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Infrastructure in Central, Eastern, and Southeastern Europe

Benchmarking, Macroeconomic Impact, and Policy Issues

Anil Ari, David Bartolini, Vizhdan Boranova, Gabriel Di Bella, Kamil Dybczak, Keiko Honjo, Raju Huidrom, Andreas Jobst, Nemanja Jovanovic, Ezgi Ozturk, Laura Papi, Sergio Sola, Michelle Stone, and Petia Topalova

No. 20/11

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Cataloging-in-Publication Data
IMF Library

Names: Ari, Anil. | Bartolini, David. | Boranova, Vizhdan. | Di Bella, Gabriel. | Dybczak, Kamil. | Honjo, Keiko. | Huidrom, Raju. | Jobst, Andreas. | Jovanovic, Nemanja. | Ozturk, Ezgi. | Papi, Laura. | Sola, Sergio. | Stone, Michelle (Economist). | Topalova, Petia. | International Monetary Fund. European Department, issuing body. | International Monetary Fund. Fiscal Affairs Department, issuing body. | International Monetary Fund, publisher.
Title: Infrastructure in Central, Eastern, and Southeastern Europe : benchmarking, macroeconomic impact, and policy issues / Anil Ari, David Bartolini, Vizhdan Boranova, Gabriel Di Bella, Kamil Dybczak, Keiko Honjo, Raju Huidrom, Andreas Jobst, Nemanja Jovanovic, Ezgi Ozturk, Laura Papi, Sergio Sola, Michelle Stone, and Petia Topalova.
Other titles: Benchmarking, macroeconomic impact, and policy issues. | International Monetary Fund. European Department (Series). | International Monetary Fund. Fiscal Affairs Department (Series).
Description: Washington, DC : International Monetary Fund, 2020. | Departmental paper series. | Includes bibliographical references.
Identifiers: ISBN 9781513550558 (paper)
Subjects: LCSH: Infrastructure (Economics)—Government policy—Europe. | Benchmarking (Management)—Europe. | Europe—Economic policy.
Classification: LCC HC79.C3 A75 2020

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Acknowledgments

The authors are grateful to Jörg Decressin, Alfonso Garcia Mora, Torben Hansen, Ben Hunt, Yuko Kinoshita, Ceyla Pazarbasioglu, Carolina Renteria Rodriguez, Gerd Schwartz, Michal Andrle, Emine Boz, Ezequiel Cabezon, and colleagues from the IMF and the Office of the Executive Directors for their comments and suggestions. We would also like to thank participants in IMF seminars for fruitful discussions and useful feedback. We are grateful to Abdul Abiad from the Asian Development Bank, Makhtar Diop from the World Bank, and Debora Revoltella from the European Investment Bank for serving as external reviewers, and to Olivier Debande, Edward Farquharson, Peter McGoldrick, Aristeidis Pantelias, Patricia Wruuk (all EIB), Silva Anderson Caputo, Vivien Foster, Catalina Garcia-Kilroy, and Maria Vagliasindi (all World Bank) for constructive comments.

The authors are indebted to CESEE country authorities for taking the time to complete the survey on public investment management frameworks and infrastructure risks and provide comments.

The authors would also like to thank Nomelie Veluz for formatting assistance and Christian Schmieder and Gonzalo Martinez Torres for data support on infrastructure finance.

Thanks are also due to Houda Berrada for leading the editorial and production process and Karina Manasseh and Natalie Ramirez-Djumena for outreach assistance.

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Glossary

3SI	Three Seas Initiative
3SIIF	Three Seas Initiative Investment Fund
CESEE	Central, Eastern, and Southeastern Europe
CSRs	country-specific recommendations
CT	computerized tomography
EC	European Commission
EFSI	European Fund for Strategic Investment
EIB	European Investment Bank
EM	emerging markets
EMDE	emerging market and developing economies
EU	European Union
EU15	European Union-15
FTE	Fiscal Transparency Evaluations
GDP	gross domestic product
GHG	greenhouse gases
GIMF	Global Integrated Monetary and Fiscal model

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ICT	information and communication technology
LCCR	low-carbon, climate-resilient
MFF	Multiannual Financial Framework
MRG	minimum revenue guarantees
MRI	magnetic resonance imaging
PBCE	Project Bond Credit Enhancement
PFRAM	IMF-World Bank PPP Fiscal Risk Assessment Module
PIM	Public Investment Management
PIMA	IMF Public Investment Management Assessment
PPP	public-private partnership
SOE	state-owned enterprise
WB	Western Balkan region
WBIF	Western Balkans Investment Framework
WDI	World Development Indicators
WEF	World Economic Forum
WEO	*World Economic Outlook*

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Executive Summary

Countries in Central, Eastern, and Southeastern Europe (CESEE) have made remarkable economic progress in the last 30 years and aspire to further improve living standards toward the level of the more advanced European economies—the EU15. Infrastructure investment is a key priority for CESEE to accelerate convergence. In the context of the COVID-19 pandemic, it has also gained ground as a tool to support activity in the recovery phase. With considerable slack in the economy, infrastructure investment can have high multipliers, besides boosting the economy's productive capacity in the longer term and potentially accelerating the green and digital transitions. Several initiatives currently aim to strengthen infrastructure in CESEE.

In this paper, we benchmark the availability of physical infrastructure in CESEE versus the EU15; estimate the macroeconomic impact of public investment in the region, including when conducted in a coordinated manner across countries; and discuss how to make the most of such investment.

Although there is significant cross-country variation, CESEE lags the EU15 in the quantity and quality of infrastructure. Our illustrative estimates suggest that closing 50 percent of the current gaps relative to the EU15 in terms of infrastructure quantity by 2030 could cost between 3 percent and 8 percent of GDP annually—more would be needed to make the investment climate-resilient and green.

Narrowing these infrastructure gaps can have a significant impact on CESEE's output. Our analysis suggests sizable multipliers—increase in output for a euro spent on infrastructure—both in the short term (0.5–0.8) as well as in the long term (1.7–2.5). We confirm previous findings of larger multipliers during recessions and in countries with stronger infrastructure governance. Over the longer term, scaling up infrastructure investment can speed up CESEE convergence, especially when conducted in a coordinated

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manner across countries. Our model simulations suggest that if the efficiency of public investment in CESEE were to rise to EU15 levels and coordinated investment were to improve connectivity, the output dividend would almost double in the long term. If appropriately calibrated, infrastructure investment need not compromise fiscal or external sustainability.

Infrastructure investment, however, comes with significant challenges and risks. As in other countries, CESEE's infrastructure projects suffer from implementation delays and cost overruns. These, in turn, are manifestations of weaker infrastructure governance, though countries differ considerably. Hence, strengthening infrastructure governance—including for state-owned enterprises, to achieve more effective and integrated public investment and risk management—is critical. Attracting greater private sector participation raises the stakes for more effective infrastructure governance, especially of public-private partnerships.

Cross-border projects could magnify the benefits of infrastructure investment but entail greater coordination challenges and additional risks. More successful cross-border projects appear to be those with clear payoffs for individual countries, and those governed by the EU framework as a basis for transparency and coordination.

Scaling up public investment as part of the recovery from the pandemic presents an opportunity to strengthen digital and green infrastructure. With budgets stretched and high uncertainty, achieving value for money will be even more relevant.

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CHAPTER

1 Introduction

In the past 30 years, countries in Central, Eastern, and Southeastern Europe (CESEE) have made remarkable strides toward growth and convergence.[1] These countries have transformed from centrally planned into market-based economies, and since 2004, 11 CESEE countries have become members of the European Union (EU). After rising steadily since the mid-1990s, CESEE's per capita income now stands at about 55 percent of that of the EU15 (Figure 1).[2] CESEE-EU economies have been particularly successful—their income levels have reached about 70 percent of the EU15 level.

Nevertheless, CESEE economies aspire to further improve living standards and converge to the EU15. Following a slowdown in medium-term growth after the global financial crisis, IMF (2016) argues for infrastructure investment to remedy capital deficiencies to get back on the fast convergence path, in addition to labor market policies to counter adverse demographics and enhanced institutional quality and government efficiency to boost productivity. A number of studies have identified infrastructure bottlenecks as obstacles to CESEE's faster convergence (Atoyan and others 2018; Bubbico and others 2017; OECD 2007; Zuk and others 2018). The need to improve connectivity within the region has been highlighted by EC (2017, 2018a) and EIB (2018a, 2018b). With IMF (2017) and Batog and others (2019) having

[1]CESEE includes Albania, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Kosovo, Latvia, Lithuania, Moldova, Montenegro, North Macedonia, Poland, Romania, Russia, Serbia, the Slovak Republic, Slovenia, Turkey, and Ukraine. Of these, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic, and Slovenia are members of the European Union, which we refer to as CESEE-EU.

[2]The EU15 includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom. While the United Kingdom left the EU in 2020, for the purposes of this study, it is included in the EU15.

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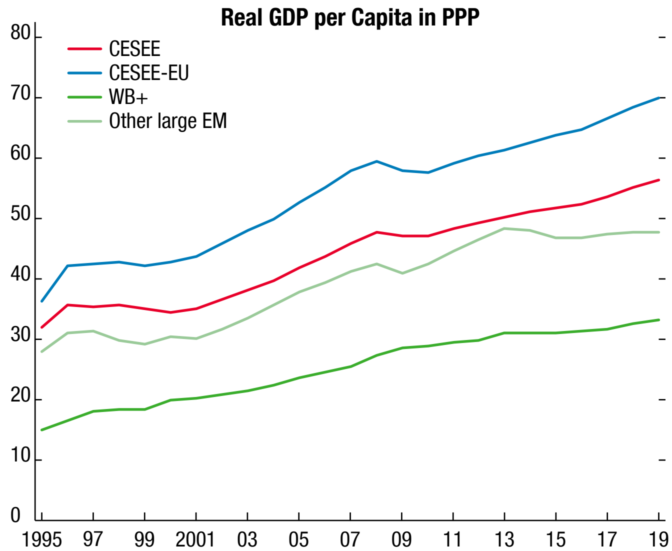
Figure 1. Income Convergence of CESEE Countries to the EU15
(Percent of EU15)



Sources: IMF, *World Economic Outlook*; and IMF staff calculations.
Note: The lines represent the average per capita GDP in purchasing power parity (PPP) terms for each group of countries as a share of the EU15 average, where the country group average is weighted by GDP PPP. CESEE-EU includes Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic, and Slovenia. Other large emerging markets (Other large EM) includes Russia, Turkey, and Ukraine. Western Balkans plus (WB+) includes Albania, Belarus, Bosnia and Herzegovina, Kosovo, Moldova, Montenegro, North Macedonia, and Serbia.

explored CESEE's institutions and demographics, respectively, this paper focuses on infrastructure.[3]

In the context of the COVID-19 pandemic, infrastructure investment has gained ground as a policy tool for the recovery phase. Boosting infrastructure spending could support activity given its high multiplier in downturns. Over the longer term, more and better infrastructure investment could boost potential output, while making the physical capital stock more resilient and climate sensitive. For CESEE-EU, this objective would be consistent with the European Commission's (EC) call to protect public investment and focus on green and digital priorities.

[3]Infrastructure comprises both economic infrastructure (basic structures that facilitate and support economic activity such as roads and other transportation facilities, power generation, water and sanitation, other utilities, and communications systems) and social infrastructure (for example, healthcare, education, public spaces). The main focus of this study is economic infrastructure, namely roads, railways, air transport, power generation capacity, and internet, fixed and mobile telephone density. We do not cover water and sanitation, as the gaps between CESEE and the EU15 are significantly smaller in these sectors. Box 2 discusses select measures of healthcare infrastructure.

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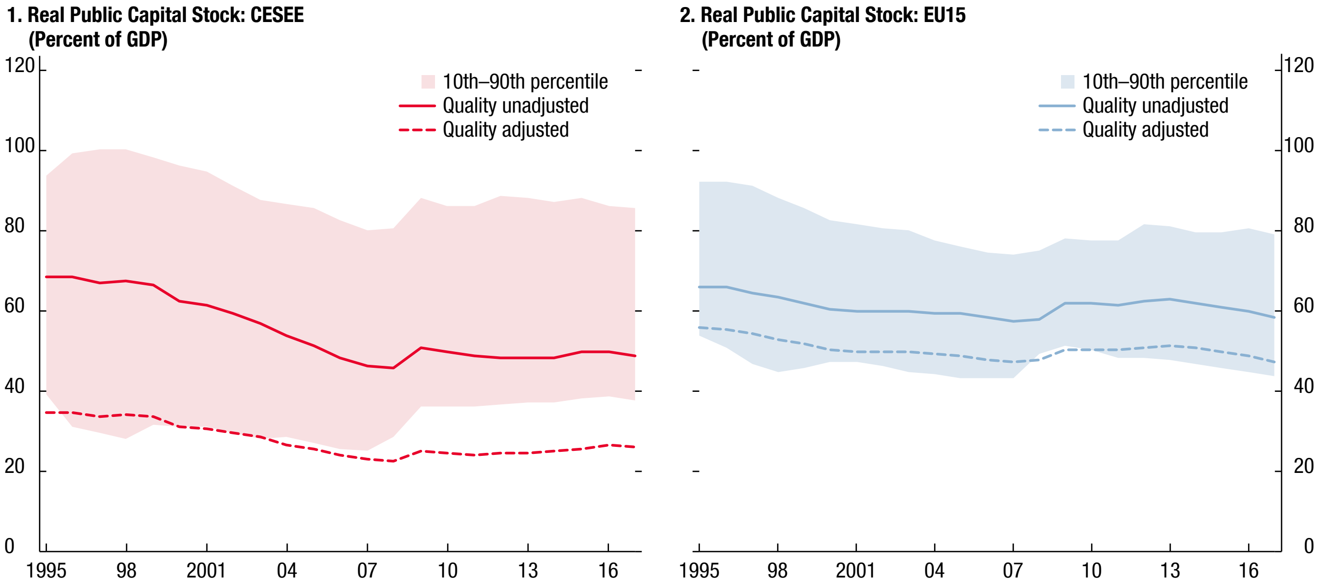
Figure 2. Public Capital Stock and Public Investment



Sources: IMF, Fiscal Monitor database; World Economic Forum; and IMF staff calculations.
Note: The quality adjusted measure is based on the World Economic Forum measure of overall infrastructure quality, which relies on business executives' assessments. Following IMF (2014), the adjustment marks down public investment flow in each period by the infrastructure quality score, which is then used to compute the stock of public capital next period. Lines indicate the GDP PPP-weighted average in each group. Bands indicate the respective cross-sectional 10th–90th percentile range. PPP = purchasing power parity.

CESEE countries have long sought to improve public infrastructure, both domestically and via regional initiatives (Box 1). With these efforts, CESEE has moved closer to the level of public capital stock in the EU15, a natural benchmark peer group. Yet gaps remain. CESEE's stock of public capital has not kept pace with output since the mid-1990s and is currently some 10 percentage points below the EU15 stock of public capital as a share of output (Figure 2). The gap is even more pronounced when infrastructure quality is taken into account. Public capital stock in per capita terms as well as physical measures of infrastructure—such as kilometers of roads and kilowatts of power generation capacity per capita—reveal similar deficiencies.

Despite its potential for sizable macroeconomic benefits, infrastructure investment comes with significant challenges and risks (Schwartz and others 2020). Long delays and large cost overruns are not uncommon, infrastructure projects can entail fiscal risks and offer opportunities for corruption. Cross-border infrastructure projects add layers of complexity, notably related to coordination challenges, inconsistent regulatory frameworks across countries, and varied levels of governance and creditworthiness. The pandemic has also adversely affected public investment as some projects had to be postponed or cancelled. In CESEE, some of these challenges are magnified. Weaker gov-

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ernance and transparency, including in state-owned enterprises (SOE), make these countries more vulnerable to the risks inherent in infrastructure projects (IMF 2017a, Darwin and others 2019, Richmond and others 2019, Akitoby and others 2020). Together with shallow capital markets, these weaknesses weigh on private sector participation in infrastructure (Bubbico and others 2017, IMF 2016).

This paper presents a comprehensive analysis of infrastructure in CESEE. First, it provides an assessment of infrastructure deficiencies in the region relative to the EU15 and estimates the cost of narrowing these gaps (Chapter 2). Second, it analyzes the macroeconomic impact of boosting infrastructure investment using both empirical estimates and model-based simulations (Chapter 3). The paper presents new evidence of the effect of scaling up public investment in CESEE countries and the implications of cross-border projects. We also examine the role of investment efficiency, different financing options, and the economic cycle in shaping the macroeconomic response of higher investment. Third, using information collected from novel surveys of CESEE authorities, the paper presents an in-depth analysis of key policy issues (Chapter 4), including enhancing infrastructure governance, managing fiscal risks including those related to cross-border projects, mobilizing private sector participation, and addressing issues arising in the post-pandemic context.

The main findings are as follows:

- Although there is significant cross-country variation, CESEE lags the EU15 in terms of public capital and various measures of physical infrastructure. Our illustrative estimates suggest that closing 50 percent of the current physical infrastructure gaps with the EU15 by 2030 could cost 3–8 percent of GDP annually—more to make the investment climate-resilient and green. While these cost estimates should not be interpreted as recommended investment—many other considerations determine the envelope of infrastructure investment, such as detailed analysis of the pool of savings, available policy space, depth of the financial sector and access to external finance, absorptive and technical capacity, and expected demand for various infrastructure services—they are suggestive of sizable investment needs in some of the countries in the region.
- Narrowing the infrastructure gaps could significantly boost CESEE's output and convergence. We estimate sizable multipliers—increase in output for a euro spent on infrastructure—in CESEE, both in the short term (0.5–0.8) and in the long term (1.7–2.5). Larger multipliers during recessions suggest infrastructure investment can play a key role in supporting activity during the recovery phase from the pandemic. Model-based simulations highlight greater output dividends in countries with better

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infrastructure governance and for cross-border projects that improve connectivity and lower trade costs. Infrastructure investment—if appropriately calibrated—need not compromise fiscal and external sustainability.

- Stronger infrastructure governance incorporating effective public investment and risk management could raise the benefits of infrastructure spending. While there is significant variation across countries, CESEE has considerable room to improve infrastructure governance, especially in medium-term budgeting, project appraisal and selection, procurement, and project implementation management. CESEE authorities also reveal gaps in fiscal risk analysis and management, implying scope to strengthen the institutional arrangements for effective and integrated risk management and transparency. An IMF Public Investment Management Assessment (PIMA) could help countries develop tailored action plans toward better infrastructure governance and leverage the higher marginal returns from investment in economies with lower infrastructure stock.
- Raising private sector participation is desirable as it could raise efficiency in service provision and increase the financing envelope. However, to achieve higher efficiency, better service provision and long-term benefits, it should be accompanied by more effective public investment and risk management, including in public-private partnerships (PPPs). The IMF–World Bank PPP Fiscal Risk Assessment Module (PFRAM 2.0) can help assess PPP design options and long-term fiscal consequences. Widening risk mitigation options for private investors, while prudently managing public risks and ensuring value for money, may also be needed. Attracting greater domestic financing, especially by CESEE's long-term institutional investors, would be desirable, but might require reviewing investment regulations to allow higher limits in infrastructure, while maintaining an appropriate level of risk.
- More successful cross-border projects appear to be those with clear payoffs for individual countries, and those governed by the EU framework as a basis for transparency, adherence to international standards, better planning, and greater coordination.

An infrastructure push can form an essential part of the policy response during the post-pandemic recovery phase. Nevertheless, the crisis has also complicated scaling up public investment and put even greater premium on good governance, including for SOEs. It will be important to reprioritize investments toward digital and green infrastructure. With budgets stretched and high uncertainty impacting investment decisions, achieving value for money and ensuring optimal risk allocation in "bankable" projects will become even more relevant.

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Box 1. Regional Infrastructure Initiatives in CESEE and EU Investment Plans

Several initiatives aim to address infrastructure needs in CESEE. Although these span both national and regional projects, this box focuses on regional initiatives to improve connectivity and strengthen cross-country cooperation. Some are sponsored by international institutions, others by governments from inside and outside the region.

CESEE countries that are EU members benefit from several EU infrastructure programs. The EC's Investment Plan for Europe, known as the Juncker Plan, was first announced in 2014, with the European Fund for Strategic Investment (EFSI) as its central pillar. The EFSI supports investments in energy efficiency, digital technology, health and social projects by providing a first loss guarantee, which allows the European Investment Bank Group (the European Investment Bank [EIB] and the European Investment Fund [EIF]) to invest in more, often riskier, projects. In 2016, EFSI was extended to 2020 and its initial investment target was raised to at least €500 billion (about 3.5 percent of 2019 EU GDP). In July 2020, the approved EFSI financing generated €514 billion worth of investments, one-tenth of which in CESEE-EU. In early 2018, the EC proposed to establish the InvestEU Program as part of the EU Multiannual Financial Framework (MFF) for 2021–27, which brings under one roof the EFSI and 13 EU financial instruments and aims to mobilize investments of at least €650 billion (about 4.5 percent of 2019 EU GDP) in four main areas: sustainable infrastructure; research, innovation and digitalization; small- and medium-sized businesses; and social investment and skills.

In July 2020, the European Council approved a recovery package, dubbed Next Generation EU, to finance investment in a "green, digital, and resilient Europe" (EC 2020). It envisages a one-off augmentation to the 2021–27 MFF, funded by €750 billion of EU debt issuance to be repaid over 30 years partially via national contributions and new tax receipts accruing to the EU budget. More than half of the funds (€390 billion) would be disbursed as grants over the next three years mostly through the Recovery and Resilience Facility (RRF), and the rest would take the form of loans to governments, top-ups of EU structural funds and additional budgetary guarantees to the EIB Group to mobilize private investment (EC 2018a and 2018b).

From the perspective of infrastructure finance in CESEE-EU, three points are relevant:

- Based on indicative allocation keys, CESEE-EU countries are likely to benefit considerably from the RRF, with a projected allocation up to €212 billion of grants and loans (5¾ percent of CESEE-EU GDP) to fund public investment under national recovery and resilience plans. Countries' National Energy and Climate Plans, which are reviewed by the EC, will be used to ensure that investments are consistent with EU's long-term climate objectives.

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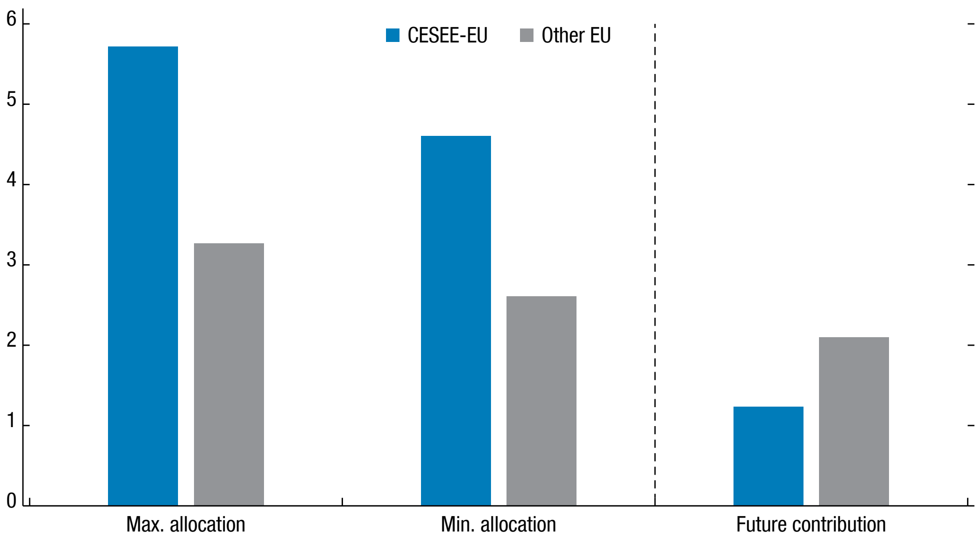
Box 1. Regional Infrastructure Initiatives in CESEE and EU Investment Plans *(continued)*

Figure 1.1. Proposed Next Generation EU Package: Expected Allocation and Future Contribution
(Percent of GDP)



Sources: European Commission (2020); European Council (2020); and IMF staff calculations.
Note: The maximum allocation includes all grants countries could receive under the proposed allocation key across all grant elements of the Next Generation EU package, including those available under the Recovery and Resilience Fund, and the highest possible loan amount available for each country under the Recovery and Resilience Fund. The minimum allocation assumes that countries will receive only proposed grants from the Recovery and Resilience Fund, and the allocation of loans is capped at 4.7 percent of GNI per member state. Future contribution refers to the grant amount of the package member states need to contribute via transfers or by boosting the European Commission's budget over the next 10 years.

- The package increases EU funding for private participation in infrastructure through the scale-up of the InvestEU Program (€5.6 billion), which aims to develop strong and independent value chains, such as critical infrastructure, technologies, and health care.
- The current cohesion policy program will be increased by €47.5 billion, of which a large part is expected to flow to CESEE-EU.

The Western Balkans Investment Framework (WBIF) was launched in 2009 by the EC, international financial institutions and bilateral donors to enhance cooperation in strategic investments in the energy, environment, social, transport, and digital infrastructure sectors. Over the past 10 years, WBIF has allocated €1.3 billion in grants for some €20 billion investments. One of the main priorities of this initiative is to support the Connectivity Agenda, which the EU launched in 2015 to improve key transport and energy connections in the Western Balkans (EC 2018d).

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Box 1. Regional Infrastructure Initiatives in CESEE and EU Investment Plans *(continued)*

In addition to EU initiatives, the Three Seas Initiative (3SI), established in 2016, is a forum of the 11 CESEE-EU countries and Austria to promote cooperation for the development of cross-border infrastructure in the transport, energy, and digital sectors, improve interconnectedness from the Baltic to the Black and Adriatic Seas, and strengthen energy security. Its investment vehicle, the Three Seas Initiative Investment Fund (3SIIF), supplements public and EU funds by attracting institutional investors. As of June 2020, Poland and Romania had committed over €500 million in seed capital, while other Three Seas countries like Estonia, Hungary, and Latvia, as well as the United States, have announced their decision to commit to the Fund. 3SIIF aims to raise a total of €5 billion, including from private investors, to generate investments of up to €100 billion (Three Seas Initiative & Fund 2019).

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CHAPTER

2 Benchmarking Infrastructure in CESEE

Stylized Facts and Benchmarking

This chapter compares CESEE's infrastructure to that of the EU15 using a range of measures. Following IMF (2014), we first use the stock of public capital as a broad proxy for infrastructure. We then examine physical measures of infrastructure, such as kilometers of roads, to compare CESEE's infrastructure to the EU15. Public capital and infrastructure stock are closely related. A significant component of the public capital stock in most countries consists of infrastructure, and the public sector was and continues to be its main provider. However, there are differences: public capital can include non-infrastructure components, and infrastructure can also be provided by the private sector.[1] That said, public capital correlates strongly with infrastructure and has much better data coverage both over time and across countries.

The stock of public capital in per capita terms in CESEE is only about half of that of the EU15 (Figure 3, panel 1). Within CESEE, there is considerable heterogeneity with the Western Balkans having less than a third of the per capita capital stock of EU15 and the CESEE-EU closest to the EU15 level. The deficiency in CESEE's public capital stock is despite the fact that public investment rate (as percent of GDP) has remained comparable to or even exceeded that of the EU15 (Figure 3, panel 2) after the global financial crisis, reflecting the low base in CESEE's initial public capital stock.

We also use physical measures of infrastructure, covering the energy, transport, and information and communication technology (ICT) sectors, to more formally benchmark each CESEE country infrastructure to that of the

[1] For a detailed discussion of alternative measures of infrastructure investment, see, for instance, ADB (2017), Brutscher and Revoltella (2018), and Fay and others (2019).

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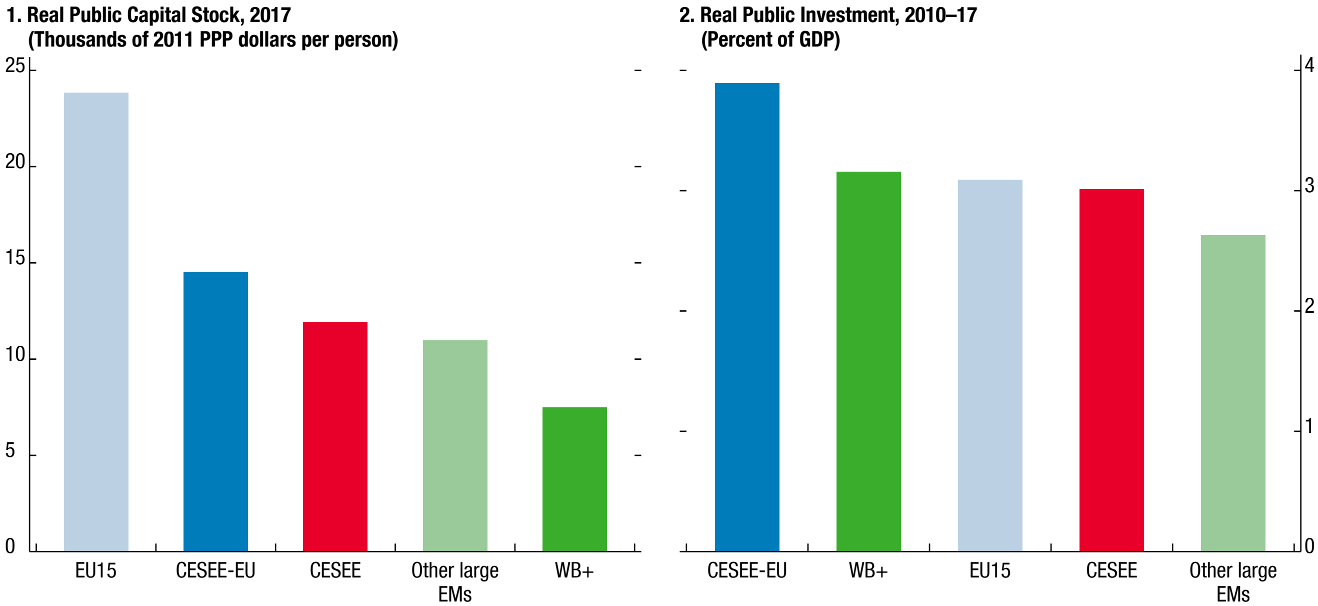
Figure 3. Public Capital Stock and Public Investment



Sources: IMF, Fiscal Monitor database; and IMF staff calculations.
Note: Bars in the figure indicate the weighted average in each country group. Weights used are population (panel 1) and GDP PPP (panel 2). See Figure 1 for country group definitions. PPP = purchasing power parity.

EU15. We exclude water and sanitation because CESEE gaps are significantly smaller than for the sectors considered.[2] In a basic benchmarking exercise, we compute the percent deviation for each infrastructure sector from the respective EU15 average. This approach is not need-based, meaning determinants of infrastructure—such as the desired level of development, and population dynamics—are not taken into consideration. We also estimate a simple econometric model of the demand for physical infrastructure, following a common approach in the literature (see Annex 1 for details). We estimate current investment gaps, defined as the amount needed to fill in deficiencies in infrastructure provision given the country's level of development. We then assess the desired infrastructure needed to move up the economic ladder, which is the amount consistent with the average EU15 level of per capita income. Our results are broadly consistent across the two approaches.

Physical infrastructure measures reveal considerable gaps between CESEE and the EU15 (Figure 4). Electricity generation per million people in CESEE, on average, is some 50 percent less than that of the EU15. However, this gap shows significant variation across CESEE countries—ranging from a shortfall of about 90 percent in Moldova to only about 10 percent in the Czech

[2]For instance, the share of population with access to basic water and sanitation services in CESEE is about 3–4 percentage points lower than the EU15 average.

