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UNLOCKING TRANSPORT CONNECTIVITY IN THE TRANS-CASPIAN CORRIDOR

Edited by Dina Azhgaliyeva and Yelena Kalyuzhnova

ASIAN DEVELOPMENT BANK INSTITUTE

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Abbreviations

ABEC	Almaty–Bishkek Economic Corridor
ADB	Asian Development Bank
bcm	billion cubic meters
BCP	border-crossing points
bpd	barrels per day
BRI	Belt and Road Initiative
BTC	Baku–Tbilisi–Ceyhanmacro
CAREC	Central Asia Regional Economic Cooperation
CGE	computable general equilibrium
COC	carrier's own container
CPC	Caspian Pipeline Consortium
CPMM	Corridor Performance Measurement and Monitoring
CWA	Central West Asia
dwt	deadweight tons
E&E	electrical and electronic equipment
EU	European Union
GDP	gross domestic product
GLINS	global logistics intermodal network simulation
GRDP	gross regional domestic product
GTAP	Global Trade Analysis Project
GVC	global value chain
IDE-GSM	Institute of Developing Economies-Geographical Simulation Model
KCTS	Kazakhstan Caspian Transportation System
KTZ	Kazakhstan Railways (Kazakhstan Temir Zholy)
LPI	Logistics Performance Index
NDRC	National Development and Reform Commission
PRC	People's Republic of China
RoRo	roll-on–roll-off
SOC	shipper's own container
STKEC	Shymkent–Tashkent–Khujand Economic Corridor
TCDD	Türkiye Cumhuriyeti Devlet Demiryolları (Turkish State Railways)
TCO	Tengizchevroil
TCP	Trans-Caspian Pipeline

TCTC	Trans-Caspian Transport Corridor
TEU	twenty-foot equivalent unit
TITR	Trans-Caspian International Transport Route
TRACECA	Transport Corridor Europe–Caucasus–Asia
US	United States

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Foreword

Unlocking Transport Connectivity in the Trans-Caspian Corridor examines the major challenges and barriers to developing infrastructure and transportation in the Central Asia Regional Economic Cooperation (CAREC) region. It measures the impact of policies and infrastructure on trade costs and economic development through trade and aims to provide insightful policy recommendations for the regional governments.

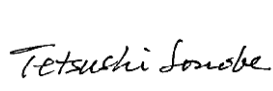
The book's chapters demonstrate that investments in infrastructure reduce transportation costs and time and positively impact both intra-regional trade (within the CAREC region) and inter-regional trade (such as through increasing transit trade by linking the CAREC region with other regional economic powerhouses). Increased trade can stimulate economic development through business development, job creation, and better quality of life. However, the magnitude of the impacts vary by country, transport corridor, type of infrastructure (road, rail, airport, or seaport), and the duration aspect (short- or long-term). Also, the economic impacts of infrastructure investments are not spatially limited to the regions where the projects are located because populations and industries may shift to areas with better connectivity under corridor developments.

We hope that this book will contribute to a better understanding of the importance of cross-border infrastructure for efficient transport, leading to enhanced trade and economic development for the CAREC region. This will help in designing better policies that can maximize the benefits of infrastructure for economic development and mobilize investment. This book will be useful for experts and policy makers looking for efficient and effective ways of providing infrastructure for cross-border transportation in CAREC corridors.

Researchers from academia, the Asian Development Bank Institute (ADBI), the CAREC Institute, and the Centre for Euro-Asian Studies (CEAS) of the University of Reading have worked on this edited volume to present the latest evidence on the topic. ADBI, CAREC Institute, CEAS, and Asian Development Bank (ADB) staff, along with other experts, contributed to this book by providing comments during a workshop and review of the book's chapters, which greatly helped in improving the quality of the chapters and their policy recommendations. We acknowledge and appreciate all efforts by the excellent team of authors,

reviewers, editors, and researchers from both outside and within ADB, ADBI, the CAREC Institute, and CEAS. It is our hope that this book will contribute meaningfully to the ongoing dialogue on how to strengthen cross-border connectivity in the CAREC region.

Syed Shakeel Shah
Director
CAREC Institute



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This book is the product of collaboration between the Asian Development Bank Institute (ADBI), the CAREC Institute, and the Centre for Euro-Asian Studies. Drawing on these institutions' interdisciplinary expertise in economics, geopolitics, and engineering, the book seeks to contribute significantly to studies of the Trans-Caspian Transport Corridor.

The editors would like to express their gratitude to Peter Morgan, senior consulting economist and vice chair of research at ADBI, for his generous support and guidance during the entire process; Tetsushi Sonobe, dean of ADBI, for his helpful comments on the book; Iskandar Abdullaev, deputy director two of the CAREC Institute, Eisa Khan Ayoob Ayoobi, chief of the Capacity Building Division of the CAREC Institute, Rovshan Mahmudov, senior capacity building specialist at the CAREC Institute, and Dildar Zakir, capacity building specialist at the CAREC Institute, for their excellent support, especially with the "ADBI-CAREC Institute Virtual Workshop on the Trans-Caspian Transport Corridor: Infrastructure and Trade" held on 16, 17, and 20 November 2020, and the book launch event; David Hendrickson and Adam Majoe for coordinating the editing and production process; Ian Youngs for the design of the book cover; Toby Miller, Maria Priscila del Rosario, and Kae Sugawara for their diligent editing and proofreading; and Aileen Magparangalan for typesetting the book. We also wish to thank Asian Development Bank staff Lyaziza G. Sabyrova, principal regional economist at the Central and West Asia Department, Dorothea C. Lazaro, regional cooperation specialist at the East Asia Department, and Loreli De Dios, consultant (economist) at the East Asia Department, for their active participation in the above workshop, as well as for reviewing and providing comments on the book chapters. We also wish to thank ADBI staff Ranjeeta Mishra and Kumiko Suzuki for their excellent support and are grateful to the speakers and participants of the above workshop.

Summary

Dina Azhgaliyeva and Yelena Kalyuzhnova

This Summary give an overview of the chapters in this book, focusing on the major findings and policy recommendations. The book is divided into three parts: (i) The Trans-Caspian Transport Corridor: What Does the Future Hold? (ii) Policy Development: Drivers and Barriers of Cross-Border Connectivity, and (iii) Measuring the Economic Impacts of the Trans-Caspian Corridor.

Part I overviews the historical and future trends of the development of the Trans-Caspian Transport Corridor (TCTC). It comprises three chapters. Table 1 briefly describes the analyses conducted in the chapters.

