financial markets.* The increase in public investment spending is fully financed by market borrowing.[10] As this would have adverse effects on borrowing costs, the simulations assume a rise in the risk premium by 3 basis points per unit increase in the ratio of public debt to GDP. While, for simplicity, the change in the risk premium in relation to debt increases is assumed to

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[7] This analysis uses the Asia and Pacific Department Model (APDMOD), a module of the Flexible System of Global Models (FSGM) which contains individual blocks for 15 Asian countries and 9 additional regions that represent the rest of the world.

[8] For simplicity, it is assumed that project costs are the same under the different options. Financing of infrastructure through state-owned enterprises (SOEs) is not modeled in this section because of inadequate cross-country data regarding SOE financial positions and efficiency levels.

[9] Given the potential scarring effects of the Covid-19 crisis, a consumption tax increase is preferred over direct taxes (both personal income tax and corporate income tax), as it has the least distortionary effects on capital and labor supply in the long term (see IMF, 2013 and the analysis for Emerging Asia in Vu et al., 2020). Model simulations, which are not presented in this paper for the sake of brevity, show that an increase in direct taxes (PIT and CIT) results in much smaller output gains than a VAT hike.

[10] In the FSGM, this financing option is implemented by adjustment of the fiscal deficit target to the additional discretionary spending. In Options 2 and 3, the fiscal balance is affected by the cycle, reflecting the effects of automatic stabilizers, while general lumpsum transfers adjust to cover the increased debt-service costs associated with a permanently higher deficit. In principle, any expenditure or fiscal instrument in FSGM can be used for automatic adjustment towards the deficit target. General lumpsum transfers are used because they have the least distortionary effects.

be the same for all countries, the impact on interest costs is larger for countries with an initial higher debt level.[11]

3. *Option 3: Debt financing through concessional loans*. The rise in public investment spending is fully financed by concessional loans that are extended on terms more generous than market loans. The simulations assume that the concessional loans are granted with below-market interest rates.[12]

4. *Option 4: Private sector financing through public-private partnerships (PPPs)*. The government and the private sector partner to build and operate public infrastructure. Private concessionaires build the infrastructure using private finance, and then operate the facilities, recouping their expenses through future income stream from concession, e.g. toll revenue or other user charges.[13] The simulations assume user-funded PPPs—where the users pay fees for using the infrastructure—that allow the private concessionaire to fully recover costs and the government has no direct payment obligations.[14] The simplifying assumption in the model is that PPPs will have similar costs to traditional public investment and that users will be willing to pay the fees to cover these costs. However, experience in this regard has varied from country to country, and project to project, and inefficiencies in implementation of PPPs can result in higher costs (see Section D).

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[11] The risk premium is exogenous in the FSGM and calibrated based on the increase in the debt-to-GDP ratio to better reflect the crowding-out effect of government debt. The assumption of 3 basis points (the same for all countries in the sample) is based on Kumar and Baldacci (2010), who find that appropriate risk premium elasticities would be in the range of 3-5 basis points for a panel of advanced and emerging market economies. The value of 3 basis points is somewhat conservative in light of the relatively high initial debt-to-GDP ratios in most of the selected economies, with the notable exception of Bangladesh. The model does not account for possible differences in risk premiums across countries arising from initial debt levels and market access. However, if countries with high initial debt stock were assumed to face a larger change in risk premium, the results would be qualitatively the same.
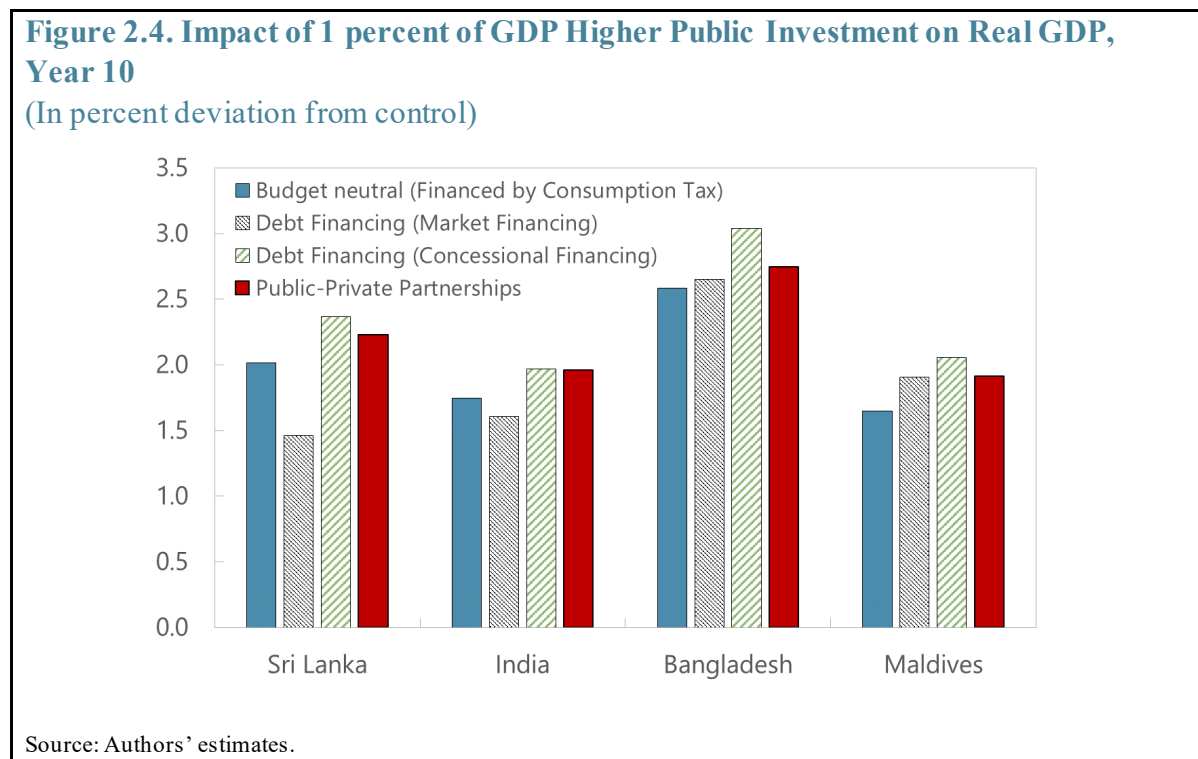
[12] In Option 3, the FSGM simulations are conducted under the assumption that the risk premium does not respond to the rise in the debt-to-GDP ratio.