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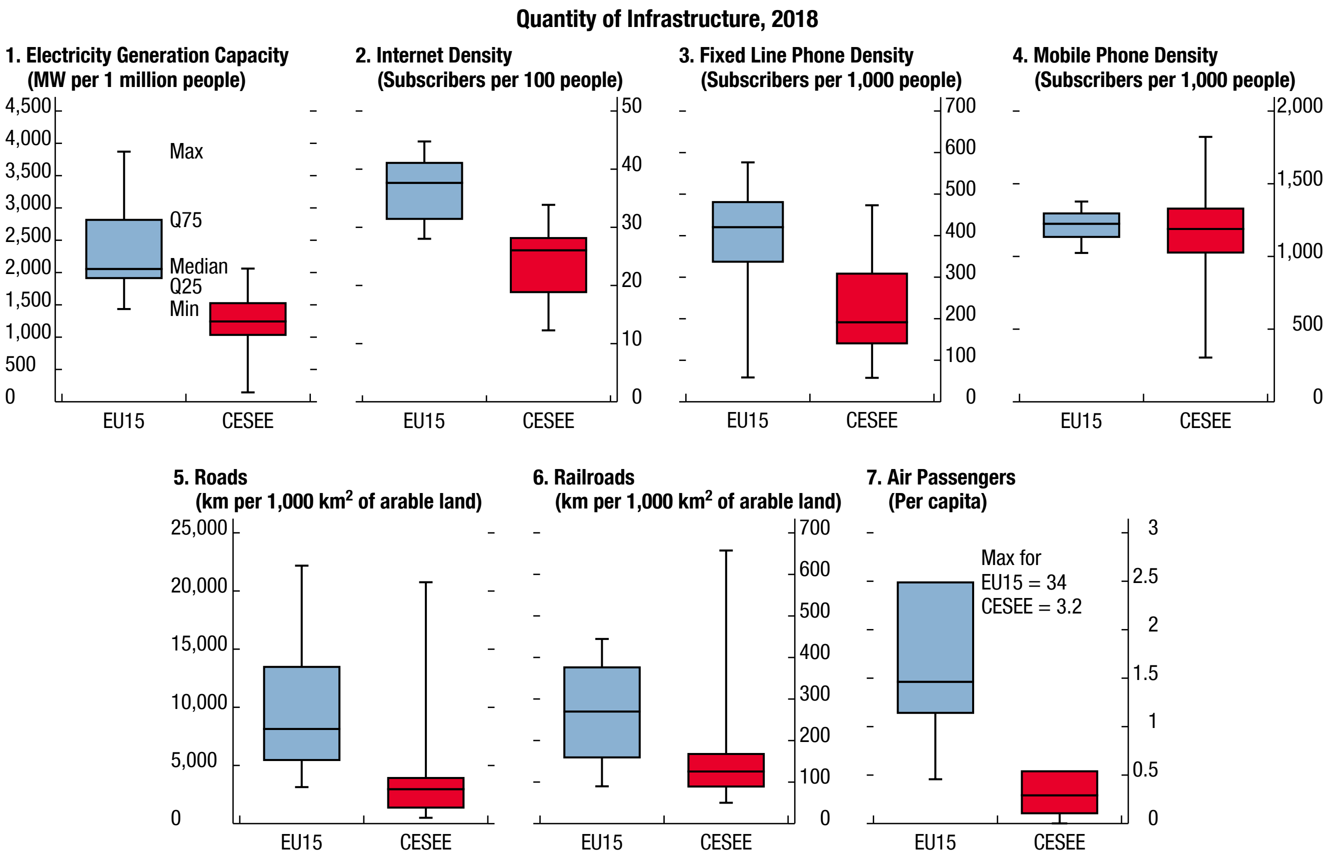
Figure 4. Physical Measures of Infrastructure Stock, 2018



Sources: Eurostat; national sources; World Bank, World Development Indicators; and IMF staff calculations.
Note: All panels show data for 2018 or the latest available year. The box denotes the 75th and 25th percentile, the line represents the median and the error bands, the minimum and maximum within the sample of countries, respectively.

Republic (Figure 5). In the transport sector, roads and railways in CESEE—normalized for arable land area—are, on average, some 60 and 40 percent below the EU15 level, respectively.[3] The variation in this sector is also notable with Slovenia exceeding EU15 levels, while Bulgaria, Kosovo, Moldova, and Ukraine have gaps of about 80 percent in roads, and Turkey has a gap of more than 75 percent in railways.[4]

[3]For roads and railways, we use arable land instead of total land area as some countries, such as Russia, have large uninhabitable areas. As a robustness check, we also normalize roads and railways by total land area and population size. Due to data constraints, we use total kilometers of roads available, without distinguishing between motorways, express roads and other types of road infrastructure.

[4]Better infrastructure in a sector is typically the outcome of an expressed public investment priority. For instance, Slovenia's railway density considerably outperforms the EU15 average, due to the surge in rail infrastructure investment in recent years, with the annual rail-related investment budget amounting to 0.75 percent of GDP per year.

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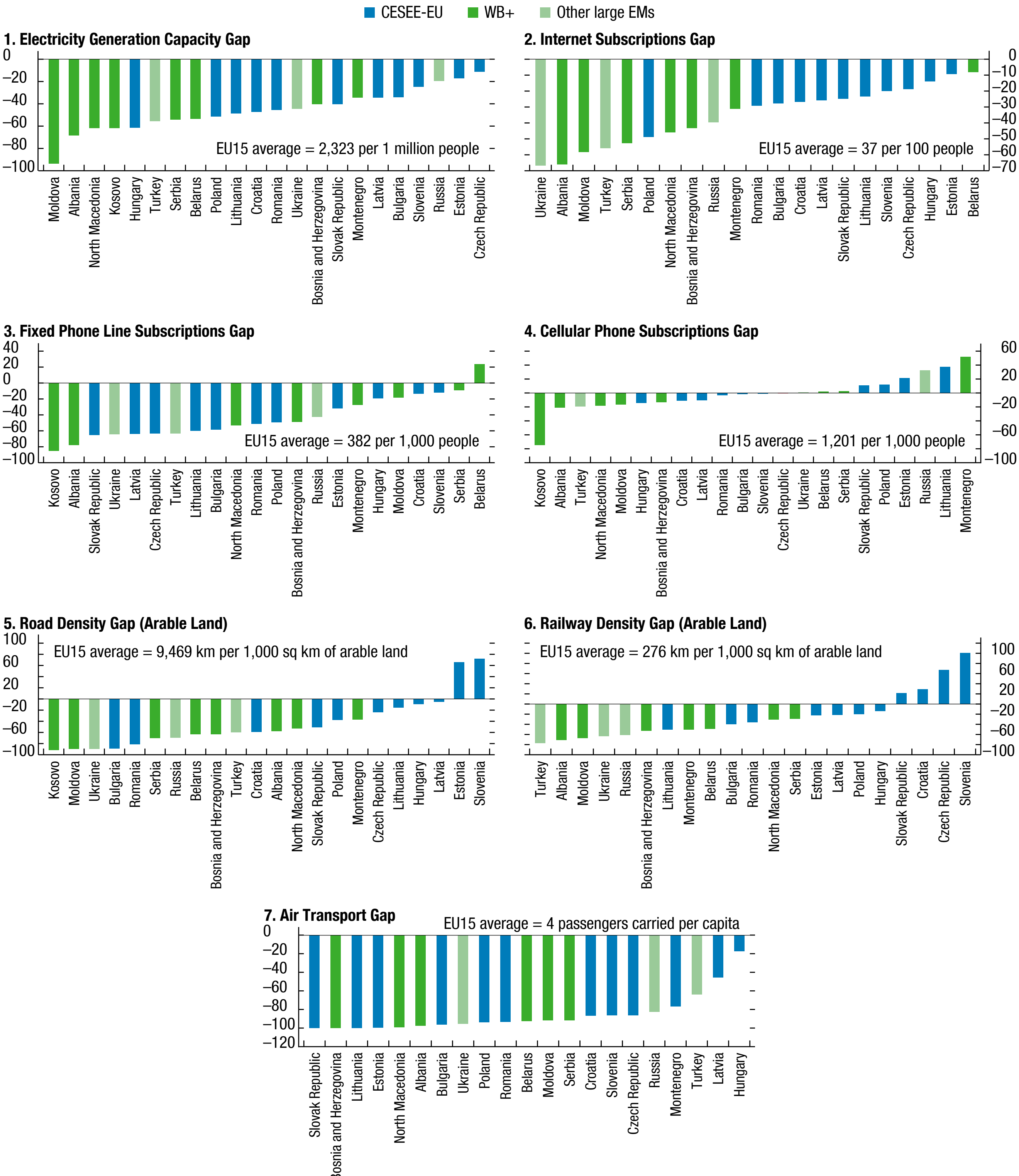
Figure 5. Public Infrastructure Gaps: Basic Benchmarking
(Percent of EU15 average)



Sources: Eurostat; national sources; World Bank, World Development Indicators; and IMF staff calculations.
Note: All calculations are based on 2018 or latest available year. Gaps are computed vis-à-vis the EU15 average. In the case of road and railway density, gaps are adjusted for population density. No data are available for internet subscriptions, railways, and air transport for Kosovo.

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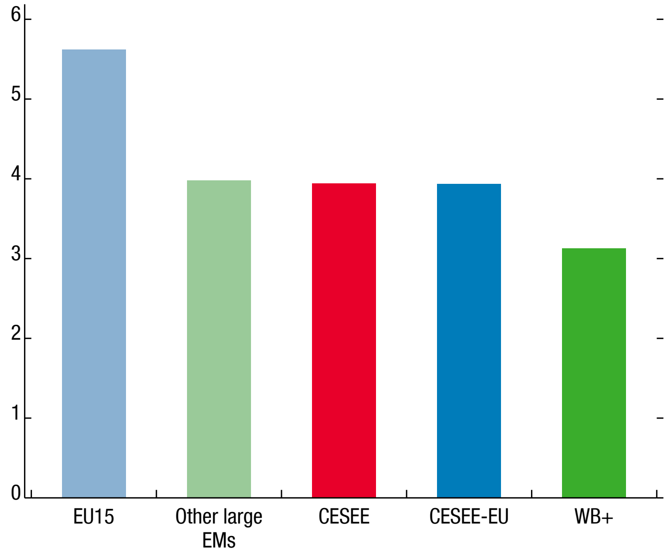
Figure 6. Quality of Overall Infrastructure, 2007–17
(1–7 [best] score)



Sources: World Economic Forum, *2019 Global Competitiveness Report*; and IMF staff calculations.
Note: The measure captures business executives' subjective assessments of the quality of different types of infrastructure stock. The bars represent the GDP PPP-weighted average across country groups. See Figure 1 for country group definition. PPP = purchasing power parity.

CESEE also lags in digital infrastructure, with significantly fewer internet subscriptions per 100 people than in the EU15. However, in mobile phone density, CESEE is close to EU15 levels, possibly a result of the active role of the private sector in mobile phone infrastructure. In all sectors, the gaps in CESEE-EU are somewhat smaller than the rest of CESEE. The estimation-based benchmarking results paint a similar picture as discussed in Annex 1.

CESEE also lags the EU15 in terms of the quality of infrastructure. Business executives' subjective assessment of the overall quality of infrastructure in CESEE is lower than in the EU15 (Figure 6).

While we have focused predominantly on economic infrastructure in CESEE, the COVID-19 crisis has highlighted the importance of social infrastructure, such as health care and education. Box 2 provides a concise comparison of selected aspects of health infrastructure in CESEE and EU15.

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Table 1. Infrastructure Unit Costs by Sector

Sector	Unit	Unit Costs (inflation adjusted unit costs from the literature, USD)	Yepes (2008) (2005 prices, USD)	ADB (2017) (2010 prices, USD)	Rothman and others (2014) (2000 prices, USD)
	(1)	(2)	(3)	(4)	(5)
Electricity generation	per kW of added capacity	2,970	2,000	2,513	1,900
Roads	per km	608,794	410,000	600,000	425,000
Railways	per km	1,336,378	900,000	3,855,000	N/A
Airports	per person	8	N/A	7	N/A
Fixed telephone line subscription	per subscription	861	580	261	200
Mobile telephone subscription	per subscription	668	450	127	125
Broadband internet subscription	per subscription	566	N/A	326	250

Sources: ADB (2017); Rothman and others (2014); Yepes (2008); IMF, *World Economic Outlook*; and IMF staff calculations.
Note: Column 2 presents the unit costs in current US dollars used in this study. These are obtained by adjusting the unit costs highlighted in columns (3)–(5) with average inflation rates.

How Much Would It Cost to Narrow CESEE's Infrastructure Gaps?

Building on the benchmarking exercise, we present illustrative estimates of how much it would cost to close part of the infrastructure gaps versus the EU15, translating the physical unit gaps into monetary amounts. For this, we apply sector unit costs from the literature (see Table 1)—which we assume to be the same for all countries—to our basic benchmarking gap estimates. We use Yepes (2008) as our main source for unit costs since it has been widely used in related studies and adjust these unit costs for inflation.

We assume that CESEE countries close half of the estimated current gaps relative to the EU15 by 2030.[5] For some CESEE countries, closing the gaps entirely may be achievable, while for others even closing a fraction of the gap may be challenging. Hence, as a practical solution, we use a uniform target of 50 percent. For each country, we aggregate the calculations performed separately for transport, telecom, and electricity production capacity. For transport, in order to facilitate comparisons with the literature, we use three measures of the gap—based on total land area, arable land, and population size. Narrowing the infrastructure gaps by the year 2030 is consistent with the target year chosen in recent studies (Rozenberg and Fay 2019, IMF 2020).

Our estimates suggest that closing the infrastructure gaps in CESEE would require sizable investment. In the next 10 years, CESEE would need to invest 3–8 percent of GDP per year in order to close 50 percent of the infrastructure gap relative to EU15 (Table 2).[6] An alternative approach—which econometrically estimates infrastructure demand for CESEE consistent with the current development level of the EU15—suggests *total* costs of about

[5]This applies to those CESEE countries that lag behind the EU15. For those countries that outperform the EU15, the gap is assumed to be zero.
[6]Our estimates refer to *total* investment needs rather than *additional* investment over current investment.

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Table 2. Infrastructure Cost Estimates for the Next 10 Years in CESEE

A. Comparison of CESEE Infrastructure Cost Estimates

	IMF Estimates			Beyond the Gap (World Bank)			Global Infrastructure Hub (A G20 Initiative)	Three Seas Initiative	
	A	B	C	Preferred	Low spending	High spending	Energy, telecom, transportation	Energy, telecom, transportation	
CESEE					(rescaled for CESEE)		(rescaled for CESEE)	(11 3SI members)	(rescaled for CESEE)
% of GDP/year	8.4	7.0	2.8	4.2	0.6	3.4	4.3	7.9	7.9
Total cost by 2030 (billion USD)	3670	3063	1237	1843	252	1481	1899	1291	3453

B. IMF Estimates for Country Subgroups

	CESEE-EU			Western Balkans +			Other Large EMs		
	A	B	C	A	B	C	A	B	C
% of GDP/year	1.7	2.9	1.9	7.9	12.0	7.1	12.7	9.3	3.1
Total cost by 2030 (billion USD)	278	473	305	144	219	130	3248	2371	802

Sources: Global Infrastructure Hub; Three Seas Initiative; World Bank; and IMF staff calculations.
Note: The costing in the IMF estimates includes the energy, transport, and ICT sectors. Gaps in roads and railways are assessed in kilometer per total land in column A, per arable land in B, and per population in C. Estimates from the World Bank *Beyond the Gap* report originally refer to Eastern Europe and Central Asia. The numbers presented in the table are rescaled for CESEE using GDP. The preferred scenario assumes investing in renewable energy, energy efficiency, increasing the utilization rate of rail and public transport, densifying cities, and promoting electric mobility. The low spending scenario assumes high energy efficiency and demand management, increasing the utilization rate of rail and public transport, densifying cities, and reducing demand for transport through gasoline taxes. The high spending scenario assumes no investment in energy efficiency (fossil energy use is assumed for 10 years before a switch to low carbon), urban sprawl, and favoring rail investments without accompanying policies. See Figure 1 for country group definitions.

5.5 percent of GDP for the current year (Annex 1). Our findings fall in the range of estimates in related studies, despite differences in sectoral coverage, methodology, and definition of infrastructure gaps. For example, Schwartz and others (2020) estimate that, on average, emerging market economies face an annual infrastructure investment need of 2.7 percent of GDP for roads, electricity, and water and sanitation, until 2030, while it is 9.8 percent of GDP for low-income developing countries. The World Bank *Beyond the Gap* report targets achieving the infrastructure-related UN Sustainable Development Goals and limiting climate change to 2°C (Rozenberg and Fay 2019). The Global Infrastructure Hub provides estimates for the investment needed in energy, telecommunication, roads, and railways, to close the gap with the best performing countries in the same income group. However, it covers only 5 CESEE countries (Hungary, Poland, Romania, Russia, and Turkey), thus the results are rescaled by GDP. The Three Seas Initiative, which covers CESEE-EU and focuses on boosting regional connectivity and diversifying energy sources, envisages larger needs of 8 percent of GDP.[7] Nevertheless, despite the inevitable differences across these estimates, the important and

[7]The Three Seas Initiative estimates €1.15 trillion for total infrastructure costs for the Three Seas Region (see Box 1) until 2030, €530 billion on roads, railways, inland waterways, ports, airports, energy lines and telecommunication lines, digitalization, and €270 billion on infrastructure networks with transnational significance (Three Seas Initiative 2019). See Gaspar and others (2019) for estimates of the cost of reaching the sustainable development goals.

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common message is that infrastructure needs in CESEE are sizable. More would also be needed to close the gap in the quality of infrastructure.

Narrowing infrastructure gaps would require very different levels of investment across CESEE subregions (Table 2, panel B). The Western Balkans have the largest infrastructure gaps across all sectors, partly an outcome of the war-related destruction of the physical infrastructure stock. In this subregion, our estimates suggest that about 7–12 percent of GDP per year would be needed in total investment to close 50 percent of the gap relative to the EU15. Given their current investment level, this implies additional investment of about 4–9 percent of GDP per year. The estimated total costs in large EMs—about 3–13 percent of GDP annually— are mainly driven by gaps in land transportation, with Russia accounting for a large share of the needed investment.[8] However, when we scale by population, Russia's needs become much lower. The estimated costs in CESEE-EU are the smallest—total costs between 2–3 percent of GDP annually—given the subregion's smaller gaps in the quantity of infrastructure stock. Completely closing the gap with the EU15 by 2030 would raise CESEE-EU estimated total costs to 3½–6 percent of GDP annually.

Several important caveats are worth highlighting. First, our estimates reflect the simplistic (and arguably arbitrary) goal of closing half of the infrastructure gap, without considering the need for additional investment to improve the quality of infrastructure or make it more climate resilient and sensitive (see Chapter 4 for further discussion). Second, our approach posits equal weight across sectors, while countries may prioritize specific sectors, such as digital infrastructure and health care in light of the pandemic. Third, we assume unit costs in each sector are the same across countries, despite sizable differences in infrastructure quality and labor costs.[9] Finally, our estimates do not consider other types of costs, such as environmental costs, or the opportunity cost of capital (Ianchovichina and others 2013).

It is important to emphasize that our cost estimates should not be interpreted as recommended investment. The total envelope of infrastructure investment will have to be determined for each country with much more detailed analysis of the pool of savings, policy space, absorptive capacity, the country's economic situation and structure, and availability of financing. For instance, spending an additional 3 percent of GDP per year in infrastructure invest-

[8]As shown in Figure 5, Russia is in the bottom half in roads and railways, which translates into large monetary amounts. Without Russia, CESEE's infrastructure cost estimates—for instance, scaled by arable land—decline to $1.7 trillion.

[9]According to the European Court of Auditors (2013)—an audit report for road projects in Germany, Greece, Poland, and Spain—the unit cost for motorway, express-road, or two-lane road is more than 10 times the unit cost we use for total roads.

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ment could create fiscal or external instability risks in some countries, while it could be achievable in others. Similarly, the decision on which infrastructure sectors to prioritize will depend on development goals, predicted future demand, and detailed project analysis. Although an infrastructure sector may have a particularly large gap, say air transport, it may not be economically desirable to invest significantly in this area as demand for air travel may fall in the post-pandemic world. Alternatively, although internet density has a relatively small gap, investment in this sector may be highly warranted as the demand for digital services is likely to expand substantially.

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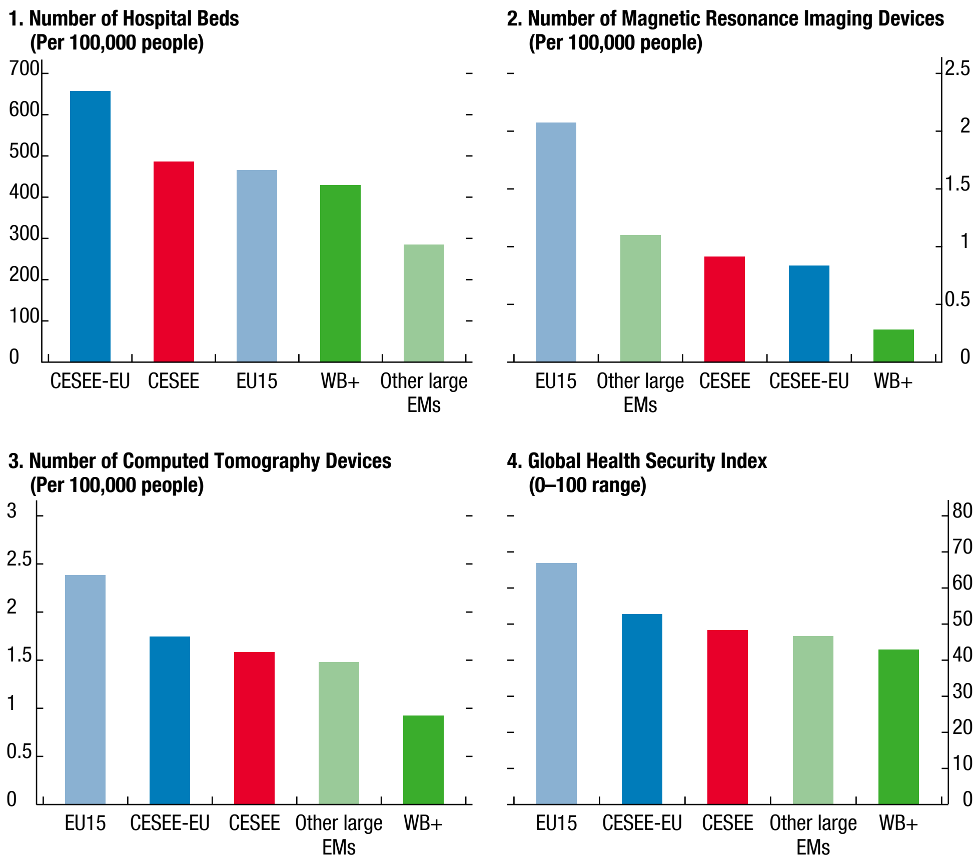
Box 2. Health Care Infrastructure in CESEE

As health care infrastructure is hard to measure, we present some illustrative indicators: hospital beds and medical equipment scaled by population, as well as an overall health security index. The latter assesses countries' health security and capabilities across six categories—disease prevention, detection, rapid response, health system, compliance with international norms, and risk environment—and proxies the quality of health care. Relative to the EU15, CESEE, on average, has a higher number of hospital beds per capita, but less medical equipment such as magnetic resonance imaging (MRI) and computerized tomography (CT) scanners. Almost all CESEE countries have lower health security than the EU15 average.

Figure 2.1. Health Care Infrastructure in CESEE and EU15



Sources: Eurostat; Global Health Security Index; national sources; and IMF staff calculations.
Note: All panels show data for 2018 or the latest available year. The bars for hospital beds and medical devices (magnetic resonance imaging and computed tomography devices) represent population-weighted averages across country groups. The bars for the Global Health Security Index represent GDP PPP-weighted average across country groups. See Figure 1 for country group definitions. PPP = purchasing power parity.

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CHAPTER

3 The Macroeconomic Impact of Infrastructure Investment

This chapter analyzes the macroeconomic impact of infrastructure investment, a key issue for policymakers as they assess the costs and benefits of additional public spending. An increase in infrastructure investment can affect activity both in the short term, by boosting aggregate demand, and in the long term, by expanding the productive capacity of the economy with a higher infrastructure stock (IMF 2014). We begin by presenting an empirical analysis of the short-term macroeconomic impact of higher infrastructure spending. We then turn to model-based simulations that highlight the key transmission mechanisms from public investment to macroeconomic outcomes, the role of various factors that determine its effectiveness, and spillovers from cross-country coordination. For both analyses, given data limitations and modeling considerations, we use public investment as a proxy for infrastructure investment.

Empirical Analysis

Methodology

To assess the short-term impact of an increase in public investment, we examine the dynamics of key macroeconomic variables following episodes of public investment booms. We first identify a boom as a significant and sustained increase in the public investment-to-GDP ratio (IMF 2014, Warner 2014) using annual data from an unbalanced global sample of countries since 1970. In CESEE, most of the identified booms occurred during the mid-1990s—consistent with the surge in public investment during this period. Once the initial year of the investment boom is identified, we trace the evolution of key macroeconomic variables, namely real output, private investment and public debt, following the start of the public investment boom using a local projections framework (Jordà 2005). Our goal is sim-

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ply to establish stylized facts about the macroeconomic conditions around booms, rather than to make causal inferences. Although we rely on the variation in a global sample to estimate the average response to public investment booms, we allow this response to vary for CESEE countries. Annex 2 provides details on the identification of investment booms, econometric specifications, alternative approaches, and extensions.

It is important to note that some caution is warranted in making causal inferences in this empirical approach.[1] The identified public investment booms are quite sparse, and their occurrence and timing may not be exogenous to the country's macroeconomic conditions. We address some of these shortcomings in an alternative specification, which uses public investment shocks, derived as unexplained residuals in a public investment equation (Abiad, Debuque-Gonzales, and Sy 2018; Annex 2). This approach isolates shocks to public investment that can plausibly be deemed exogenous to macroeconomic conditions. Compared with booms—which are discrete episodes—the identified public investment shocks are continuous, providing us with greater degrees of freedom and allowing us to explore the role of various factors in shaping the effect of public investment. We focus on some of the key considerations that have been identified in the literature and that are particularly relevant for CESEE countries in the aftermath of the COVID-19 outbreak: the cyclical stance of the economy (recessions versus expansions) and structural factors such as the efficiency of public investment and the (initial) stock of public capital.

Dynamics of Macroeconomic Variables following Public Investment Booms

Public investment booms tend to be associated with a sizable and statistically significant increase in real output (Figure 7). The rise in output is persistent, consistent with the persistent increase in public investment following a boom. The implicit fiscal multiplier—increase in output for a euro spent on public investment—on impact is about 1.7, suggesting that public investment can have a sizable "bang for the buck," as often documented in the literature (see, among others, Ilzetzki, Mendoza, and Végh 2013; Abiad, Furceri, and Topalova 2016; Deleidi, Iafrate, and Levrero 2020). Nevertheless, such impacts from public investment booms are not always a given. Several studies find a weak association between public investment and growth, especially in the context of low-income countries, due to cost overruns, absorptive capacity constraints, and shortcomings in the quality of government (Warner

[1]Data constraints for CESEE countries prevent us from using alternative identification schemes, such as forecasts errors or instrumental variables, as in, for instance, Abiad, Furceri, and Topalova (2016) and Izquierdo and others (2019).

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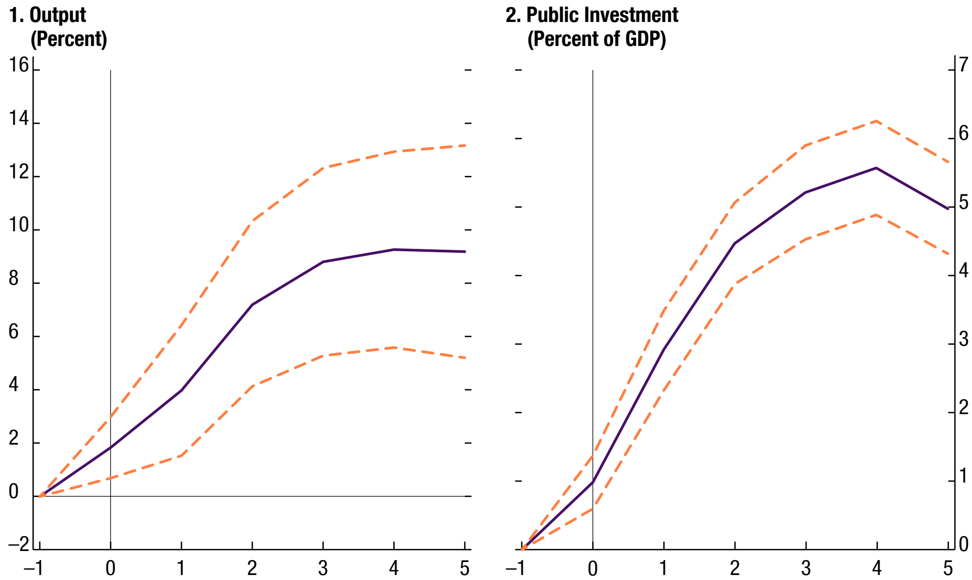
Figure 7. Output and Investment following Public Investment Booms



Sources: IMF, *Fiscal Monitor*; IMF, *World Economic Outlook*; and IMF staff calculations.
Note: Cumulative response of GDP growth (panel 1) and public investment as percent of GDP (panel 2) following public investment boom episodes. The episode is normalized such that public investment as percent of GDP increases by 1 percentage point on impact. $t = 0$ is the year of the shock; dashed lines denote 90 percent confidence bands. Estimation is based on a global sample of countries.

2014; Crescenzi, Di Cataldo, and Rodríguez-Pose 2016; Presbitero 2016; Gurara and others 2020).

Public investment booms tend to be associated with larger increases in output in CESEE relative to the EU15. The point estimates in CESEE are larger than in the EU15, and although the CESEE confidence bands are wider, they continue to be statistically significant in the first few years (Figure 8).

Figure 9 shows the dynamics of real private investment and public debt (as percent of GDP) in CESEE in the aftermath of a public investment boom. While the point estimate for private investment is positive, suggesting some crowding-in, the response is not statistically significant. Similarly, though public-debt-to-GDP appears to be declining following a boom, the estimates are quite imprecise. Empirically, it is therefore difficult to draw any conclusive inferences regarding the impact of public booms on private investment and public debt. At the same time, we do not find compelling empirical evidence of crowding out of private investment or sharp rises in public indebtedness.