Chapter 1, "Trade Corridors in the Caspian Region: Present and Future" by Yelena Kalyuzhnova and Richard Pomfret, examines the establishment of new trade corridors focusing on Trans-Caspian links. It also discusses the impact of the COVID-19 pandemic on international trade. This chapter notes that the disruption of lockdowns and quarantine requirements negatively affected transportation. Also, the pandemic, coupled with substantially depressed energy prices, put additional financial pressure on the Caspian governments.

Chapter 2, "CAREC Corridors: Increased Connectivity and Improved Trade" by Iskandar Abdullaev and Shakhboz Akhmedov, analyzes the increased connectivity of the Central Asian region via (i) better trade and border-crossing services and (ii) new economic corridors. Better trade and border-crossing services include coordinated border management, customs modernization, and integrated trade facilitation. Improvements in border-crossing services can reduce customs clearance times and the related costs. This chapter overviews two economic corridors, the Almaty–Bishkek and Turkistan–Tashkent–Khujand corridors, and proposes a new Uchkuduk–Kyzylorda economic corridor. This new corridor aims to link the economically advanced zone of Uzbekistan (Navoi region) with Kyzylorda and then toward the main roads into Europe and the People's Republic of China (PRC). Chapter 2 identifies the areas or locations and relevant activities to form a new transport–trade corridor and strategic framework for promoting the new transport corridor and linking its operations with broader partnerships on trade-related issues under the CAREC Integrated Trade Agenda 2030 (CAREC and ADB 2019) and specific country interests and needs.

Chapter 3, "Trans-Caspian Transport Corridor Infrastructure: Oil and Gas Pipelines" by Julian Lee and Yelena Kalyuzhnova, reviews and analyses the networks of rail, ship, and pipeline routes developed to transport hydrocarbons out of the Caspian Sea region and those still in consideration for the future. The chapter examines the obstacles and constraints, including those faced during the COVID-19 pandemic, causing governments and oil companies to reassess future hydrocarbon developments in Central Asia and the Caucasus, along with the export networks needed to deliver the region's crude oil and natural gas to markets.

Table 1: Summary of Part I: The Trans-Caspian Transport Corridor: What Does the Future Hold?

Chapter	Authors	Theme	Coverage	Key Takeaways
1	Kalyuzhnova and Pomfret	Establishment of new trade corridors, focusing on Trans-Caspian links	Central Asia	Central Asian countries should implement domestic policy reforms that will make it easier to start new businesses and trade across borders to take advantage of new transport options, including the trans-Caspian corridor.
2	Abdullaev and Akhmedov	Economic corridors: Almaty–Bishkek; Shymkent–Tashkent–Khujand; Uchkuduk–Kyzylorda	CAREC countries	Greater connectivity of the Central Asian region via (i) better trade and border-crossing services and (ii) new economic corridors.
3	Lee and Kalyuzhnova	Development of hydrocarbon transportation routes from the Caspian Sea region	Caspian Sea region	Developing completely new export routes may no longer be a viable option.

CAREC = Central Asia Regional Economic Cooperation.
Source: Authors.

Part II, "Policy Development: Drivers and Barriers of Cross-Border Connectivity," investigates the issues of policy development as well as the drivers and barriers of cross-border connectivity. It comprises two chapters. Table 2 briefly describes the analyses conducted in the chapters.

Table 2: Summary of Part II: Policy Development: Drivers and Barriers of Cross-Border Connectivity

Chapter	Authors	Theme	Coverage	Key Findings
4	Kenderdine and Bucsky	The institutional development of transport infrastructure and the economic potential	Central Asia, the Caucasus, Turkey, and Eastern Europe	Growth in transcontinental containerized rail transport is politically feasible. At the same time, demand-side factors define the limitations of trade development potential and extra-regional connectivity from the Middle Corridor economies.
5	Kalyuzhnova and Holzhacker	The need for further steps in developing products based on countries' natural or historically accumulated comparative advantages	CAREC countries	Initiatives can be clustered into economic corridors that provide economies of scale and scope for good connectivity. Therefore, the impact can be scaled up.

Source: Authors.

Chapter 4 is entitled "The Middle Corridor: Policy Development and Trade Potential of the Trans-Caspian International Transport Route." From three macroregional angles—policy and subsidy-driven development, Central Asia–Caucasus–Turkey physical industrial geography, and political institution limitations—Tristan Kenderdine and Péter Bucsky explore the institutional development of transport

infrastructure and economic potential. They conclude that growth in transcontinental containerized rail transport is politically feasible. At the same time, demand-side factors define the limitations of trade development potential and extra-regional connectivity from the Middle Corridor economies.

In Chapter 5, "Enhancing Connectivity and Trade between CAREC Countries and the World: Benefits, Risks, and Policy Implications," Yelena Kalyuzhnova and Hans Holzhacker discuss that broadening and expanding the export range of products and services require a robust set of measures in areas such as trade policy, the coordination of sectoral policies, diversification, and business reforms. Re-designing schemes for local and foreign investments, along with the development of capital markets, is required. The chapter suggests that initiatives can be clustered into economic corridors that provide economies of scale and scope for good connectivity; therefore, the impact can be scaled up. However, corridor development must be well-aligned with the overall economic policies and development plans of the countries involved. The authors suggest better coordination of sectoral policies and priorities through collaborative policy formulation and implementation, alignment of national and regional planning, and regulatory convergence in the region. Policy recommendations include suggestions to revise development plans in the light of accelerated technological change, not least due to COVID-19, and facilitate the social change brought about by the technological change by active re-qualification and labor market policies.

Part III, "Measuring the Economic Impacts of the Trans-Caspian Corridor," provides quantitative estimates of the economic impacts of investments in the Trans-Caspian Corridor. It comprises four chapters. Table 3 briefly describes the analyses conducted in the chapters.

