CHAPTER 6

Digitalization and Public Finances

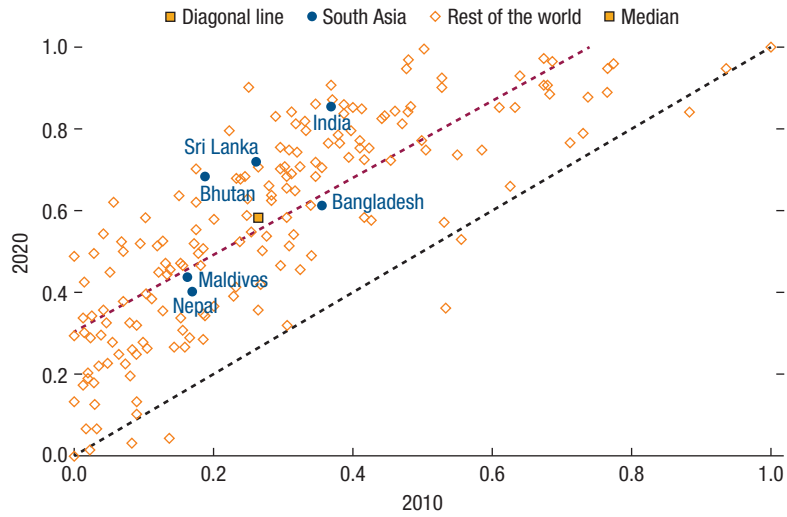
Emmanouil Kitsios and Sanghamitra Warrier Mukherjee

Digital technologies offer powerful tools that public administrations can leverage to modernize and improve their operational efficiency. South Asian economies have progressively adopted GovTech solutions over the past decade. This chapter discusses their digitization advancements and presents empirical evidence in support of GovTech efforts to improve tax revenue performance, as well as health and education outcomes.

INTRODUCTION

Can South Asian countries increase government efficiency by stepping up their digitalization efforts? Public services are increasingly turning digital across the region, albeit at a different pace for each country. Digitalization can enable governments to improve the efficiency of expenditure and tax policies by facilitating the collection and processing of more reliable, timely, and accurate information on relevant stakeholders. Moreover, the digitalization of public finances can help

Figure 6.1. Government Online Services Index for Years 2010 and 2020



Sources: UN e-Government Survey; and authors' estimates.

enhance access to services and entitlements, reduce errors and frauds, strengthen procurement procedures, and improve tax compliance by simplifying the tax-filing process. By gradually digitalizing their government operations, South Asian countries are incrementally reducing their digital divide to the public administrations of more advanced economies.

The important policy question that arises is whether e-governments are better at mobilizing revenue or spending their resources more efficiently. This question is explored empirically in this chapter using a broad sample of 180 countries at different stages of GovTech development during the period 2008–2019. We focus on three public administration performance areas that digitalization has significant potential to improve (1) government revenue productivity; (2) health outcomes; and (3) educational outcomes. The overall progress in e-government is proxied by the United Nation's Online Service Index that assesses the scope and quality of public sector online services, including online services for tax submission and registration of businesses.[1] We find that building on their recent progress, South Asian countries stand to benefit from further GovTech advancements in terms of public finance efficiency in revenue collection and health and education spending efficiency.

STATE OF GOVTECH IN SOUTH ASIA

Despite the impressive progress made, there is scope to scale up the use of digital technologies in revenue administration, payroll systems, and procurement. Each bullet in this section discusses a set of GovTech indicators for countries in South Asia as of the end of 2020, with the accompanying text tables reflecting the values and implementation year of the corresponding GovTech option. Higher values in the tables indicate more digitally advanced public financial management systems. The horizontal bar charts accompanying the tables document the labels of the indicator values reported in the columns of the tables, along with the number of countries in the world implementing a GovTech solution with similar characteristics.

- *Treasury single account (TSA):* Most South Asian countries benefit from centralized TSA systems that record at least 75 percent of their government's revenue and expenditure transactions.[2] Bangladesh and Bhutan have decentralized TSA systems, with the former recording between 25 to 50 percent of transactions. Most countries worldwide do not have fully centralized TSA systems, although most countries have TSA systems that cover more than 75 percent of transactions (see Table 6.1 and Figure 6.2).
- *Tax Management Information System (TMIS):* Most countries in the region—and worldwide—have fully operational TMISs. Digitalizing the business process of the revenue administration can help minimize the tax

[1] The index is based on data collected from an independent Online Service Questionnaire conducted by the UN Department of Economic and Social Affairs.

[2] TSA operational scope in the text table refers to the revenue and expenditure shares captured by the TSA.

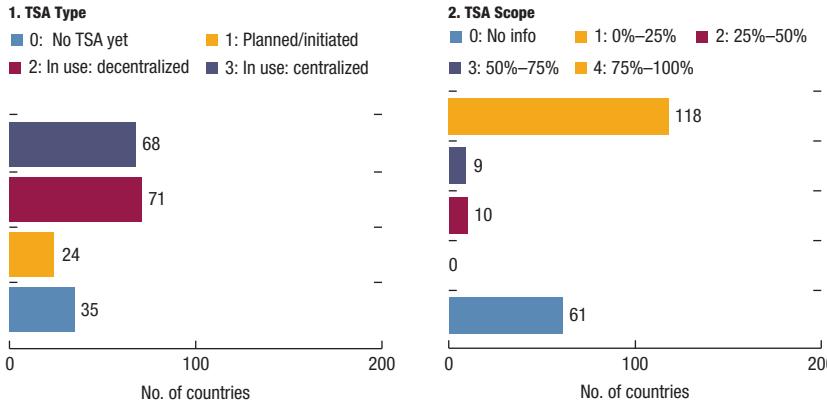
TABLE 6.1.