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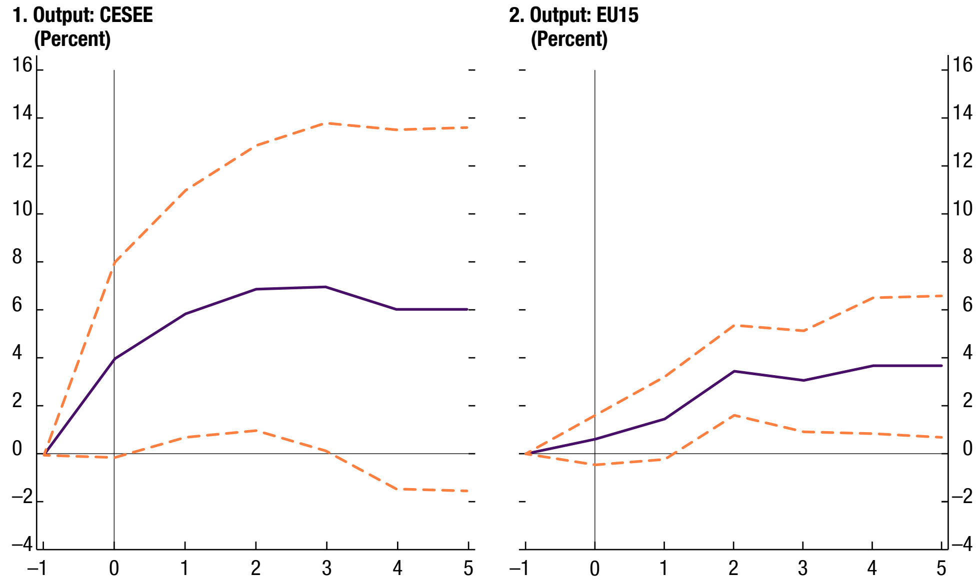
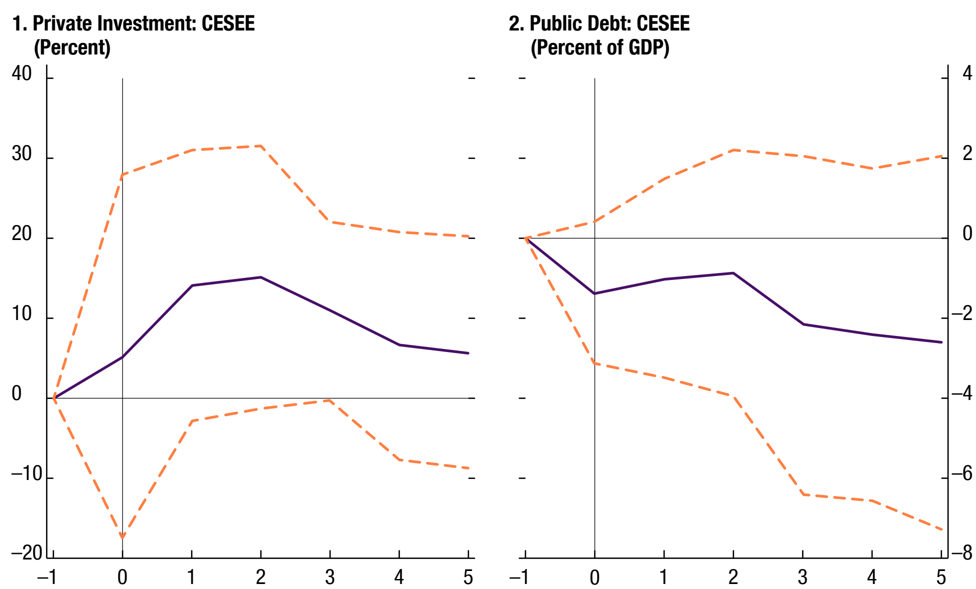
Figure 8. Output following Public Investment Booms: CESEE vs. EU15



Sources: IMF, *Fiscal Monitor*; IMF, *World Economic Outlook*; and IMF staff calculations.
Note: Cumulative response of GDP growth for CESEE (panel 1) and EU15 (panel 2) following public investment boom episodes. The episode is normalized such that public investment as percent of GDP increases by 1 percentage point on impact. $t = 0$ is the year of the shock; dashed lines denote 90 percent confidence bands. Estimation is based on a global sample of countries. CESEE (EU15) estimates are derived by including CESEE (EU15)-specific dummies.

Figure 9. Private Investment and Public Debt following Public Investment Booms in CESEE



Sources: IMF, *Fiscal Monitor*; IMF, *World Economic Outlook*; and IMF staff calculations.
Note: Cumulative response of growth in private investment (panel 1) and public debt as percent of GDP (panel 2) following public investment boom episodes. The episode is normalized such that public investment as percent of GDP increases by 1 percentage point on impact. $t = 0$ is the year of the shock; dashed lines denote 90 percent confidence bands. Estimation is based on a global sample of countries. CESEE estimates are derived by including CESEE-specific dummies.

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The Role of Cyclical and Structural Factors

The effect of public investment on output tends to be larger during recessions than expansions. Using the public investment shocks described earlier, we find that the impact of an unanticipated unit increase in public investment during recessions is about 2 percent, while during expansions is much smaller and statistically insignificant (Figure 10).[2] Theoretically, the larger output response during recessions can be attributed to the presence of greater slack and liquidity-constrained households. Our results are consistent with many empirical studies that document larger multipliers during recessions (Auerbach and Gorodnichenko 2012; Abiad, Furceri and Topalova 2016). While it is difficult to extrapolate from historical estimates to the unique context of the COVID-19 crisis—fiscal multipliers could be lower when supply is constrained because of social distancing policies (Guerrieri and others 2020)—our findings suggest that public investment could make a substantial contribution to the recovery from the deep recession triggered by the pandemic.

In addition, public investment tends to have a larger impact on output when the initial public capital stock is smaller. Figure 11 shows the impact of a 1 percentage point increase in public investment on output for different levels of public capital stock.[3] The output response is larger and also statistically significant when the public capital stock is smaller. Economic theory would suggest that a lower stock of public capital should imply larger returns from public investment. Our result is also consistent with empirical studies—for instance, Izquierdo and others (2019)—which report similar findings for a different set of countries and using alternative identification schemes. Although there are many factors that determine the impact of public investment, this is one way to rationalize the larger output response in CESEE relative to the EU15.[4]

Finally, the output response tends to be larger when infrastructure quality is better. Figure 12 shows the impact on output for different levels of infrastructure quality, based on the World Economic Forum, measure of overall infrastructure quality. The output response is larger and also statistically significant when quality is better, consistent with related studies (Abiad, Furceri, and Topalova 2016; Baum and others 2020). As elaborated in Chapter 4, the key channels relate to better infrastructure governance. Our results underscore the crucial role of scaling up infrastructure quality and efficiency for maximizing returns from public investment.

[2]Unlike booms, public investment shocks do not have persistent effects on public investment itself. This likely explains the difference in the response of output at longer horizons.

[3]This is based on a specification that includes both the public capital stock and infrastructure quality as conditioning variables. To show how the output response varies by the public capital stock, we evaluate the marginal impact of the shock for different percentiles of the public capital stock, while fixing infrastructure quality—without loss of generality—at the CESEE median. We deploy a similar scheme to assess the role of infrastructure quality.

[4]We get qualitatively similar results when we use booms instead of shocks.

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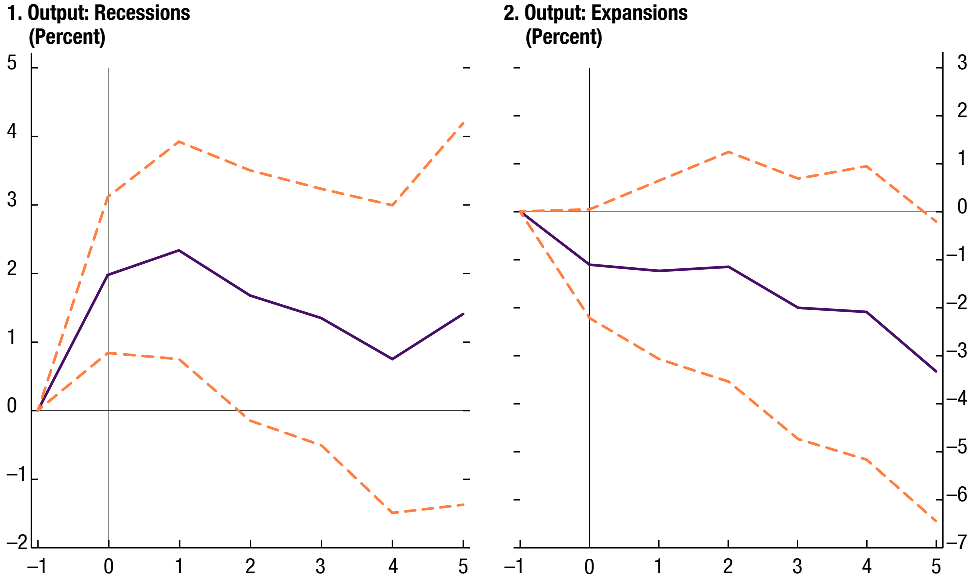
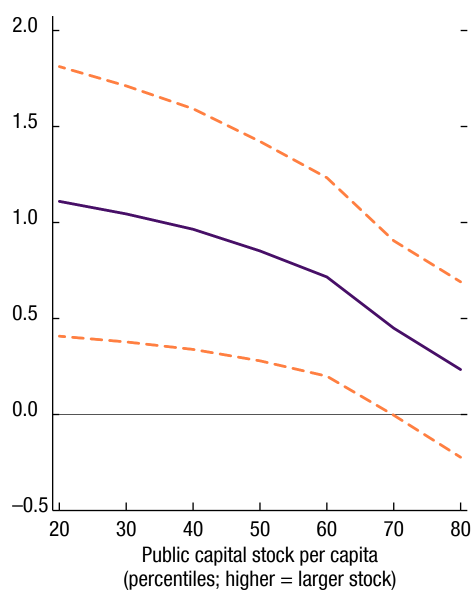
Figure 10. Output Responses to Public Investment Shocks: The Role of the Economic Cycle



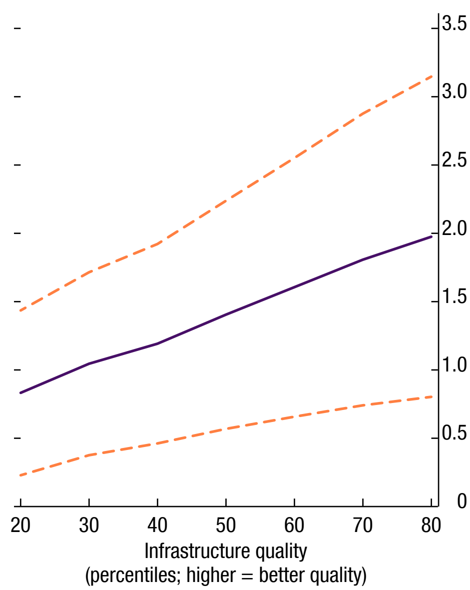
Sources: IMF, *Fiscal Monitor*; IMF, *World Economic Outlook*; and IMF staff calculations.
Note: Cumulative response of GDP growth due to a public investment shock during recessions (panel 1) and expansions (panel 2). The shock is normalized such that public investment as percent of GDP increases by 1 percentage point on impact. $t = 0$ is the year of the shock; dashed lines denote 90 percent confidence bands. Estimation is based on a sample of European economies.

Figure 11. Output Responses to Public Investment Shocks: The Role of Capital Stock
(Percent)



Sources: IMF, *Fiscal Monitor*; IMF, *World Economic Outlook*; and IMF staff calculations.
Note: Response of GDP growth on impact due to a public investment shock for different levels of public capital stock (in the *x*-axis). Dashed lines denote 90 percent confidence bands. Estimation is based on a sample of European economies.

Figure 12. Output Responses to Public Investment Shocks: The Role of Infrastructure Quality
(Percent)



Sources: IMF, *Fiscal Monitor*; IMF, *World Economic Outlook*; World Economic Forum; and IMF staff calculations.
Note: Response of GDP growth on impact due to a public investment shock for different levels of infrastructure quality (in the *x*-axis). Dashed lines denote 90 percent confidence bands. Estimation is based on a sample of European economies.

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Model-Based Approach

We build on the empirical analysis with a general equilibrium model calibrated to CESEE countries, in which we simulate the macroeconomic effects of higher public investment. Using a formal structural model complements the empirical analysis in several ways. First, it allows us to consistently assess the impact of higher public investment in the short and long term, while accounting for the dynamic interactions of households, firms, and governments. Second, it sheds light on the transmission channels through which public investment affects macroeconomic variables. Third, the model helps identify key country characteristics and policy parameters, which shape the impact of infrastructure investment. Finally, it allows us to examine cross-border spillovers of infrastructure projects, which are undertaken jointly by several countries.

We analyze the effects of increased infrastructure spending on CESEE using the IMF Global Integrated Monetary and Fiscal (GIMF) model.[5] The GIMF model is a multi-region, forward-looking, dynamic stochastic general equilibrium (DSGE) model with several real, nominal, financial, and trade frictions. In the model, output is a function of labor inputs, as well as public and private capital. Public investment in infrastructure increases the stock of public capital and expands the economy's production capacity. Notably, the production function in the GIMF model treats public capital as a complementary input to private capital and labor. As such, higher public investment increases the return to private investment and labor, thereby crowding in private capital, increasing real wages, and boosting aggregate demand. The model is calibrated to match the empirical counterparts of main macroeconomic variables in the steady state for each of the six regions.[6]

In our analysis, we take advantage of several features of GIMF. First, we use the rich public sector block, which has several tax and public expenditure categories and the possibility of debt financing, to analyze the implications of alternative modes of financing for macroeconomic outcomes, public balances, and public debt dynamics. Second, we use the multi-region structure of GIMF to conduct quantitative analysis of spillovers originating from large cross-country investment projects. To do this, we contrast a scenario where infrastructure spending increases only in a single region with a scenario where all CESEE regions increase infrastructure investment at the same time. Third, we shed light on the importance of effective procurement procedures and implementation capacity by distinguishing between regions in terms of public investment efficiency. Finally, against the backdrop of elevated uncertainty,

[5]See Kumhof and others (2010) for a detailed description of the GIMF model.

[6]Following the meta-analysis by Bom and Ligthart (2014) and in line with Ligthart and Suarez (2011), the elasticity of output with respect to public capital is calibrated as 0.14.

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high private savings, and potentially slow recovery after the COVID-19 outbreak, we design a scenario with accommodative monetary policy, where policy interest rates do not respond to demand pressures caused by higher infrastructure spending.

We group countries that share similarities in terms of their economic development, policy frameworks, stock of public capital, and public investment efficiency into an economic region. Of the six regions in GIMF, four cover CESEE countries. The first region (CESEE-EUa) includes the euro area countries in CESEE, namely Estonia, Latvia, Lithuania, the Slovak Republic, and Slovenia, which have progressed the most in terms of integration with and convergence to the EU15. Countries that have joined the EU but have not joined the single currency area (CESEE-EUb, that is Bulgaria, Croatia, the Czech Republic, Hungary, Poland, and Romania) constitute the second region. The third region includes the Western Balkan countries (Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia), Belarus, and Moldova, which are not in the EU and have significantly larger infrastructure needs. The three large emerging European economies (Turkey, Russia, and Ukraine) with idiosyncratic properties are grouped under the fourth region. The last two regions represent the rest of the euro area and the rest of the world.

Chapter 2 highlighted the difficulties in the quantification and costing of infrastructure needs for individual countries and regions. Hence, in all scenarios, we assume a stylized shock that brings infrastructure investment above its baseline level by 1 percent of GDP for a period of 10 years. A sustained increase in public investment of this magnitude is both realistic and meaningful. A 10-year implementation horizon is also a reasonable assumption as large infrastructure projects take longer to implement and finalize, and costs are typically not entirely financed upfront.

Model Simulations

We present model simulations pertaining to the four main areas of our analysis: (1) the mode of financing; (2) the efficiency of public investment; (3) spillovers of infrastructure projects across regions; and (4) the impact of monetary accommodation. For exposition, we discuss the findings for one of the four CESEE regions, namely CESEE-EUb (CESEE countries that are part of the EU but are not in the euro area). Annex 3 contains the results for all CESEE subregions.

Alternative financing options may have implications for the impact of infrastructure investment on the economy. The three scenarios presented here

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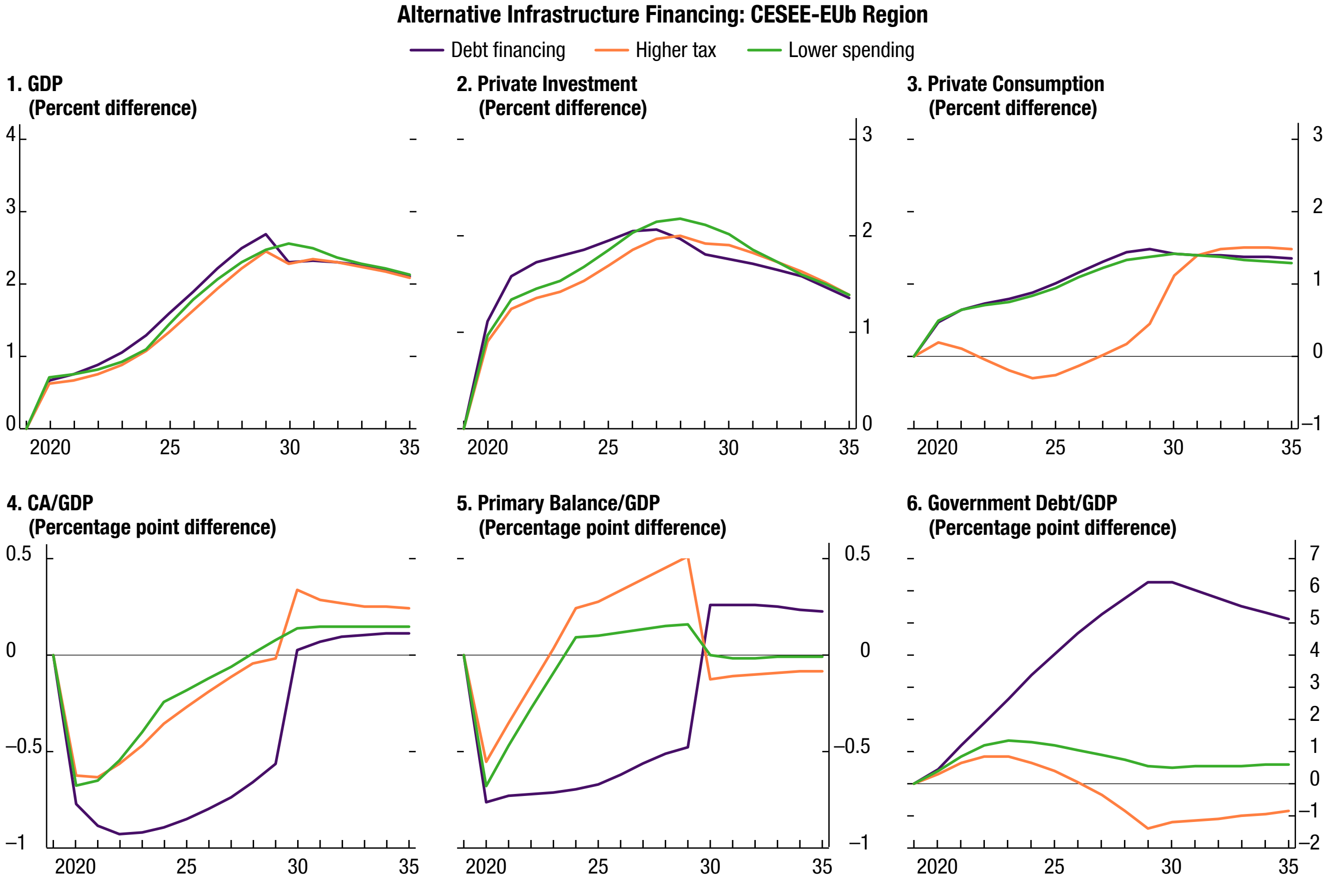
Figure 13. Model Simulations: The Role of Alternative Financing Options



Source: IMF staff calculations.
Note: CESEE-EUb includes Bulgaria, Croatia, the Czech Republic, Hungary, Poland, and Romania.

(Figure 13) consider financing by domestic public debt, higher consumption taxes, and lower public consumption, respectively.

When new infrastructure investment is financed by domestic public debt accumulation, increasing public investment contributes to higher aggregate demand in the short term as well as to higher production capacity of the economy in the medium to long term. Higher infrastructure investment by 1 percent of GDP leads to higher real GDP by about ½ to 1 percent immediately during the first year and by 2 to 3 percent over a decade.[7] Both private consumption and investment increase as well. However, larger fiscal deficits lead to a widening of the current account deficit and increasing

[7]The model-based multipliers are somewhat smaller than those estimated in Chapter 3.1. This is not surprising given the difference in analytical approaches. However, both the model and empirical exercise suggest that the output impact from infrastructure investment can be sizable.

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public debt. The public debt to GDP ratio peaks at about 5 to 6 percentage points above the baseline in 2030. Notably, the increase in public indebtedness is less than the assumed increase in public capital (10 percent of GDP over a decade) due to the positive impact of infrastructure investment on the production capacity of the economy. In the long term, the increase in economic activity contributes to a small but lasting primary surplus, partly reversing the increase in public debt. We observe a similar pattern in the current account balance, which turns into surplus once public investment subsides back to initial levels.

If the government were to finance the new infrastructure investment by a gradual increase in consumption taxes, the long-term response of GDP and private investment would be quite similar to the debt financing scenario.[8] However, the short-term impact on economic activity would be somewhat lower, predominantly on account of lower private consumption in response to the higher consumption taxes. Higher consumption taxes would also impact the fiscal outlook. Specifically, in the long term, the economy would end up with substantially lower public indebtedness than in the debt-financing scenario.

Finally, the government may decide to finance new infrastructure investment by reducing other public spending. In this scenario, we assume that public consumption as a share of GDP gradually declines to reach 1 percentage point below its steady state level over 5 years, without affecting the quality of governance. While the long-term impact on economic activity is comparable to the other two scenarios, public debt under public spending cuts remains broadly stable and private consumption does not drop as much as in the case of increased consumption taxes.

All three financing scenarios suggest that the impact on domestic economic activity could be significant. In the long term, regardless of the type of financing, GDP would rise above its steady-state value by about 2½ percent in all CESEE subregions. On the one hand, domestic public debt financing brings about larger fiscal deficits, a higher stock of debt, and an increase in the current account deficit. On the other hand, higher taxes or lower public consumption lead to smaller fiscal and current account deficits and public debt-to-GDP ratios that remain stable or eventually fall below their initial levels. In the short term, however, the mode of financing has significant implications for macroeconomic aggregates—for example, private consumption and investment—and the fiscal outlook, which differ among regions due to differences in monetary policy frameworks, fiscal rules, the degree of openness and the share of liquidity-constrained households in each region. The

[8] In this scenario, the consumption tax to GDP ratio gradually increases to reach 1 percentage point above its steady state level over two years.

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positive impact on economic growth could further increase if infrastructure investment is even partially financed by external grants, as currently assumed under the EU recovery fund proposal.

For illustrative purposes for the rest of our analysis, we assume that new infrastructure projects are financed by additional domestic public debt.

Higher efficiency of public investment, an important aspect of infrastructure governance, means that the same amount of public investment outlays translates into a greater rise in public capital. As depicted in Figure 14, this in turn leads to larger crowding in of private investment, higher economic output, and lower public debt. The efficiency of public investment in CESEE is currently assumed to be 85 percent, meaning that 15 percent of funds allocated to public investment are lost due to inefficiencies.[9] If the efficiency of public investment were to be higher by 10 percent, the increase in public investment described above would raise GDP by a further ½ percent and private investment and consumption by approximately ¼ of a percent.

When countries raise public investment simultaneously, they may benefit from positive demand spillovers. The benefits from coordination may be even higher if cross-country infrastructure projects, such as those envisaged by the Three Seas and other regional initiatives, lead to lower trade costs through improvements in regional connectivity. Kóczán and Plekhanov (2013) estimate that infrastructure spending that is coordinated across countries could yield almost double the impact on trade compared to the case where infrastructure spending is increased by a single country.[10] Beyond their impact on trade, cross-border projects could have additional benefits. For instance, improving cross-country power grids and storage capacity can help improve energy security and increase shared capacity in the context of developing renewable energy.[11]

[9]In GIMF, the efficiency of public investment is calibrated in two steps. First, it is calibrated so that 1 percent of GDP public investment shock produces an increase of 0.2 percent of GDP in year 10 in advanced economies and 0.3 percent in emerging economies. Specifically, public investment efficiency is set at 82.5 percent for the large emerging markets and the Western Balkan region and 88.5 percent for CESEE-EU countries. The euro area's efficiency is at 92 percent, with 100 percent being the theoretical upper bound. These estimates are based on evidence by Ligthart and Suarez (2011), Bom and Ligthart (2009), and Bom and Ligthart (2014). Second, the coefficient is adjusted using the efficiency indicators based on the IMF's Public Investment Management Assessment (PIMA) for individual countries, typically downward.

[10]Shepherd and Wilson (2006) and Felipe and Kumar (2010) also find that infrastructure improvements are associated with significant gains in trade and intraregional trade flows. For the purpose of this simulation, we calibrate the model so that the trade benefits from cross-border public investment projects, which lead to improved regional connectivity and lower non-tariff trade barriers, are almost twice as large as the increase in trade that comes from infrastructure improvements implemented by a single country.

[11]Despite their potential for higher benefits, significant delays in cross-border projects can lower the expected return. The European Court of Auditors (2020) analyzed eight flagship cross-border projects in the transport sector and concluded that six of them will not be able to operate at full capacity by 2030, as planned in 2013.

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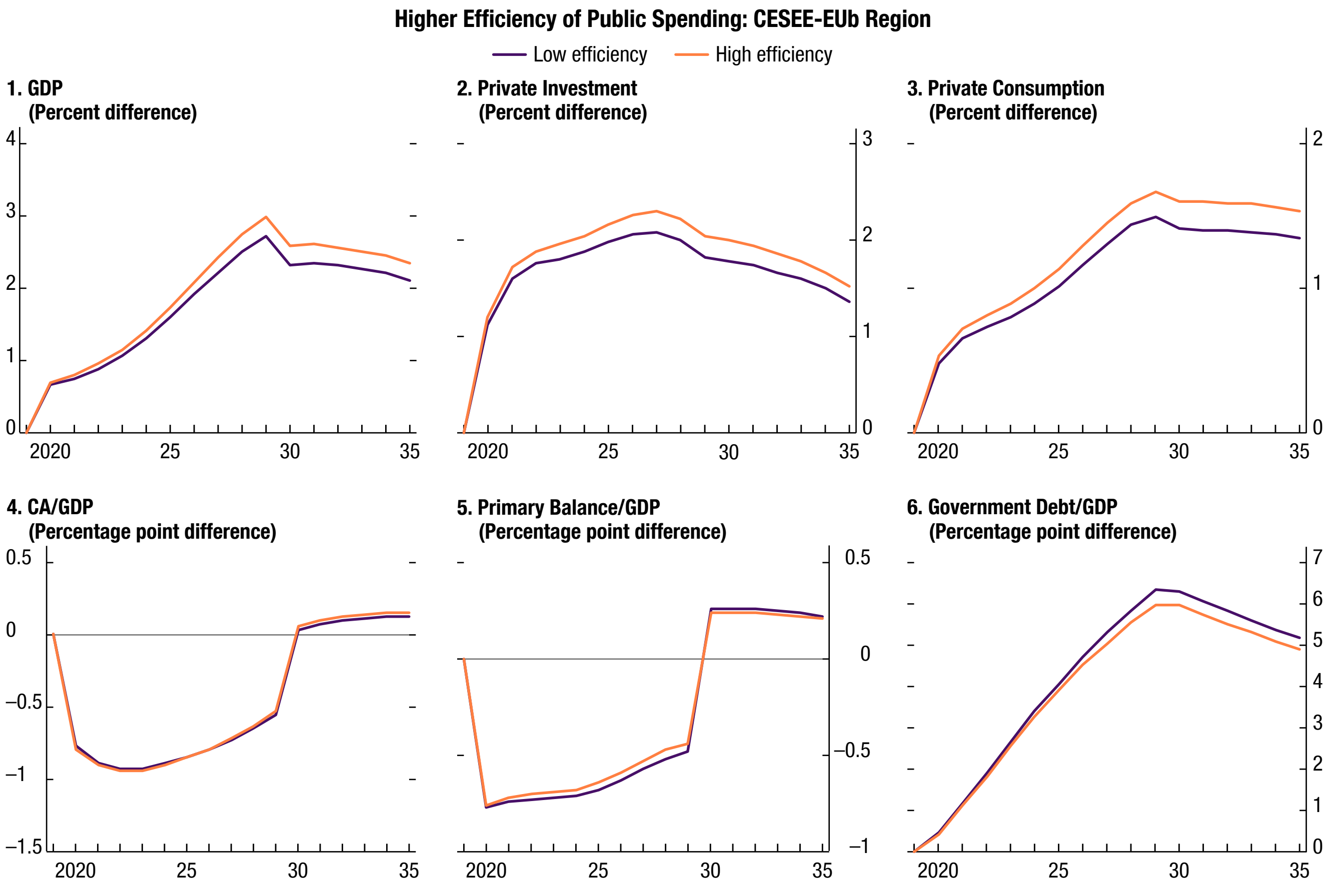
Figure 14. Model Simulations: The Role of Higher Efficiency of Public Investment



Source: IMF staff calculations.
Note: CESEE-EUb includes Bulgaria, Croatia, the Czech Republic, Hungary, Poland, and Romania.

Figure 15 compares three alternative simulations: (1) the response to a public investment shock if it happens in one region only; (2) a situation where the infrastructure investment push is coordinated, that is, all CESEE subregions spend 1 percent of GDP on infrastructure at the same time over next 10 years; and (3) a scenario where coordinated infrastructure investment leads to improved connectivity and a gradual decline in non-tariff barriers to trade by 5 percent across regions over 10 years.

When a coordinated infrastructure investment push does not lead to improved connectivity, the economic gains are similar to a situation where the public investment shock takes place in one region only. This reflects the current low levels of trade among CESEE countries. Not surprisingly, the impact on economic growth is the largest when coordinated infrastructure investments improve connectivity across regions, thereby reducing trade costs

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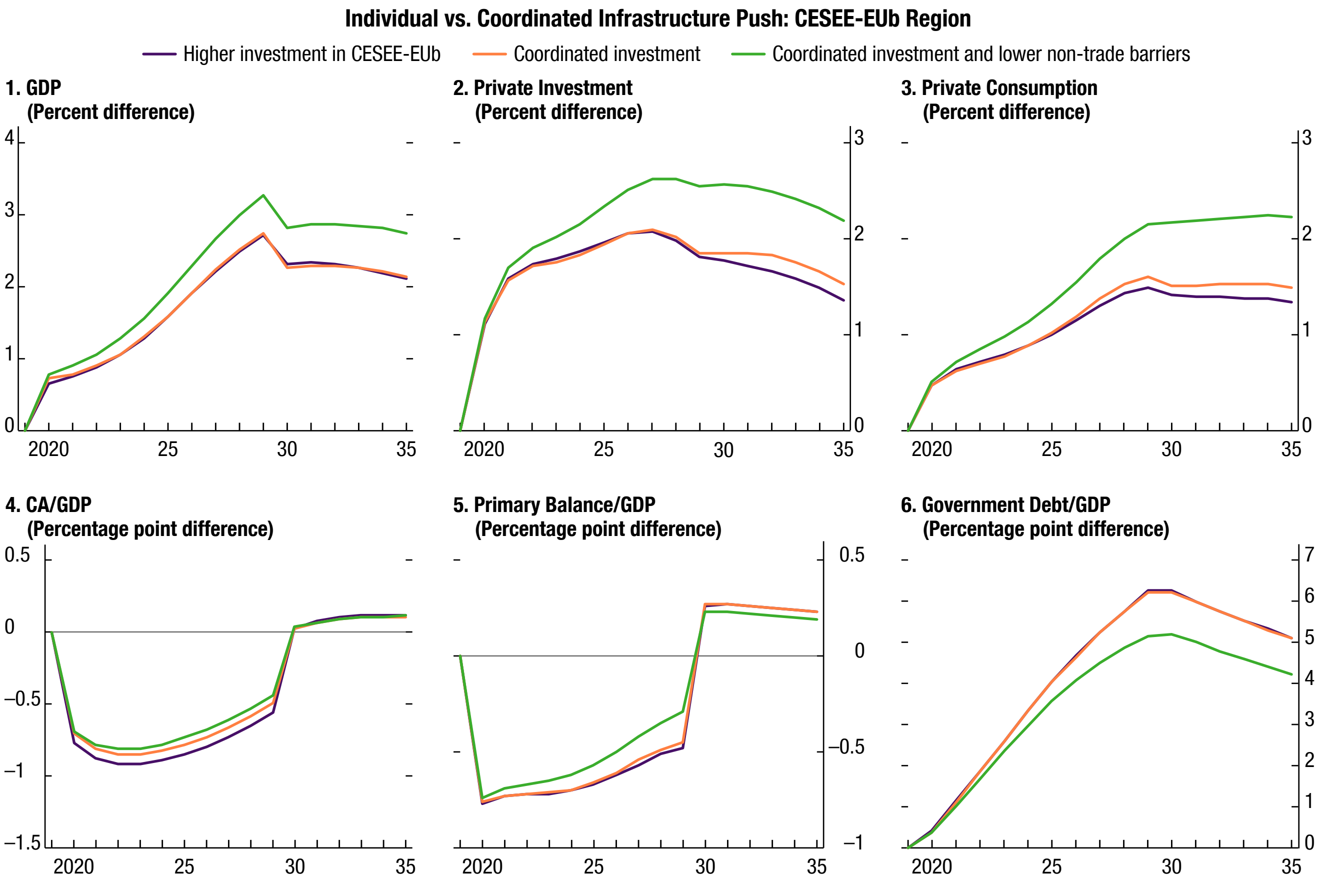
Figure 15. Model Simulations: The Role of Cross-Border Coordination



Source: IMF staff calculations.
Note: CESEE-EUb includes Bulgaria, Croatia, the Czech Republic, Hungary, Poland, and Romania.

and facilitating greater trade among CESEE countries. Similar conclusions apply to private investment, consumption, and fiscal balances.