In Chapter 6, "Infrastructure and Firm Performance in CAREC Countries: Cross-Sectional Evidence at the Firm Level," Dina Azhgaliyeva, Ranjeeta Mishra, Naoyuki Yoshino, and Kamalbek Karymshakov examine the impact of infrastructure on firm performance in nine CAREC countries. Using 2008, 2009, and 2013 firm-level data, they measure the impact of quality and access to infrastructure on firms' total sales and exports. Their results show that the duration of power outages and electricity expenses negatively affect firm performance. Moreover, access to broadband internet significantly increases the total sales and export sales of small firms, while the efficiency of customs increases the exporting activities of medium-sized and large firms. These findings underline that, for the development of the private sector and international trade in CAREC, sustainable access to and the quality of electricity, telecommunication, and the efficiency of customs are

Table 3: Summary of Part III: Measuring the Economic Impacts of the Trans-Caspian Corridor

Chapter	Authors	Theme	Coverage	Method	Main Data Source	Period	Key Findings
6	Azhgaliyeva, Mishra, Yoshino, and Karymshakov	The impact of quality and access to infrastructure (electricity, internet, and customs) on firms' sales and exports	Afghanistan, Azerbaijan, Georgia, Kazakhstan, Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Uzbekistan	Econometric (tobit and probit)	World Bank, Enterprise Surveys data	2009, 2013, 2019	Broadband internet access significantly impacts all small and medium-sized enterprises and large firms; electricity expenses largely impact small firms; higher efficiency of customs and border management have a greater impact on medium and large firms.
7	Kumagai, Tsubota, and Gokan	The impacts of five corridors on gross domestic product (GDP)	Armenia, Georgia, Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, Uzbekistan	Spatial computable general equilibrium model	National statistics, international statistics, and satellite data	2005–2010 and simulation 2030	Economic impacts are largely due to the growth in the service sector.
8	Watanabe, Shibasaki, and Arai	The impact of new rail construction and increasing level of service of the Kazakhstan railways and Caspian ferry; reducing the rate of freight of the China Railway Express; decreasing the rate of border barriers between the Trans-Caspian Transport Corridor countries on laden containers transported by land from the PRC to Armenia, Azerbaijan, Georgia, Iran, and Turkey	People's Republic of China (PRC), Armenia, Azerbaijan, Georgia, Iran, Turkey, Kazakhstan	Global intermodal logistics network simulation (GLINS) model	Kazakhstan Freight Forwarders Association and interviews	2016	Significant reduction of rail freight and reduction of barriers at national borders will positively affect the transportation of containers by land from the PRC to the South Caucasus countries.
9	Li, Wang, and Chen	The impact of transportation infrastructure investments on trade costs and real GDP	Azerbaijan, the PRC, Georgia, Kazakhstan, Poland, Romania, Turkey, Ukraine	Computable general equilibrium (CGE) model	Global Competitiveness Report, World Economic Forum, World Bank, UNESCAP Trade Costs, World Bank Open Data	2011–2015	Transportation infrastructure investment tends to significantly reduce interregional trade costs, generating positive impacts on real GDP in the countries around the Trans-Caspian International Transport Route.

Source: Authors.

essential objectives for government policy. Broadband internet access significantly impacts small and medium-sized enterprises and large firms. However, the impact of other infrastructure depends on firm size. The importance of electricity expenses is greater for small firms, while medium-sized and large firms primarily benefit from higher customs and border management efficiency. Thus, the authors provide policy recommendations for each firm size (Table 4).

Table 4: Results of the Impacts of Infrastructure by Firm Size

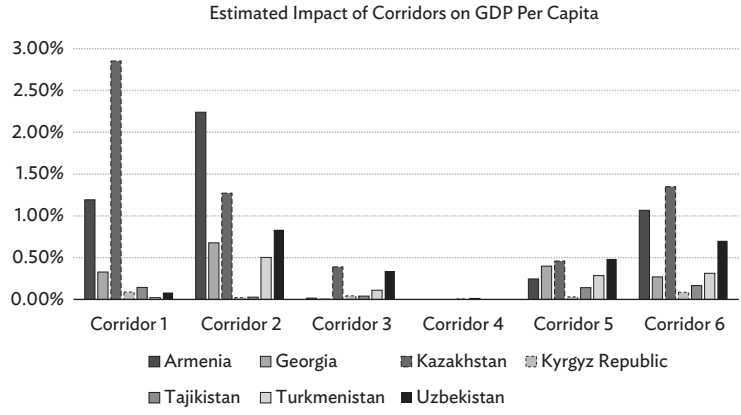
Firm Size	Broadband +	Customs +	Electricity Outages −	Electricity Expenses −
Small	Large	No impact	No impact	Large
Medium	Large	Large	No impact	Small
Large	Large	Large	No impact	Small
All	Large	Large	Small	Small
Policy	*Improve access and affordability of broadband*	*Improve customs efficiency*	*Reduce electricity outages*	*Use-based progressive electricity tariffs*

Source: Azhgaliyeva, Mishra, Yoshino, and Karymshakov (2021).

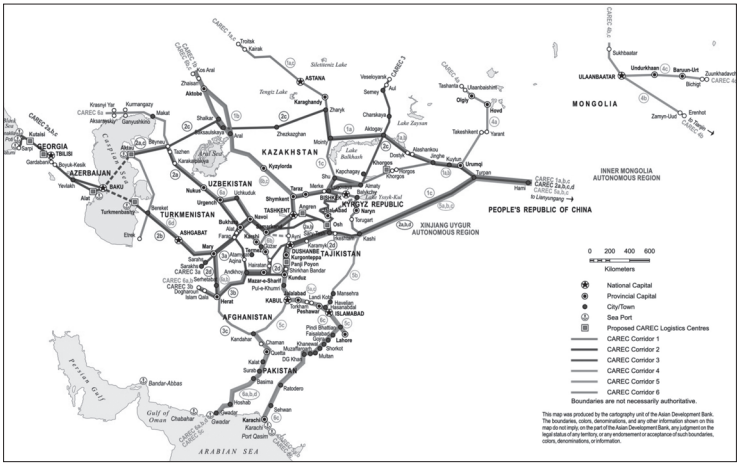
Chapter 7, "Corridor Developments for Transforming Central Asia—A Spatial Computable General Equilibrium Model" by Satoru Kumagai, Toshitaka Gokan, and Kenmei Tsubota, evaluate the potential regional economic impacts of the CAREC Program corridors and the Trans-Caspian International Transport Route in Armenia, Georgia, Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan. The authors used the Institute of Developing Economies–Geographical Simulation Model (IDE-GSM), a spatial computable general equilibrium model on spatial economics with subnational data from all over the world, newly developed by the authors. They perform simulation analyses using IDE-GSM for the combination of the following two types of corridor developments:

- highways: raise the average speed of specified roads in the CAREC Corridor from 19.25 km/h to 38.5 km/h;
- railways: raise the average speed of specified railways in the CAREC Corridor from 19.1 km/h to 40.0 km/h.