[13] In the simulations, investment financed with PPPs funds is assumed to be equivalent to traditional government investment, and hence raises the infrastructure capital stock. In addition, user fees, which do not explicitly appear in the model, are accounted for as a reduction in targeted transfers to households, which are associated with lower multipliers than taxes.

[14] Rather than relying on user fees, the government could alternatively compensate the private concessionaire through availability payments (where the government pays for the services through predetermined payments over the term of the contract). In the model, availability payments would need to be financed with taxation or debt, and therefore the model results would be similar to options 1 or 2.

How scaling up infrastructure investment bolsters output

The increase in public investment lifts real GDP in the short run and long run in all selected countries across the four financing options. The magnitude of the output gains varies, however, depending on the financing options as well as each country's initial conditions, especially the level of government investment efficiency.[15] Figure 2.4 shows the simulation results of the effects of a ramp up in infrastructure spending on real GDP after ten years.[16]

Figure 2.4. Impact of 1 percent of GDP Higher Public Investment on Real GDP, Year 10
(In percent deviation from control)

Source: Authors' estimates.

- *Option 1.* Under the consumption tax-financed option, the public investment push leads to significant output gains in the long run. Higher public investment raises the public capital stock, which boosts the general productivity of the economy. The resulting rise in the marginal productivity of capital and labor stimulates private investment and raises labor demand. This lifts private consumption in the long run. In the short term, however, the increase in taxes discourages private consumption,

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[15] In the FSGM, the calibration of the parameter of public investment efficiency is based on the combination of long-term output elasticity of government investment (see Ligthart and Suárez, 2005) and the IMF's survey-based measures of infrastructure quality (see IMF, 2015).

[16] The output gains after twenty years are larger, with the levels of GDP higher by about 3.5 percent to 5.2 percent (option 1), 3.2 percent to 5.0 percent (option 2), 3.9 percent to 5.6 percent (option 3) and 3.8 percent to 5.4 percent (option 4).

partially offsetting the stimulative impact of higher public investment spending. All in all, the rise in public investment financed with consumption taxes results in cumulative increases in real GDP between around 1.6 percent and 2.7 percent in the long run.

- *Option 2*. The long-term impact on real GDP of the market-financed increase in public investment is more muted. The adverse effects on output become apparent over time, as the rise in government's borrowing costs associated with higher public debt-to-GDP crowds out private investment and depresses the private capital stock. However, private consumption is higher. Labor supply expands by more than in the tax-financed variant, as households need to work more to offset lower transfers that are required to stabilize public debt in the long run. Overall, real GDP gains from higher public investment in the market-financing option are comprised between 1.5 percent and 2.6 percent in the long run.

- *Option 3*. With concessional financing, the public investment push generates sustained output gains, through both aggregate demand and supply effects. The rising government debt-to-GDP ratio no longer crowds out significantly private investment, reflecting the absence of risk-premia. Private consumption increases substantially in the short to medium terms, as households need to work more to offset lower transfers that are required to stabilize public debt in the long run. Overall, real GDP is 2 percent to around 3 percent higher in the long run.

- *Option 4*. The public-private partnerships (PPPs) arrangement generates substantial GDP gains in the short and long terms. As in the other financing options, in the short term, higher aggregate demand lifts output through multiplier effects. Private consumption is, however, initially somewhat dampened by lower targeted transfers (user fees). Similar to the other options, private investment as well as labor demand—and hence wages—rise sharply reflecting the permanent increase in the level of productivity. This bolsters private consumption over the medium- to long-run. Overall, the level of GDP is between about 1.9 percent and 2.7 percent higher in the long run.