Reflecting on the implications of the COVID-19 crisis and the uncertainty about the future recovery, Figure 16 presents additional gains from coordinated infrastructure investment and improved connectivity when it is supported by persistently low interest rates.[12] The results suggest that if interest rates were to remain accommodative in response to the new infrastructure investment (in other words, policymakers do not raise interest rates), the economies would enjoy significantly greater output dividends in the short term of about 2 to 3 percent of GDP. While we model low interest rates as

[12]In the accommodative monetary policy scenario, policy rates adjust to inflation only to a limited extent, as they increase only by 0.4–0.6 percentage points over the next 10 years.

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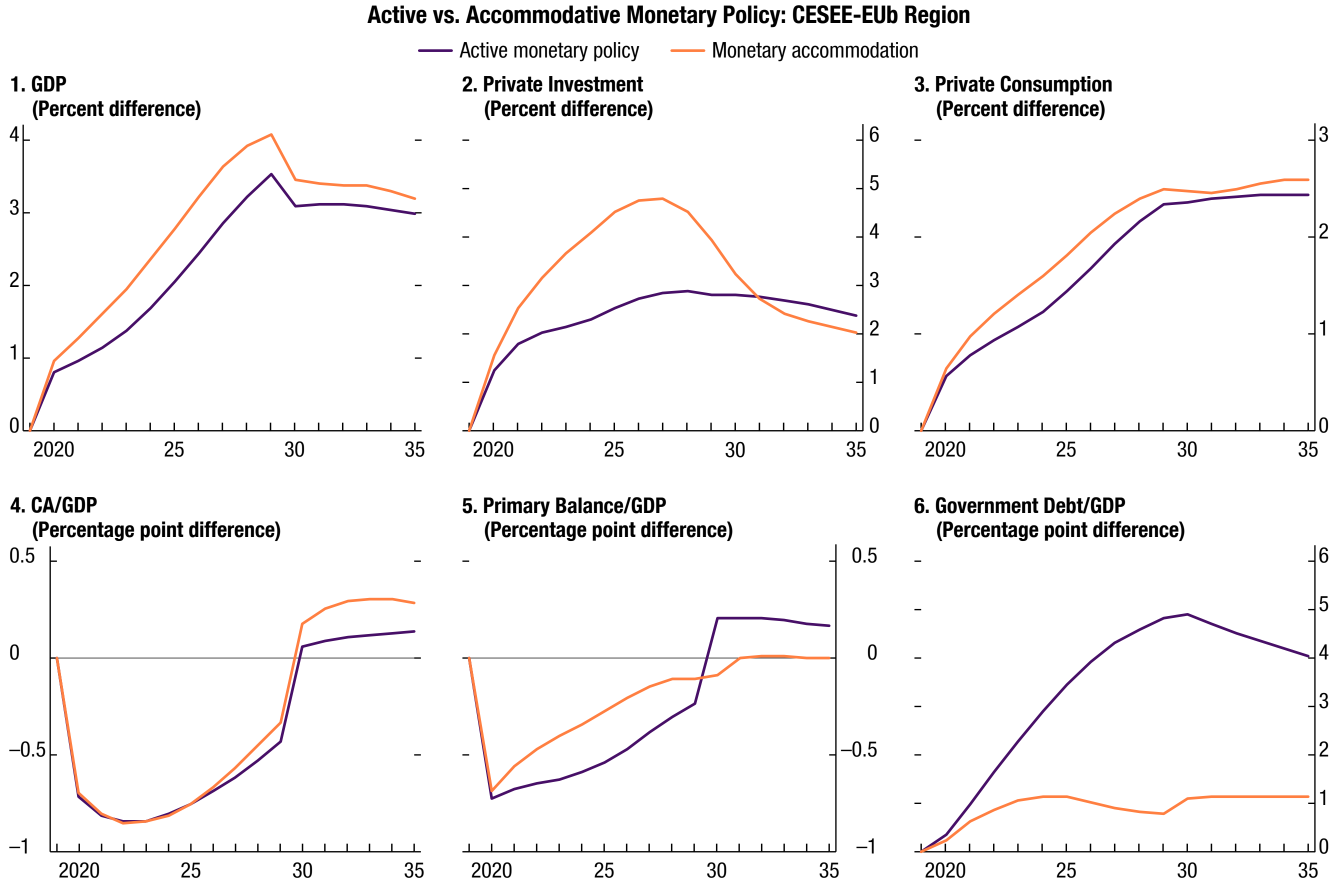
Figure 16. Model Simulations: The Role of Monetary Accommodation



Source: IMF staff calculations.
Note: CESEE-EUb includes Bulgaria, Croatia, the Czech Republic, Hungary, Poland, and Romania.

reflecting accommodative monetary policies, the outcome would be similar under persistently low world interest rates due to a global saving glut (Arezki and others 2016).

In Figure 17, we present the implications of higher infrastructure investment for CESEE's convergence to the EU15 in terms of per capita GDP in purchasing power parity terms. The baseline scenario (solid lines) assumes a continuation of current trends as envisioned in the June 2020 *World Economic Outlook Update* forecasts for CESEE and the EU15 till 2025 and beyond. The public investment scenario (dashed lines) incorporates the favorable elements detailed above, including an increase in public investment efficiency, persistently low interest rates, and a rise in regional connectivity as a result of public investment.

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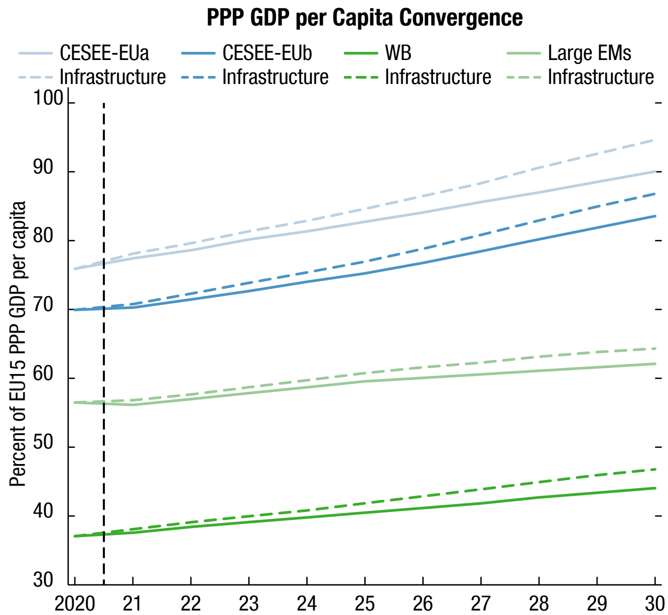
Figure 17. Infrastructure Investment in CESEE and Convergence to the EU15



Source: IMF staff calculations.
Note: See Figure 1 for country group definitions. PPP = purchasing power parity.

Our findings indicate that infrastructure spending can speed up convergence as the gains from public investment—via the supply side—materialize over the medium to long term. The results are shaped by many factors such as openness and the share of credit-constrained households. And while convergence should be faster for countries with a lower initial capital stock, our results suggest that the effect of higher efficiency of public investments dominates. Larger gains in terms of GDP per capita and faster convergence could be expected for countries with higher efficiency of public spending. For example, the per capita GDP gap between CESEE countries in the euro area and the EU15 would decrease by almost 5 percentage points. In the Western Balkan and Large EM region, the convergence gain will be smaller, in part due to these regions' lower efficiency of public investment.

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CHAPTER

4 Policy Issues

As discussed in Chapter 3, raising infrastructure investment could have significant macroeconomic benefits. It would not only speed CESEE's convergence to EU15 living standards but also provide a much-needed stimulus to activity in the aftermath of the pandemic. Yet with fiscal space limited, maximizing the benefits of such investment has become more necessary than ever.

In this chapter, we explore how to make the most out of infrastructure investment in CESEE. With most of CESEE infrastructure owned and operated by the public sector (Figure 18), we start by highlighting the importance of strengthening infrastructure governance, which encompasses effective public investment and risk management. We then focus on what could help mobilize more private capital—an expressed goal of policymakers—and realize additional efficiency gains (Figure 19).

We also explore cross-border projects, which could become more prevalent as policymakers address the relatively limited connectivity within CESEE (EC 2017, 2018a; EIB 2018a; Three Seas Initiative 2019), but present additional challenges. We conclude by discussing how the COVID-19 crisis may impact infrastructure investment.

Enhancing Infrastructure Governance

Public Investment Management (PIM)

Most infrastructure investments are intended to boost growth and employment, however, their impact depends on investment efficiency as shown in Chapter 3 and in many related studies (see, for example, Abiad, Furceri, and Topalova 2016, and Baum and others 2020). Investment efficiency, in turn,

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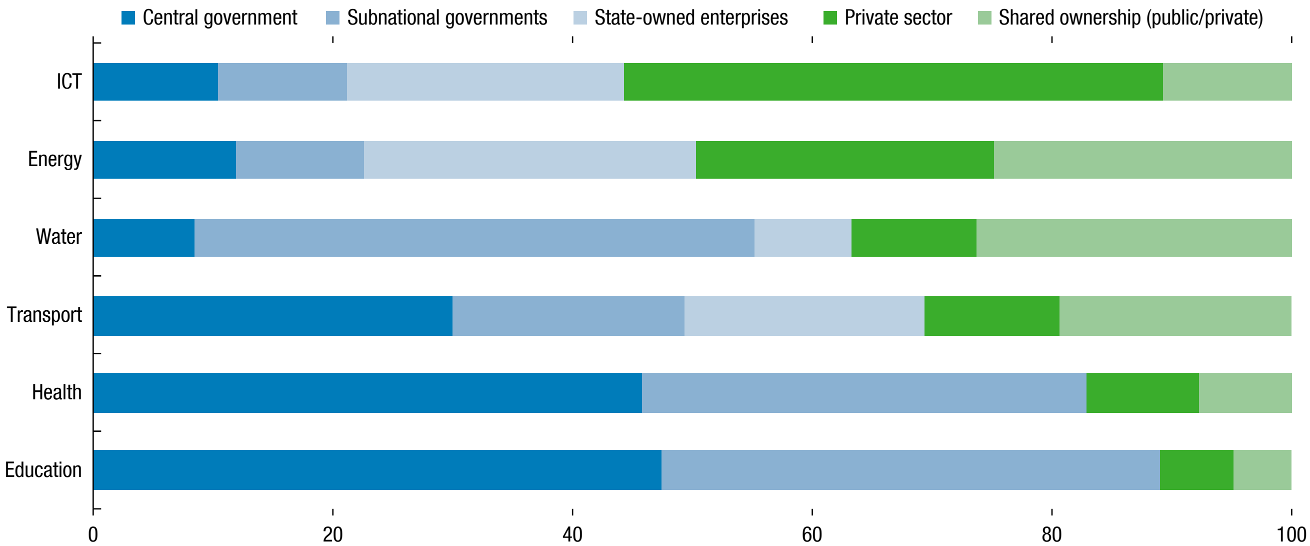
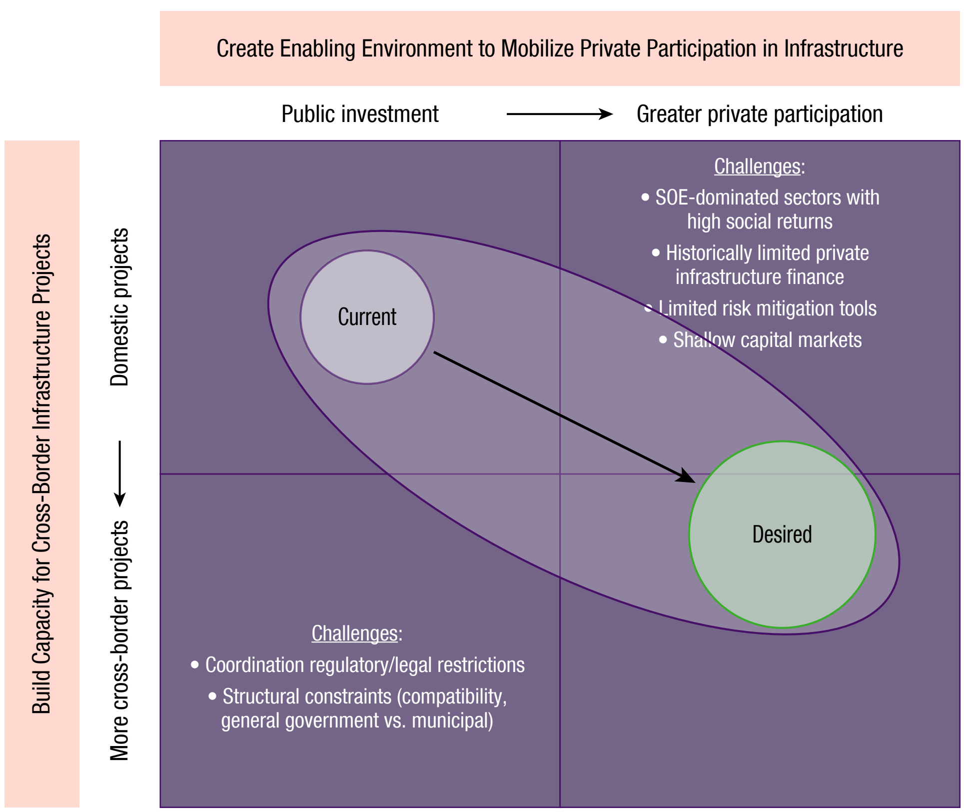
Figure 18. CESEE Infrastructure Survey: Projects by Ownership and Sector
(Percent)



Sources: Country authorities; and IMF staff calculations.
Note: ICT = information and communication technology.

Figure 19. Private Sector Participation and Cross-Border Projects in CESEE



Source: IMF staff.
Note: SOE = state-owned enterprise.

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hinges on a country's infrastructure governance, including the planning and selection process, as well as the effectiveness of implementation and maintenance (Baum, Mogues, and Verdier 2020).

While measuring the efficiency of public investment frameworks in a consistent, transparent and objective manner across countries is difficult, the IMF's Public Investment Management Assessment (PIMA) provides a useful diagnostic tool. PIMA evaluates the efficiency of public investment management institutions in terms of their design and effectiveness along the entire public investment cycle—planning, allocation, and implementation—based on 15 criteria (see IMF 2015, 2018a).[1] We complement the analysis with authorities' self-assessed surveys based on the PIMA tool, which, however, are not easily comparable (Annex 4).

According to the formally completed IMF PIMAs, there is significant room to improve infrastructure governance in the CESEE region. Figure 20 shows the average PIMA scores for the design and effectiveness of investment institutions in the nine CESEE countries that have participated in a PIMA assessment since 2016.[2] For the CESEE countries, the design of PIM institutions tends to be better than their effectiveness, a common pattern given the challenges of implementing robust frameworks and tools even where they exist. They score, on average, similarly to emerging market economies, but in almost all areas the effectiveness of their PIM practices is below that of the EU15 that have been assessed and is also substantially below best practice.

While there are significant differences in CESEE as depicted in Figure 21, some of the common findings from the effectiveness scores in PIMAs in the region are summarized as follows.

- **In the planning phase**, the design of public investment institutions in CESEE is significantly stronger than the practice. Most CESEE countries have scope to improve the integration of national and sectoral strategies and the coordination of infrastructure plans between entities, such as over-

[1]Baum, Mogues and Verdier (2020) find a strong positive relationship between countries' PIMA scores and capital spending efficiency. Baum and others (2020) find that the positive impact of public investment on growth and private investment are larger where PIMA scores are higher. In countries with weaker PIMA scores, output and private investment tend to decline, and public debt tends to rise, in response to higher public investment, possibly suggesting problems with project selection and costing, and crowding out of private investment.

[2]At the end of 2019, PIMAs had been published for Estonia (IMF 2019a), Kosovo (IMF 2016b), the Slovak Republic (IMF 2019b), and Ukraine (IMF 2019c) and undertaken but not published for Albania, Bosnia and Herzegovina, Bulgaria, Moldova, and Serbia, though some of the findings are available in other publication (for example, Bulgaria in IMF 2018b). The PIMA for North Macedonia in 2020 was not finalized by the time of publication of this study. Some countries will have improved public investment management systems since these assessments were completed.

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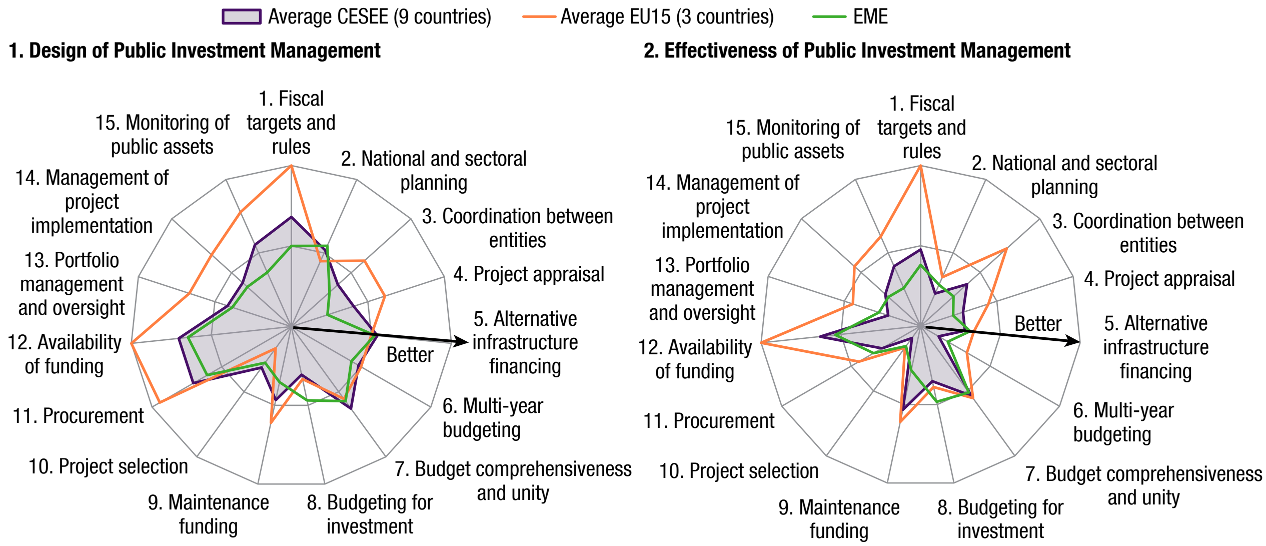
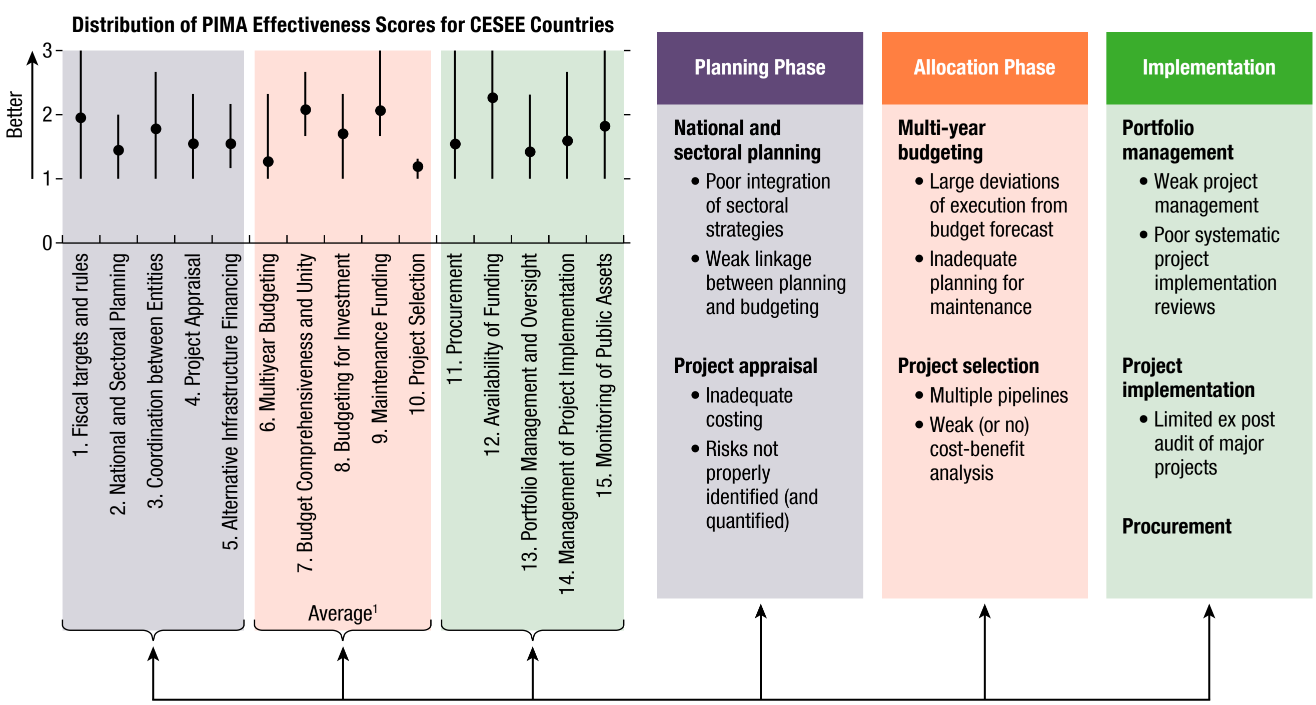
Figure 20. PIMA Scores: Design and Effectiveness



Source: IMF staff calculations using Public Investment Management Assessments (PIMA) completed until March 2020.
Note: EME = emerging market economies.

Figure 21. PIMA Scores and Areas of Weakness in CESEE



Source: IMF staff calculations using Public Investment Management Assessments (PIMA) assessments completed until March 2020.
Note: In the left panel, the lines for each indicator indicates the maximum and minimum value.

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sight and reporting of infrastructure managed by subnational governments and SOEs. For countries that fund public investment from EU funds, separate PIM rules and processes for EU-funded and nationally-funded investments may reduce overall effectiveness. For example, in the Slovak Republic, EU-funded projects are assessed and selected in accordance with EU rules and their coordination is considered to be strong. Projects funded by the national budget, however, are handled separately, and may not be subject to the same scrutiny during the planning phase. Difficulties in coordinating central and subnational government investment plans are also more common in nationally funded projects. Importantly, most CESEE countries would gain from better appraisal processes that more rigorously and consistently analyze the long-term costs, benefits, and risks of projects. Good practice includes (1) a clear and objective methodology and process; (2) rigorous analysis of costs, benefits, and risks; (3) inclusion of maintenance costs; and (4) independent review.

- **In the allocation phase**, project selection and multiyear budgeting stand out as two areas of weakness, both in terms of design and effectiveness. Project selection would be improved by ensuring that project appraisals are reviewed before decisions are taken, having standard and transparent criteria for project selection and maintaining a pipeline of projects, which reflects the country's infrastructure strategy. This finding is in line with the result of CESEE authorities' self-assessment surveys, where two-thirds of respondents report this as one of their weaker areas (see Annex 4). In addition, failure to prepare a medium-term funding framework for public investment on a full cost basis creates uncertainty and weighs on investment efficiency in many countries (for example, Kosovo and Ukraine). In 2019, Serbia strengthened its public investment management framework, introducing a centralized process for appraising and selecting projects, to be supported by an integrated project database. PIMAs also point to insufficient budget comprehensiveness (including reporting all projects in the budget regardless of funding sources, and reporting capital and recurrent spending together). The need to enhance processes to ensure appropriate maintenance of already implemented infrastructure projects is highlighted and accords with the relatively low rating in the self-assessment survey for maintenance funding.
- **In the implementation phase**, the PIMA results in several countries suggest that the effectiveness of procurement, portfolio management and oversight, and the management of project implementation fall significantly short of best practice. The average CESEE self-assessment survey rating for management of project implementation was the lowest (see Annex 4). Although tender procedures are transparent in most CESEE countries, there is room to improve procurement practices, develop procedures for project adjustment throughout the implementation, and conduct ex post

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evaluation of projects. Investment implementation is particularly strong in Estonia, reflecting the country's electronic procurement framework, an effective treasury single account system to guarantee cash availability, and transparent asset monitoring through full accrual accounting for the entire public sector together with active project management. This stands in contrast to uncertainty surrounding availability of funding for capital spending due to protection of current spending and weak cash management arrangements (for example, Albania and Moldova, where external funding has also been delayed).

For CESEE countries, strengthening the governance of SOEs is also critical, as SOEs own and operate a large share of the region's infrastructure (see Figure 18, Richmond and others 2019, and Di Bella, Dynnikova, and Slavov 2019). Improving SOEs' governance in the region, which falls short of best practice, would boost infrastructure efficiency. Reviewing regulatory frameworks that govern SOEs and the sectors in which they operate could also help level the playing field with the private sector.

The quality of PIM is also significantly influenced by the availability of EU structural and cohesion funds (see Box 1). Not only have EU funds provided a critical source of investment funding, averaging almost 2 percent of GDP annually since 2009 in CESEE-EU (Bubbico and others 2017), but ex ante conditionality for their disbursement and the introduction of a performance framework have also raised the standards in infrastructure governance, especially in the planning and project selection phases.[3] To some extent, such an impact has also been present for the countries that are in the EU pre-accession phase.

Minimizing Fiscal Risks

Infrastructure projects are typically large and complex, with long planning, implementation, and operational periods, making them particularly prone to risks (see, for example, Monteiro, Rial, and Tandberg 2020). The sources of risks are multiple: from project-specific factors linked to project design, construction and operation, to macroeconomic factors that may affect demand and prices, and government actions (for example, changes in regulations, taxation, political support) that could significantly alter the cost-benefit equation of a project. Table 3 provides an overview of the most common risks associated with infrastructure projects, and how their prominence varies across the project's lifecycle. Risks are usually the highest during the development

[3]During the 2014–20 programming period, the EC introduced regulations to incentivize countries to deliver on EU priorities. Countries must fulfill a set of legal, policy, and institutional requirements prior to funding approval and comply with a performance framework.

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Table 3. Risks for Public and Private Infrastructure Investment

Risk Category	Full Project Life Cycle	Phase of Project Life Cycle			
		Development Phase	Construction Phase	Operational Phase	Termination Phase
Political/Legal/ Regulatory	Adverse change in taxation, social acceptance, regulation/ laws, and contract enforceability[1] War, terrorism, and civil disturbance	• Environmental review • Delayed permitting	• Cancelation of permits • Contract renegotiation	• Change in tariff regulation • Contract termination	• Contract duration • Decommissioning • Asset transfer restrictions
				Currency convertibility	
			Material adverse government actions (e.g., expropriation)		
Macroeconomic	Macroeconomic conditions (growth, inflation)		• Currency depreciation/FX volatility and inflation risk • Sovereign distress		
Technical	Force majeure	• Project feasibility • Archeological assessment	Construction risk	• Operating and maintenance risks • Revenue risk	Hand-back risk
			Governance risk: poor execution and monitoring		
		• ESG risks • Obsolescence due to technological innovation			
Financial	Prudential and financing constraints[2]	Financing availability (incl. pre-funding)		• Refinancing risk[3] • Liquidity risk	
			Counterparty (incl. non-payment) risk		

Sources: Jobst (2018a, 2019); OECD (2015a); Vecchi, Hellowell, and Casalini (2017).
Note: ESG = environmental, social, and governance.
[1]Legal changes or unsupportive government policies, including contractual derogation/renegotiation, and insolvency procedures (including asset recovery).
[2]Prudential constraints affecting regulated investors (for example, capital intensity, minimum rating requirements, concentration limits).
[3]Refinancing risk refers to higher cost of debt (that is, initial borrowing rates above initial cost of capital estimate) and higher refinancing cost in a later stage of the project life.

phase and tend to decrease as projects move toward the operational phase, and more information becomes available (for example, infrastructure quality, operational efficiency, and demand volumes are observable as the project becomes operational).

As the materialization of infrastructure risks could lead to sizable fiscal costs, strengthening public investment risk management practices can improve outcomes of public investment projects (Schwartz, Ruiz-Nunez, and Chelsky 2014). Assessing and managing fiscal risks from public investment is challenging as methodologies for risk quantification are still underdeveloped. Risks are usually the highest during the development phase and tend to decrease as projects move toward the operational phase (Fainboim, Last, and Tandberg 2013; OECD 2015a, 2015c). Project outcomes can deviate significantly from forecasts, risks might not be well integrated in governance frameworks and may receive insufficient attention in investment decisions. Long-term demand forecasts are challenging due to uncertainty related to project and market risks. This is particularly the case for "greenfield" projects. Some projects may overestimate demand and underestimate user fees to make them financially and politically viable, respectively.

To better understand the infrastructure risks and risk management practices in CESEE, we conducted a survey of governments in the region in the spring

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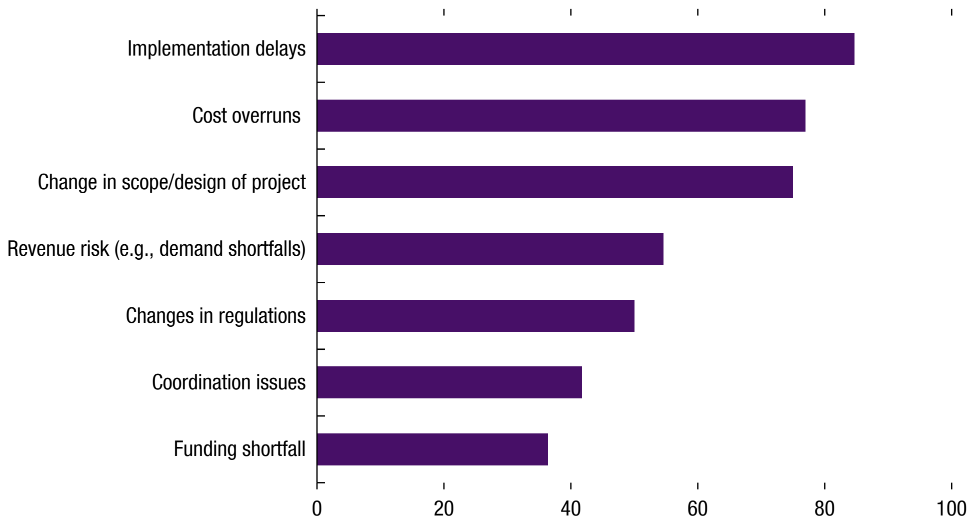
Figure 22. CESEE Infrastructure Survey: Risk Factors in Domestic Infrastructure
(Percent)



Sources: Country authorities; and IMF staff calculations.
Note: Share of respondents that assessed the risk factor to be significant or somewhat significant after adjusting for "cannot tell" responses.

of 2020 (Annex 5). The authorities identified implementation delays, other costs overruns, changes in scope and design of a project, and challenges in accurately forecasting revenues as key sources of risks (Figure 22). However, regulatory uncertainty, difficulties in coordinating between different actors (be it different levels of government, government, and private sector or across countries) as well as financial risks were also singled out as serious issues.