Treasury Single Accounts in South Asia

Country	Year	Type	Scope
Bangladesh	2008	2	2
Bhutan	2008	2	4
India	1963	3	4
Maldives	2009	3	4
Nepal	2013	3	4
Sri Lanka	2007	2	4

Sources: World Bank Digital Government/GovTech Systems and Services (DGSS) Dataset; and IMF staff calculations.

Figure 6.2. TSA Type and Scope



Source: World Bank, Digital Government/GovTech Systems and Services (DGSS) Dataset.
Note: TSA = Treasury single account.

compliance costs and enable the faster processing of returns and payment data, as well improve the communication between taxpayers and the tax authority. Sri Lanka and 29 other countries have connected services or are operating a single-window platform. Implementation of a fully operational and connected TMIS is in progress in Bangladesh, Maldives, and 5 other countries, while 25 countries have not developed a TMIS. Fully integrating a TMIS with existing information systems at other government agencies can help analyze taxpayer information more comprehensively, as well as strengthen the capacity of the revenue authority to assess tax liabilities and monitor compliance (see Table 6.2 and Figure 6.3).

- *e-id and e-signature:* All countries in the region benefit from digitized identification (ID) systems. With more than 1.2 billion residents enrolled, India's Aadhaar unique ID number represents the largest biometrics-based digital ID system in the world. India is also among the 70 countries that implement digital signatures in the public sector for operations and service delivery, backed by relevant digital signature regulation and public infrastructure. Bangladesh, Nepal, and Sri Lanka are among the 36 countries that have developed regulations and infrastructure to support the adoption of digital signatures, while Bhutan has only formulated the supporting

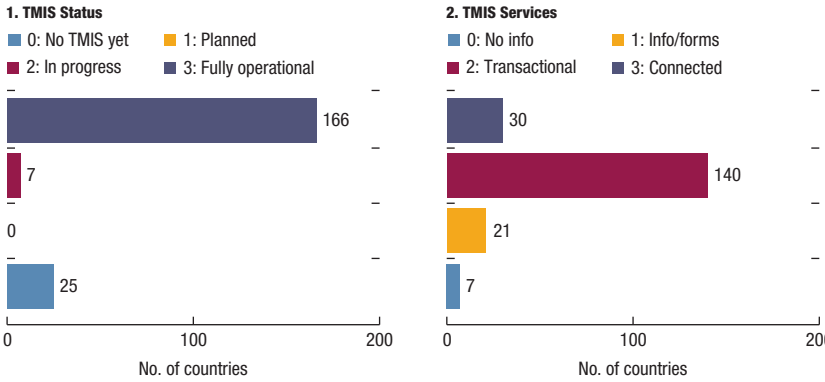
TABLE 6.2.

Tax Administration: Tax Management Information Systems in South Asia

Country	Year	Status	Services
Bangladesh	2018	2	2
Bhutan	2015	3	2
India	1981	3	2
Maldives	—	2	2
Nepal	2010	3	2
Sri Lanka	2014	3	3

Source: World Bank, Digital Government/GovTech Systems and Services (DGSS) Dataset; and IMF staff calculations.

Figure 6.3. TMIS Status and Services



Source: World Bank, Digital Government/GovTech Systems and Services (DGSS) Dataset.
Note: TMIS = Tax Management Information System.

regulatory system. Maldives is among the 52 countries that do not have such digital signature systems and lack the regulation or infrastructure to support them (see Table 6.3 and Figure 6.4).

- *e-filing and e-payment:* Most countries in the region and in the world provide online e-filing services for government to citizens (G2C) or government to businesses (G2B) through their e-tax systems, but do not offer government e-payment solutions. India stands out among South Asian

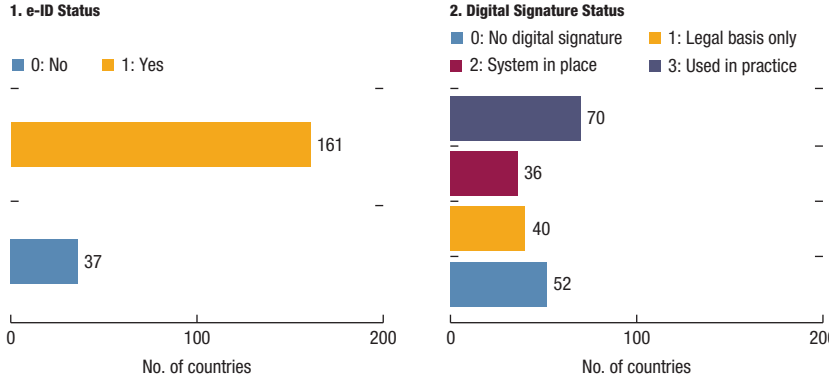
TABLE 6.3.

e-IDs and e-Signatures in South Asia

	e-ID	Digital Signature	
Country	Status	Year	Status
Bangladesh	1	2009	2
Bhutan	1	2006	1
India	1	2008	3
Maldives	1	—	0
Nepal	1	2012	2
Sri Lanka	1	2013	2

Sources: World Bank Digital Government/GovTech Systems and Services (DGSS) Dataset; and IMF staff calculations.
Note: ID = identification.

Figure 6.4. e-ID and Digital Signature Status



Source: World Bank, Digital Government/GovTech Systems and Services (DGSS) Dataset.
Note: ID = identification.