Importantly, across all options, countries with relatively lower initial public debt ratio and higher initial levels of government investment efficiency record the largest cumulative increase in real GDP in the long run. Bangladesh, which has a higher calibrated value for efficiency and a lower initial ratio of public debt to GDP, displays the biggest output gains in the long run under all four financing options.
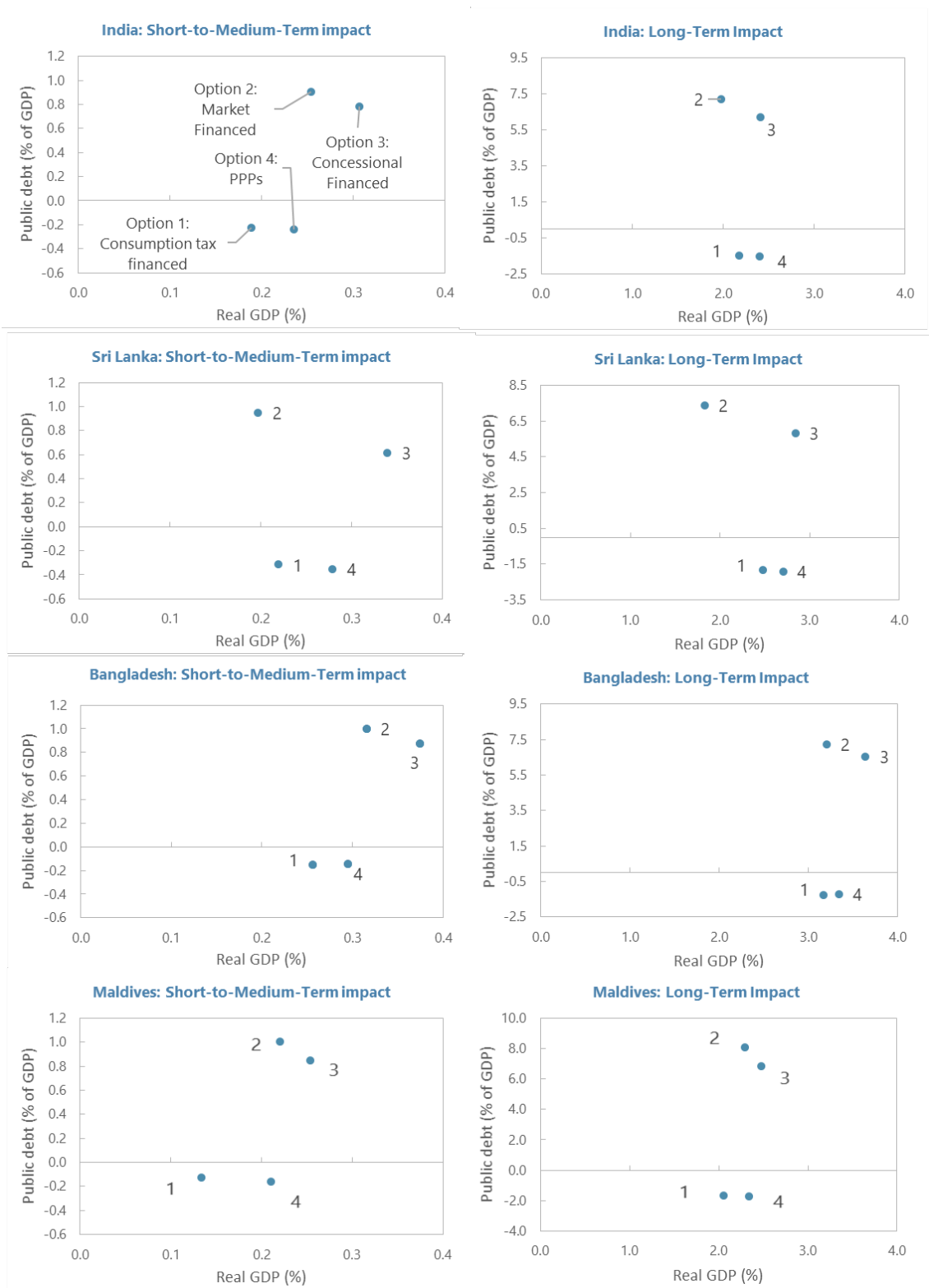
Beware the growth-debt trade-offs

The macroeconomic benefits of additional infrastructure investment need to be balanced with the fiscal costs. This is especially crucial for countries such as India, Sri Lanka and the

Maldives, where government debt-to-GDP ratios are running high by historical standard, and hence have more limited fiscal room (IMF, 2020a). Moreover, the Covid-19 crisis has exacerbated the fiscal challenges that these countries face to finance an infrastructure push. Most countries are expected to face larger debt-to-GDP ratios, pressure on borrowing costs, weaker tax collection reflecting a sharp output contraction, and possible limits on the availability of concessional financing given the increased demand for resources worldwide.

The simulation results displayed in Figure 2.5 quantify the trade-off between growth and debt that each country faces. The set of figures plot the simulation results of the effects of an increase in government investment on real GDP and debt-to-GDP ratio in the short to medium term (three years) and in the long-run (ten years), relative to a control scenario without a scale-up in infrastructure investment. The main findings are as follows:

- Under the budget neutral scenario (Option 1), by construction, the general government balance is unchanged, as the increase in public investment spending is financed with higher consumption taxes. The debt-to-GDP ratios improve slightly in the short-to-medium term, reflecting the impact of higher output, and converge to steady state in the long run.

- Under both debt financing options – market (Option 2) and concessional lending (Option 3)—the government debt-to-GDP ratios increase markedly. Under the market financing scenario (Option 2), higher public debt raises the government's borrowing costs (higher risk premium). The debt-to-GDP ratios in Option (2) increase by about 7-8 percentage points in most of the selected economies in the long run. The rise in the public debt ratios is slightly more contained in Option 3 (6-7 percentage points).

- Under the public-private partnerships (Option 4), the government balance remains unchanged, as the infrastructure investment is financed by the private sector that recoups its expenses through user charges. The debt-to-GDP ratios decline slightly in the short to medium term, reflecting higher output, and converge to steady state in the long run.

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Figure 2.5. Growth-Debt Trade-Off from Higher Public Investment

India: Short-to-Medium-Term impact

Option 2: Market Financed
Option 4: PPPs
Option 3: Concessional Financed
Option 1: Consumption tax financed

India: Long-Term Impact

Sri Lanka: Short-to-Medium-Term impact

Sri Lanka: Long-Term Impact

Bangladesh: Short-to-Medium-Term impact

Bangladesh: Long-Term Impact

Maldives: Short-to-Medium-Term impact

Maldives: Long-Term Impact

Sources: Authors' calculations from FSGM simulations.

What is the optimal financing option?

The simulation results show that tax financing, concessional lending, or PPP financing are more advantageous than market financing in addressing the long run growth-debt trade-off. Overall, the optimal financing choice is country specific and depends on the level of government debt-to-GDP ratio, taxation capacity, implementation risks for PPPs, and the efficiency of the public sector.

- *In the short-to-medium term*, a ramp-up in public infrastructure investment financed with concessional resources (Option 3) yields higher output gains than market-funding (Option 2), as the borrowing costs remain contained under the former option. Concessional lending generates also slightly higher output than the consumption tax-financing (Option 1) and the PPPs scheme (Option 4). However, option 3 also results in higher public debt that can increase fiscal vulnerability. Moreover, in the wake of the pandemic crisis, countries may not be eligible for concessional financing, or may face challenges in accessing sufficient amounts of concessional financing, in view of the increased demand for resources from countries around the world and uncertainty as to whether donor countries will be scaling up support.[17] Hence, the concessional financing (Option 3) may still not be preferred (or feasible) compared to consumption tax-financing (Option 1) or PPPs arrangement (Option 4).