Surveying CESEE governments on their practices also reveals sizable gaps in fiscal risk analysis and management in most countries. Figure 23 shows that risk coverage and monitoring, risk analysis, and management of financial risks is not present or only somewhat present in about half of the CESEE countries, and that hedging project-specific risks seems to be particularly rare. This implies that there is room to improve the institutional arrangements for effective and integrated risk management, including by expanding the nature of risks analyzed (for instance by incorporating analysis of contingent liabilities, risks originating in SOEs and in PPPs, and by better quantifying the size and probability of risks, also by taking a portfolio approach thus accounting for the correlation of risks across projects. Although there is some control in the issuance of guarantees, contingent liabilities are generally not provisioned for, and thus, their realization can increase public debt (Bova and others 2016). Fiscal transparency is weak especially when it comes to risk

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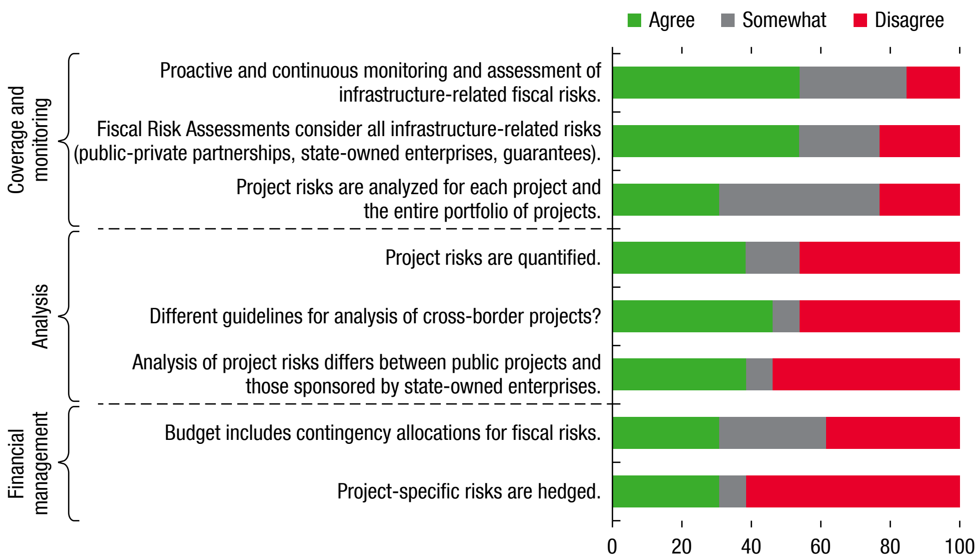
Figure 23. CESEE Infrastructure Survey: Risk Management Practices
(Percent)



Sources: Country authorities; and IMF staff calculations.

analysis and risk management (Akitoby and others 2020).[4] Fiscal risks are often not adequately disclosed, and the frequency and timeliness of reporting can be improved.

A review of the aspects of risk management covered by the PIMAs that have been undertaken in CESEE countries also suggests considerable scope for strengthening the effectiveness of risk management and mitigation practices. Three of the nine CESEE country PIMAs found that risks were not systematically assessed as part of the project appraisal process. Where risks were included, plans to mitigate those risks were prepared in only one country. In four of the nine CESEE PIMAs, contingent liabilities arising from capital projects of subnational governments, public corporations, and PPPs were found to not be systematically reported to the central government, meaning that the central government did not have a complete picture of fiscal risks related to infrastructure investment.

Shortfalls in SOE governance, which often results in soft budget constraints, could lead to the materialization of budgetary risks from SOE-provided infrastructure (Kornai, Maskin, and Roland 2003). SOEs frequently benefit from covert subsidies in the form of procurement privileges or advantageous tax

[4]Fiscal transparency evaluations (FTE) have been conducted for only six CESEE countries. To expand the coverage to other CESEE countries, Akitoby and others (2020) use an expert survey.

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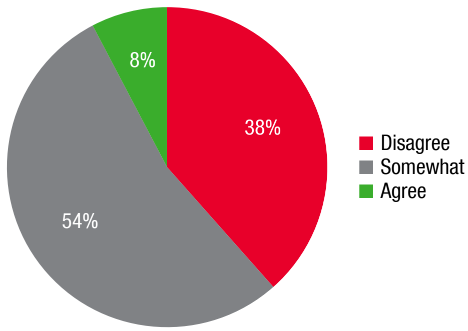
Figure 24. CESEE Infrastructure Survey: Private Sector Participation in Existing Infrastructure (Asset Recycling)
(Percent)



Sources: Country authorities; and IMF staff calculations.
Note: The figure plots the share of respondents that agreed, somewhat agreed, and did not agree with the statement that authorities use asset recycling to finance new public investments.

treatments. For instance, in Belarus, SOEs receive off-balance sheet support including capital injections, and debt assumption, with quasi fiscal transfers amounting to 2 percent of GDP per year over 2014–19 (Richmond and others 2019). To mitigate these risks, needed improvements in CESEE SOEs include more independent and professional boards, stricter financial reporting and auditing, and a more transparent relation between the central government's budget and SOEs.

Increasing Private Participation in Infrastructure Investment

As our survey of CESEE authorities suggests, central and subnational governments dominate the provision of social infrastructure, and SOEs play a large role in the provision of economic infrastructure. The private sector's role is relatively limited, with the exception of ICT and energy (Figure 18). In CESEE, private participation occurs mainly via PPPs, but it has also been supported by "asset recycling" when governments sell (or lease) existing public assets to private operators and use the proceeds to fund new investments (Figure 24).

PPPs amounted to about 0.5 percent of GDP per year on average in CESEE over the last decade (Figure 25). The prevalence of PPPs is more common for CESEE countries outside the EU, where PPPs have amounted to about

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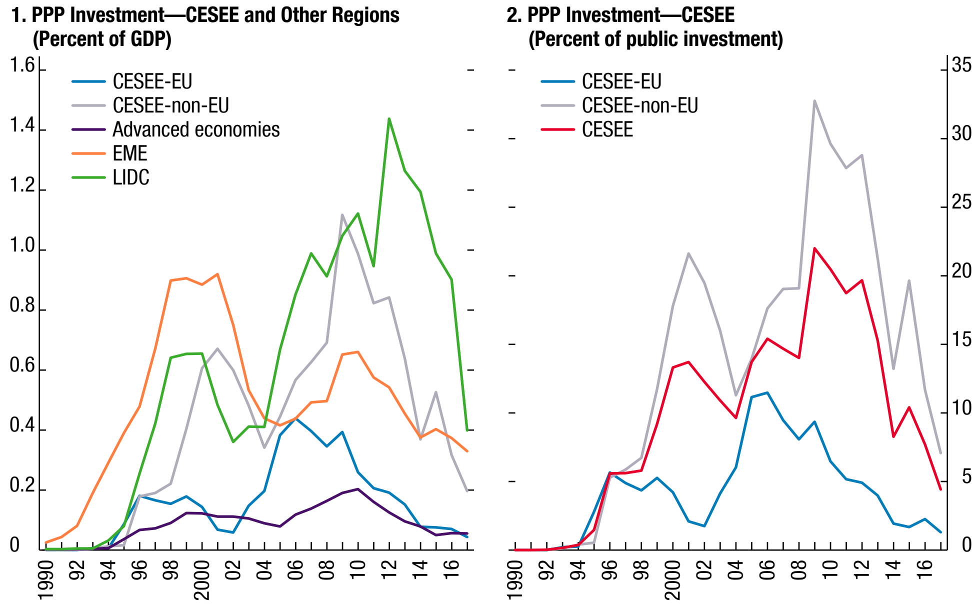
Figure 25. PPP Infrastructure Investment in CESEE



Sources: Haver Analytics; and IMF staff calculations.
Note: In panel 1, the percentage share is defined in nominal terms. For CESEE and CESEE subgroups, see Figure 1. EME = emerging market economy; LIDC = low-income developing country; PPP = public-private partnership.

a quarter of total public investment.[5] Most PPPs in CESEE are financed through project loans and bonds. Figure 26 shows annual flows of private infrastructure finance globally since 2005, which includes PPPs and privately owned infrastructure projects. The financing volumes in CESEE countries are larger than in emerging markets but lower than in advanced economies. They stood at 0.9 percent of GDP at the end of 2019 (and averaged 0.6 percent of GDP over the last decade). Private infrastructure finance only marginally exceeds the current PPP volume, which is explained by some refinancing of projects and by private capital also flowing into infrastructure projects outside PPPs.

An enhanced role of the private sector in the provision and financing of infrastructure can be desirable for several reasons. It could alleviate concerns about the public sector's efficiency in delivering infrastructure services, even if the public goods nature of infrastructure, equity considerations and market imperfections due to network effects, positive externalities, and natural monopoly characteristics have traditionally resulted in a dominant role of

[5]The lower prevalence of PPPs in CESEE-EU may reflect their access to EU structural funds as an alternative financing source. The full accounting for contingent liabilities under Eurostat rules may also render PPPs somewhat less attractive to EU member states.

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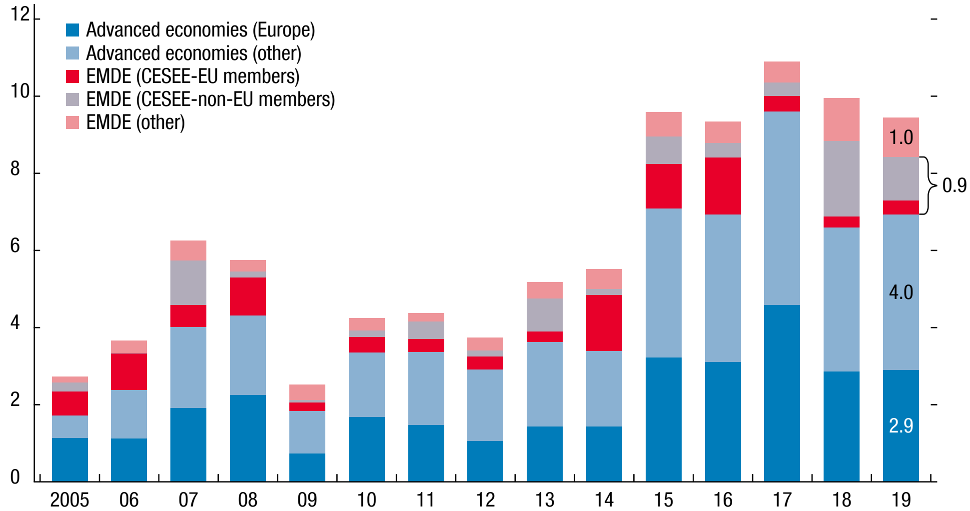
Figure 26. Global Private Infrastructure Finance
(Percent of GDP)



Sources: IJGlobal; and IMF staff calculations.
Note: The bars in the figure exclude projects in the oil and gas and mining sectors, as well as refining transactions. The total volume was USD229 billion in 2019, of which about USD10 billion was attributable to projects in CESEE. EMDE = emerging market and developing economies.

the public sector. Nevertheless, this requires effective regulators in sectors with limited competition.[6] While private financing can be expensive, efficiency gains over the total lifecycle of well-executed projects can outweigh potential contingent liabilities, especially if contractual features ensure the financing is robust to a wide range of risks (Annex 6) and risk allocation is appropriate. Greater private participation in infrastructure could also help governments overcome temporary budget constraints in financing, especially during times when public investment needs to be scaled up, but it should not drive public investment decisions. The latter consideration may become particularly relevant in the aftermath of the COVID-19 crisis discussed in Chapter 4.4 (OECD 2008).

PPPs can offer advantages over traditional public procurement in terms of mobilizing private resources and know-how, leveraging public funds, and improving service quality. Nevertheless, the evidence of whether PPPs can provide infrastructure more efficiently than traditional public procurement

[6]A full discussion of the role of regulators is beyond the scope of the paper, but this does not diminish the criticality of this issue. A large body of literature has documented sizable gains in productivity and efficiency gains of improving regulation both for the infrastructure sectors themselves and the downstream firms that use their services (see, among others, Arnold and others 2011, Bourlès and others 2013, and Lanau and Topalova 2016).

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is mixed.[7] PPPs involve potential future obligations by the government that should be considered upfront, mitigated where appropriate, and actively monitored and managed through project delivery and the life of the infrastructure asset. The use of PPPs requires careful management, not least because of their scope to pose unexpected costs to the government. There is evidence (including from PIMA) that in many countries, the fiscal risks of PPPs are not well quantified and actively considered when deciding on PPPs. In other cases, the risks may be considered, but PPPs could be pursued because they can be a way to reduce the call on the government budget in the near term. For all these reasons, strong capacity in governments to design and manage PPPs, and robust governance processes that select projects and financing structures to maximize the public benefit, are needed.

Mobilizing and channeling private capital to infrastructure projects has been challenging in many CESEE countries for several reasons.

- PPP institutional and financing frameworks appear somewhat weak in CESEE, which might entail important inefficiencies and may hinder private investors' participation (Figure 27).
- Private investors are exposed to a variety of risks that they find difficult to mitigate. The incentives for potential project sponsors to commit to the high costs associated with the preparation of bid proposals are low due to project implementation uncertainties and poor revenue visibility. Challenges include poor project preparation and procurement practices (including insufficiently developed proposals, poor market sounding practices and inadequately resourced or skilled government counterparts), and unclear legal and regulatory frameworks (including price and quality regulation that applies to infrastructure service providers) that lead to delays and a lack of transparency in bidding. Since fully operational underlying assets ("brownfield") provide greater stability of returns and potentially simpler operational management, investors generally prefer projects that either (1) entail renovating existing infrastructure assets or (2) have an established performance track record and no construction and operational delay risks (Table 4).[8] Based on our survey results, changes in tariffs, renegotiation

[7] Schwartz, Corbacho, and Funke (2008) and Engel, Fischer, and Galetovic (2010, 2014) document significant variations in the benefits of PPPs across projects and countries, with some PPPs leading to considerable cost savings, while others resulting in large fiscal costs due to poor contract designs, optimistic assumptions about revenues from user fees, and minimum income guarantees provided by the governments. Khachatryan and others (forthcoming) will focus specifically on PPPs in CESEE.

[8] Institutional investors also show increasing risk-taking in "greenfield" or new projects in the energy sector (as opposed to transportation, water, or information and communications technology); this is partly explained by the fact that the construction period, which is typically associated with elevated default risk, tends to be shorter in the energy sector. Investment in other sectors, such as transport, often occurs after construction, during the "brownfield" phase, where greater certainty of revenue streams and stability of the regulatory environment

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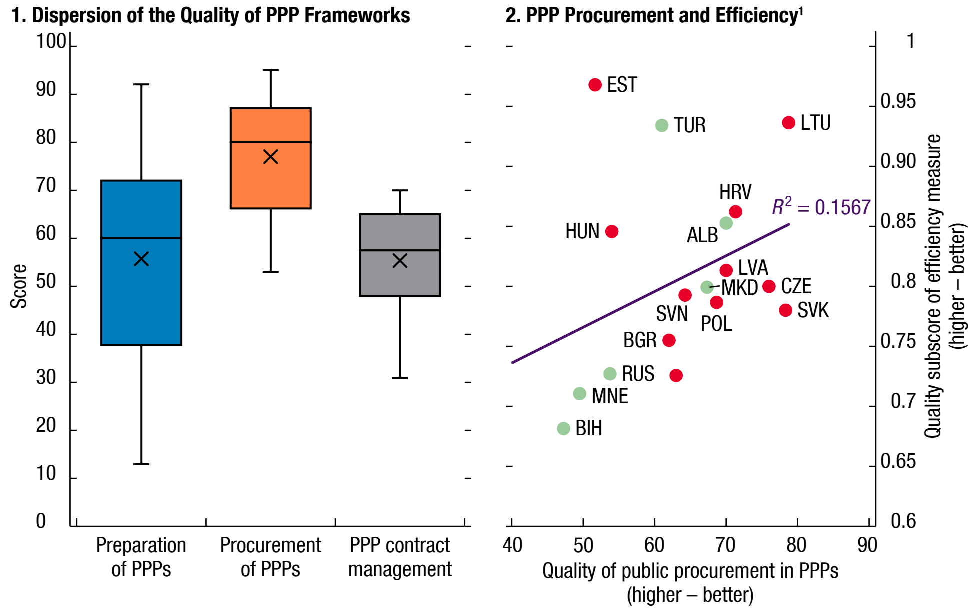
Figure 27. PPP Frameworks and Infrastructure Quality in CESEE



Sources: IMF Fiscal Affairs Department Survey; World Bank (2018); and IMF staff calculations.
Note: PPP = public-private partnership.
[1]Red dot = CESEE (EU); green dot = CESEE (non-EU).

of contracts and the cancellation of permits are quite common and add to regulatory uncertainty in many CESEE countries (Figure 28). Many CESEE countries still lack scalable and comprehensive risk mitigation tools to attract private investors. Only a few countries offer guarantees to cover nonpayment risk or upgrade the rating of a transaction. No country, however, offers liquidity facilities to hedge for instance against FX risk, nor guarantees to cover for refinancing risk (Figure 29).

The more successful PPPs in the region, with Poland, Russia, and Turkey as key markets, tend to exhibit a confluence of three important characteristics: (1) a strong and transparent PPP framework with political commitment to support a strategic PPP agenda; (2) a unified and standardized process to public investment (planning, allocation, implementation) across relevant institutions; and (3) the availability of highly skilled staff for project preparation, procurement, and contract management (Flor 2018). In addition, in some CESEE countries, private participation occurs in the form of foreign direct investment and portfolio flows to companies that execute the projects, given the limited depth of local financial markets. This requires adherence to international standards in terms of public investment management and

help avoid the carrying costs arising from a gradual draw-down of the debt portion during the construction period (Jobst 2018a; Saha 2018).

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Table 4. Private Participation in Infrastructure: Project Life Cycle and Complementarity of Finance Providers

			Planning				Construction ("greenfield")	Operation ("brownfield")	
			Identified Need	Project Proposal	Project Design	Project Financing	Construction	Operation/ Maintenance	Ownership
Infrastructure Procurement Options[1]	*Non-PPP*	Build (B)	Public[2]	Public[2]	Public	Public	Private	Public	Public
		Design-Build (DB)	Public[2]	Public[2]	Private	Public	Private	Public	Public
		Design-Build-Finance (DBF)	Public[2]	Public[2]	Private	Private	Private	Private	Public
	PPP	Design-Build-Operate-Maintain (DBOM)	Public[2]	Public[2]	Private	Public	Private	Private	Public
		Design-Build-Finance-Operate-Maintain (DBFOM)	Public[2]	Public[2]	Private	Private	Private	Private	Public
Risk Characteristics and Financing		*Financial Requirements*	Substantial planning and material financial resources required prior to construction				Accounts for most capital outlays; project does not generate revenues[3]	Revenues generated by user charges or availability payments by public entity; mature projects generate steady and reliable cash flows	
		Risk Profile	Significant uncertainty and risk				Higher level of risk and rising probability of default[4]	Rapidly declining default risk due to improving risk profile	
		Financing Types	Specialist ("early stage") equity and high-cost debt investors				Re-financing is difficult	Re-financing becomes more feasible and appeals to long-term investors (with focus on lower risk and regular interest payments).[5]	
Investors		*Banks*	Provide most financing during the construction phase and may seek to exit						
		Long-term investors	Insurance companies, pension funds, and SWFs mostly interested in operational projects; rarely early-stage equity investors[6]						
		Investment funds	May participate in any phase depending on funding structure, type, and mandate						

Sources: Brookings Institution; Financial Stability Board; World Bank, Public Private Infrastructure Advisory Facility; and IMF staff.

Note: SWF = sovereign wealth fund.

[1]PPIs that do not constitute public-private partnerships (that is, lack of natural incentives for the contractor to care about the quality and resilience of the asset) include the following procurement options: (1) in "build only" (B) contracts, a design has already been completed by a different entity and a contract is tendered to build the infrastructure asset; (2) in Design-Build (DB) contracts, a single contract is tendered for both the design and construction of the infrastructure asset. In some countries, B or DB contracts may also be referred to as Engineering, Procurement and Construction (EPC), especially when the asset to be built consists mainly of a plant; and (3) in Design-Build-Finance (DBF) contracts, the government receives the asset upon completion of construction and retains the responsibilities and risks related to the state of the asset over its lifetime; the deferred payment by the government makes the contractor a "de facto" lender until the construction is completed). PPIs that constitute PPPs are (1) Design-Build-Operate-Maintain (DBOM) contracts, which are still financed by the public sector (that is, construction work is paid for directly as work progresses), while the operations and management price is closely tied to the performance and paid for in a separated stream, and (2) Design-Finance-Build-Operate-Maintain (DFBOM) contracts (and other equivalent terms such as Build-Operate-Transfer [BOT], Build-Own-Operate-Transfer [BOOT], Build-Transfer-Operate [BTO]), which fulfill all of the conditions (in terms of scope) required to be a private finance PPP; however, whether a DBFOM contract may be regarded as a true private finance PPP depends upon the effectiveness of risk transfer and the nature of the links between the performance and revenue; other contracts that involve private investors are (1) contracts for managing services or existing infrastructure (that is, "at-risk" long-term management or service contracts that can be regarded as service PPPs (not DBFOM contracts); and (2) other private involvement in public infrastructure and services (for example, specific infrastructure development projects where a private promoter is authorized to develop infrastructure or a plant, and operate the asset under regulated conditions, sometimes including subsidies and regulated price).

[2]This includes unsolicited private sector bids.

[3]That is, no amortization and interest cannot be financed from project revenues.

[4]And in early operational phase.

[5]Project bonds may be issued, and equity stakes may be sold in secondary market to realize capital gains.

[6]And if so, mostly in controlling position.

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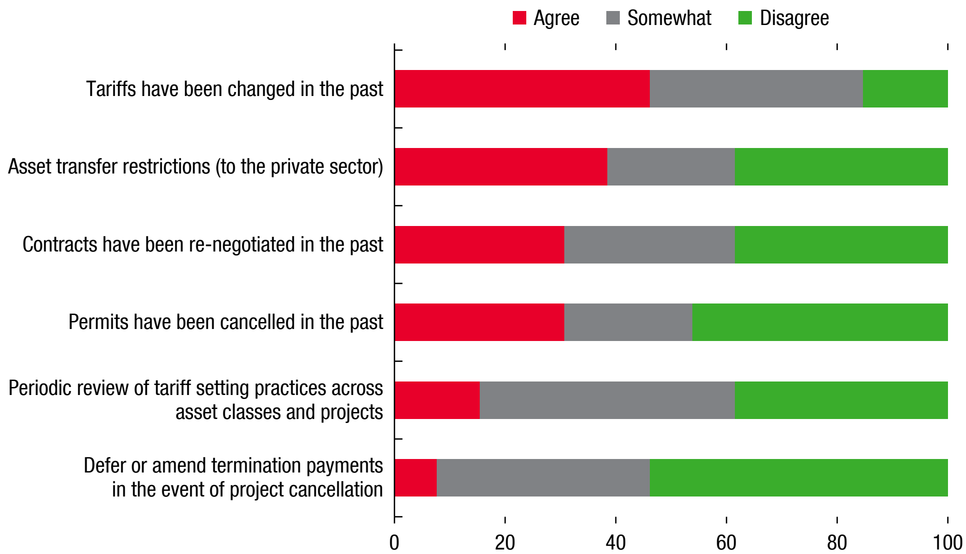
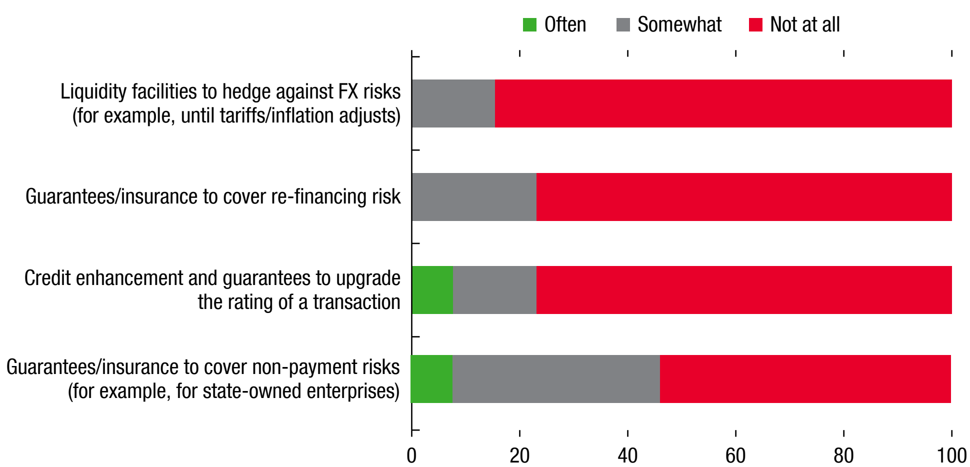
Figure 28. CESEE Infrastructure Survey: Sources of Risk for Private Investors
(Percent)



Sources: Country authorities; and IMF staff calculations.

Figure 29. CESEE Infrastructure Survey: Risk Mitigation Instruments for Private Investors
(Percent)



Sources: Country authorities; and IMF staff calculations.
Note: FX = foreign exchange.

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transparency in procurement practices. The risks of contractual failures can be mitigated through routine monitoring and triggers for enhanced reporting and controls to allow for early intervention.

The IMF has been working with countries in the region to further strengthen their ability to manage PPPs. The latest version of the IMF/World Bank PPP Fiscal Risk Assessment (PFRAM 2.0) was released in September 2019 and helps assess the potential costs and risks from PPP projects at both individual project and portfolio levels. The IMF provides capacity development training on PPPs and/or PFRAM, and several CESEE countries have already taken advantage of this opportunity (Albania, Belarus, Latvia, North Macedonia, Montenegro, Serbia, Slovenia, and Turkey). These engagements underscore the need to strengthen skills and knowledge to manage PPPs not only in procuring agencies, but also in Ministries of Finance to adequately safeguard the fiscal position.

Going forward, countries should look to strengthen their ability to manage PPPs and could also explore mechanisms that attract private sector involvement through more effective risk allocation. Building on existing guarantee schemes, countries could benefit from streamlining, coordinating and expanding existing guarantee offerings to target very specific risks, especially during early-stage development, which are difficult to manage by the private sector. Nevertheless, this has to be balanced with prudent fiscal risk management. Box 3 describes the main risk mitigation instruments generally available for infrastructure financing to address the key risks set out below. Whether countries should offer these instruments requires careful consideration of the risk involved for the government, the expected return, and the optimal allocation of risk. In particular:

- **Local currency and liquidity risks.** Addressing currency risks of infrastructure projects is important as infrastructure revenues generally are in local currency, creating mismatches when foreign equity and debt are used in financing. The impact of currency volatility on cashflow can be hard to absorb because tolls, tariffs or fees are typically not adjusted with local currency fluctuations. A liquidity facility could help support private participants' cashflow in real terms after a large devaluation until revenues can be adjusted.
- **Refinancing risks.** Long-term investors are unlikely to invest in early-stage infrastructure projects due to the lack of cash flows and high risk. Banks tend to provide so-called "mini-perms" (that is, short-term loans) for the construction phase but have difficulty refinancing their project loans. A contingent refinancing facility, funded by the government, could offer a refinancing backstop.

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- **Counterparty risk.** SOEs tend to be low-rated, which makes it difficult to seek capital market financing without a sovereign counter-indemnity. In addition, credit enhancements might be required to cover debt service shortfalls for capital market issuers in sub-investment grade jurisdictions.[9]

Nevertheless, the expanded use of guarantees must be balanced with prudent fiscal risk management. For instance, in case of a large currency depreciation, governments might struggle to provide sufficient liquidity support to infrastructure projects without causing a further deterioration of the public and external accounts.

Promoting greater domestic private financing would be desirable as infrastructure evolves into an investable asset class (OECD 2020a, 2020b), thus reducing the need for additional risk mitigation measures. While it is likely that foreign capital will continue to be needed given the size of potential infrastructure needs, mobilizing more domestic savings to finance infrastructure can also support local capital market development (EC 2013). To achieve this, domestic long-term institutional investors, such as life insurers and pension funds, would have to become more involved in infrastructure financing and complement domestic bank lending (Gründl, Dong, and Gal 2016). Infrastructure projects tend to yield stable and predictable operational cash flows over the long term thereby providing a natural match to the long-term liabilities of institutional investors (Jobst 2018a).[10] Even though infrastructure project finance tends to be less standardized than corporate debt or bonds, covenants, such as step-in options (Annex 6), could significantly strengthen lenders' control rights and boost recovery values in case of default (Blanc-Brude 2014).

However, this requires coordinating upstream infrastructure and downstream financial sector policies. Better aligning the design, procurement, and structure of infrastructure projects with investors' needs and expectations through greater contractual and financial standardization could increase the pipeline of "bankable" projects. Governments, however, should do this only as long as fiscal risks are fully understood and can be properly managed. Besides enhanced public investment and risk management, it may be necessary to review investment requirements of long-term investors.

Cross-Border Coordination

As discussed in Chapter 3, cross-border projects have the potential to amplify the macroeconomic benefits of infrastructure investment. These projects

[9]The EIB credit enhances project bonds (Project Bond Credit Enhancement, PBCE) to achieve robust credit quality attractive to institutional investors via the Europe 2020 Project Bond Initiative (EIB 2012).

[10]Banks' appetite as traditional lenders has declined in recent years due to caution in committing to long-term loans.

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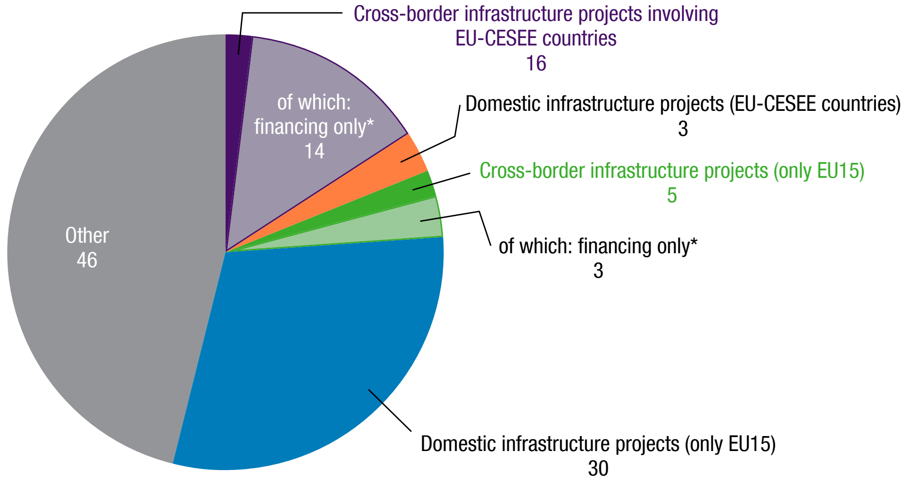
Figure 30. European Fund for Strategic Investments: Signed Projects (2015–20)
(Percent)



Sources: European Investment Bank; and IMF staff calculations.
Note: The total amount invested over this time period is roughly €255 billion. * refers to designated infrastructure funds with multi-country allocation. Cross-border infrastructure projects involving CESEE-EU include EU-wide projects and projects joint with one or more EU15 countries. There has been no cross-border EFSI-signed project comprising only CESEE-EU countries. "Other" includes cross-border and domestic non-infrastructure projects in EU countries.
EFSI = European Fund for Strategic Investments.

aim to promote cross-country cooperation and connectivity through trade, finance, and investment, creating value beyond what individual infrastructure projects would bring by integrating markets and connecting communities (ADB 2007). Cross-border projects can spur virtuous cycles: greater coordination, improved information sharing, shared risks, and common benefits provide incentives to enhance transparency and accountability, and strengthen the weakest parts of a network (Derudder and others 2018; Straub, Vellutini, and Warlters 2008; World Bank Group 2019).

Cross-border projects have attracted increasing attention over the last few years in Europe as discussed in Box 1, with EU initiatives like Connecting Europe and the InvestEU program.[11] In the case of InvestEU, about 20 percent of all supported projects are cross-border (that is, they involve mostly pooled financing for multiple countries rather than single projects that are jointly completed by two or more countries). Eighty percent of these projects involve at least one CESEE country, but none involve only CESEE-EU countries, suggesting that so far such projects have mainly connected the EU15 with CESEE-EU (Figure 30). In CESEE, the Three Seas Initiative specifically aims to augment the existing resources from these EU initiatives

[11]Infrastructure projects represent more than half of the projects supported by Invest EU.