Figure 1: Estimated Impact of CAREC Corridors on GDP per Capita



Map of Corridors



Note:	
Corridor 1	The People's Republic of China (PRC) and Europe through Kazakhstan and the Kyrgyz Republic
Corridor 2	The PRC and the Caucasus and Mediterranean regions through the Caspian Sea
Corridor 3	The Russian Federation and the Middle East through Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan
Corridor 5	The PRC and the Arabian Sea through the Kyrgyz Republic and Tajikistan
Corridor 6	The Russian Federation, the Caspian Sea, and the Arabian Sea through Kazakhstan, Turkmenistan, Uzbekistan, and Tajikistan

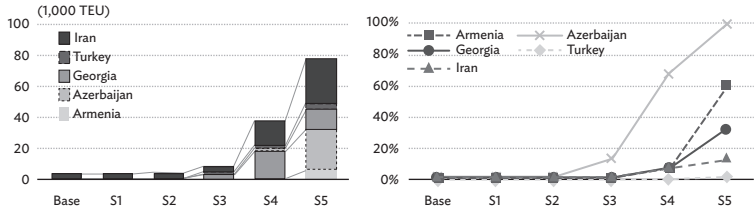
Source: Authors' elaboration using Kumagai, Gokan, and Tsubota (2021).

Their results show that the economic impacts are not spatially limited to the regions where projects are implemented because population and industries may shift to areas with better connectivity under corridor developments (Figure 1). The economic impacts are largely due to the growth in the service sector, suggesting the need for additional public investments, such as special economic zones for boosting industries other than services.

Chapter 8 is entitled "Logistics Policy Analysis and Network Model Simulation for Cross-Border Transport in the Trans-Caspian Transport Corridor: The Global Intermodal Logistics Network Simulation Model." Here, Daisuke Watanabe, Ryuichi Shibasaki, and Hirofumi Arai conduct logistics policy analysis applying the global intermodal logistics network simulation (GLINS) model on the impact of policies on laden containers transported by land from the PRC to Armenia, Azerbaijan, Georgia, Iran, and Turkey. The authors developed the GLINS model to cover intermodal freight transport networks for policy simulation. The simulation incorporates the impact of the logistics policies related to cross-border transport in the TCTC, including (i) the new rail construction and increasing level of service of the Kazakhstan railways and Caspian ferry, (ii) reducing the freight rate of the China Railway Express, and (iii) the declining rate of border barriers between the TCTC countries. Their simulation results emphasize the importance of reducing transit times and the role of transport tariffs. In particular, a substantial reduction in the rail freight charge increases the estimated number of containers transported by land from the PRC to the South Caucasus countries (Figure 2). In addition, the reduction of barriers at national borders between the TCTC will increase the estimated shares of containers transported by land from the PRC to Georgia and Armenia (Figure 2).

In Chapter 9, entitled "Regional Economic Impacts of Trans-Caspian Infrastructure Improvement and Implications for the Post-COVID-19 Era: A Computable General Equilibrium Analysis," Xinmeng Li, Kailai Wang, and Zhenhua Chen, using a computable general equilibrium analysis, capture the uncertainty of infrastructure investment given the impact of COVID-19. To capture the uncertainty of infrastructure, they evaluate the different impacts of five scenarios of trade costs reduction (from very conservative to very optimistic) of four modes of freight transportation—rail, road, sea, and air—on real GDP per capita in Azerbaijan, Georgia, Kazakhstan, Poland, the PRC, Romania, Turkey, and Ukraine. Their results show that transportation infrastructure investment tends to significantly reduce interregional

Figure 2: Impact of Five Policies on Laden Containers Transported by Land from the PRC to Armenia, Azerbaijan, Georgia, Iran, and Turkey

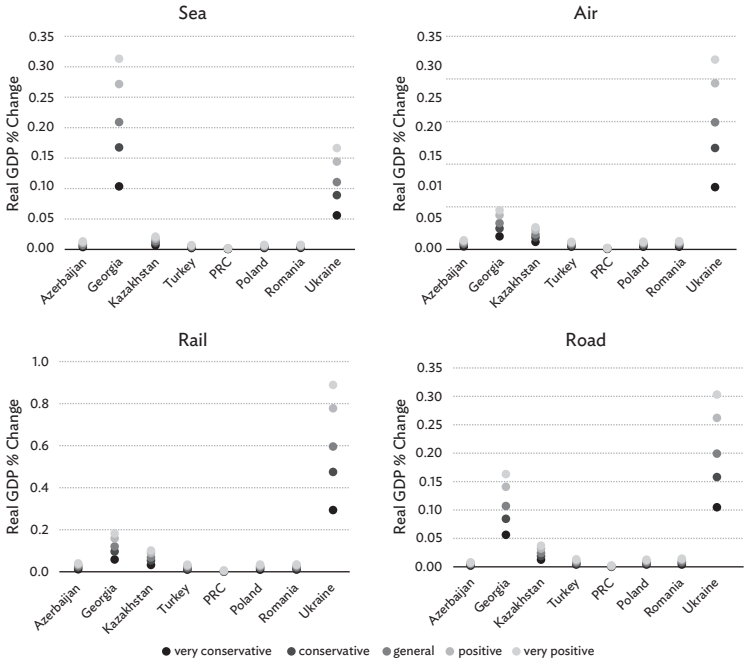


Scenario	New rail construction and increasing level of service of Kazakhstan railways and Caspian ferry	Reducing rate of freight of the China Railway Express, %	Decreasing rate of border barriers between the Trans-Caspian Transport Corridor, %
Base	No	0	0
S1	Yes	0	0
S2	Yes	25	0
S3	Yes	50	0
S4	Yes	75	0
S5	Yes	75	50

Source: Authors' elaboration using Watanabe, Shibasaki, and Arai (2021).

trade costs, positively impacting real GDP in the countries around the Trans-Caspian International Transport Route (Figure 3). Our results suggest that the construction of transportation infrastructure in airports and railways has a more extensive stimulation of GDP growth through the channel of trade cost reduction. They find that infrastructure investments in airports and railways have larger positive effects on GDP growth than seaport and roadway infrastructure. If trade costs in air and rail modes are reduced by 5.9% and 4.3%, average GDP increases by 0.11% and 0.10%, respectively. Although countries face uncertainty of investment due to COVID-19, strengthening infrastructure investment can be a useful tool to stimulate the economy while reducing the negative impact of the pandemic on the economy.

Figure 3: Impact of Trade Cost Reduction under Five Scenarios on Real GDP



Scenario	Very conservative	Conservative	General	Positive	Very positive
Rail	–2.2%	–3.5%	–4.3%	–5.6%	–6.5%
Air	–2.9%	–4.7%	–5.9%	–7.7%	–8.8%
Sea	–3.5%	–5.6%	–7.0%	–9.1%	–10.5%
Road	–1.0%	–1.5%	–1.9%	–2.5%	–2.9%

Source: Authors' elaboration using Li, Wang, and Chen (2021).

This book enhances our understanding of the TCTC development and infrastructure and trade policy imperatives. It concludes that more policy dialogue and collaboration on TCTC growth issues are required. Also, investments in new corridors or improvements of existing corridors can positively impact the economic development of countries along the TCTC.