TABLE 6.4.

e-Filing and e-Payment in South Asia

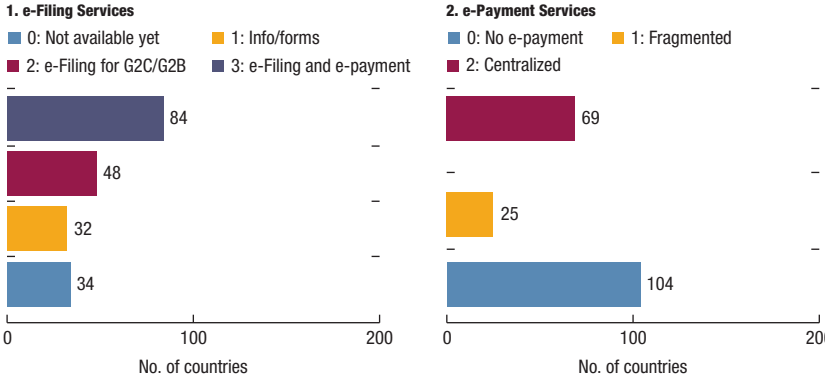
	e-Filing		e-Payment	
Country	Year	Services	Year	Services
Bangladesh	—	1	2012	1
Bhutan	2009	2	—	0
India	2005	3	2011	1
Maldives	2013	2	—	0
Nepal	2013	2	—	0
Sri Lanka	—	1	2012	2

Sources: World Bank Digital Government/GovTech Systems and Services (DGSS) Dataset; and IMF staff calculations.

countries in offering both e-filing and e-payment options. Sri Lanka implements a centralized e-payment platform. Sri Lanka and Bangladesh provide tax-related information and forms online, but do not yet offer centralized e-filing and e-payment G2C or G2B services (see Table 6.4 and Figure 6.5).

- *Customs Administration Management Information System (CMIS):* All South Asian countries benefit from fully operational online customs systems that offer transactional capabilities but are not operating yet as single windows. Fully operational single-window systems allow traders to submit all import, export, and transit information required by customs and other agencies through a single electronic gateway instead of paper-based processing systems. Most countries in the world operate the CMIS with similar functionalities, whereas 40 countries benefit from more advanced systems (see Table 6.5 and Figure 6.6).
- *Payroll system:* All South Asian countries have fully operational payroll systems. Bhutan, Maldives, Nepal, and Sri Lanka are implementing a centralized payroll platform that is shared across line ministries. Bangladesh and India have not fully centralized their payroll platform. In the case of

Figure 6.5. e-Filing and e-Payment Services



Source: World Bank, Digital Government/GovTech Systems and Services (DGSS) Dataset.
Note: G2C/G2B = government to citizens/government to businesses.

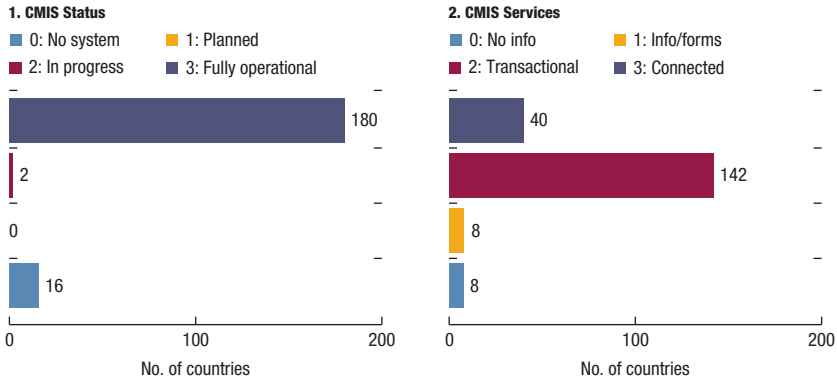
TABLE 6.5.

Customs Administration: Customs Management Information System

Country	Year	Status	Services
Bangladesh	1994	3	2
Bhutan	2015	3	2
India	1997	3	2
Maldives	1994	3	2
Nepal	1998	3	2
Sri Lanka	1994	3	2

Sources: World Bank Digital Government/GovTech Systems and Services (DGSS) Dataset; and IMF staff calculations.

Figure 6.6. CMIS Status and Services



Source: World Bank, Digital Government/GovTech Systems and Services (DGSS) Dataset.
Note: CMIS = Customs Administration Management System.

Bangladesh, for example, the iBAS++ system currently covers about 96 percent of the payment of salaries and allowances, and its coverage is expected to be completed with the forthcoming inclusion of a few self-accounting entities. Most countries operate fully centralized payroll systems (see Table 6.6 and Figure 6.7).

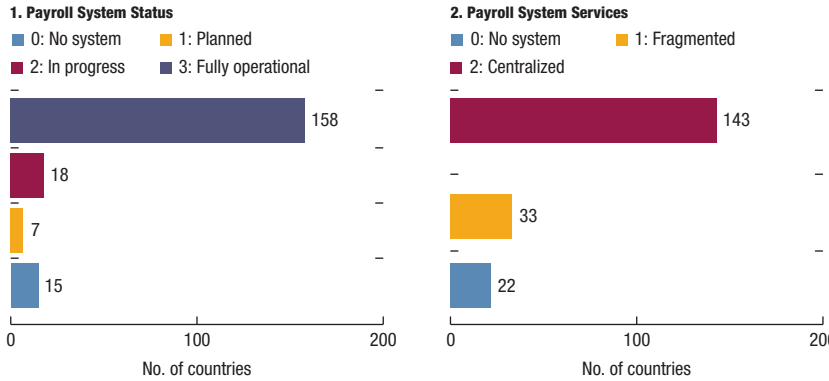
TABLE 6.6.