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Table 5. Infrastructure Risks: Considerations for Cross-Border Projects

Risk Category	Risks	Additional Risks in Cross-Border Context
Political/Legal/ Regulatory	• Adverse changes in tariffs, taxation, social acceptance, regulation/laws, and contract enforceability • Permit cancelation, contract termination, asset transfer restrictions • War, terrorism, and civil disturbance	• Different **regulatory/legal frameworks** (e.g., dispute resolution and asset recovery) • Potential **asymmetric information problem** in planning, allocation, and implementation
Macroeconomic	Macroeconomic conditions (growth, inflation, domestic activity)	• Asymmetric shocks and risk spillovers • **Unilateral (uncoordinated) macro policy choice(s)**
Technical	• Force majeure, construction/operational/revenue risks • ESG and technological risks	• More difficult procurement, cost-benefit analysis, project selection, and contract design • Additional approvals and **coordination/monitoring challenges**
Financial	• Regulatory and funding constraints • Counterparty and non-payment risks	More **difficult risk-sharing** and structuring of payments and guarantees

Sources: Jobst (2018a, 2019); OECD (2015a); Vecchi, Hellowell, and Casalini (2017); and IMF staff.
Note: ESG=environmental, social, and governance standards.

by mobilizing more private capital to improve regional infrastructure, energy security, and connectivity between its members.

Their potential benefits notwithstanding, cross-border infrastructure projects carry complex risks. Such projects typically have longer planning and implementation horizons, given coordination challenges. The main risks are resource misallocation at the project selection, implementation, or management stages, but projects may face other risks as well (Table 5). Once constructed, there is a risk that some countries may lack the capacity or financial resources to maintain infrastructure within their borders if planning is poor or fiscal space is lacking, reducing the benefits of the overall project. In other words, cross-border projects can amplify some of the risks inherent in infrastructure projects. Even if a country has good public investment and risk management institutions, it may suffer from the failure of the other countries to manage risk ("weakest link dilemma"). More generally, risks are related to different institutional frameworks and faulty risk allocation across countries, given that gains from the project may be asymmetrically distributed. Implementation challenges may arise if the capacity to manage cross-border projects in participating countries differs.

Our CESEE authorities' survey reveals the perceived complexity and risks of cross-border projects. About half of the countries surveyed reported that project-related issues (that is, difficulties in estimation of costs and cash flows, among other) were serious problems. The same share of respondents flagged that political uncertainty and inconsistent regulatory frameworks across countries were also problems. On the other hand, cost sharing allocation across countries and the lack of institutional framework for cross-border coordination were reported as problematic only by about 30 percent of respondents (Figure 31). The presence of supranational institutions coordinating cross-border projects reduces these problems to some extent, facilitating coordination and commitment between countries. These findings, together with

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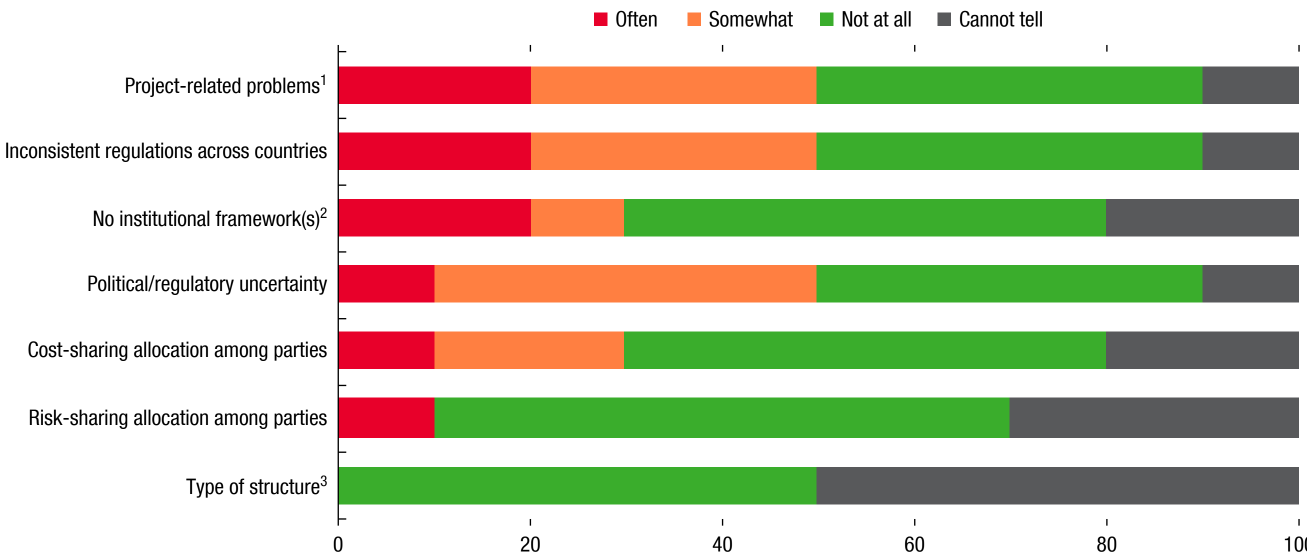
Figure 31. CESEE Infrastructure Survey: Risk Factors in Cross-Border Projects
(Percent)



Sources: Country authorities; and IMF staff calculations.
[1]For example, underestimation of construction/maintenance costs.
[2]For cross-border coordination.
[3]For example, publicly funded investment, public-private partnership (concession payment versus availability-based revenues), and other arrangement.

the fact that cross-border projects tend to be more complex and costly, might explain the lower private participation in cross-border projects compared to those within national borders. Figure 32 supports this conjecture by comparing the ownership composition of economic infrastructure between national and cross-border projects.

Several case studies in the CESEE region provide insights on the characteristics of successful cross-border projects (Box 4). Survey responses from country authorities allow to classify these case studies as "successful" or "challenging." Successful cross-border projects tend to have clear payoffs and risk-sharing mechanisms (mostly in transport and energy sectors); adhere to international standards (which reduces uncertainty), mostly due to the conditionality of EU funding (even though this might also create challenges for project planning); establish clear coordination and monitoring protocols; and follow strict transparency rules. Likewise, country authorities reported that projects tend to fail because of extensive implementation delays or ineffective selection processes.

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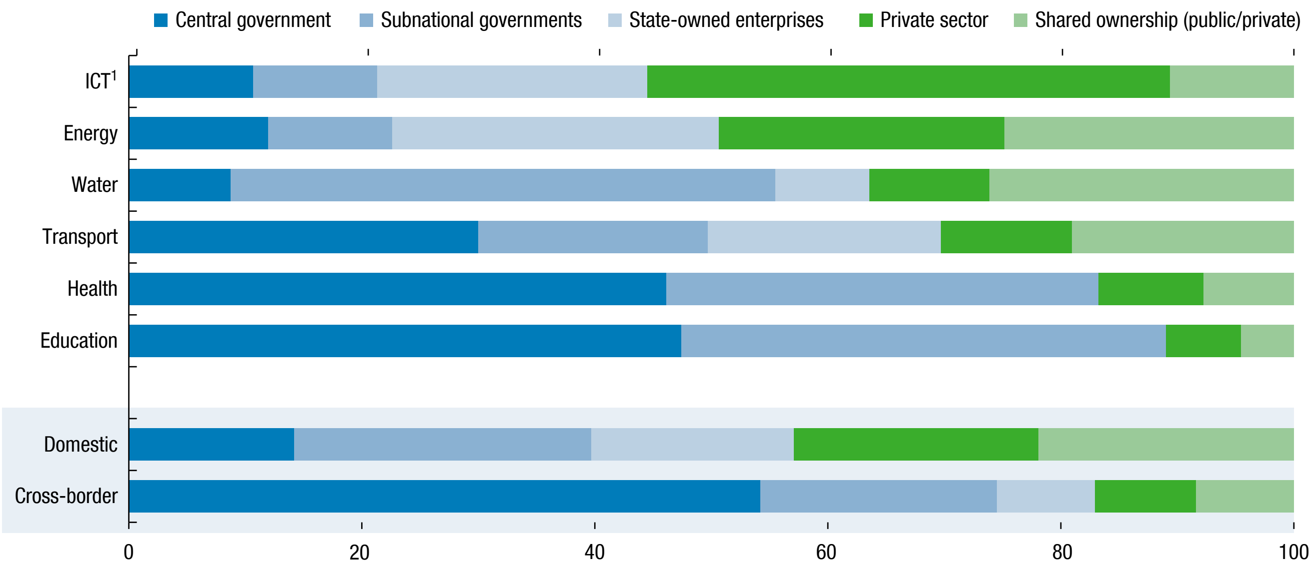
Figure 32. CESEE Infrastructure Survey: Projects by Ownership
(Percent)



Sources: Country authorities; and IMF staff calculations.
Note: ICT = information and communication technology.
[1]Domestic infrastructure aggregates the shares of economic infrastructure (namely, ICT, energy, water, and transport).

Infrastructure Investment in the Aftermath of the COVID-19 Pandemic

Scaling up public investment could be an essential element of fiscal stimulus in the aftermath of the pandemic, but it might not be appropriate for all countries and crucially depends on the quality of infrastructure governance. The COVID-19 crisis not only revealed deficiencies in some infrastructure sectors, such as health and digital connectivity, but also disrupted ongoing projects, and lowered the demand and/or ability to pay for several infrastructure services Revenue shortfalls of SOEs delivering some of these services and the potential realization of contingent liabilities are likely to drain fiscal resources, which could otherwise have been invested in new infrastructure projects and maintenance.

The crisis raises the need for more and better public investment to support the recovery after what is evolving into a deep and potentially long-lasting recession (Tandberg and Allen 2020). Indeed, public investment is a common fiscal stimulus tool due to its high multiplier, especially during recessions, as well as its discretionary and lumpy nature. Some CESEE countries (for example, Croatia, Estonia, Hungary, Poland, and Romania) are already planning to include infrastructure projects as part of their stimulus packages

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and the European Commission has called countries to protect public investment and focus on green and digital priorities.[12]

While the pandemic offers an opportunity to transform infrastructure systems and incorporate climate adaptation and mitigation into the policy response (Global Commission on Adaptation 2020), it can also complicate scaling-up public investment for several reasons.

- The future structure of the economy is highly uncertain as is the demand for infrastructure and its costs. For example, demand for digital infrastructure will likely rise (Gereben and Wruuck 2020). The pandemic revealed that in many countries health spending, including in health infrastructure, may need to increase. On the other hand, prospects for energy and transportation are less clear-cut. While the oil price decline might make energy investments less attractive, it could provide options to cancel existing projects and re-orient them toward cleaner energy generation and a more resilient energy grid (Box 5). Despite the large drop in transport demand during the crisis, higher demand for greater connectivity within Europe could increase from a possible relocation of production to Europe from outside the region.
- Current infrastructure projects/assets have been negatively affected by implementation delays, lower revenues, higher costs, credit stress, force majeure disputes, and guarantees being called during the pandemic (Fakhoury 2020). The policies introduced by many governments to protect the most vulnerable consumers during the crisis—for example, moratorium on utility bills, deferment of payment for business users and, in some cases, more generalized price freezes or reductions—could jeopardize the financial viability of utility companies. This could weigh on the appetite for new infrastructure projects, especially by the private sector.
- Both public and private balance sheets will come out of the pandemic with higher debt. Nevertheless, private savings are also likely to have increased, and interest rates, at least on government bonds, are likely to be low for an extended period, which could generate a search for yield by private investors.
- With a bigger role of government, opportunities for corruption may have increased, especially when large projects are decided in a rush without appropriate controls and accountability. Several studies have documented greater cost overruns and inefficiencies when public investment is scaled up substantially during a boom (Presbitero 2016; Gurara and others 2020).

We can draw some tentative implications for public policy.

[12]See OECD (2020b) and the European Semester Spring Package, which includes EU country-specific recommendations (CSRs) for 2020–21. Part of national recovery plans could be financed by the recovery facility of the Next Generation EU package.

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- First, it is necessary to review and potentially reprioritize capital spending to reflect changes in the economy. The project pipeline should be reassessed to choose well-planned projects that deliver the highest growth and other benefits relative to the expected cost. Beginning this work quickly would help identify high-quality projects, ensure they are ready for implementation and support the recovery while identifying early capacity constraints (for example, in procurement systems, or access to capital, labor, and materials).
- High uncertainty and a need for a timely boost to economic activity will require maintaining flexible policy responses, including in supporting ongoing projects. However, this should be accompanied by enhanced transparency, controls, and accountability regarding project planning, allocation, and implementation.
- The many demands on governments' budgets, higher debt, and greater opportunity for corruption put a premium on strong infrastructure governance. The PIMA recommendations are very relevant for those countries that recently participated in this exercise. Other countries could consider undertaking an assessment as it would offer tailored and detailed action plans.
- Better governance will also help mobilize private involvement and financing, which could remain depressed amid high uncertainty and debt overhang.
- The postcrisis recovery also offers an opportunity to promote investment aimed at enhancing socioeconomic resilience. This crisis underscores that the cost of failing to build resilience can vastly exceed that of preventing a crisis. Infrastructure projects will need to have long-term benefits to society, which implies a fundamental shift from optimizing short-term performance to ensuring longer-term resilience. For instance, investing in climate-resilient energy grids would make sense as energy grids appear particularly vulnerable to natural disasters in CESEE (Rentschler and others 2019).

As highlighted in IMF (2020a), public investment should also support more environmentally sustainable development (Box 5). Public investment programs create infrastructure that will shape carbon emissions for decades. Hence, countries should avoid locking in carbon-intensive growth (Dechezlepretre and others 2020; IMF 2020b; Zhang 2020)[13] by choosing climate-smart network infrastructure projects (for example, renewables and electric vehicle charging stations) (Arregui and others 2020), and supporting green technologies and emerging practices (for example, battery storage and carbon capture) (EC 2019c). They should also encourage adaptation (for

[13]The EU supports green infrastructure, including via the Connecting Europe Facility that promotes sustainable transport infrastructure.

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example, flood protection as well as resilient roads and buildings) and avoid carbon-intensive activities (for example, fossil fuel energy generation). Governments should adopt strategic approaches to public investment and account systematically for the contribution to and vulnerability of infrastructure projects to climate risks in a cost-benefit analysis that includes environmental, social, and governance considerations (IMF 2020e; Batini and others, forthcoming). Over the long term, green public investment will likely turn out to be cost effective given the macroeconomic impact of unmitigated climate change and its effect on infrastructure (Hepburn and others 2020; Guo and Quayyum 2020). For CESEE, the average investment need for climate mitigation through 2030 is estimated at roughly 1.5 percent of GDP per year.[14]

[14]The costing of investment needed for climate-sensitive infrastructure builds on EC (2019b, 2018b, and 2016) estimates but incorporates the latest emission reduction targets of 50 percent according to the EU Green Deal. For CESEE countries outside the EU, the results were scaled proportionately based on the difference in the average annual public investment and the capital stock as of the end-2016. These estimates include investment in low-carbon, climate-resilient power generation and networks, and public transport but exclude investment in water systems and waste management for consistency with the benchmarking results in Table 2.

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Box 3. Risk Mitigation Instruments for Private Infrastructure Financing

Governments use different mechanisms to overcome constraints to private sector participation in infrastructure projects (OECD 2015a, 2015c). These include fiscal incentives, capital pooling platforms and risk mitigation mechanisms (such as guarantees, insurance, credit enhancement, currency risk protection, and grants, among other). They can also help arrange for support from multilateral investment agencies and risk insurers. Risk mitigation instruments are available to all types of investors including public and private equity, and various debt investment instruments (OECD 2016, 2018a, 2018b). Whether they are applied to projects should be subject to careful evaluation of the benefits and risks by the government, including potential future fiscal impacts.

Guarantees are issued by national and subnational governments, multilateral and bilateral institutions, development banks, and other public entities and may have direct and indirect budget impacts. Guarantees or insurance can differentiate between the cause of a default, usually either political or commercial in nature. Public guarantees reduce repayment and foreign exchange risks, which lowers the cost of credit. This could render the project eligible for investment by institutions facing regulatory barriers (Levy 2017b; Inderst and Stewart 2014). However, eligibility for guarantee schemes should be examined thoroughly to avoid moral hazard and adverse selection.

- **Minimum revenue guarantees (MRG).** MRGs may be suitable for projects that are considered commercially viable but have difficulty attracting financing due to revenue uncertainty. The revenue usually covered under the guarantee is only provided to service debt held by third-party investors if the project does not generate enough revenue. However, a project relying on guarantees can be more vulnerable to political risk or can diminish the incentives to deliver quality facilities and service if contractual obligations do not include appropriate covenants or maintenance obligation.
- **Guarantees, letters of credit, and insurance contracts on infrastructure finance instruments.** Appropriate economic incentives can help mitigate performance risk, including provisions for liquidated damages as well as financial support instruments, such as a bank letter of credit or other performance support instruments.
- **Export credit guarantees.** They are usually provided by export credit agencies and mitigate risks linked to the export of goods and services, covering a percentage of both political and commercial risk.
- **Grants.** They are payments by the contracting authority to the entity executing the project. Grants can be paid out at any time during the project lifecycle, reducing financing costs during the development and construction phases or stabilizing revenue in the operation phase by providing public funds. They can be lump-sum payments, tied to project revenues, or to certain milestones to be achieved in the project lifecycle.
- **Taxation.** Tax incentives can be used to increase the attractiveness of infrastructure investment. Reducing or suspending property taxes or extending tax breaks on investment revenues could subsidize projects throughout the life of the asset. Taxation is a form of a grant because it essentially amounts to a fiscal transfer either enhancing revenue directly, or reducing outlays needed at project inception.

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Table 3.1. Infrastructure Risks: Available Risks Mitigation Instruments and Existing Shortcomings

		Risk Mitigation		
Risk Category	**Risks**	**Available Instruments *(if applicable)***	**Providers**	**Limitations**
Political/Legal/ Regulatory	• Adverse changes in tariffs, taxation, social acceptance, regulation/laws, and contract enforceability • Permit cancelation, contract termination, asset transfer restrictions	Targeted guarantees/insurance covering political and regulatory risks (incl. partial risk guarantees)	MDBs, DFIs, MIGA, and ECAs	Limited project eligibility in some other cases; also many MDBs require counter-indemnity from governments (in many cases)
Macroeconomic	Macroeconomic conditions (growth, inflation, domestic activity)	• FX guarantees or targeted hedging instruments covering FX depreciation risk • Inflation-indexing of proceeds/revenues • Demand guarantees (minimum payment)	Commercial financial institutions	Limited size, currency availability, tenor, and affordability
Technical	Force majeure, construction/operational/revenue risks	• Contract design (guarantees, availability-based payment mechanism, offtake contracts) • Demand guarantees (minimum payment)	• EPC contractors • Governments, public agencies, and DFIs	n.a.
	ESG and technological risks	• ESG assessment • Technology guarantees	Insurance companies	
Financial	Regulatory and financing constraints	• Mini-perms and project loan CLOs but no general re-financing possibility • Differentiated regulatory treatment limited to a few countries only	Commercial financial institutions, insurance companies/pension funds	• Limited availability of long-term debt finance • Limited (or no) differentiated prudential treatment of (long-term risk profile of) infrastructure for regulated investors
	Non-payment risk	Targeted guarantees/insurance covering non-payment risk	MDBs, DFIs, MIGA	Limited risk appetite or coverage for SoEs; also many MDBs require counter-indemnity from governments (in many cases)
	Counterparty risk	Credit guarantees providing general coverage for debt financing	MDBs, DFIs, MIGA, ECAs, and monoline insurers	Limited risk appetite for sub-investment grade transactions; also many MDBs require counter-indemnity from governments (in many cases)

Sources: Jobst (2019); and IMF staff.
Note: CLO = collateralized loan obligation; DFI = development finance institution; ECA = export credit agency; EPC = engineering, procurement and construction; MIGA = Multi-lateral Investment Guarantee Agency; MDB = multilateral development bank. A mini-perm loan is a temporary form of financing that is commonly used in commercial projects without (or with low) repayment capacity during the early stages of development. It provides the borrower with repayment flexibility, which is suitable for projects that start generating income only over time. Monoline insurance pays the principal and interest on a bond in the event of a default. In an EPC agreement, the owner engages one entity to design and construct the desired facility, which must also produce some guaranteed level of output. The performance of the facility is typically tested at substantial completion, and the contractor pays performance liquidated damages for failing to achieve the guaranteed level of performance.

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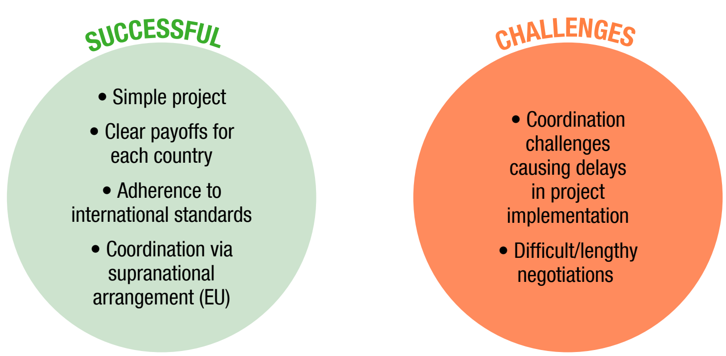
Box 4. Cross-Border Investment in CESEE

This box summarizes the responses of CESEE countries that provided information about cross-border infrastructure projects involving two or more countries, as well as challenges faced in the process. Survey responses suggest that cross-border projects are more common in the areas of energy and communication, where the benefits of interconnection compensate for the larger coordination costs involving public and private players of different countries. Survey responses suggest that the need to agree on common standards and timing of the project can lead to long delays in project implementation. EU financing dominates cross-border projects and provides an effective coordination mechanism and ensures adherence to international standards in public procurement and project execution.

Examples of cross-border infrastructure projects in CESEE include the following:

- **Railway line between Katowice (Poland) and Ostrava (Czech Republic).** Currently under construction, it aims to improve communication and facilitate travel, presenting clear payoffs for each country. The EU supports the project providing 50 percent of financing under the Connecting Europe facility.
- **Natural gas pipeline between Ungheni (Moldova) and Iasi (Romania).** This project was a first step to connect Moldova's capital Chisinau with the European network. The project is not complex in nature and presents clear payoffs for both countries. International institutions helped finance the cost, providing loans (EBRD and EIB) and grants (EU).
- **The "Nordbalt" energy infrastructure project** aims to connect the Baltic countries to the European electricity grid through the construction of a submarine power cable

Figure 4.1. CESEE Infrastructure Survey: Factors that Promote Successful Cross-Border Projects and Challenges



Sources: Country authorities; and IMF staff calculations.

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Box 4. Cross-Border Investment in CESEE *(continued)*

linking Lithuania with Sweden. The cost of the project was co-financed by the EU under the European Energy Program for Recovery.

- **Water management projects at the Czech-Polish border.** Under the EU programs, several projects on water management have been implemented, including one at the Czech-Polish border to reduce the risk of flooding. Similar to the other cases, this project had a clear payoff for each country involved and was co-financed by the EU.
- **Motorway D52 between Brno (Czech Republic) and Vienna (Austria).** Although the project presented several of the characteristics of a successful cross-border infrastructure (that is, simple project, clear payoffs), it suffered significant implementation delays.
- **Improvement of the Polish-Ukrainian portion of the European corridor (E40) connecting Germany to Ukraine.** The project was originally part of the preparation for the Euro 2012 Football Championship, organized jointly by Poland and Ukraine. Although it was successfully concluded, the implementation phase suffered several delays on both the Polish and Ukrainian side.

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Box 5. Considerations for Low-Carbon, Climate-Resilient Infrastructure

Effective climate change mitigation and adaptation requires greater investment in *low-carbon, climate-resilient* (LCCR) infrastructure. Infrastructure choices can have lasting impacts on the environment and the economy. Because roughly two-thirds of global greenhouse gas (GHG) emissions are attributable to infrastructure (Levy 2017a; Jobst 2018b; Saha 2018), making infrastructure projects climate-smart would help countries transition toward a low-carbon, more environmentally sustainable economic model, and mitigate the effects of more frequent natural disasters and global warming. Investment in modern, smart, and clean infrastructure over the next decade will not only provide a boost to short-term growth and enhance the longer-term resilience of societies but also reduce the carbon footprint of economic progress (OECD 2015b, 2015d, 2017).

Investment in climate-sensitive infrastructure is costly but carries significant long-term benefits, which reduce the net cost overall. While estimates of resources needed for climate action vary considerably, most projections suggest additional investments of more than US$1 trillion annually will be needed by 2030 to make infrastructure projects climate compatible.[1] Infrastructure worldwide has suffered from chronic under-investment for decades, so most investment will be in new projects, which will cost emerging market and developing economies up to 8 percent of GDP per year to 2030, depending on their ambition and spending efficiency. However, lower cost from renewable energy sources and greater energy efficiency are likely to offset these investment costs over time.[2] Some spending must also be allocated to accelerate the retirement of legacy carbon-based infrastructure and ensure that the adaptation and the structural transition to more resilient economies is socially fair and inclusive (Jobst and Pazarbasioglu 2019).

Because the impact of public investment is usually measured based on economic aggregates, climate change risks affecting infrastructure remain insufficiently factored in public policy.[3] Governments should adopt strategic approaches to public investment with a view to accounting systematically for the contribution and vulnerability of infrastructure projects to climate risks in project identification, appraisal and selection. These approaches would need to be robust given the uncertainty surrounding climate change effects at local and regional levels and require an understanding of the (1) climate impact of large projects (GHG emissions), (2) the sources, types, and sizes of damage/economic losses, (3) the project resilience to the size or strength of different natural hazards ("resilience score"), and (4) the capacity to predict frequency/impact of future disaster shocks ("climate damage function"). Le, Leow, and Seiderer (2020) provide guidance on how to integrate considerations of climate-related risks into infrastructure governance, focusing on the planning, design, appraisal, selection, and financing of public investments.

[1]The OECD (2017) estimates that US$6.3 trillion of infrastructure investment is required annually on average between 2016 and 2030 to meet development needs globally.

[2]Climate-friendly infrastructure is more energy-efficient and would lead to fossil fuel savings totaling US$1.7 trillion annually, more than offsetting the incremental cost.

[3]The EU Commission has committed to spending 25 percent of its total budget on climate-change related actions for the next seven-year budget, which was increased to 40 percent under the EU Green Deal (EC 2018c, 2019d).

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CHAPTER

5 Conclusion

Since the early 1990s, CESEE has made remarkable economic progress and aspires to further improve living standards and converge to the EU15. Infrastructure investment is a key priority to accelerate convergence. Several initiatives aim to increase investment in this area. In the context of the COVID-19 pandemic and the associated economic slack, infrastructure investment is an important policy tool to support activity. It has a high multiplier, it can boost the productive capacity of the economy in the longer term, and it presents an opportunity to accelerate the green and digital transition and improve regional connectivity.

This paper presents a comprehensive analysis of infrastructure in CESEE. First, it benchmarks CESEE's infrastructure stock and estimates the cost to narrow the gap with the EU15. Second, it presents new evidence on the macroeconomic impact of boosting infrastructure investment in the region, including via cross-border projects. Third, it uses a novel survey of CESEE authorities to analyze relevant policy issues, namely strengthening infrastructure governance, mobilizing private participation, making the most of cross-border projects, and addressing issues arising in the post-pandemic context.

Although countries differ considerably, CESEE lags the EU15 both in the quantity and quality of infrastructure. The largest gaps are estimated in the Western Balkans, while CESEE-EU countries have smaller gaps. Narrowing these gaps would require sizable investment. Our illustrative estimates suggest that closing 50 percent of the physical infrastructure gaps, in terms of quantity, relative to the EU15 by 2030 could cost 3–8 percent of GDP annually, more to make the infrastructure stock climate resilient, green, and of EU15 quality. While these cost estimates should not be interpreted as recommended investment—many other considerations determine the envelope of infrastructure investment, such as detailed analysis of the pool of savings; available

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policy space, depth of financial sector, and access to external finance; absorptive and technical capacity; and expected demand for various infrastructure services—they are suggestive of sizable investment needs in some of the countries in the region.

Boosting infrastructure investment would have a significant impact on CESEE's output. Our analysis suggests sizable multipliers in CESEE, both in the short term (0.5–0.8) as well as in the long term (1.7–2.5). Similar to other studies, we estimate larger multipliers during recessions, suggesting infrastructure investment can play a key role during the recovery phase from the pandemic. Infrastructure investment could also enhance convergence, especially in CESEE countries with better infrastructure governance and when conducted in a coordinated manner across countries that improves connectivity and reduces trade costs. Our model simulations suggest that if the efficiency of public investment in CESEE were to rise to current EU15 levels and coordinated public infrastructure investment were to lower non-tariff trade barriers by 5 percent, the dividend from higher investment could almost double in the long run. If appropriately calibrated, infrastructure investment need not compromise fiscal and external sustainability.

Infrastructure investment, however, comes with significant challenges and risks. Infrastructure projects can entail long delays and large cost overruns, increase fiscal risks, and offer opportunities for corruption. In CESEE, some of these challenges are magnified due to weaker governance and transparency. Despite considerable cross-country differences, CESEE countries have room to improve public investment management frameworks, especially in project appraisal and selection, medium-term budgeting, procurement, and project implementation management. Our novel survey also points to significant gaps in fiscal risk analysis and management in CESEE. Thus, maximizing the benefits of infrastructure investment would require improving institutional frameworks for effective and integrated public risk analysis and investment management, including in SOEs. An IMF PIMA could help governments develop detailed action plans to strengthen infrastructure governance frameworks, where they have not already been conducted. Strong infrastructure governance could leverage the higher marginal returns from investment in economies with lower infrastructure stock.

Attracting private sector participation is desirable, but for it to achieve its intended higher efficiency and better service provision, it would be important to strengthen public investment and risk management, especially in PPPs, where weaknesses persist in CESEE. The IMF/World Bank PPP Fiscal Risk Assessment Module (P-FRAM) can help assess PPP design options and their long-term fiscal consequences. Widening risk mitigation options for private

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investors, while prudently managing public risks and ensuring public value, could also attract greater private participation.

Cross-border projects could yield greater output dividends when they improve regional connectivity and integration. But they pose coordination challenges and additional risks. More successful cross-border projects appear to be those with clear payoffs for individual countries, and those governed by the EU framework as a basis for transparency, adherence to international standards, better planning, and greater coordination.

An infrastructure push can form an essential part of the policy response during the post-pandemic recovery phase. But the crisis has also complicated scaling-up public investment, given the stress on current infrastructure projects, stretched public sector balance sheets, and highly uncertain future demand. It will be important to reprioritize projects toward digital and green infrastructure. A greater role for governments puts even more of a premium on stronger governance. Demand for de-risking options for private investors may rise given high uncertainty, but risk mitigation tools should be provided prudently to safeguard the fiscal position. Such a strategy would put CESEE on a more sustainable economic development path with greater social and economic resilience.

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Annex 1. Infrastructure Benchmarking Methodology

Basic Benchmarking

Measuring infrastructure gaps poses many challenges, such as lack of data or differences in quality of infrastructure across countries. Following the literature, a very basic benchmarking is used to approximate the infrastructure gaps of the CESEE countries relative to the EU15 average (Atoyan and others 2018).

$$Infrastructure\ gap_{c,s,t} = \left[\frac{Physical\ stock_{c,s,t}}{average(Physical\ stock)_{EU15,s,t}} - 1\right] * 100$$

where, c is the country, s is the infrastructure measures covered: electricity generation capacity per 1 million people, total roads per square kilometer of arable land after controlling for population density, total railways per square kilometer of arable land after controlling for population density, air passengers carried per capita, fixed telephone line subscriptions per capita, mobile phone subscriptions per capita and broadband internet subscriptions per capita. Although fixed telephone lines are increasingly less popular, we include them for the sake of completeness as also done in related studies.

Following Atoyan and others (2018), roads and railways are also adjusted for population density, where the gaps are calculated relative to the average EU15 but adjusted for population density. The adjustment addresses the issue that countries with higher population densities have, on average, higher roads and railways density. For example, the infrastructure gap for Ukraine is constructed by comparing Ukrainian roads density with the density of a theoretical Ukraine country in the EU15, which has the same population density as Ukraine, but it is equipped with the average roads density characterizing the EU15. The following is the infrastructure gap for roads in Ukraine:

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$$\textit{Infrastructure gap}_{UKR,roads,t} = \left[\frac{\textit{Roads per km2 of arable land}_{UKR,t}}{\textit{Roads per km2 of arable land}(UKR)_{EU15,t}} - 1 \right] * 100$$

Roads per square kilometer $(\text{UKR})_{EU15,\ t}$ results from a simple regression of total roads per square kilometer on population density over the EU15 average. Then the roads per square kilometer for Ukraine is projected using the estimated coefficients and Ukrainian population density.