- *In the long term*, however, the relative advantage of concessional financing (Option 3) over PPPs financing (Option 4) diminishes, as the output gains under Option 3 are broadly the same as in Option 4 in all countries while debt is considerably higher. Option 4 achieves a relatively higher output boost with no increase in the ratio of public debt to GDP. By contrast, the public debt ratio increases in Option 3. PPPs arrangement is also more appealing than VAT-financing, as it appears better suited in addressing the growth-debt trade-off in the long term, especially in post- Covid-19 crisis environment where raising taxes might be politically challenging.

- While PPPs might seem more appealing than the other forms of financing infrastructure investment, they also entail implementation risks that can result in higher costs than traditional public investment (see Section D). Therefore, larger growth payoffs under PPP financing are feasible only if projects are well-designed and well-implemented to be significantly more efficient than traditional public investment. Importantly, PPPs pose challenges for fiscal management and entail fiscal risks (see next section). The FSGM simulations are conducted to gauge the output gains with lower public investment efficiency under the PPPs arrangement (Option

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[17] Some countries may not be eligible for concessional financing given either their income level or the scale/size of projects.

4b).[18] The results in Figure 2.6 show that lower public investment efficiency of PPPs would dampen the positive effect on GDP, with an increase of about 1.7 to 2.4 percent in the long run compared to 1.9 to 2.7 percent under baseline efficiency levels in Option 4.

Figure 2.6. Impact of 1 Percent of GDP Higher Public Investment on Real GDP, Year 10
(In percent deviation from control)
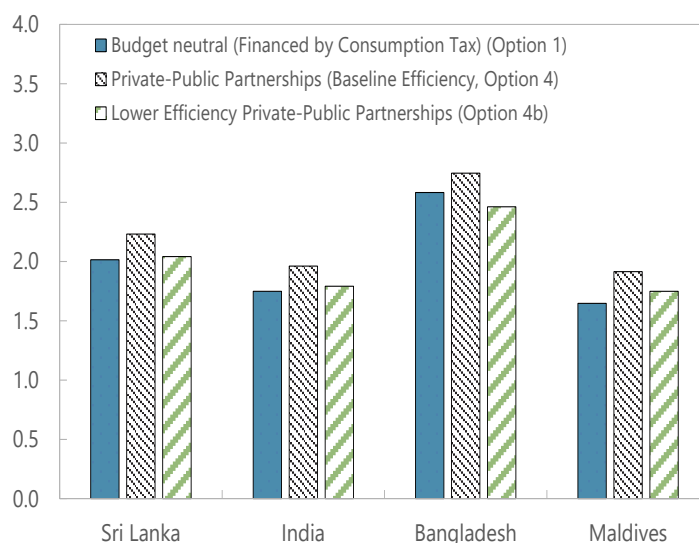
Source: Authors' estimates.
Note: In the lower efficiency PPPs option, public investment efficiency is reduced by 10 percent.

D. Infrastructure Investment through Public Private Partnerships and State-Owned Enterprises

**Public and private contributions to infrastructure investment**

A larger share of infrastructure projects in South Asia are implemented by state-owned enterprises (SOEs) than by general government entities, while private involvement remains relatively limited.[19] SOEs carry out 44 percent of infrastructure investment, compared by 40 percent by the general government and 15 through private participation in infrastructure (Figure 2.7). While annual general government spending on public investment averaged 8 percent of GDP in 2017 across countries in South Asia, yearly PPP investments remained relatively small (1 percent of GDP) (Figure 2.8). SOEs and private participation in

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[18] The simulations assume that the calibrated value for public investment efficiency is lower by 10 percent.

[19] OECD (2015) classifies the modes of infrastructure delivery as: (1) Direct (public) provision; (2) Traditional public procurement; (3) State-owned enterprises (in full or in part); (4) Public-private partnerships and concessions; and (5) Privatization with regulation.

infrastructure have been prominent in the transport and energy sectors, more so than in other regions, with SOEs also investing in water infrastructure (Figure 2.9).[20]

Figure 2.7. SOE, PPPs, and Public Entity Investment by Region, 2017
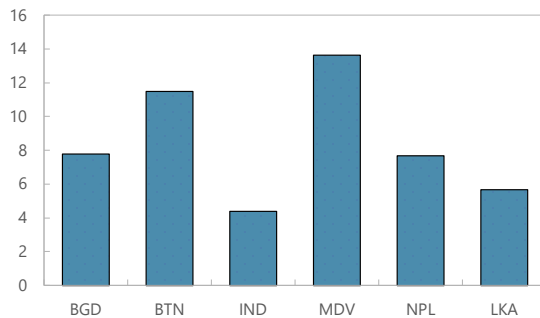(share of total infrastructure project investment)
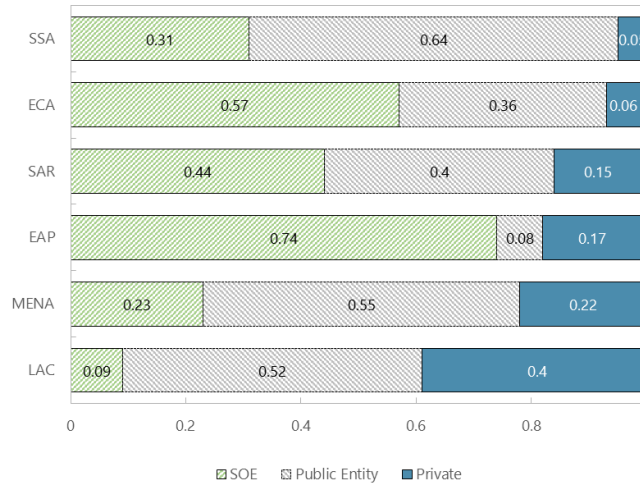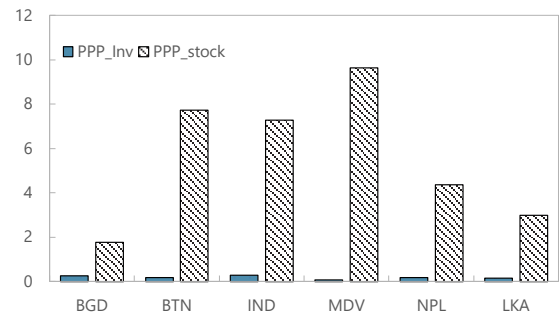

Source: World Bank (2017).