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Introduction

Dina Azhgaliyeva and Yelena Kalyuzhnova

Investments in infrastructure are essential for the economic growth of developing countries. Such investments include those in the development of new infrastructure and quality improvements.

Central Asia will require $33 billion of investments in infrastructure annually, or 6.8% of gross domestic product (GDP), through 2030. According to the Asian Development Bank (ADB 2017) report *Meeting Asia's Infrastructure Needs*, infrastructure investment needs in Central Asia increase to $38 billion annually, or 7.8% of the region's GDP, if those necessary for climate change mitigation and climate change adaptation are included.

Targets to build 7,800 kilometers (km) of roads and 1,800 km of rail track by 2020 set by the CAREC Transport and Trade Facilitation Strategy 2020 (ADB 2014) were achieved by 2017. The new CAREC Transport Strategy 2030 (ADB 2020a) focuses on reducing trade barriers and costs, increasing trade connectivity, and reducing trade turnover times. CAREC Corridor Performance Measurement and Monitoring, developed by ADB, shows that the average border-crossing time remained unchanged for road but improved by 11.3% for rail transport in 2019 compared to 2018. Average border-crossing costs deteriorated and increased for road (4.1%) and rail (1.2%), respectively. The total average transport cost declined by 5.5% for road transport and 15.5% for rail, while the speed decreased for road transport and increased for rail (ADB 2020b).

Major barriers for infrastructure investments include long-term projects, high up-front costs, large-scale investments, high risk, and uncertain benefits. Apart from these, Central Asia faces additional barriers. Central Asia is different from South Asia, Southeast Asia, and North Asia, where population densities are much higher and distances between cities are shorter. In Central Asia, cross-border connectivity is more important than elsewhere in Asia. In other Asian countries, domestic connectivity could provide sufficient demand for infrastructure. However, cross-border connectivity is more crucial in Central Asia, with less densely populated areas and more considerable distances between cities. Cross-border connectivity should be created to develop the region further and support continuous development.

The potential economic benefits of the Trans-Caspian Transport Corridor (TCTC) include an increase in cross-border trade, GDP, investments, and employment and a decrease in transportation costs. The benefits of infrastructure projects depend on many factors, including population density, connectivity, access to complementary infrastructure, and economic growth. Low population density and large distances challenge infrastructure investments in Central Asia. Greater regional connectivity in Central Asia would create business opportunities for firms and increase access to markets and jobs for individuals. In addition, the Trans-Caspian Corridor will allow participating countries to benefit from export and import activities and transit. Thus, the spillover effects will be greater.

COVID-19 has significantly affected public revenues and spending. Health, education, and social security expenses have increased in many Asian countries and government spending on infrastructure has become more constrained. However, infrastructure is an essential source of economic growth. Investments in quality infrastructure will bring spillover effects on jobs, trade, and income, etc. Cross-border connectivity could increase the spillover effects of infrastructure investments.

This book is inspired by the following books published by ADB and ADBI: *Infrastructure for a Seamless Asia* (2009), *Connecting South Asia and Southeast Asia* (2015), *Connecting Asia: Infrastructure for Integrating South and Southeast Asia* (2016), *Financing Infrastructure in Asia and the Pacific: Capturing Impacts and New Sources* (2018), and *Developing Infrastructure in Central Asia: Impacts and Financing Mechanisms* (2021). To the best of our knowledge, this is the first book on the TCTC. Unlike the recently published *Developing Infrastructure in Central Asia: Impacts and Financing Mechanisms* by Yoshino et al. (2021) that measures the economic impacts of infrastructure projects in Central Asia Regional Economic Cooperation (CAREC) member countries and *Financing Infrastructure in Asia and the Pacific* by Yoshino, Helble, and Abidhadjaev (2018) that provides the scientific evidence on infrastructure investment, including new ideas on how to finance infrastructure, this book focuses on infrastructure that provides cross-border connectivity. Cross-border connectivity in South Asia and Southeast Asia is discussed in *Connecting South Asia and Southeast Asia* (ADB and ADBI 2015) and *Connecting Asia: Infrastructure for Integrating South and Southeast Asia* (Plummer, Morgan, and Wignaraja 2016); however, Central Asia was outside of the scope.

Against this backdrop, this publication answers what greater regional connectivity in Central Asia via the TCTC would bring to the countries of the region. The authors conclude that the TCTC could boost

market access, new trade and business opportunities, and employment. However, fully realizing these benefits will depend on infrastructure growth to improve transportation linkages and cost efficiency in a region challenged by low population density and large distances.

This book features new research on the development of the TCTC, its trade and economic potential, and infrastructure expansion challenges and opportunities. It comprehensively reviews policies for enabling infrastructure investment, overcoming barriers such as long project timelines, sizable up-front costs, and high risks. It analyzes policy drivers for further infrastructure development and the technical, social, political, and economic contexts in which these changes occur. This book also examines the barriers and estimates the impacts of the Trans-Caspian Corridor.

Although the primary focus is economic, this book is interdisciplinary because it is crucial to recognize geopolitical, geographical, and technical issues on investment options. In addition, it emphasizes the obstacles that have emerged since the COVID-19 pandemic. Individual chapters address a wide range of topics—from logistics policy to the economic impact of the Trans-Caspian Corridor. These topics became very prominent, especially in light of the continuous pandemic's conditions.

The book comprises three parts: "the Trans-Caspian Transport Corridor: What Does the Future Hold?", "Policy Development: Drivers and Barriers of Cross-Border Connectivity," and "Measuring the Economic Impacts of the Trans-Caspian Corridor."

Yelena Kalyuzhnova and Richard Pomfret set the scene by examining the establishment of new trade corridors, focusing on trans-Caspian links. They also discuss the impact of the COVID-19 pandemic on international trade. Next, Iskandar Abdullaev and Shakhboz Akhmetov analyze the increased connectivity of the Central Asian region. Finally, Julian Lee and Yelena Kalyuzhnova review the development of the rail, ship, and pipeline routes developed to transport hydrocarbons out of the Caspian Sea region and those still in consideration for the future.

The second part investigates the issues of policy development as well as drivers and barriers of cross-border connectivity. From three macroregional angles—policy and subsidy-driven development, Central Asia–Caucasus–Turkey physical industrial geography, and political institution limitations—Tristan Kenderdine and Péter Bucsky explore the institutional development of transport infrastructure and its economic potential. They conclude that growth in transcontinental containerized rail transport is politically feasible. At the same time, demand-side factors define the limitations of trade development potential and extra-regional connectivity from the Middle Corridor

economies. Broadening and expanding the export range of products and services require a robust set of measures in areas such as trade policy, coordination of sectoral policies, diversification, and business reforms. Re-designing schemes for local and foreign investments, along with the development of capital markets, is required. Thus, trade facilitation remains an overarching objective for the CAREC region (Chapter 5).