Payroll System

Country	Year	Status	Services
Bangladesh	2016	3	1
Bhutan	2014	3	2
India	—	3	1
Maldives	2010	3	2
Nepal	2004	3	2
Sri Lanka	2012	3	2

Sources: World Bank Digital Government/GovTech Systems and Services (DGSS) Dataset; and IMF staff calculations.

Figure 6.7. Payroll System Status and Services



Source: World Bank, Digital Government/GovTech Systems and Services (DGSS) Dataset.

TABLE 6.7.

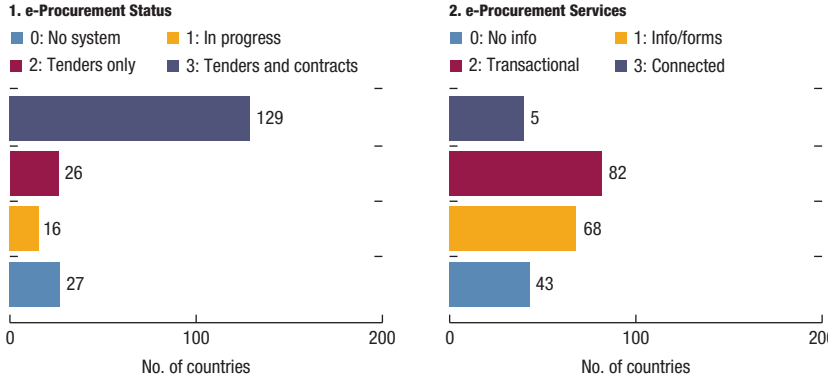
e-Procurement System

Country	Year	Status	Services
Bangladesh	2011	3	2
Bhutan	2017	2	3
India	2007	3	2
Maldives	2011	2	1
Nepal	2014	3	2
Sri Lanka	—	1	0

Sources: World Bank Digital Government/GovTech Systems and Services (DGSS) Dataset; and IMF staff calculations.

- *e-Procurement System:* The electronic procurement systems of Bangladesh, India, and Nepal publish tender and contract information and include bidding documents and contract awards. Their procurement portals, as well as those of most other countries, offer more functionality compared with those of Bhutan and Maldives that only publish tenders. Bhutan's e-procurement system is one of the five in the world that are fully connected, while most other countries' systems either provide bidding documents and contract awards, or include only tender or contract information. Sri Lanka's e-procurement system is among the 43 that do not provide such information (see Table 6.7 and Figure 6.8).

Figure 6.8. e-Procurement Status and Services



Source: World Bank, Digital Government/GovTech Systems and Services (DGSS) Dataset.

DIGITALIZATION AND REVENUE COLLECTION EFFICIENCY

Can digitalization help countries in the region improve their revenue efficiency? To explore this question, we estimate the effect of the government digitalization proxy (GovTech) on annual efficiency measures of value-added tax (VAT), personal income tax (PIT), and corporate income tax (CIT).[3] These tax efficiency measures are the dependent variables of interest ($Tax_{i,t}$).[4] Figure 6.9 demonstrates a positive association between the CIT revenue productivity when plotted against the e-government online service index.[5] Advanced and emerging economies tend to have both higher digitalization indices and revenue productivities. Actual CIT revenue productivity is lower than average based on the government digitalization efforts of Bangladesh, India, Nepal, and Sri Lanka. This is likely because of the presence of tax exemptions or revenue administration inefficiencies associated with the economic structure of these countries. To address omitted variable bias, we include in our specification country characteristics that are also likely to affect revenue productivity besides government digitalization (Equation 6.1).

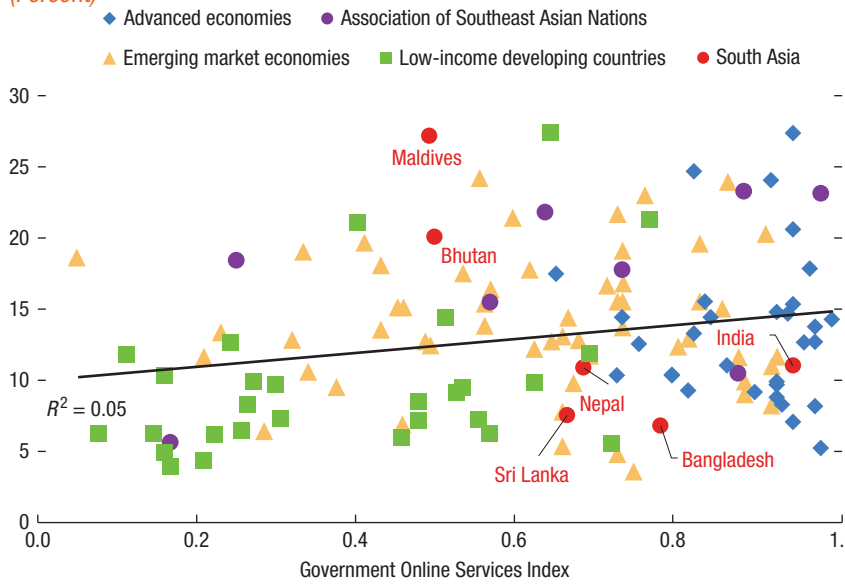
$$Tax_{i,t} = \beta \bullet GovTech_{i,t-1} + \theta \bullet X_{i,t-1} + \alpha_i + \gamma_t + u_{i,t} \qquad (6.1)$$

[3] See Kitsios, Jalles, and Verdier (2022) for a study examining the effect of government digitalization on reducing cross-border fraud and increasing trade-related revenue.