Notes: Private refers to private participation in infrastructure, which includes PPPs as well as other forms of private involvement in the delivery and/or management of public infrastructure. Sub-Saharan Africa (SSA), Europe and Central Asia (ECA), South Asia Region (SAR), East Asia and Pacific (EAP), Middle East and North Africa (MENA) and Latin America and the Caribbean (LAC).

Figure 2.8. Public Investment in South Asia, 2017

General Government Public Investment, 2017
(percent of GDP)

**PPP Stock and Investment, 2017**
(percent of GDP)

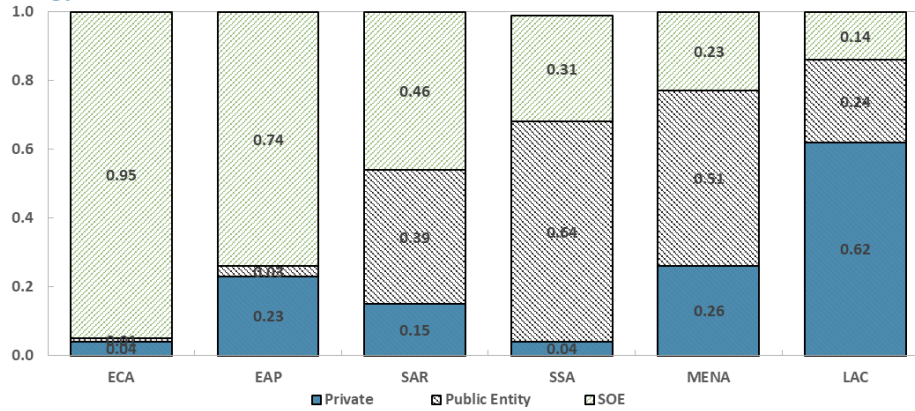Source: Investment and Capital stock database, Fiscal Affairs Department, IMF (2019).

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[20] Some countries have also pursued public investments through the Belt-Road initiative (BRI) but reliable data is not readily available for these investments.

Figure 2.9. Public Entity, State-Owned Enterprise, and Private Participation in Investment by Region and Sector, 2017
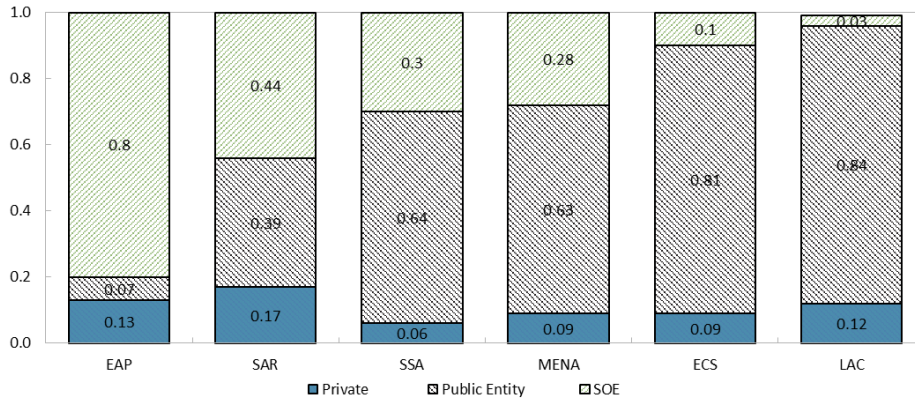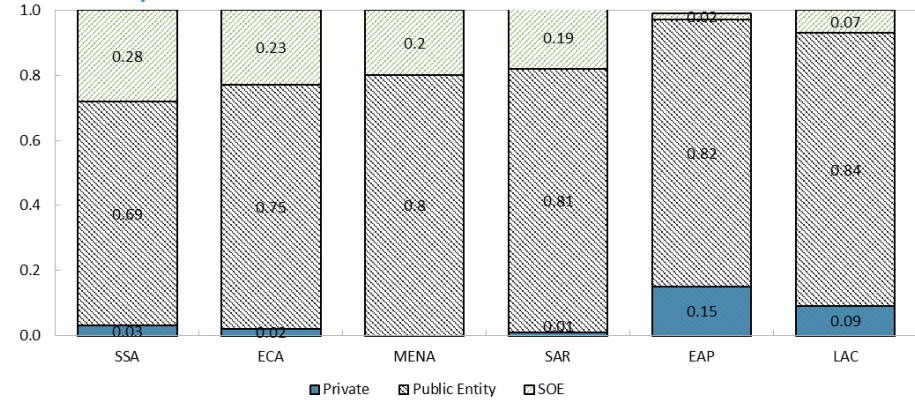
Source: World Bank (2017).

Notes: Private refers to private participation in infrastructure, which includes PPPs as well as other forms of private involvement in the delivery and/or management of public infrastructure. Sub-Saharan Africa (SSA), Europe and Central Asia (ECA), South Asia Region (SAR), East Asia and Pacific (EAP), Middle East and North Africa (MENA) and Latin America and the Caribbean (LAC).