Estimation-based Benchmarking

The evolution of infrastructure stock can be represented by the following partial adjustment model, since they change slowly over time and adjust gradually toward their equilibrium:

$$I_{it} - I_{it-1} = \gamma(I_{it}^{*} - I_{it-1}) \tag{1}$$

where I_{it} is the (log of) infrastructure stock in a country i at time t, γ the speed of adjustment toward the equilibrium, and I_{it}^{*} its equilibrium level or the level needed based on countries' structural characteristics (X_{it}). The level of infrastructure needed, I_{it}^{*}, can be expressed as a function of X_{it}:

$$I_{it}^{*} = \alpha + \beta X_{it} + \varepsilon_{it} \tag{2}$$

Then, the infrastructure gap is the difference between I_{it} and I_{it}^{*}. However, the equilibrium level of infrastructure, I_{it}^{*}, is not observed. Using equation (2) to substitute for I_{it}^{*} in equation (1), we can estimate the following specification, which will allow us to uncover the demand for infrastructure based on a country's observable characteristics:

$$I_{it} = b_o + b_1 I_{it-1} + b_2 X_{it} + \mu_{it} \tag{3}$$

where $b_o = \alpha\gamma$; $b_1 = 1 - \gamma$; $b_2 = \beta\gamma$; and $\mu_{it} = \gamma\varepsilon_{it}$

$$Gap_{it} = I_{it} - (\widehat{b_o} + \widehat{b_1} I_{i,t-1} + \widehat{b_2} X_{it}) \tag{4}$$

This specification is similar to those used in previous studies on infrastructure gaps (for example, Fay and Yepes 2003, Liberini 2006, Yepes 2008, and Ianchovichina and others 2013). Equation (3) is estimated using OLS for an unbalanced sample of 37 European countries for the 1960–2018 period. The

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Annex Table 1. Additional Infrastructure Cost Estimates Based on Current Demand

	CESEE	CESEE-EU	Western Balkans +	Other Large EMs
A. Infrastructure investment required to satisfy current demand				
Total cost (billion USD)	90.5	15.8	6.3	68.5
% of GDP	2.1	1.0	3.4	2.7
B. Infrastructure investment required to satisfy demand if they had current average GDP per capita of EU15				
Total cost (billion USD)	111.0	19.3	8.1	83.6
% of GDP	2.5	1.2	4.4	3.3

Source: IMF staff calculations.
Note: The numbers refer to additional investment costs for 2018.

set of countries' structural characteristics (X_{it}) used to estimate the equilibrium (needed) level of infrastructure stock includes:

- *Level of development*, proxied by the level GDP per capita and its square. The demand for infrastructure is expected to increase with the level of economic development in a nonlinear fashion as technological advances that may accompany economic development, such as the arrival of the mobile phone networks, or increases in energy efficiency, may allow economic activity to expand at a faster rate than infrastructure demand
- *Economic size*, proxied by population. The level of infrastructure stock is likely to be higher in more populated countries
- *Total land* (TLand). A higher level of infrastructure stock is required in larger geographical areas
- *Urban population* (UrbPop). As a percent of total population. A higher percent of urban population may result in higher needs for infrastructure stock.
- *Economic structure* (MVA and AVA). Proxied by the share of value added in manufacturing and agriculture). Given the variation in the intensity with which infrastructure inputs are used in different economic activities, it is expected that a higher (lower) level of infrastructure stock (particularly energy) is needed in countries with higher share of value added in manufacturing (agriculture).

Unlike the basic benchmarking in Chapter 2, where we benchmark CESEE relative to the EU15 average, the estimation-based analysis benchmarks CESEE's physical stocks of infrastructure with respect to their own country characteristics. We first focus on current gaps in infrastructure stock: the amount needed to fill in deficiencies in infrastructure provision given a CESEE country's current level of development. We then assess its infrastructure gaps consistent with a higher level of economic development, which we take to be the EU15 average. Then, based on these gaps we calculate the infrastructure costs. The estimated additional infrastructure cost for CESEE to satisfy the current level of development is about 2 percent of GDP, and it

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is somewhat higher at about 2.5 percent of GDP to satisfy the level of the EU15 (Annex Table 1). Given that CESEE's current public investment averages at about 3 percent of GDP, these would translate into total infrastructure investment costs of about 5–5.5 percent of GDP.

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Annex 2. Macroeconomic Impact of Public Investment: Empirical Estimates

We follow a two-step process to empirically estimate dynamics of macroeconomic variables around public investment booms. First, we identify episodes of public investment booms. Second, we trace the impact of these identified booms on macro variables using a local projections framework. Our goal is simply to establish stylized facts about the macroeconomic conditions around booms, rather than to make causal inferences.

Identification of Public Investment Booms. We identify a public investment boom episode as a period of a sustained and significant increase in the public investment-to-GDP ratio (IMF 2014, Warner 2014). In particular, the beginning of a boom is identified as the period at which:

- The difference between the five-year-forward average public investment ratio and the five-year backward average public investment ratio exceeds the 80th percentile of such differences for a particular country for at least three consecutive years.
- The difference between the five-year-forward average public investment ratio and five-year backward average public investment ratio exceeds a certain absolute threshold, which is set at 3 percentage points of GDP for emerging and developing economies (EMDE) and 1 percentage point of GDP for advanced economies, where public investment ratios tend to be lower.

We use an unbalanced panel that covers a global sample of countries at the annual frequency with data starting as early as 1970. While a Europe-only sample is ideal, we deploy a global sample mainly on grounds of degrees of freedom as the identified booms are quite sparse. For CESEE countries, most of the identified booms occurred during the mid-1990s which coincided with the surge in public investment in the region around this time.

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Local Projections Model: The second step deploys a local projections framework, regressing macroeconomic variables on the identified boom episodes. The model is described as follows:

$$y_{i,t+h} - y_{i,t} = \alpha_i^h + \gamma_t^h + \beta^h Boom_{i,t} + \varepsilon_{i,t+h}$$

in which $y_{i,t+h}$ denotes GDP level in logs at time $t + h$ for country i. The variable *Boom* denotes a boom dummy. The model includes controls for country fixed and time effects, as well as lag of the dependent variable. The model is estimated for different horizons h, which is then used to project the impact of the public investment boom episode on GDP growth (or log change) h periods ahead. We use the same database with global coverage as in the first step to estimate the local projections model. We estimate similar regressions—one at a time—for public investment, private investment, and public debt. We use 90 percent confidence bands to assess the statistical significance of our results, in line with IMF (2014).

For CESEE-specific inference, we estimate the above model by including CESEE dummies as:

$$y_{i,t+h} - y_{i,t} = \alpha_i^h + \gamma_t^h + \beta^h Boom_{i,t} + \delta^h Boom_{i,t} * CESEE_i + \varepsilon_{i,t+h}$$

in which $CESEE_i$ denotes a dummy variable indicating a CESEE country from the global sample. We follow a similar scheme for EU15 specific inference.

Identification of Public Investment Shocks. For this, we estimate a first-stage regression that describes the behavior of public investment. We then derive public investment shocks as the unexplained residuals from this equation. This approach isolates shocks to public investment that can plausibly be deemed exogenous to macroeconomic conditions. The specification follows the flexible accelerator framework, as implemented in Abiad, Debuque-Gonzales, and Sy (2018):

$$Pinv_{i,t} = \alpha_i + \gamma_t - \beta \boldsymbol{X}_{i,t} + \varepsilon_{i,t}$$

in which $Pinv_{i,t}$ denotes public investment as percent of GDP. The set of independent variables is captured in the vector X which includes lags of public investment, GDP growth, and public debt. We also control for country and time fixed effects. We then take public investment shocks as the estimated residuals from this equation.

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Interaction terms. Relative to booms, we have more degrees of freedom with public investment shocks. We exploit this feature to explore the role of different factors that can determine the macroeconomic impact of public investment. These include cyclical factors—recessions versus expansions—and structural factors—infrastructure quality (efficiency) and public capital stock.

Cyclical Factors. To assess how the output response of public investment differs by the stance of the business cycle, we estimate the following regression:

$$y_{i,t+h} - y_{i,t} = \alpha_i^h + \gamma_t^h + \beta_1^h G(z_{i,t}) Shock_{i,t} + \beta_2^h \left(1 - G(z_{i,t})\right) Shock_{i,t} + \varepsilon_{i,t+h}$$

$$\text{with } G(z_{i,t}) = \frac{\exp(-\theta z_{i,t})}{1+\exp(-\theta z_{i,t})},\ \theta > 0,$$

in which z is an indicator of the cyclical stance of the economy which we take to be GDP growth. The variable z is normalized to have zero mean and unit variance. The transformation $G(.)$ then yields the probability of an expansion, with $(1 - G)$ the probability of a recession. The coefficient β_2^h then gives the estimated impact, at horizon h, of a public investment shock during recessions. The parameter θ is calibrated as 1.5. With public investment shocks, unlike the booms, we estimate the local projections model using a Europe-only sample which allows us to make Europe-specific inferences.

Structural Factors. We also explore the role of stock of public capital and quality of infrastructure. The estimated regression is as follows:

$$y_{i,t+h} - y_{i,t} = \alpha_i^h + \gamma_t^h + \beta^h Shock_{i,t} + \delta^h Shock_{i,t} * Pcap_{i,t} + \varphi^h Shock_{i,t} * Quality_{i,t} + \varepsilon_{i,t+h}$$

in which *Pcap* denotes public capital stock (in per capita terms) and *Quality* denotes the quality of infrastructure (as proxy for efficiency). For comparability and ease of inference, we normalize both public capital stock and infrastructure quality to lie between 0 and 100.[1] In this specification, the marginal impact of a public investment shock depends on both public capital stock and infrastructure quality. To assess the role of public capital stock in determining the output response, we evaluate the marginal impact for different percentiles of public capital stock while fixing infrastructure quality, without loss of generality, at CESEE median. We use a similar scheme to assess the role of infrastructure quality.

[1]We use the World Economic Forum overall infrastructure quality score. The series starts only from 2007. We extend the earlier years backward using the 2007 value.

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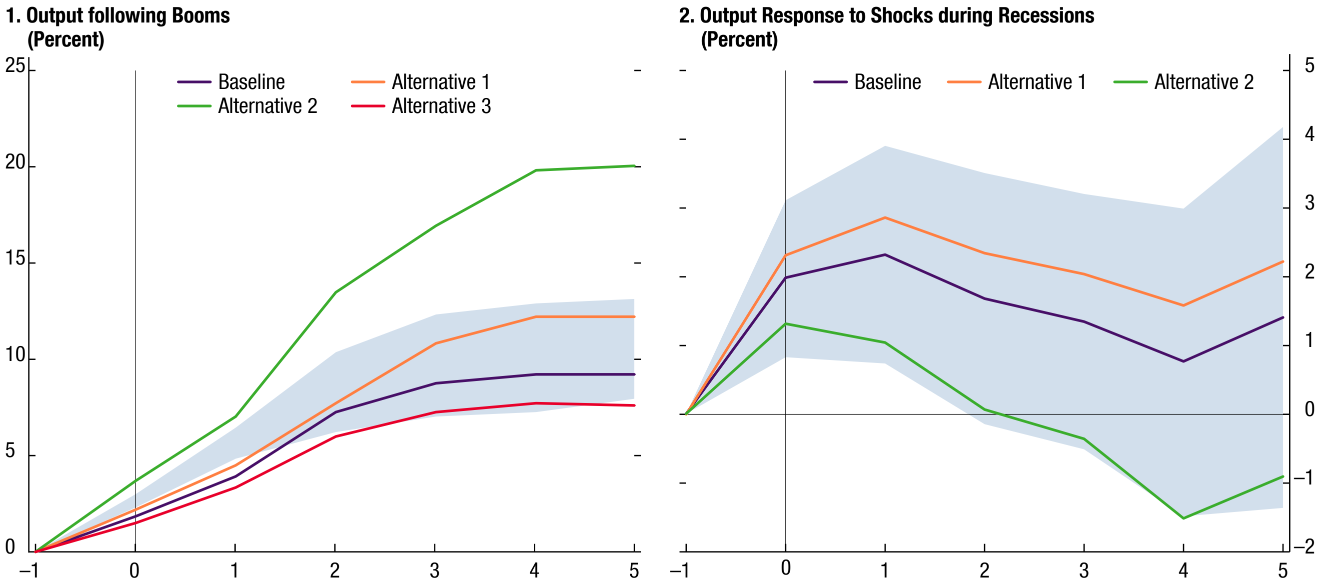
Annex Figure 1. Empirical Estimation: Robustness



Sources: IMF, *Fiscal Monitor*; IMF, *World Economic Outlook*; and IMF staff calculations.
Note: Left: Cumulative response of GDP growth following public investment boom episodes based on the global sample. Baseline: baseline model with 90 percent confidence bands shaded; Alternative 1: Country-specific threshold is 50 percent; Alternative 2: Group threshold is 1 percentage point for advanced economies as well as emerging and developing economies; Alternative 3: No lags of the dependent variable in local projections. Right: Cumulative response of GDP growth during recessions following public investment shocks, based on Europe-only sample. Baseline: baseline model with 90 percent confidence bands shaded; Alternative 1: additionally include growth forecast while estimating public investment shocks; Alternative 2: No lags of the dependent variable in local projections. For both panels, the boom/shock is normalized such that public investment as percent of GDP increases by 1 percentage point on impact. $t = 0$ is the year of the shock.

Robustness. We also deploy a battery of other alternative specifications. For the boom version (Annex Figure 1, panel 1), we use different cutoffs to define booms and exclusion of lags of the dependent variable in the local projections. Additional robustness exercises include different subsamples and different public investment series (not shown here). For the shock version (Annex Figure 1, panel 2), we use an alternative version that excludes lags of the dependent variable in the local projections. Another specification uses a different first-stage regression to estimate shocks by additionally including growth forecasts. Coming to the model that explores the role of structural variables, for robustness, we estimate the local projections model by conditioning separately on public capital stock (Annex Figure 2, panel 1) and infrastructure quality (Annex Figure 2, panel 2), one at a time. Across all of these alternative specifications, the point estimates and the confidence bands, unsurprisingly, differ somewhat from the respective baseline specifications, but our headline results generally remain robust.

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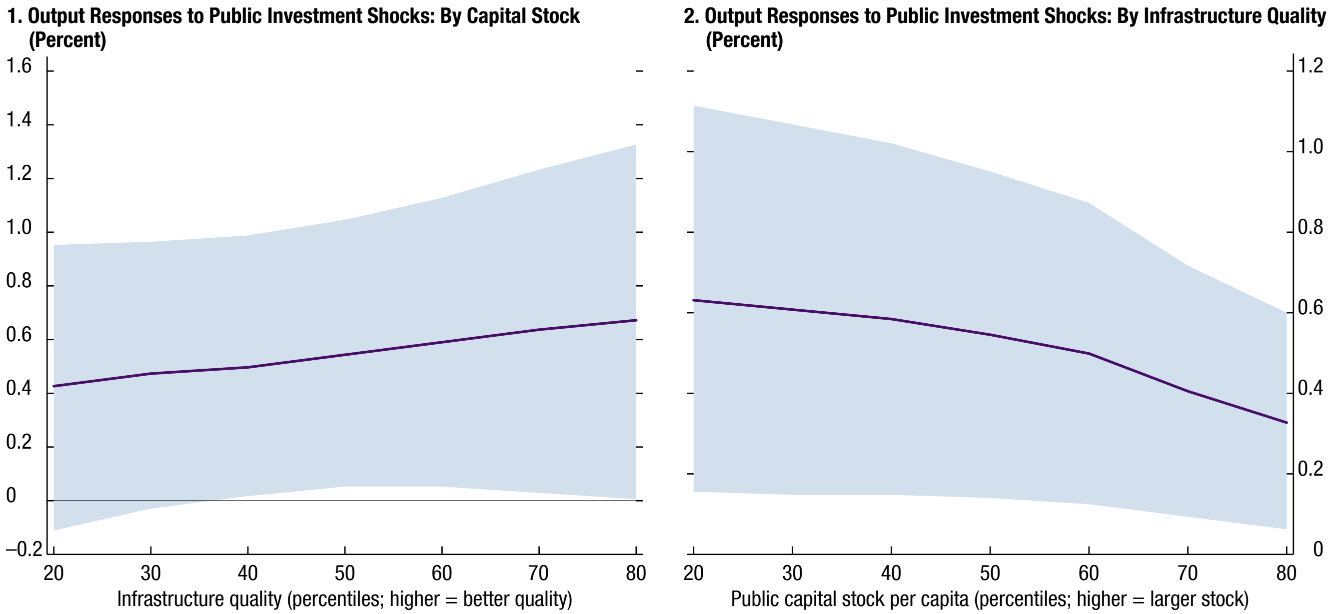
Annex Figure 2. Output Responses to Public Investment Shocks: The Role of Capital Stock and Infrastructure Quality



Sources: IMF, *Fiscal Monitor*; IMF, *World Economic Outlook*; World Economic Forum; and IMF staff calculations.
Note: Left (Right): Response of GDP growth on impact due to a public investment shock for different levels of public capital stock (infrastructure quality). This is based on the local projections model that conditions separately on public capital stock (infrastructure quality). Lines denote the point estimates and shaded denote the 90 percent confidence bands.

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Annex 3. Macroeconomic Impact of Public Investment: Model Simulations

This annex presents model simulations for all four CESEE subregions included in our analysis. The subregions are defined as follows: (1) CESEE-EUa (Estonia, Latvia, Lithuania, the Slovak Republic, and Slovenia); (2) CESEE-EUb (Bulgaria, Croatia, the Czech Republic, Hungary, Poland, and Romania); (3) Western Balkans (Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia) plus Belarus and Moldova; and (4) Large EMs (Turkey, Russia and Ukraine). Similarly to Chapter 3.2, the results presented in this annex pertain to the four main areas: (1) impact of alternative financing options; (2) impact of higher efficiency of public investment; (3) impact of coordinated cross-border projects; and (4) impact of monetary accommodation. All scenarios illustrate the effect of a stylized shock that brings infrastructure investment above its baseline level by 1 percent of GDP for a period of 10 years. The results are expressed as deviations from the steady-state and are discussed in detail in Chapter 3.2.

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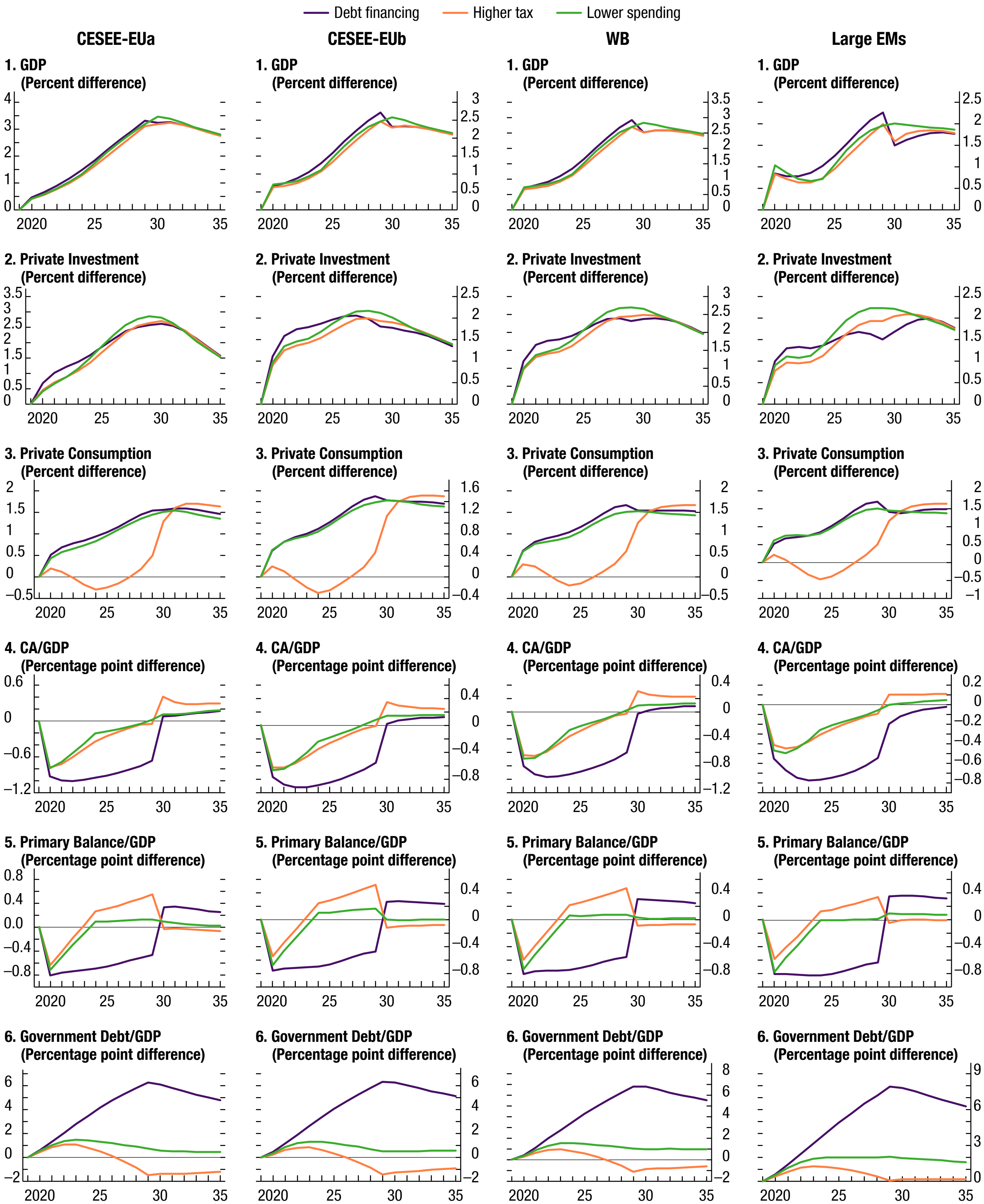
Annex Figure 3. Model Simulations: The Role of Financing Options



Source: IMF staff calculations.

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Annex Table 2. Model Simulations: The Role of Financing Options

	Real GDP (Percent difference)											
	Debt				Tax				Expenditure			
Region	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	0.46	1.82	3.22	2.78	0.40	1.62	3.19	2.75	0.41	1.74	3.45	2.79
CESEE-EU	0.66	1.58	2.30	2.11	0.62	1.34	2.29	2.09	0.70	1.44	2.57	2.14
WB	0.70	1.65	2.52	2.43	0.66	1.42	2.51	2.41	0.74	1.52	2.83	2.47
Large EMs	0.85	1.25	1.49	1.76	0.83	0.96	1.59	1.79	1.03	1.05	2.00	1.85
	Real investment (Percent difference)											
	Debt				Tax				Expenditure			
Region	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	0.69	1.87	2.63	1.58	0.46	1.69	2.71	1.55	0.42	1.89	2.82	1.54
CESEE-EU	1.12	1.96	1.77	1.36	0.91	1.70	1.91	1.39	0.98	1.87	2.02	1.39
WB	1.20	2.06	2.38	1.97	0.97	1.85	2.50	1.97	1.01	2.05	2.66	1.96
Large EMs	1.00	1.49	1.68	1.78	0.78	1.38	2.04	1.76	0.91	1.66	2.21	1.74
	Real consumption (Percent difference)											
	Debt				Tax				Expenditure			
Region	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	0.49	1.03	1.54	1.45	0.19	−0.27	1.27	1.62	0.42	0.94	1.50	1.33
CESEE-EU	0.48	1.00	1.41	1.35	0.18	−0.25	1.13	1.49	0.48	0.95	1.41	1.30
WB	0.60	1.14	1.54	1.51	0.28	−0.17	1.24	1.66	0.57	1.04	1.51	1.42
Large EMs	0.53	1.01	1.41	1.49	0.22	−0.38	1.16	1.64	0.62	0.96	1.45	1.38
	Current account/GDP (Percentage point difference)											
	Debt				Tax				Expenditure			
Region	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	−0.92	−0.91	0.08	0.17	−0.77	−0.25	0.41	0.30	−0.78	−0.17	0.12	0.19
CESEE-EU	−0.78	−0.85	0.02	0.11	−0.63	−0.27	0.34	0.24	−0.68	−0.18	0.14	0.14
WB	−0.81	−0.89	−0.03	0.09	−0.65	−0.28	0.30	0.22	−0.70	−0.22	0.09	0.12
Large EMs	−0.55	−0.75	−0.19	−0.02	−0.41	−0.25	0.11	0.12	−0.47	−0.21	0.00	0.05
	Primary surplus/GDP (Percentage point difference)											
	Debt				Tax				Expenditure			
Region	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	−0.81	−0.66	0.33	0.24	−0.64	0.30	−0.04	−0.07	−0.72	0.09	0.09	0.02
CESEE-EU	−0.77	−0.67	0.27	0.23	−0.55	0.28	−0.12	−0.08	−0.68	0.10	0.00	0.00
WB	−0.81	−0.72	0.30	0.24	−0.60	0.25	−0.10	−0.07	−0.74	0.05	0.03	0.01
Large EMs	−0.82	−0.81	0.34	0.31	−0.59	0.14	−0.05	−0.01	−0.78	−0.02	0.09	0.07
	Government net debt/GDP (Percentage point difference)											
	Debt				Tax				Expenditure			
Region	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	0.61	4.16	6.12	4.82	0.47	0.50	−1.37	−1.18	0.55	1.33	0.60	0.48
CESEE-EU	0.45	4.06	6.28	5.15	0.26	0.36	−1.24	−0.89	0.36	1.19	0.50	0.57
WB	0.38	4.23	6.75	5.51	0.21	0.52	−0.91	−0.63	0.31	1.42	0.95	0.94
Large EMs	0.60	4.91	7.83	6.29	0.38	1.09	0.21	0.18	0.53	2.01	1.96	1.63

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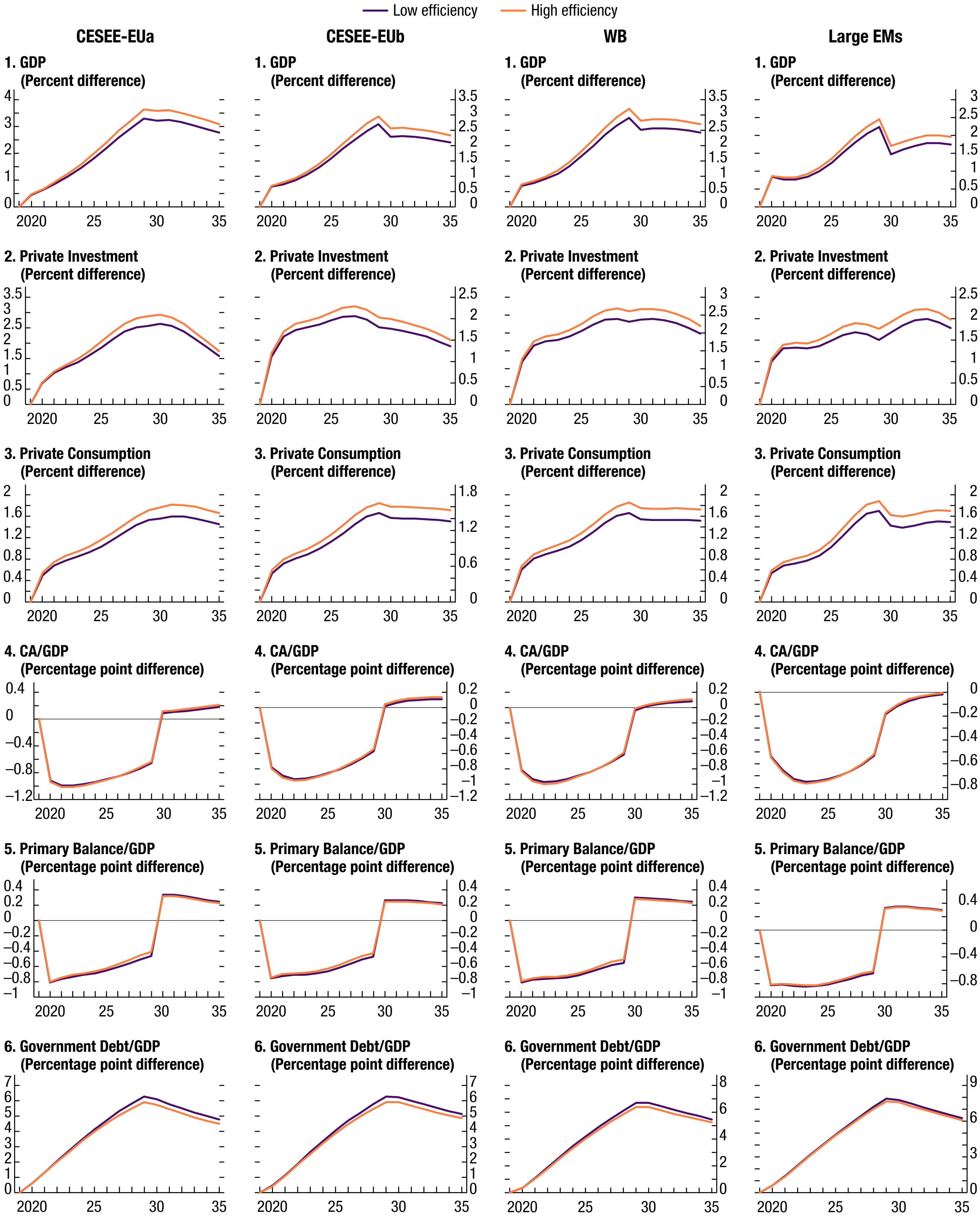
Annex Figure 4. Model Simulations: The Role of Public Investment Efficiency



Source: IMF staff calculations.