[4] VAT productivity is measured as the ratio of VAT revenue to the product of GDP and the standard VAT rate. VAT C-efficiency is measured as the ratio of actual VAT revenues to the product of the standard rate and final consumption expenditure. Similarly, CIT productivity = (CIT revenue as percent of GDP)/(CIT rate) and PIT productivity = (PIT revenue in percent of GDP)/(highest PIT rate).

[5] We use the UN Online Service Index as a proxy for government digitalization because it is significantly correlated with other digitalization indices available—such as the World Bank's GovTech Maturity Index—and it has a broader sample coverage across countries and over time.

Figure 6.9. CIT Productivity and GovTech
(Percent)



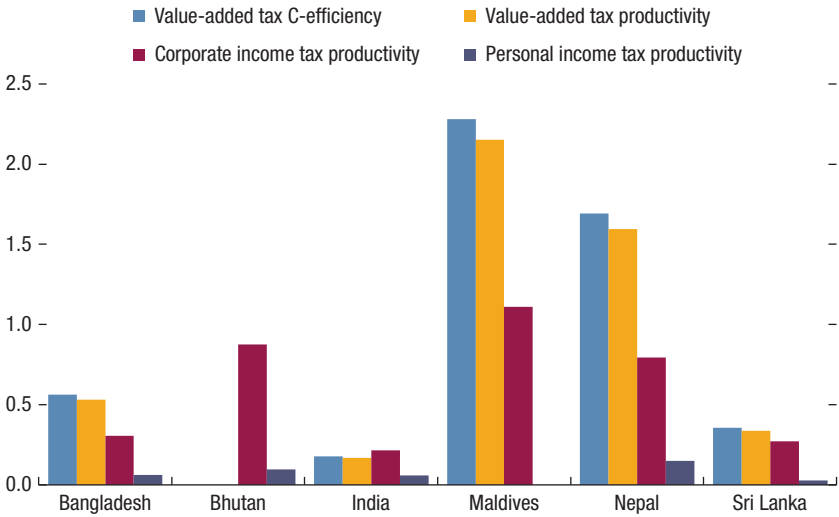
Sources: IMF Government Finance Statistics; IMF Fiscal Affairs Department Tax Rates database; IMF's World Economic Outlook database; OECD Global Revenue Statistics Database; UN e-Government Survey; USAID Collecting Taxes Database; World Bank's World Development Indicators; and IMF staff estimates.

The vector $X_{i,t-1}$ of lagged values of covariates includes (1) GDP per capita to proxy for the level of development; (2) real GDP growth to account for the business cycle effects on revenue performance; (3) agriculture's share of GDP as a proxy for informality; (4) the United Nation's telecommunication index to control for the broader digital technological infrastructure available in the country; (5) the country's nonoil imports and exports shares of GDP as a proxy for trade dependence; (6) the oil trade balance share of GDP to account for oil trade's impact on revenue collection efforts; (7) demographic characteristics impacting the workforce structure, such as population growth and the age dependency ratio; (8) the UN's human capital index to proxy for digital literacy; and (9) an indicator on government effectiveness to account for more effective governments being more likely to adopt GovTech solutions.[6] Country-fixed effects (α_i) are used to capture any time-invariant country-level heterogeneity and year-fixed effects (γ_t) are included to account for cross-country shocks and general trends in revenue performance measures over time.

The estimates suggest that there is a positive association between the GovTech index and revenue efficiency measures (Table 6.1). The results hold when the government effectiveness indicator is used as an additional regressor (columns 2,

[6] Similar determinants of revenue efficiency and tax effort are used by Fenochieto and Pessino (2013) and Cevik and others (2019).

Figure 6.10. GovTech Frontier's Effect on Revenue Efficiency
(Change in percent; 2019)



Sources: IMF Government Finance Statistics; IMF Fiscal Affairs Department Tax Rates Database; IMF's World Economic Outlook database; OECD Global Revenue Statistics Database; USAID Collecting Taxes Database; World Bank's World Development Indicators; IMF staff estimates.

4, 6, and 8), though digitalization can also impact revenue efficiency through improving perceived government effectiveness by promoting transparency and reducing corruption vulnerabilities. Revenue efficiency measures on VAT and CIT tend to be higher in periods of higher GDP growth and when overall government effectiveness is stronger. On the other hand, PIT revenue efficiency is negatively associated with agriculture's share of value added in the economy, likely because of the presence of greater informality in the economy. Similarly, VAT and CIT revenue performance measures tend to be lower for more export-dependent economies that may reflect the presence of higher tax incentives for exporters. Countries that have stronger oil trade balances have lower revenue efficiency given that there is likely less pressure on public administration to generate revenue. Revenue performance tends to be lower for economies with a lower proportion of the population participating in the labor force, likely reflecting less economic dynamism.

Bridging the government digitalization divide would result in higher revenue collection efficiency. The estimates of Table 6.8 suggest that if South Asian countries reached the GovTech frontier (that is, government online services index equaled one), then revenue efficiency would improve.[7] For example, VAT productivity and VAT C-efficiency measures would increase by about 0.6 and 0.5 percentage points, respectively, for Bangladesh. Similarly, CIT productivity would

[7] Efficiency gains for VAT and PIT are not shown for Bhutan and Maldives, respectively, because of the lack of relevant taxes before 2020.

TABLE 6.8.