Public private partnerships

When used effectively, PPPs can deliver substantial benefits.[21] Governments are typically motivated to enter into PPPs for infrastructure to: (1) attract private capital investment that can supplement public resources (or release them for other public needs), with the private sector compensated for its services through fees for services rendered; (2) increase efficiency of investment and use available resources more effectively; and (3) reform sectors through a reallocation of roles, incentives, and accountability (Asian Development Bank, 2008). By involving private-sector management and innovation, PPPs may deliver better quality and lower cost services than traditional public procurement of assets and services.

However, PPPs can also entail additional costs. In some cases, a well-structured well-implemented PPP will have lower life-cycle costs than traditional public investment (see U.S. Department of the Treasury, 2016). However, other studies suggest that PPPs have tended to be more expensive than traditional public investment (see United Nations, 2016). This reflects the fact that private sector borrowing costs often tend to be higher than those of the public sector. In addition, PPPs often involve higher transaction costs, as they are very complex to negotiate, implement, and are also frequently renegotiated.[22] Finally, PPPs are associated with potential risks or contingent fiscal liabilities that add to these costs (see IMF, 2018c). These additional costs suggest that PPPs user fees would need to be higher than taxes collected to finance traditional government investment. In addition, users' willingness to pay may vary widely from project to project and charging cost-based fees may not always be politically feasible. PPP contracts therefore may involve some element of government contribution. This can be explicit (for example, availability payments) or implicit (for example, minimum revenue payments or other forms of guarantees).

Fiscal risks associated with PPPs can have a significant impact on the government's finances through direct and contingent liabilities.[23] Such liabilities include capital subsidies, volume-based payments for services, tax incentives, and payments related to guarantees on revenue, exchange-rate, interest-rate or debt (Irwin et al., 2018). Implicit liabilities, created by ineffective contract management or poorly managed renegotiation, generate additional fiscal risks. Bova et al. (2016) find that the average fiscal cost of the realization of PPP contingencies in advanced and emerging market economies has been 1.2 percent of GDP. Moreover, if public investment through PPP projects are not adequately

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[21] A PPP, as defined by World Bank (2014a), is "a long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance."

[22] For instance, infrastructure projects entail risks related to land acquisition, environmental, and other clearances. Complexities arise as PPP contracts allocate these risks between the government and private sector.

[23] In contrast to traditional investment projects fully financed by the government that can be rolled back if needed, PPPs create long-term binding commitments that cannot be scaled down once entered into.

disclosed, it could threaten the integrity of the budget and complicate fiscal discipline and good governance (IMF, 2004; Akitoby et al. 2007).

The benefits from PPPs can only be reaped if associated fiscal risks are managed adequately, based on a strong legal and fiscal institutional framework. Several important steps to address fiscal risks related to PPPs include:[24]

- **Sound PPP framework**. This requires policies, procedures, institutions, and rules that define how PPPs will be identified, planned, assessed, selected, budgeted, procured, monitored, and accounted.[25]

- **Controlling costs:**[26] (1) establish a gateway process managed by the ministry of finance; (2) develop a framework for risk sharing, where the government bears only those risks that it strongly influences; (3) establish clear lines of accountability, where central review of major commitments is combined with the decentralization of smaller decisions and contract monitoring; (4) impose limits on the total sum of commitments on PPPs.

- **Disclosure of costs and risks.** An inventory of all PPP projects should be maintained with proper fiscal accounting of their full lifetime costs. Governments should aim at full disclosure in the budget documents of current government commitments (including guarantees) and expected budgetary costs of existing PPP contracts. New PPPs should be assessed within the budget process and medium-term fiscal framework to check for fiscal affordability. Fiscal risks created by PPPs should be disclosed in statements of fiscal risk (IMF, 2014; IMF 2018b).

State owned enterprises

Government infrastructure investment through SOEs is often justified to correct market failures. One example of market failure is a natural monopoly, wherein the initial cost of building the infrastructure to provide the good or service is so large that private firms are reluctant to enter the market (IMF, 2020d). SOEs have been therefore typically involved in network industries, such as energy, transportation, and water and sewer systems. Governments have also relied on SOEs when the latter are able to raise financing independently, or also to keep the investment off the government's balance sheet.

However, weak governance affects SOEs' financial performance and their ability to provide quality infrastructure investment. Profits and labor productivity have been lower in SOEs than in private firms (IMF, 2020d), which can be partly attributed to weak

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[24] See Irwin et al. (2018) and IMF (2018c).

[25] See World Bank (2014a) and Asian Development Bank (2008).

[26] Irwin et al. (2018) provide details on each of these elements.

governance and also to the cost of unfunded mandates (for example, providing services at below-cost recovery levels or promoting employment beyond what is efficient for the firm).[27] From the infrastructure investment perspective, SOEs that are inefficient and cash-strapped are not able to invest to adequately maintain or expand infrastructure networks. They may also suffer from lack of transparency and accountability.

Improvements in the governance and productivity of SOEs are paramount to improve profitability and minimize fiscal risks. Countries should improve the financial oversight of SOEs, including through periodic monitoring of SOE financial performance, costing the delivery of quasi-fiscal activities in the annual budget, and disclosing them in financial reports (Allen and Alves, 2016; IMF Fiscal Transparency Code, 2014). With regard to SOE's role in infrastructure investment more specifically, countries should take steps to promote objective pricing of infrastructure assets and services, and implement effective supervision of public enterprises' investment plans. In addition, by reducing internal inefficiencies, SOEs can provide better results for infrastructure spending.

E.   Improving Public Investment Efficiency

Increasing the efficiency of public investment will give countries greater growth payoffs from public infrastructure spending. Public Investment Management Assessment (PIMA) results for a sample countries in the region suggest that South Asia has significant room to enhance the efficiency of public investment.[28] The estimated efficiency score—which estimates the relationship between the public capital stock and indicators of access to and the quality of infrastructure assets—for South Asia is around 50 percent of the best performing peer countries, and is below other emerging and developing countries in Asia (Figure 2.10).[29] Reducing the public investment efficiency gap could increase long-run growth, as highlighted in the previous section using model-based simulations and also in IMF (2015).