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Annex Table 3. Model Simulations: The Role of Public Investment Efficiency

Real GDP (Percent difference)								
	Unchanged Efficiency				Improved Efficiency			
Region	**2020**	**2025**	**2030**	**2035**	**2020**	**2025**	**2030**	**2035**
CESEE-AE	0.46	1.82	3.22	2.78	0.48	2.00	3.59	3.09
CESEE-EU	0.66	1.58	2.30	2.11	0.69	1.73	2.57	2.34
WB	0.70	1.65	2.52	2.43	0.73	1.81	2.82	2.70
Large EMs	0.85	1.25	1.49	1.76	0.88	1.36	1.71	1.97
Real investment (Percent difference)								
	Unchanged Efficiency				Improved Efficiency			
Region	**2020**	**2025**	**2030**	**2035**	**2020**	**2025**	**2030**	**2035**
CESEE-AE	0.69	1.87	2.63	1.58	0.72	2.06	2.93	1.74
CESEE-EU	1.12	1.96	1.77	1.36	1.19	2.15	1.99	1.51
WB	1.20	2.06	2.38	1.97	1.27	2.26	2.67	2.20
Large EMs	1.00	1.49	1.68	1.78	1.06	1.65	1.93	1.98
Real consumption (Percent difference)								
	Unchanged Efficiency				Improved Efficiency			
Region	**2020**	**2025**	**2030**	**2035**	**2020**	**2025**	**2030**	**2035**
CESEE-AE	0.49	1.03	1.54	1.45	0.54	1.15	1.75	1.65
CESEE-EU	0.48	1.00	1.41	1.35	0.53	1.12	1.59	1.53
WB	0.60	1.14	1.54	1.51	0.66	1.27	1.74	1.72
Large EMs	0.53	1.01	1.41	1.49	0.58	1.13	1.61	1.70
Current account/GDP (Percentage point difference)								
	Unchanged Efficiency				Improved Efficiency			
Region	**2020**	**2025**	**2030**	**2035**	**2020**	**2025**	**2030**	**2035**
CESEE-AE	−0.92	−0.91	0.08	0.17	−0.95	−0.91	0.11	0.21
CESEE-EU	−0.78	−0.85	0.02	0.11	−0.80	−0.86	0.05	0.14
WB	−0.81	−0.89	−0.03	0.09	−0.83	−0.90	−0.01	0.11
Large EMs	−0.55	−0.75	−0.19	−0.02	−0.56	−0.75	−0.18	−0.01
Primary surplus/GDP (Percentage point difference)								
	Unchanged Efficiency				Improved Efficiency			
Region	**2020**	**2025**	**2030**	**2035**	**2020**	**2025**	**2030**	**2035**
CESEE-AE	−0.81	−0.66	0.33	0.24	−0.80	−0.63	0.32	0.23
CESEE-EU	−0.77	−0.67	0.27	0.23	−0.75	−0.64	0.25	0.21
WB	−0.81	−0.72	0.30	0.24	−0.80	−0.69	0.28	0.23
Large EMs	−0.82	−0.81	0.34	0.31	−0.81	−0.79	0.33	0.30
Government net debt/GDP (Percentage point difference)								
	Unchanged Efficiency				Improved Efficiency			
Region	**2020**	**2025**	**2030**	**2035**	**2020**	**2025**	**2030**	**2035**
CESEE-AE	0.61	4.16	6.12	4.82	0.60	4.00	5.76	4.53
CESEE-EU	0.45	4.06	6.28	5.15	0.42	3.89	5.94	4.89
WB	0.38	4.23	6.75	5.51	0.35	4.07	6.43	5.27
Large EMs	0.60	4.91	7.83	6.29	0.58	4.81	7.62	6.13

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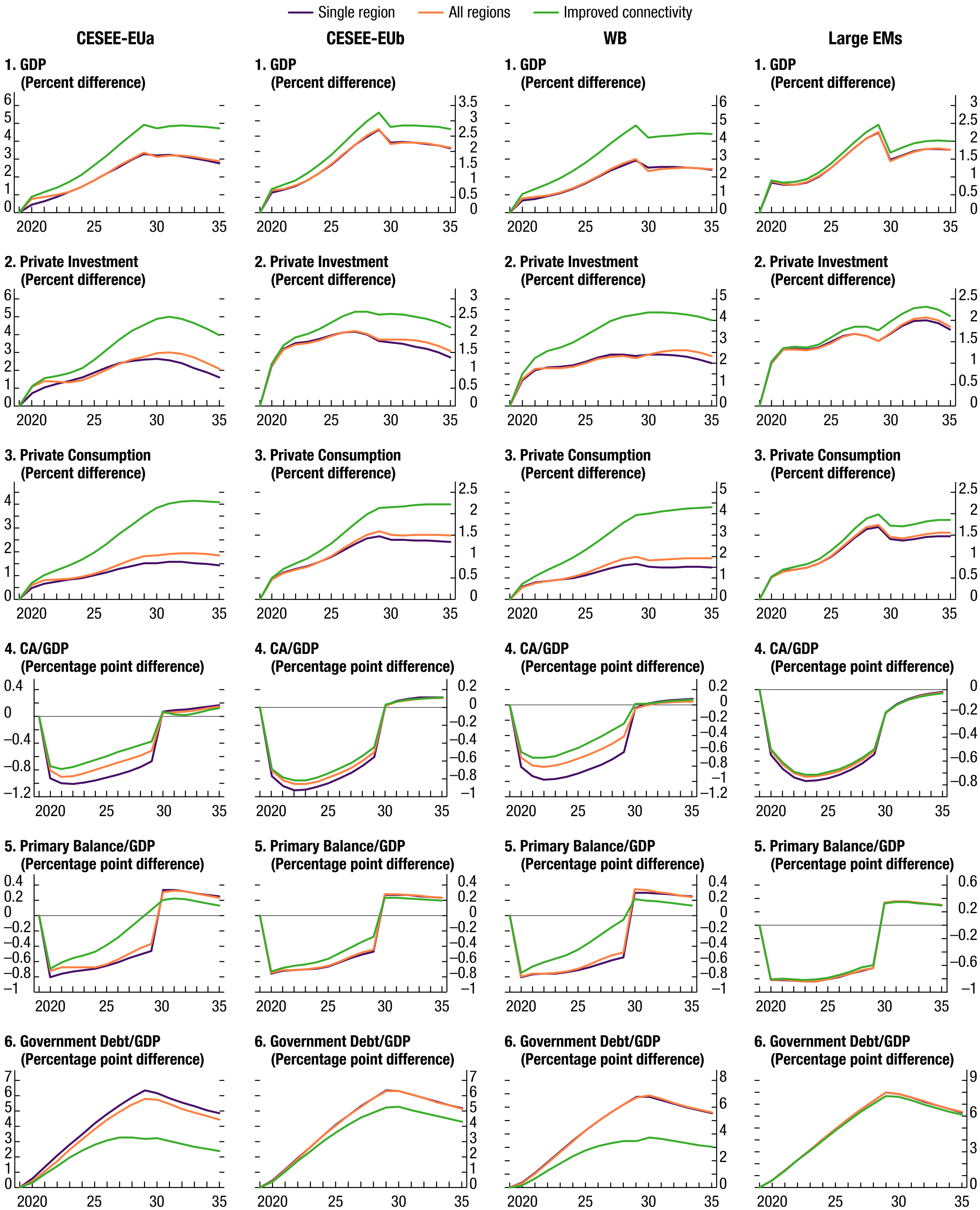
Annex Figure 5. Model Simulations: The Role of Cross-Border Coordination



Source: IMF staff calculations.

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Annex Table 4. Model Simulations: The Role of Cross-Border Coordination

Real GDP (Percent difference)												
	Individual Region Investment				Coordinated Investment				Improved Connectivity			
Region	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	0.48	2.00	3.59	3.09	0.79	1.98	3.50	3.23	0.92	2.82	5.13	5.08
CESEE-EU	0.69	1.73	2.57	2.34	0.76	1.74	2.52	2.37	0.81	2.05	3.09	2.98
WB	0.73	1.81	2.82	2.70	0.87	1.86	2.65	2.74	1.10	2.96	4.54	4.74
Large EMs	0.88	1.36	1.71	1.97	0.92	1.37	1.68	1.98	0.94	1.49	1.90	2.22
Real investment (Percent difference)												
	Individual Region Investment				Coordinated Investment				Improved Connectivity			
Region	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	0.72	2.06	2.93	1.74	1.12	1.89	3.30	2.30	1.16	2.78	5.23	4.19
CESEE-EU	1.19	2.15	1.99	1.51	1.20	2.14	2.09	1.71	1.25	2.52	2.81	2.36
WB	1.27	2.26	2.67	2.20	1.35	2.19	2.72	2.57	1.58	3.48	4.68	4.27
Large EMs	1.06	1.65	1.93	1.98	1.07	1.63	1.96	2.06	1.08	1.75	2.22	2.31
Real consumption (Percent difference)												
	Individual Region Investment				Coordinated Investment				Improved Connectivity			
Region	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	0.54	1.15	1.75	1.65	0.68	1.24	2.11	2.12	0.77	2.13	4.12	4.38
CESEE-EU	0.53	1.12	1.59	1.53	0.52	1.15	1.71	1.70	0.56	1.45	2.36	2.44
WB	0.66	1.27	1.74	1.72	0.65	1.40	2.10	2.19	0.80	2.48	4.31	4.62
Large EMs	0.58	1.13	1.61	1.70	0.58	1.15	1.68	1.78	0.60	1.27	1.95	2.09
Current account/GDP (Percentage point difference)												
	Individual Region Investment				Coordinated Investment				Improved Connectivity			
Region	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	−0.95	−0.91	0.11	0.21	−0.82	−0.73	0.09	0.19	−0.75	−0.59	0.10	0.16
CESEE-EU	−0.80	−0.86	0.05	0.14	−0.73	−0.80	0.04	0.13	−0.71	−0.75	0.06	0.13
WB	−0.83	−0.90	−0.01	0.11	−0.70	−0.70	−0.02	0.07	−0.63	−0.56	0.04	0.09
Large EMs	−0.56	−0.75	−0.18	−0.01	−0.56	−0.72	−0.19	−0.01	−0.52	−0.71	−0.18	−0.02
Primary surplus/GDP (Percentage point difference)												
	Individual Region Investment				Coordinated Investment				Improved Connectivity			
Region	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	−0.80	−0.63	0.32	0.23	−0.71	−0.61	0.29	0.21	−0.69	−0.36	0.19	0.11
CESEE-EU	−0.75	−0.64	0.25	0.21	−0.74	−0.63	0.25	0.21	−0.72	−0.53	0.21	0.17
WB	−0.80	−0.69	0.28	0.23	−0.79	−0.67	0.32	0.22	−0.74	−0.42	0.19	0.11
Large EMs	−0.81	−0.79	0.33	0.30	−0.80	−0.79	0.33	0.30	−0.80	−0.76	0.32	0.29
Government net debt/GDP (Percentage point difference)												
	Individual Region Investment				Coordinated Investment				Improved Connectivity			
Region	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	0.60	4.00	5.76	4.53	0.37	3.62	5.30	4.09	0.31	2.62	2.78	2.04
CESEE-EU	0.42	3.89	5.94	4.89	0.38	3.88	5.92	4.85	0.34	3.41	4.86	4.00
WB	0.35	4.07	6.43	5.27	0.25	4.05	6.50	5.29	0.11	2.57	3.35	2.74
Large EMs	0.58	4.81	7.62	6.13	0.56	4.81	7.62	6.13	0.56	4.68	7.34	5.90

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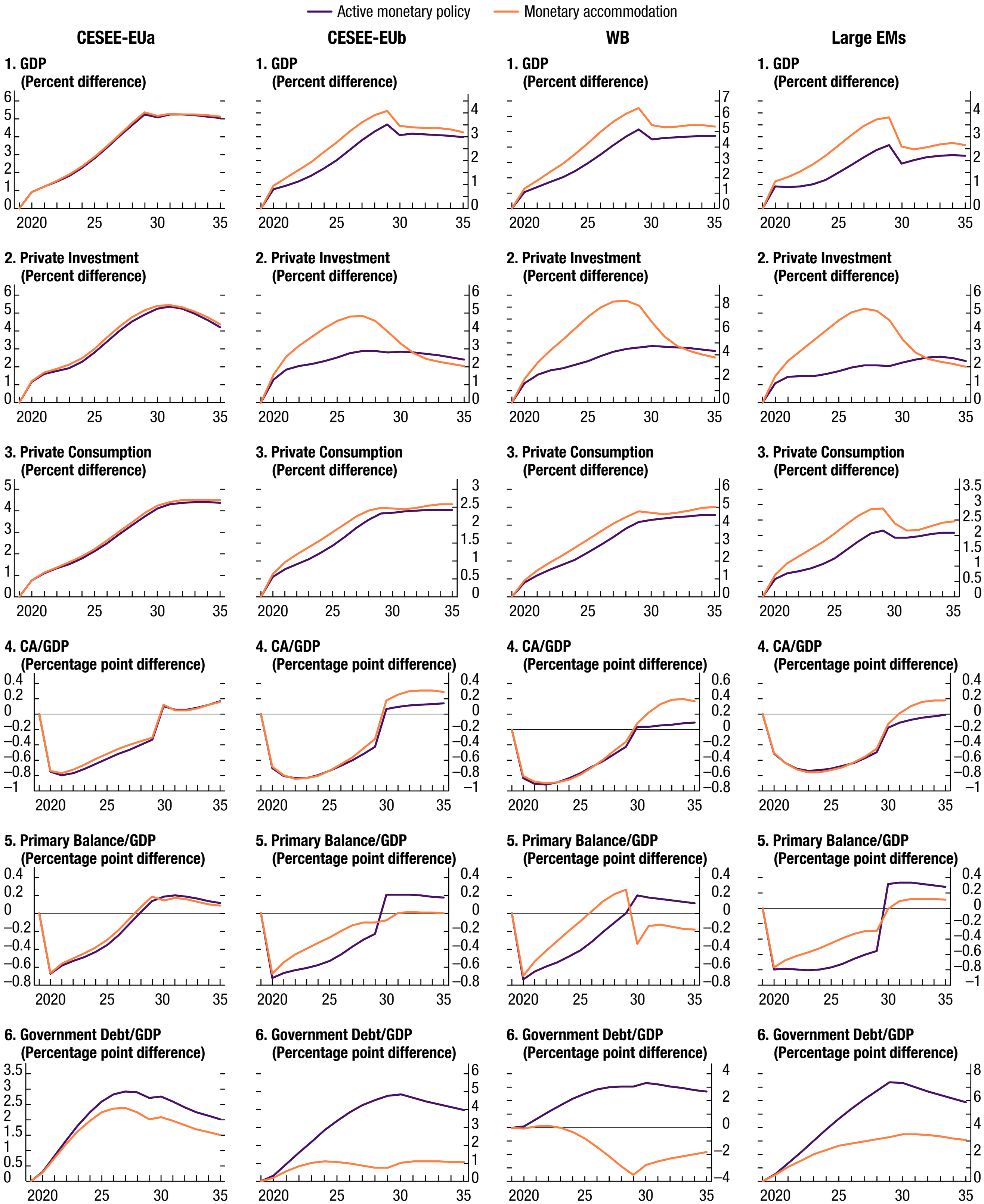
Annex Figure 6. Model Simulations: The Role of Monetary Accommodation



Source: IMF staff calculations.

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Annex Table 5. Model Simulations: The Role of Monetary Accommodation

Real GDP (Percent difference)								
	Improved Connectivity				Monetary Accommodation			
Region	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	0.92	2.82	5.13	5.08	0.93	2.92	5.21	5.15
CESEE-EU	0.81	2.05	3.09	2.98	0.97	2.80	3.46	3.20
WB	1.10	2.96	4.54	4.74	1.30	4.29	5.45	5.36
Large EMs	0.94	1.49	1.90	2.22	1.13	2.64	2.60	2.68
Real investment (Percent difference)								
	Improved Connectivity				Monetary Accommodation			
Region	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	1.16	2.78	5.23	4.19	1.19	2.99	5.38	4.33
CESEE-EU	1.25	2.52	2.81	2.36	1.56	4.52	3.25	2.01
WB	1.58	3.48	4.68	4.27	1.98	7.14	6.66	3.78
Large EMs	1.08	1.75	2.22	2.31	1.45	4.57	3.51	2.00
Real consumption (Percent difference)								
	Improved Connectivity				Monetary Accommodation			
Region	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	0.77	2.13	4.12	4.38	0.78	2.24	4.26	4.51
CESEE-EU	0.56	1.45	2.36	2.44	0.65	1.82	2.47	2.60
WB	0.80	2.48	4.31	4.62	0.93	3.21	4.73	5.04
Large EMs	0.60	1.27	1.95	2.09	0.74	2.08	2.41	2.47
Current account/GDP (Percentage point difference)								
	Improved Connectivity				Monetary Accommodation			
Region	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	−0.75	−0.59	0.10	0.16	−0.74	−0.52	0.11	0.15
CESEE-EU	−0.71	−0.75	0.06	0.13	−0.69	−0.75	0.18	0.29
WB	−0.63	−0.56	0.04	0.09	−0.60	−0.58	0.09	0.37
Large EMs	−0.52	−0.71	−0.18	−0.02	−0.51	−0.73	−0.13	0.18
Primary surplus/GDP (Percentage point difference)								
	Improved Connectivity				Monetary Accommodation			
Region	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	−0.69	−0.36	0.19	0.11	−0.68	−0.31	0.14	0.08
CESEE-EU	−0.72	−0.53	0.21	0.17	−0.68	−0.27	−0.08	0.00
WB	−0.74	−0.42	0.19	0.11	−0.70	−0.09	−0.34	−0.19
Large EMs	−0.80	−0.76	0.32	0.29	−0.76	−0.45	−0.01	0.12
Government net debt/GDP (Percentage point difference)								
	Improved Connectivity				Monetary Accommodation			
Region	2020	2025	2030	2035	2020	2025	2030	2035
CESEE-AE	0.31	2.62	2.78	2.04	0.31	2.25	2.11	1.52
CESEE-EU	0.34	3.41	4.86	4.00	0.34	1.10	1.06	1.10
WB	0.11	2.57	3.35	2.74	0.11	−0.79	−2.77	−1.80
Large EMs	0.56	4.68	7.34	5.90	0.56	2.66	3.54	3.10

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Annex 4. Results of CESEE Authorities' Self-Assessment of Public Investment Management

Authorities in 14 CESEE countries completed a self-assessment of the effectiveness of public investment management based on the current PIMA questionnaire.[1] The results are not easily comparable to formal PIMA assessments taken by the IMF. Formal IMF PIMA reports are completed following detailed assessment of a country's institutions, interviews with all stakeholders involved in public investment in each country, and extensive internal reviews to ensure consistency of approach between countries:

The average of the self-assessments exceeds the average scores from CESEE PIMAs completed by the IMF in almost all areas, and also compare favorably with the EU15 CESEE PIMAs (Annex Figure 7). The results of the self-assessment are also significantly higher than the results assessed by PIMA where an earlier PIMA was available for that country. While improvements in public investment institutions may have taken place since the PIMAs were done, these factors together suggest it is possible that positive bias exists in the self-assessments relative to IMF assessments. Respondents were asked to assess effectiveness of their institutions, but they may have answered with design in mind, which typically scores higher against the framework.

Nonetheless, the self-assessments provide interesting information about perceived relative strengths and weaknesses of different aspects of infrastructure governance in CESEE countries. Relative strengths and weaknesses identified in the self-assessments differ somewhat from those shown by the formal PIMAs undertaken in the CESEE region to date.

- Fiscal rules, budget comprehensiveness, availability of funding, and monitoring of public assets are relative strengths in both the self-assessments and formal PIMA assessments.

[1]Countries that completed the self-assessment were Albania, Belarus, Czech Republic, Hungary, Kosovo, Latvia, North Montenegro, Poland, Romania, Russia, Serbia, Slovenia, Turkey and Ukraine. Not all countries responded to all questions. Responses to questionnaires were generally coordinated through the Ministry of Finance.

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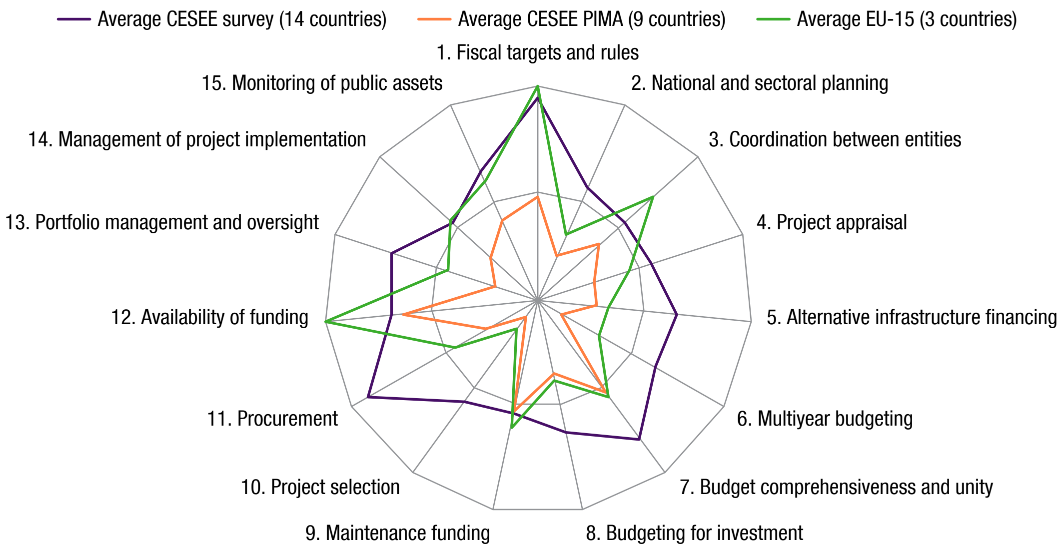
Annex Figure 7. Comparison of CESEE Self-Assessments with CESEE IMF PIMA Results



Sources: Country authorities; and IMF staff calculations; using Public Investment Management Assessments (PIMA) completed until March 2020.
Note: At end 2019, PIMAs had been published for Estonia (IMF 2019a), Kosovo (IMF 2016b), Slovak Republic (IMF 2019b), and Ukraine (IMF 2019c), and undertaken but not published in Albania, Bosnia, Bulgaria, Moldova, and Serbia.

- The self-assessment indicates relative weakness in project appraisal and project selection, which also scores poorly in formal PIMA assessments in the CESEE region. In addition, the self-assessment respondents identified maintenance funding, coordination between entities, national and sectoral planning and management of project implementation as the other weakest areas.
- Respondents perceived the strength of procurement processes to be significantly higher than the average score for CESEE countries formally assessed by PIMA.

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Annex 5. Infrastructure Survey

We asked authorities in CESEE countries to complete a questionnaire on important key aspects of infrastructure investment. Responses were generally coordinated through the ministry of finance. The questionnaire was designed to complement the findings of the PIMA on how enhanced governance of public investment can help mitigate fiscal risks and alleviate structural barriers to greater mobilization of private capital given the significant cross-country variations in the region. The focus was on the main characteristics and the typical risks in infrastructure investments, as well as the availability of risk mitigation tools for private investors. The questionnaire also captured the differential impact of cross-border projects on infrastructure risks and their implications for both public and private investment. We received responses from 14 countries out of a total of 22 CESEE countries (those shaded in green in Annex Figure 8), a reasonable sample to draw some general lessons.

The survey contained 12 questions, organized in three sections: (1) general questions; (2) governance of infrastructure investments; and (3) participation of the private sector in infrastructure investments. The general questions were geared toward understanding the degree of involvements of different actors across sectors, the typical maturity and currency composition of investments and the degree to which FX risk is hedged, and the prevalence of PPPs and guarantees. The governance section covered the main risks in the implementation phase for domestic and cross-border projects separately and asked whether additional risk factors emerge in the latter case. It also investigated the extent to which risks are analyzed, quantified, and managed. Finally, the third section analyzed the involvement of the private sector in infrastructure investment and investigated whether there exist elements which can hinder private sector participation. The questionnaire also asked the authorities to list examples of successful as well as unsuccessful public investments and

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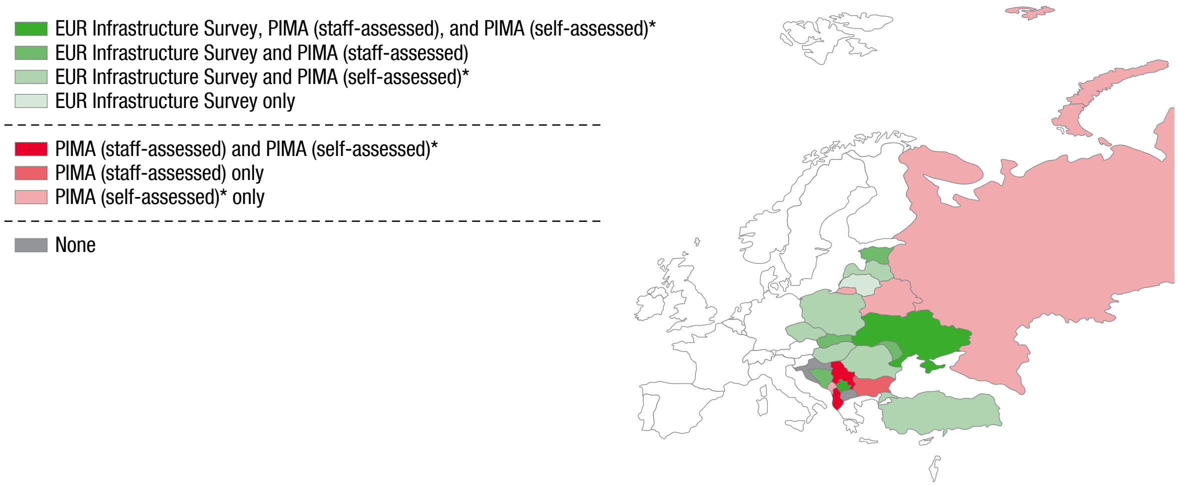
Annex Figure 8. CESEE Country Coverage of Infrastructure Survey and PIMA Self-Assessment



Sources: Country authorities; and IMF staff calculations.
Note: The IMF Public Investment Management Assessment (PIMA) is a diagnostic tool, which measures the strength of public investment management both in terms of design and effectiveness. Country authorities were requested to complete a self-assessment of all PIMA categories.

PPPs, both for national and cross-border projects. Findings from this question have informed the analysis in Box 4.

List of Questions

- **Question 1**: Please indicate the *approximate ownership share* (in percent of book value) by type of economic (energy, transportation, water and waste, ICT) and social infrastructure (education and health) as of end-2019 (or latest) for (1) the central government, (2) subnational governments (that is, regional and local governments), (3) state-owned enterprises (SOEs), (4) private sector, and (5) shared ownership (public/private).
- **Question 2**: Please indicate the *current amount (in percent of GDP) and share of guarantees and public-private partnerships (PPPs)* (in percent of existing stock of infrastructure) in the different types of economic (energy, transportation, water and waste, ICT) and social infrastructure (education and health) as of end-2019 (or latest).
- **Question 3**: Please indicate the *average maturity* (<5 years, 5–10 years, 10–20 years, >20 years, "cannot tell"), the *share of FX-denominated financing* (none, up to 20 percent, 20–40 percent, 40–60 percent, 60–80 percent, 80–100 percent, "cannot tell"), and *inflation-indexing* of infrastructure projects (none, up to 20 percent, 20–40 percent, 40–60 percent, 60–80 percent, 80–100 percent, "cannot tell") (based on the current

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stock) for (i) the central government, (ii) subnational governments (that is, regional and local governments), (iii) state-owned enterprises (SOEs), and (iv) public-private partnerships (PPPs).

- **Question 4**: For *FX-denominated financing of infrastructure projects*, please indicate the share of projects for which FX risk has been hedged (none, up to 20 percent, 20–40 percent, 40–60 percent, 60–80 percent, 80–100 percent, "cannot tell").
- **Question 5**: Indicate the share (percent of the value of the contract) of currently planned/executed public contracts (non-EU-funded projects only) falling within the *scope of the EU regulations* (none, up to 20 percent, 20–40 percent, 40–60 percent, 60–80 percent, 80–100 percent)—domestic and cross-border projects.
- **Question 6**: Provide 1–2 *examples* of a very good (executed) and very bad (cancelled) infrastructure projects over the last 5 years (in terms of project management, impact, efficiency, sustainability) with critical issues that contributed to their success/failure—public investment versus PPP and domestic versus cross-border projects.
- **Question 7**: In recent years, how much did the following *risks affect the implementation of infrastructure projects* ("not at all," "somewhat," "significantly," "significantly," "cannot tell"): (1) cost overruns (for example, larger than initially budgeted costs), (2) implementation delays, (3) revenue risk (for example, demand shortfalls), (4) funding shortfall, (5) change in scope/design of project, (6) changes in regulations, (7) coordination issues (for example, across different levels of government, and across countries involved in the project), and (8) other—domestic and cross-border projects.
- **Question 8**: In recent years, how much did the following *factors complicate the planning, design and implementation of cross-border infrastructure projects* ("not at all," "somewhat," "significantly," "significantly," "cannot tell"): (1) risk-sharing allocation among parties, (2) cost sharing allocation among parties, (3) lack of institutional frameworks for cross-border coordination, (4) inconsistent regulatory frameworks across countries, (5) type of structure (for example, PPP, availability-based revenues), (6) project-related problems (underestimation of costs, underestimation of demand volumes), (7) political/regulatory uncertainty?
- **Question 9**: Please evaluate the following *public sector risk management practices* related to domestic infrastructure projects ("disagree," "somewhat," "agree," "cannot tell"):
    - o There is a proactive and continuous monitoring and assessment of infrastructure-related fiscal risks.

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- Infrastructure project risks are analyzed for each project and the entire portfolio of projects.
- The analysis of infrastructure project risks differs between public investment projects (central government) and those sponsored by SOEs.
- Infrastructure project risks are quantified.
- The budget includes contingency allocations in case fiscal risks materialize.
- The fiscal risk assessments consider all infrastructure-related risks, including those from PPPs, SOEs, and guarantees.
- The authorities hedge project-specific risks (that is, FX risks, inflation risks, etc.). Please specify in the comments section.
- Guidelines for cross-border projects include provisions dealing with their idiosyncratic elements not present in domestic projects.

- **Question 10**: The country *recycles existing public assets* (for example, leasing to private operators/selling older infrastructure to invest in new assets) ("disagree," "somewhat," "agree").
- **Question 11**: Please evaluate the following *practices regarding private investment risks* in infrastructure ("disagree," "somewhat," "agree"):
  - The authorities periodically review their tariff setting practices for a variety of asset classes and projects.
  - The authorities can defer or amend the termination payments in the event of project cancellation.
  - The authorities have asset transfer restrictions (to the private sector).
  - The authorities have cancelled permits in the past.
  - The authorities have re-negotiated contracts in the past.
  - The authorities have changed tariffs in the past.

- **Question 12**: Please indicated whether the authorities provide these *risk mitigation instruments* to private investors in infrastructure projects (directly or via a national/multilateral development institution) ("disagree," "somewhat," "agree"):
  - Credit enhancement and guarantees to upgrade the rating of a transaction,
  - Guarantees/insurance to cover non-payment risks (for example, for SOEs),
  - Guarantees/insurance to cover refinancing risk, and
  - Liquidity facilities to hedge against foreign exchange rate risks (for example, until tariffs/inflation adjusts).

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Annex 6. Risk Mitigation in Infrastructure Project Finance

Project finance represents the most important funding source of infrastructure in CESEE countries (and emerging markets at large), which tends to involve unsecured lending arrangements for a standalone, clearly identified economic unit (Weber and Alfen 2010), that is, the repayment in lending arrangements is based solely on the cash flow generation of the project. Liability is limited to the contributed equity capital, and lenders often have limited recourse to the project sponsors, which requires strong contractual provisions. However, the asset-heavy capital intensity, low-to-manageable operating risk and the long-term importance of infrastructure services tend to support higher levels of leverage in project finance than similarly rated nonfinancial corporates issuing debt. The scope of information provision and monitoring oversight is typically greater than for traditional corporate borrowers.

Several contractual features ensure that project finance loans are structured (1) to be both highly robust to a wide range of potentially severe risks and (2) to maximize any post-default asset recovery:

- *Default risk*—Construction risk is substantially transferred to a construction contractor through a turnkey construction contract, which specifies the delivery of a functional asset at an agreed time and within budget in accordance with required performance parameters. Appropriate economic incentives help mitigate performance risk, including provisions for liquidated damages as well as financial support instruments, such as a bank letter of credit or other performance support instruments. Offtake contracts mitigating price and demand risk that can undermine predictable and resilient revenue streams over the long term. Liquidity risks can be avoided through protective forward-looking covenants, reserving mecha-

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nisms, cash traps and other structural features; this also includes project finance transactions, which raise all necessary funding at financial close. Detailed appraisals by lenders of all aspects of the project help ensure that key risks are identified, allocated and mitigated such that residual risk is within acceptable parameters. The preparation of a detailed financial model (including whole life operating & maintenance costs, and periodic capital maintenance expenditures) and evaluation of the impact of stress scenarios help assess the project's resilience. Covenants ensure that projects cannot evolve beyond the agreed scope, underpinning a predictable trajectory for the business.

- *Asset recovery*—The high asset intensity of infrastructure places a premium on creditor rights and economic incentives for the various stakeholders to mitigate economic loss following a default. Senior secured lenders benefit from first ranking security interests over all material assets, which would need to be legal, valid, binding, and enforceable (that is, perfected) on or before financial close. A step-in regime (that is, step-in, cure, and step-out rights) provides senior secured lenders with appropriate rights and sufficient time to remedy a default. Pre-agreed inter-creditor arrangements, including decision-making and voting procedures, remove uncertainty about senior lender control upon default (or upon triggering threshold covenants before senior lenders incur any economic loss); this would also require structural risk mitigation features that prevent other creditor claimants might emerge during a bankruptcy or administration process to challenge pre-agreed inter-creditor rights and security interests. Finally, the strategic or essential nature of a profitable project creates collective interest by all stakeholders in averting default.

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