Tax Revenue Efficiency

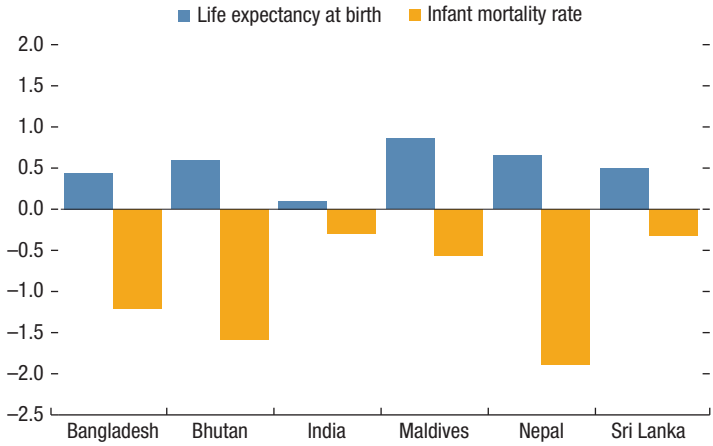
	(1) VAT C-Efficency	(2) VAT C-Efficency	(3) VAT Productivity	(4) VAT Productivity	(5) CIT Productivity	(6) CIT Productivity	(7) PIT Productivity	(8) PIT Productivity
GovTech index	0.426**	0.401*	0.397**	0.380*	0.453**	0.427*	0.242*	0.233*
	(0.186)	(0.192)	(0.185)	(0.187)	(0.210)	(0.209)	(0.126)	(0.127)
GDP per capita	0.700***	0.611***	0.569***	0.470***	0.932***	0.806***	−0.078	−0.114
	(0.149)	(0.149)	(0.152)	(0.156)	(0.212)	(0.206)	(0.060)	(0.067)
GDP growth	0.010***	0.010***	0.005*	0.005*	0.019***	0.020***	−0.002	−0.002
	(0.003)	(0.003)	(0.003)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)
Telecommunications index	0.447	0.373	0.545*	0.479	0.707	0.635	−0.156	−0.183
	(0.298)	(0.299)	(0.298)	(0.303)	(0.415)	(0.398)	(0.166)	(0.159)
Agriculture value added (% GDP)	0.027	0.020	0.108	0.099	0.022	0.014	−0.108**	−0.110**
	(0.075)	(0.079)	(0.078)	(0.083)	(0.074)	(0.074)	(0.043)	(0.044)
Nonoil imports (% GDP)	−0.000	−0.001	0.003	0.003	0.009**	0.009**	0.008***	0.008***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.002)	(0.002)
Nonoil exports (% GDP)	−0.007**	−0.007**	−0.012***	−0.012***	−0.016***	−0.016***	0.002	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Oil trade balance (% GDP)	−0.016**	−0.015**	−0.023***	−0.022***	−0.014**	−0.013**	−0.005*	−0.004
	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)
Population growth	0.024	0.022	0.012	0.010	−0.021	−0.021	−0.017	−0.019
	(0.027)	(0.028)	(0.027)	(0.028)	(0.023)	(0.023)	(0.016)	(0.017)
Age dependency ratio	−0.005*	−0.005	−0.007**	−0.006**	−0.012***	−0.012***	−0.018***	−0.019***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.004)
Human capital index		−0.003		−0.256		0.030		0.053
		(0.348)		(0.343)		(0.242)		(0.186)
Government effectiveness		0.168**		0.176**		0.221**		0.068
		(0.072)		(0.066)		(0.093)		(0.097)
No. of observations	1714	1714	1749	1749	1813	1813	1904	1904
No. of countries	130	130	134	134	134	145	145	141
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.04	0.04	0.04	0.04	0.06	0.06	0.03	0.03

Sources: IMF Government Finance Statistics; IMF Fiscal Affairs Department Tax Rates database; IMF's World Economic Outlook database; OECD Global Revenue Statistics Database; UN e-Government Survey; USAID Collecting Taxes Database; World Bank's World Development Indicators; and IMF staff estimates.

Note: Robust standard errors are in parentheses. The dependent and independent variables of GDP per capita and agriculture value added are specified in logs. CIT = corporate income tax; PIT = personal income tax; VAT = value-added tax.

*$p < 0.1$, ** $p < 0.05$, ***$p < 0.01$.

Figure 6.11. GovTech Frontier's Effect on Health Outcomes
(Change in years of life expectancy at birth; change in infant mortality rate)



Sources: World Bank's World Development Indicators; and IMF staff estimates.

increase by 0.9 and 0.8 percentage points for Bhutan and Sri Lanka, respectively. The overall impact on revenue is estimated at about 3.3 percent of GDP and 2.5 percent of GDP for Maldives and Nepal, respectively, as their relative distance to the GovTech frontier is higher than other regional peers.

DIGITALIZATION AND HEALTH SPENDING EFFICIENCY

Can digitalization improve the efficiency of health spending execution? Digital payments and e-procurement have the potential to improve the health budget execution process and simplify the provision and management of public health resources. This section uses a stochastic frontier analysis whereby the health system outcomes of average life expectancy at birth and infant mortality rates ($Health_{i,t}$) are regressed on inputs $X_{i,t-1}$, such as the level of resources made available and the level of development (Equation 6.2).[8] The compound error term $\epsilon_{i,t}$ comprises a normally distributed error term $u_{i,t}$, and a disturbance $v_{i,t}$ representing the distance of each country's error term to the frontier (Equation 6.3).[9] The latter is assumed to follow a truncated normal distribution multiplied by a function of time, t, where T_i is the last period observed in the ith country, and η is a decay parameter (Equation 6.4).[10] The estimated time-varying country-specific

[8] Grigoli and Kapsoli (2018) discussed the advantages of stochastic frontier analysis in estimating health spending efficiency.