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[27] Inefficient SOEs impose substantial fiscal costs on public finances in the form of government guarantees, subsidies, soft loans, or capital injections. IMF (2020d) finds that maximum annual support to nonfinancial SOEs reached 16 percent of GDP.

[28] IMF (2015) introduced the PIMA, which provides a comprehensive assessment of the public investment decision-making process at three key stages: (1) Planning sustainable levels of investment across the public sector; (2) Allocating investment to the right sectors and projects; and (3) Implementing projects on time and on budget. IMF (2018a) summarizes the lessons learned from PIMAs carried out to date and updates the assessment framework itself. By mid-2020, the IMF had conducted PIMAs for 3 countries in the South Asia region (the Maldives, Sri Lanka, and Bangladesh).

[29] IMF (2015) introduced the cross-country Public Investment Efficiency Index (PIE-X). A country's performance is estimated based on an index that compares its levels of infrastructure coverage and quality (outputs) to its levels of public capital stock and income per capita (inputs). A "frontier", consisting of the countries achieving the highest output per unit of input, is drawn. The performance of a total of 128 countries is compared to the frontier.

Figure 2.10. Overall Public Investment Efficiency Scores
(In percent deviation from control)
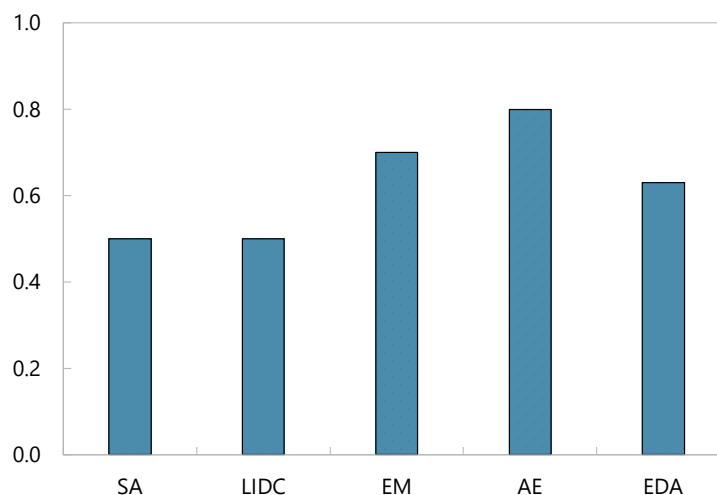
Sources: IMF (2015), Vu et al. (2020), PIMA for South Asian countries, and authors' estimates.
Note: SA (South Asia), LIDC (Low-income developing countries), EM (Emerging market economies), AE (Advanced economies), EDA (Emerging and Developing Asia).

Strengthening infrastructure governance can help countries improve public investment efficiency. The results of PIMA for a sample of countries in South Asia show that most public investment management (PIM) practices in the region have good institutional strength but effectiveness in the implementation of PIM institutions is generally weak. There is considerable room to improve PIM institutions in the practices of project appraisal and selection, maintenance funding, and multiyear budgeting (Figure 2.11).[30]

- *Project appraisal.* All the countries in the sample have weak mechanisms to effectively appraise investment project proposals before they are selected. The lack of a standard appraisal methodology makes it difficult to ensure the quality of projects. This causes delays in project implementation and raises the risk that less worthy projects are selected.

- *Project selection.* A major weakness across all South Asian countries in the sample is the lack of consistent criteria to identify and select investment projects and quantify their costs. None of the countries in the sample have an effective review of major projects by a central ministry before being included in the budget. These weaknesses not only make it difficult to ensure that the best projects are selected, but also undermine the ability to choose the most appropriate delivery modes. To improve the transparency of project selection, countries should create a pipeline of appraised,

[30] Areas for improvement found for South Asia are broadly in line with the findings by Vu et al. (2020) for emerging and developing Asia (EDA). These authors also provide examples of good public investment management practices drawing on experience in EDA.

adequately costed, projects for subsequent budget consideration. Clear and transparent criteria for project prioritization also need to be defined.

- *Maintenance funding.* Existing mechanisms for maintenance funding for the countries in the sample are not very effective and budgeted maintenance levels are low compared to the capital stock. Most countries do not have a standard methodology or sufficiently disaggregated data to estimate the costs of routine maintenance and major capital maintenance needs.

- *Multiyear budgeting.* Most of the countries in the sample do not have a medium-term framework for capital spending to guide multiyear investment planning. Countries do not publish the projections of overall or disaggregated capital spending by ministry or sector over the medium term. Moreover, the financing of project outlays is frequently subject to budget cuts and cash rationing, leading to arrears and implementation delays.