The third part of the book provides measures for the economic impacts of the Trans-Caspian Corridor. Dina Azhgaliyeva, Ranjeeta Mishra, Naoyuki Yoshino, and Kamalbek Karymshakov examine the impact of infrastructure on firm performance in nine CAREC member countries. Their findings underline that for the development of the private sector and international trade in CAREC, sustainable access to and the quality of electricity and telecommunications, and the efficiency of customs are important objectives for government policy. Daisuke Watanabe, Ryuichi Shibasaki, and Hirofumi Arai conduct logistics policy analysis applying the global intermodal logistics network simulation model. Their simulation results emphasize the importance of reducing transit times and the role of transport tariffs. Satoru Kumagai, Kenmei Tsubota, and Toshitaka Gokan evaluate the potential regional economic impacts of CAREC Program corridors and the Trans-Caspian International Transport Route by using a spatial computable general equilibrium model. They find that the economic impacts are not spatially limited to the regions where projects are implemented. They conclude that population and industries may shift to areas with better connectivity by virtue of corridor developments. Using a computable general equilibrium analysis, Xinmeng Li, Kailai Wang, and Zhenhua Chen capture the uncertainty of infrastructure investment and the impact of the COVID-19 pandemic. Their results show that infrastructure investment has heterogeneous multiplier effects on the regional economy.

This book enhances our understanding of TCTC development and infrastructure as well as trade policy imperatives. It concludes that greater policy dialogue and collaboration on TCTC growth issues are required.

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PART I

The Trans-Caspian Transport Corridor: What Does the Future Hold?

1

Trade Corridors in the Caspian Region: Present and Future

Yelena Kalyuzhnova and Richard Pomfret

1.1 Introduction

The historical silk roads from the People's Republic of China (PRC) or India to the Middle East or Europe ran north of, south of, and across the Caspian Sea. Cities flourished in Central Asia; Merv, Bukhara, and Samarkand all had periods of glory between the 1100s and the 1400s. Since 1500, however, maritime transport has dominated trade between Europe and East Asia. Central Asia became an economic backwater, incorporated into the Russian Empire and forming part of the Soviet Union from 1917 to 1991. Almost all trade links ran north to the Russian Federation.

The situation started to change in the 21st century. With the increasing significance of Central Asia as an energy producer, countries constructed oil and gas pipelines to the Black Sea and the PRC in the 2000s and exported oil across the Caspian Sea to link up with the Baku–Tbilisi–Ceyhan pipeline to the Mediterranean. For trade in other goods, new transport corridors have opened more slowly, but, in the 2010s, rail links between the PRC and the European Union (EU) began operating through Kazakhstan. This chapter examines the establishment of new trade corridors in the form of pipelines and railway lines, focusing on trans-Caspian links.

1.2 Energy and Pipelines

In the 1990s, eight countries in the Caspian region became independent, and many people named some as new potential rivals to the Middle East in the production of oil and gas. Without doubt, the region possesses sizable energy reserves, around 2.7% of the total proven oil reserves and 7% of the proven natural gas (Kalyuzhnova et al. 2002), with a complicated

geopolitical situation and an interesting location between the Russian Federation, the PRC, Iran, and Turkey. The region is a magnet for foreign countries (the neighbors and Europe, Japan, Pakistan, Saudi Arabia, and the United States, etc.) and their businesses. Political, economic, and business interests intersect here. All these create competition and cooperation but sometimes even lead to conflicts, making this region attractive and, at the same time, challenging. Historical factors play a crucial role, along with commercial interests competing with political settings.

For the last 2 decades, the newly independent countries in the Caspian region have been building new institutions and creating their national identities. At the same time, the countries have been suffering from economic hardship (Kalyuzhnova et al. 2002; Kalyuzhnova 2011; Pomfret 2003, 2019b). The countries were attempting to reform backward and very inefficient industries, and reduce their overdependence on trade with the Russian Federation. Unfortunately, all the Caspian region's countries had a low level of economic development with a concentration on the raw material sectors. A common theme of all the Caspian countries is the dependence of their economies on mineral wealth. "The last 20 years have brought significant changes to their economic development, with the hydrocarbons sector in particular giving these economies a new shape, for example in the strategic importance of Russia, Kazakhstan and Azerbaijan in world energy markets" (Kalyuzhnova and Patterson 2016, p. 6).

The size and distance played an additional negative role in economic growth. The region, being landlocked with a low gross domestic product and population density, had limited domestic markets. In addition, the extremely considerable distances of the Caspian hydrocarbon reserves from the international energy-consuming regions were a real obstacle to the full development of the energy sector. Realistically, only hydrocarbon resources could give a quick financial return to the countries struggling with economic transition. However, the landlocked geography created logistical obstacles to exploration and production (Soligo and Jaffe 2002).

Soon, increasing competition and cooperation for the control of hydrocarbon resources emerged among several geopolitical actors (Afghanistan, India, Iran, Pakistan, the PRC, the Russian Federation, Turkey, the United States, the EU and particular member states, ethno-religious groups, transnational corporations, crime groups, etc.). In the academic literature, this is also known as the New Great Game (Kalyuzhnova et al. 2002, Amineh 2003, Bayramov 2020).

It was already clear in the 1990s that it was necessary to construct transport routes to gain control of the Caspian region's hydrocarbon

resources. The question of where to construct pipelines created conflicts, including ethno-religious conflicts, between the interested actors, which often caused problems and obstacles to the building of the most economically viable and secure pipelines (Yenikeyeff 2011).

The Caspian nations faced problems such as the legal status of the Caspian Sea, which created uncertainty in pipeline construction (Karataeva 2020), and the lack of infrastructure, technology, and finance. The Caspian Basin is reputed to be among the most challenging "oil prospecting territories in the world" (Soligo and Jaffe 2002, p. 110). In addition, the region wanted to avoid overdependence on the Russian Federation, so the concept of using multiple export routes became the preferred option (Chapter 3 by Lee and Kalyuzhnova).

The complexity of all these issues around energy resources in the Caspian region has settled down slightly over the years. The economies became stronger due to the high oil prices over a long period (1999–2014). The interests of the main actors also became more pragmatic. From the "New Middle East," the region quickly gained a new name as the "region with substantial hydrocarbon resources," the exploration and production of which are expensive and technologically challenging.