[9] The stochastic frontier analysis estimates a frontier of best-performing countries that obtain higher outcomes for a given level of inputs. The method then yields efficiency scores for each country by comparing its outcome and inputs to the reference set of the best-performing countries.

[10] See Battese and Coelli (1992) for further details on the estimation procedure used.

technical efficiency is obtained through $TE_{i,t} = \exp\{(-v_{i,t})\}\ \varepsilon_{i,t}$, and is regressed upon potential determinants of health spending efficiency that include the GovTech index, the telecommunication infrastructure index ($Tcom_{i,t}$), and pre determined variables $Z_{i,t-1}$, such as GDP per capita, the ratio of births attended by skilled health staff, the urban population share, the income Gini index, and the universal health coverage index. Country-fixed effects are included to capture the possibility of time-invariant heterogeneity in efficiency (Greene 2004).

$$Health_{i,t} = \alpha_i + X_{i,t-1} \bullet \theta + \varepsilon_{i,t} \tag{6.2}$$

$$\varepsilon_{i,t} = u_{i,t} + v_{i,t} \tag{6.3}$$

$$v_{i,t} = \exp\{-\eta(t-T_i)\} \bullet v_i \tag{6.4}$$

$$TE_{i,t} = \alpha_i + \beta \bullet GovTech_{i,t} + \gamma \bullet TCom_{i,t} + \theta \bullet Z_{i,t-1} + u_{i,t} \tag{6.5}$$

The results suggest that both government digitalization as well as telecommunication infrastructure quality are positively correlated with the estimated efficiency in health spending (Table 6.9). All else being equal, better e-government services are associated with higher efficiency of health spending in increasing life expectancy and lower inefficiency of health spending in reducing infant mortality. The accompanying figure shows the estimated gains in health outcomes from bridging the gap to the GovTech frontier. Maldives and Nepal would obtain the highest increase in life expectancy by about 0.9 and 0.7 years, respectively. Similarly, Nepal and Bhutan would benefit the most among South Asian countries in reducing their infant mortality rates by 1.9 and 1.6 percentage points, respectively. Higher GDP per capita and higher health spending are associated with better health outcomes (frontier equation). Health systems tend to be more efficient in countries that are more developed or have a greater share of their population living in urban areas (efficiency equation). Also, health spending efficiency is higher for countries that deploy more skilled health staff to attend births or cover a greater share of essential health services as proxied by the universal health coverage index.[11]

DIGITALIZATION AND EDUCATION SPENDING EFFICIENCY

Are e-governments better at providing access to education? Digital approaches to remote learning during the pandemic underscored the need to promote e-education along with e-government. In this section, we examine whether e-governments tend to be more efficient in administering education spending to achieve better education outcomes. The stochastic frontier analysis described in the previous section is used with education spending per capita and GDP per

[11] The results are in line with the data envelopment analysis of Garcia-Escribano, Juarros, and Mogues (2022) who also documented that increasing universal health coverage coverage improves health spending efficiency.

TABLE 6.9.

Stochastic Frontier Analysis: Health Spending Efficiency

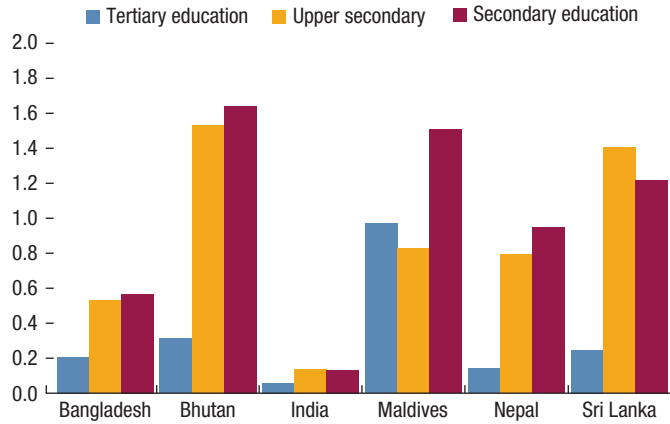
	Frontier Equation							
	Life Expectancy				Infant Mortality			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Health spending per capita	0.006***	0.006***	0.006***	0.006***				
	(0.002)	(0.002)	(0.002)	(0.002)				
GDP per capita	0.028***	0.028***	0.028***	0.028***				
	(0.002)	(0.002)	(0.002)	(0.002)				
Health spending per capita					−0.045***	−0.045***	−0.045***	−0.045***
					(0.012)	(0.012)	(0.012)	(0.012)
GDP per capita					−0.200***	−0.200***	−0.200***	−0.200***
					(0.022)	(0.022)	(0.022)	(0.022)
No. of observations	1891	1891	1891	1891	1967	1967	1967	1967
	Efficiency Equation							
	Life Expectancy				Infant Mortality			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GovTech index	0.023***	0.018***	0.006	0.008**	−0.000***	−0.000***	−0.000***	−0.000***
	(0.006)	(0.006)	(0.004)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)
Telecommunications index	0.074***	0.063***	0.041***	−0.004	−0.001***	−0.001***	−0.000***	−0.000
	(0.008)	(0.009)	(0.006)	(0.006)	(0.000)	(0.000)	(0.000)	(0.000)
GDP per capita		0.025**	0.012**	0.026***		−0.000**	−0.000**	−0.000
		(0.011)	(0.006)	(0.008)		(0.000)	(0.000)	(0.000)
Skilled health staff			0.000***	0.000***			−0.000***	−0.000***
			(0.000)	(0.000)			(0.000)	(0.000)
Urban population rate			0.108***	0.048			−0.000***	−0.000**
			(0.036)	(0.054)			(0.000)	(0.000)
Universal health coverage index				0.000*				−0.000**
				(0.000)				(0.000)
Gini index				0.000				−0.000
				(0.000)				(0.000)
No. of observations	1886	1886	1005	85	1963	1963	1038	85
No. of countries	173	173	164	51	180	180	168	51
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.43	0.45	0.67	0.74	0.43	0.46	0.72	0.79

Source: IMF staff calculations.