Figure 2.11. PIMA Scores by Dimension
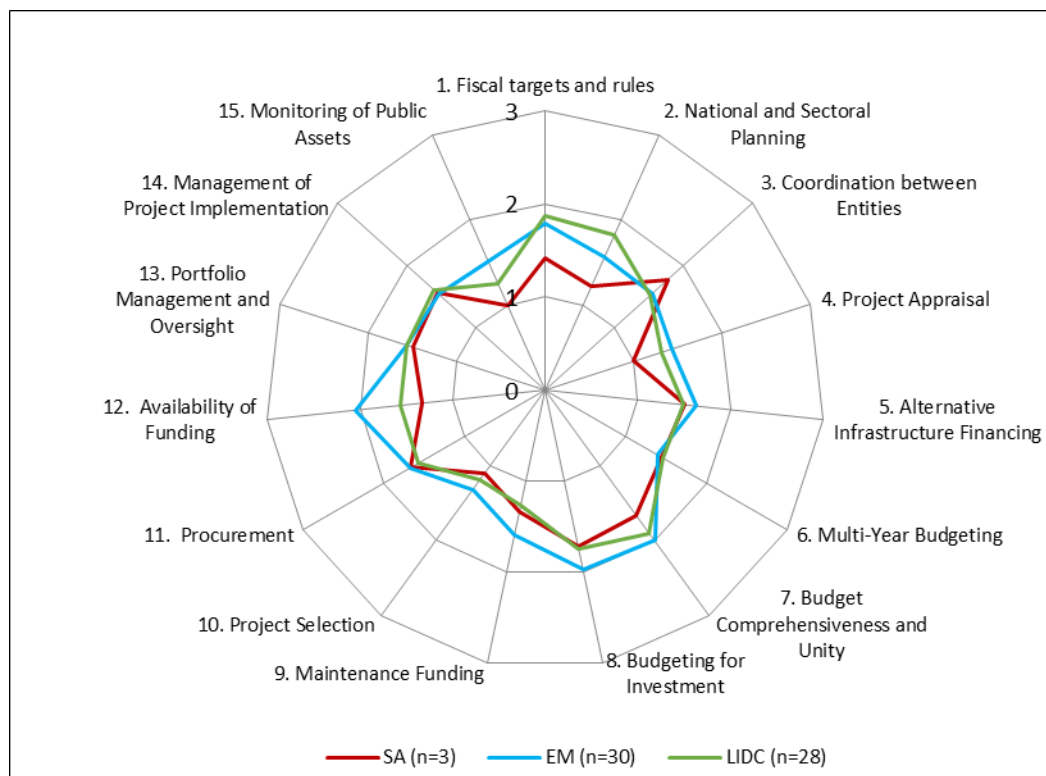
Source: PIMA for South Asian countries and IMF staff estimates.

Note: SA (South Asia), 3 countries, LIDC (Low-income developing countries), 28 countries; EM (Emerging market economies), 30 countries.

F. Conclusion

In South Asia, greater infrastructure spending can support the Covid-19 recovery and raise growth over the medium term, but its benefits will depend on how it is financed and how it is managed. Countries in South Asia need to both extend infrastructure networks and improve their quality. However, the strategy to finance the boost in infrastructure spending—whether through taxes, debt, or PPPs—will affect the outcome. The optimal financing choice is country specific and will be a function of available fiscal space, taxation capacity, as well as efficiency of the public sector. The economic gains of higher infrastructure spending will also hinge on how it is managed. Countries in South Asia rely on SOEs, while PPPs remain limited. While these alternatives can have advantages in terms of efficiency, the associated implementation and fiscal risks need to be carefully monitored, managed, and disclosed. South Asia will also need to implement reforms to strengthen public investment management to make the most of additional spending.

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Annex. Estimating the Growth Impact of Infrastructure Development[31]

To gauge the growth benefit of infrastructure, an aggregate production function augmented with the infrastructure variables is estimated, drawing on Calderón and Servén (2004 and 2008):

$$y_{it} - y_{it-1} = \rho y_{it-1} + \alpha X_{it} + \beta K_{it} + \theta_i + \tau_t + \varepsilon_{it},$$

where y_{it} is aggregate output per worker for a country i in period t in logs; X_{it} includes control variables such as human capital (secondary enrollment in percent of total with the age above 15, from Barro and Lee, 2013), financial development (domestic credit to private sector in percent of GDP), trade openness (trade in percent of GDP), inflation, government burden (government final consumption expenditure in percent of GDP), institutional quality (ICRG political Risk Index, aggregate index, a widely used indicator to capture institutional and political risk), terms of trade and their changes, and the size of the modern (non-agricultural) sector in terms of value added, all expressed in logs. Most data are from the World Bank's World Development Indicators, unless otherwise specified. The variable K_{it} captures the infrastructure measures. Time effects are included to account for unobservable common factors, and we also consider fixed effects to account for cross-country heterogeneity. We estimate this equation using a panel of 80 countries for the period of 1990−2017. Since we are interested in a longer-term trend rather than short-term business cycle, we use the non-overlapping 5-year period averages for estimation.

To capture the quantity and quality of infrastructure for the variable K_{it}, aggregate synthetic indices are considered rather than including individual measures of different types of infrastructure. The measures of different types of infrastructure tend to be highly correlated among each other (the bilateral correlations among the individual infrastructure measures used in this analysis range between 0.5 and 0.9). When assessing their relationship to growth, this renders the estimates rather unreliable. To mitigate this issue, aggregate indices are constructed following (Calderón and Servén, 2004), as the first principal component of different types of infrastructure.[32] The synthetic indices capture well the variations in the underlying individual measures.

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[31] IMF (2020c) provides further details on the methodology, based on the analysis's application to the case of Nepal.

[32] The index of infrastructure stock is constructed as the first principal component (PC) of the data on the electricity generating capacity (in megawatts per 1000 workers), the length of road network (in kilometers per a square meter of land area), and the internet access (share of households with internet access), with all variables in logs and normalized. The first PC gives weights 0.61, 0.54, and 0.58 on electricity, transport, and telecommunication variables, respectively, and capture 67 percent of the overall variation with high correlation to each underlying variable (ranging 0.75–0.83). The index for quality is constructed as the first PC of the data on the share of electricity transmitted and distributed to consumers (one minus the losses in the process), the share of paved roads to total, and the measure of internet bandwidth per user rescaled to take value between 0 and 1. The first PC gives weights 0.59, 0.61, and 0.53 on the quality measures electricity, transport, and

Various estimation methods are considered, including the GMM estimation developed by Arellano and Bond (1991) to alleviate the endogeneity issue and bias stemming from the correlation between the lagged dependent variable and fixed effects in the error term. The results confirm that infrastructure indices, both quantity and quality have a positive and significant relationship with growth, as shown in Table 2.1 above.

telecommunication variables, respectively, and capture 51 percent of the overall variation with high correlation to each underlying variable (ranging 0.7–0.8).