The legacy of the Soviet era was the oil pipeline system (Atyrau–Samara and Baku–Novorossiysk) to transport oil from the Caspian region, which the former Soviet Union designed to serve its energy needs. These pipelines passed through the Russian Federation. During the first 2 decades after its independence, the region developed a new oil export infrastructure focusing on diversification of the pipeline routes to reach new markets. The Caspian pipeline infrastructure includes the following pipelines: Baku–Supsa (1999), the Caspian Pipeline Consortium (2003), and Baku–Tbilisi–Ceyhan (2006).

At the same time, the cooperation between the PRC and Kazakhstan (the major oil producer in the region) developed significantly. "The PRC's first steps into Kazakhstan's oil and gas sector came with the Chinese National Petroleum Corporation's (CNPC) purchase in June 1997 of a 60% stake in Aktobemunaigas, then the country's fourth-largest oil producer" (Kalyuzhnova and Lee 2014, p. 209). It constructed the pipeline linking the Aktobe and Douth Turgay regions and a line connecting Aktobe and Aturauy (Chapter 3). Gradually, the PRC became one of Kazakhstan's most important trade partners. The Sino–Kazakh energy and economic cooperation created a good potential for further developing helpful links for both countries.

Kazakhstan was not the only country in the Caspian region in which the PRC possessed great interest. From Turkmenistan (the major gas producer), the PRC built natural gas pipelines through Uzbekistan and southern Kazakhstan. Undoubtedly, the PRC has filled its strategic oil

reserves with crude at low prices, tapping into the Caspian region's vast energy resources. This might change, but only if other actors decide to work proactively in the region. For example, the EU needs the Caspian region's natural gas as much as the PRC does. A conflict of interests and competition are clear here. In this light, the soon-to-be-completed Southern Gas Corridor, a new source and route of the gas supply to Europe, has led to renewed interest in constructing a Trans-Caspian Pipeline (TCP). The proposal for a new pipeline along the seabed of the Caspian Sea has been the subject of discussion for several decades. By 2018, countries had agreed on the delimitation of the Caspian Sea, which reduced the legal obstacles to a TCP. The only economical way to move natural gas from one side of the Caspian to the other is via pipeline.

From time to time, there have been intermittent efforts to revive this project. The importance of a TCP is its possibility of strengthening European energy security and linking the region with the EU. At present, some of the current arguments about the construction of the TCP are about lower construction costs and higher returns when energy prices increase (for further information on the TCP, see Chapter 3).

1.3 The Eurasian Land Bridge

In 2000, several rail lines connected the PRC and Europe; none were competitive with sea freight. International traffic made little use of the Trans-Siberian Railway after the 1960 Sino–Soviet split. A rail line between Kazakhstan and Xinjiang, completed in 1990, mainly took Kazakh coal, steel, iron ore, and other minerals to the PRC in return for Chinese manufactured goods. After a Turkmenistan–Iran railway opened in 1997, a line south of the Caspian Sea from Turkmenistan through Iran and Turkey to Europe featured on United Nations maps served as a trans-Asian mainline. However, the line operated far below capacity due to burdensome regulations for crossing Turkmenistan and Uzbekistan, a cumbersome change of gauge operations at the Turkmen–Iran border, poor track maintenance in western Iran and eastern Turkey, and the need for a ferry across Lake Van. As its flagship aid program to Central Asia, starting in 1993, the EU promoted the Transport Corridor Europe–Caucasus–Asia (TRACECA) route from Central Asia across the Caspian Sea to Baku and then across the Black Sea from Georgia to Europe. However, the mode changes (rail–sea–rail–sea–rail) made the TRACECA route commercially unattractive.

In 2008–2009, German car companies commissioned block trains to carry components via the Trans-Siberian Railway to their joint venture assembly operations in the northeast of the PRC (VW/Audi in Jilin and BMW in Shenyang). Similar services were provided for Daewoo, which

sent components by sea from the Republic of Korea to Lianyungang and then by rail to the company's car assembly operations in Uzbekistan. These trips showed that overland rail transport was feasible. However, other potential customers did not use rail transport because the trains did not run to a schedule. In addition, potential customers still believed that overland freight was uncompetitive with sea transport, apart from special cases. The situation changed dramatically between 2011 and 2016.

The stimulus for change was the decision of major electronics firms (Foxconn, HP, Acer, and others) to build large assembly facilities for laptops, printers, and other electronic equipment in Chongqing. The initial intention was to export the products via the Yangtze River and Shanghai, but the Yangtze River route soon became congested. An alternative was to send the goods by train to Europe. In 2011 and 2012, individual trains connected Sichuan province and Chongqing municipality with Europe, much like the block trains on the Trans-Siberian Railway. An important additional development was the establishment of a regular rail service between Chongqing and Duisburg in 2013, the frequency of which increased to three times a week in 2016 and daily in 2018.

The Chongqing–Duisburg route was so successful that other cities in the PRC and Europe trialed rail connections. Some routes were successful, with regular established services (e.g., Yiwu–Madrid). Some termini would become hubs; for example, Łódź (Poland) became an Eastern European hub and Klaipéda (Lithuania) a hub for southern Sweden, while other routes would be unprofitable. By May 2017, China Railway Express trains connected 37 cities in the PRC to 11 EU countries. China Railway reported over 6,000 trips in 2018 and 5,266 in the first 8 months of 2019 (*Global Times* 2019).

The creation of the Eurasian Land Bridge was market-driven as rail companies responded to the demand by coordinating services and agreeing on transit procedures (Pomfret 2019a). The revenues for Deutsche Bahn and China Railway Express and transit fees to Kazakhstan, the Russian Federation, Belarus, and Poland were substantial. Freight forwarders and couriers responded by offering more services, for example, arranging multimodal connections and improved tracking, consolidating part-container loads, organizing clearance for goods subject to EU–Russian Federation mutual sanctions, and including refrigerated containers in trains. Through this service provision, hubs such as Duisburg, Łódź, and Yiwu have become popular termini. Thus, traffic on the PRC–Kazakhstan–Belarus route grew from 46,000 twenty-foot equivalent units (TEUs) in 2015 to over 100,000 TEUs in 2016 and 175,000 in 2017 (Railfreight.com 2018).