Note: Robust standard errors are in parentheses. The dependent and independent variables of health spending, GDP per capita, and urban population rate are expressed in logs.

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

Figure 6.12. GovTech Frontier Impact on Education Outcomes
(Change in the ratio of total enrollment)



Sources: World Bank's World Development Indicators; and IMF staff estimates.

capita as the main inputs to generate education outcomes, such as school enrollment in secondary, upper secondary, and tertiary education (Equation 6.6). The estimation is carried out following a similar structure to Equations (6.3)–(6.5). The technical efficiency estimates obtained from Equation (6.6) are regressed upon determinants of education spending efficiency that include the GovTech index, the telecommunication infrastructure index, the level of development, the share of the population with access to basic sanitation, the urban population share, and the income Gini index.[12]

$$Education_{i,t} = \alpha_i + X_{i,t-1}\,\theta + \varepsilon_{i,t} \qquad (6.6)$$

Countries with stronger e-governments tend to have higher efficiency of education spending in enrolling secondary, upper secondary, and tertiary students (Table 6.10). Gross enrollment rate refers to the ratio of total enrollment to the population of the age group that officially corresponds to the level of education shown. Higher education spending and level of development are associated with better education outcomes. More advanced government digitalization is correlated with lower inefficiency in education spending for a given level of development and telecommunication infrastructure. The results are statistically significant for gross enrollment ratios in secondary and upper levels of education, while they are less strong for primary education students, where countries have already achieved higher enrollment rates. The estimated gains in education outcomes from bridging the gap to the GovTech frontier are shown in Figure 6.12. These gains are among the highest in the region for Bhutan, as its gross enrollment ratios in secondary and upper secondary education would increase by about 1.6 and 1.5 percentage points, respectively. Similarly, Maldives would increase its gross

[12] See Grigoli (2014), Herrera and Pang (2005), Herrera and Abdoulaye (2018), and Wagstaff and Wang (2011) for including similar determinants of education spending efficiency.

TABLE 6.10.

Stochastic Frontier Analysis: Education Spending Efficiency

	Frontier Equation								
	Secondary			Upper Secondary			Tertiary		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Education spending per capita	0.033	0.033	0.033						
	(0.021)	(0.021)	(0.021)						
GDP per capita	0.191***	0.191***	0.191***						
	(0.025)	(0.025)	(0.025)						
Education spending per capita				0.021	0.021	0.021			
				(0.037)	(0.037)	(0.037)			
GDP per capita				0.346***	0.346***	0.346***			
				(0.042)	(0.042)	(0.042)			
Education spending per capita							0.152***	0.152***	0.152***
							(0.044)	(0.044)	(0.044)
GDP per capita							0.399***	0.399***	0.399***
							(0.055)	(0.055)	(0.055)
No. of observations	531	531	531	535	535	535	518	518	518
	Efficiency Equation								
	Secondary			Upper Secondary			Tertiary		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GovTech index	0.036***	0.024**	0.011*	0.042***	0.027**	0.017**	0.040***	0.020*	0.006
	(0.006)	(0.010)	(0.005)	(0.006)	(0.011)	(0.006)	(0.008)	(0.011)	(0.008)
Telecommunications index	0.057***	0.028	−0.035	0.088***	0.052**	−0.012	0.105***	0.056**	0.040**
	(0.020)	(0.020)	(0.024)	(0.022)	(0.020)	(0.025)	(0.020)	(0.021)	(0.018)
GDP per capita		0.067**	0.075***		0.083**	0.079**		0.092***	0.093***
		(0.028)	(0.018)		(0.032)	(0.029)		(0.022)	(0.020)
Urban population rate			0.060			0.159			0.005
			(0.129)			(0.125)			(0.074)
Gini index			−0.001			−0.001			0.001
			(0.001)			(0.001)			(0.001)
Basic sanitation			0.082***			0.079***			0.057**
			(0.022)			(0.026)			(0.024)
No. of observations	152	152	53	152	152	53	114	114	39
No. of countries	28	28	20	28	28	20	21	21	14
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.50	0.59	0.84	0.57	0.66	0.89	0.70	0.81	0.93

Source: IMF staff calculations.

Note: Robust standard errors are in parentheses. The dependent variables of gross enrollment rates, the independent variables of education spending, GDP per capita, and urban population rates are expressed in logs.
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

enrollment ratio in tertiary education by 1 percentage point. The estimates also suggest that countries with better access to basic sanitation services and more advanced telecommunication infrastructure tend to have better education spending efficiency.

CONCLUSIONS

Scaling up the use of GovTech solutions by South Asia's public administrations offers significant potential in transforming service delivery and mobilizing resources. Countries with more digitalized government services tend to have higher efficiency in generating fiscal revenue and achieving higher outcomes from their health and education spending. The COVID-19 pandemic has accelerated the e-government transition that was already underway in the region. However, to reap the full dividends of the GovTech revolution, it is important that institutional frameworks are in place to safeguard against risks related to cybersecurity, digital exclusion, fraud, and privacy infringement.

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