Customers valued the speed and reliability of rail traffic compared with the cheaper but slower sea transport or faster and much more expensive air transport. Major customers were car and electronics companies that produced along international value chains and for which inventories are anathema, whether to allow for variations in delivery times or in the form of goods in transit. The rail times between the PRC and Europe of 12–16 days compared favorably with the maritime shipping times from Shanghai to Rotterdam of 35–45 days and longer between inland termini. Moreover, the rail track prioritizes freight trains, and the arrival times are dependable, whereas ships can be delayed by poor weather, piracy around the Horn of Africa, and congestion in the Suez Canal.[1]

Although the Kazakhstan–Russian Federation–Belarus–Poland route is the most popular, volumes are also increasing on other routes between Europe and the PRC. For example, between January and August 2018, the Trans-Siberian route from the PRC through the Russian Federation shipped 590,000 containers, already more than the 262,000 containers in 2017, according to Oleg Belozerov, CEO and chair of the Board of Russian Railways (Railfreight.com 2018). However, it is unclear whether this figure for Trans-Siberian traffic includes bilateral PRC–Russian Federation traffic and trains between the PRC and Europe.[2]

In an October 2013 speech in Astana, PRC President Xi Jinping announced the construction of the Silk Road Economic Belt, an overland connection with funding support from the Asian Infrastructure Investment Bank. Chinese maps showed the Belt following a route south of the Caspian Sea through Iran and Turkey, in contrast to the land bridge routes through the Russian Federation. With the Maritime Road that the PRC announced soon afterward, this would become the Belt and Road Initiative (BRI). In May 2017, representatives of over 130 countries attended the Belt and Road Forum in Beijing for the formal launch of the BRI.

Although the BRI often appears to be a grand overarching plan, the PRC's actions can be opportunistic. One week after the United Nations lifted its sanctions on Iran in January 2016, President Xi

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1 In March 2021, the 200,000-ton Ever Given container ship ran aground in high winds and a sandstorm, blocking the Suez Canal for a week and highlighting the potential for delays.

2 There is a general problem of inconsistent data depending on the source; compare Table 8.1 in Chapter 8 by Watanabe, Shibasaki, and Arai. However, all the estimates of freight traffic along the land bridges north of the Caspian Sea tell similar stories of continuous rapid growth since 2011.

visited Tehran.[3] On 28 January, the first train left Yiwu for Tehran with 32 containers; the train bypassed Uzbekistan by crossing Kazakhstan before following the Caspian coastal rail line from Kazakhstan to Turkmenistan and Iran, which opened in 2014 (Pomfret 2019b). A Yinchuan–Tehran train service began operation in September 2017 and, by the end of 2017, two trains per month were running to a regular schedule. The establishment of a route from Bayannur in the PRC's Inner Mongolia Autonomous Region to Tehran took place in May 2018. Reports circulated that Iran, the PRC, and Turkey were discussing an extension to a Tehran–Europe service.

A rail link between Kashi (Kashgar), the most western point on the PRC's rail network, and Andijan via the Kyrgyz Republic is under discussion.[4] That would complete a continuous line from the PRC via Uzbekistan, Turkmenistan, Iran, and Turkey to Europe. Uzbekistan is actively supporting this southern route, which, since President Mirziyoyev's election in December 2016, no longer seems like a transit-unfriendly bottleneck. Turkey's rail tunnel under the Bosporus (the Marmaray Tunnel), which opened in 2013, added an essential piece to the southern route to Europe. It means that transferring to a ferry across the Bosporus may no longer be necessary.

Meanwhile, traffic along the old TRACECA multimodal route via Baku, which people now refer to as the Middle Corridor, has increased. The westbound traffic along this corridor amounted to 200 TEUs in 2017 and 15,000 TEUs in 2018, with expectations of 60,000 TEUs in 2019 (RailFreight.com 2018).

1.4 The Middle Corridor

During the 2010s, interest in the Middle Corridor connecting Central Asia to Europe via a Caspian Sea crossing revived. Despite the resumption of the TRACECA project, the EU has not participated directly. Instead, it has been a facilitator on the western side by extending its

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[3] The PRC's $1.5 billion loan for the electrification of the Meshed–Tehran rail line was the first loan to Iran after the lifting of sanctions, although it did not sign the contract to start work on electrifying the line until August 2019.

[4] However, the Kyrgyz Republic is wary of contracting debt, even on concessional terms, from the PRC. The proposed line passes through sparsely populated regions and would unlikely generate sufficient transit revenue to service a loan (Pomfret 2020). At the Second Belt and Road Initiative (BRI) Forum in April 2019, the PRC promised to address concerns about the original concept by establishing a BRI Debt Sustainability Framework and a panel of international mediators from BRI countries to resolve disputes arising from BRI projects.

Trans-European Transport Networks to include Armenia, Azerbaijan, Belarus, Georgia, Moldova, and Ukraine with networks in Asia. The completion of two long-standing projects formed an important background: the 988-kilometer Trans-Kazakhstan railway between Zhezkazgan and Beyneu in 2014, which significantly reduced east–west travel times between the PRC and the port of Aktau,[5] and the much-delayed Baku–Tbilisi–Kars line in 2017, linking the Caspian port to the Turkish rail network.

Kazakhstan signed the Trans-Caspian International Transport Route (TITR) Protocol with Azerbaijan and Georgia in April 2017, establishing the TITR headquarters in Astana (now Nur-Sultan) and opening a TITR Istanbul office later in the year. The PRC also promoted the Middle Corridor. In November and December 2018, it launched services between Venlo (the Netherlands) and Xian and from Lianyungang to Istanbul, both using the Middle Corner and the Baku–Kars railway.[6]

Links between Eastern Europe and Iran via the Caspian region have also undergone testing. In May 2018, a train from Slavkov in Poland to Bandar Abbas in Iran via Ilyichevsk (Ukraine), Batumi (Georgia), Baku, and Turkmenistan took 12 days to cover 5,311 kilometers. In October 2019, a 42-container train from Xian crossed the Caspian Sea to Baku. It then ran via the Marmaray Tunnel to Prague, highlighting the potential complementarities between the Middle and the Southern Corridors.[7] There are also complementarities with the Trans-Siberian route. In May–June 2020, a shipment of 41 forty-foot containers took 15 days to travel from Yantai in Shandong province to Kyiv via Mongolia, the Russian Federation, and Kazakhstan. The cargo was loaded onto ships at Aktau to cross the Caspian Sea and back onto a train in Baku before crossing the Black Sea from Georgia to Ukraine. A second train from Wuhan in June 2020 used the northern route via Mongolia and the Russian Federation, avoiding sea crossings.

Kenderdine and Bucsky (Chapter 4) examined the viability of the Middle Corridor. While they acknowledged the significant

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5 Watanabe, Shibasaki, and Arai (Chapter 8) document other Kazakh government initiatives across Kazakhstan and at Caspian Sea ports intended to improve the PRC–Caspian region rail links.

6 The train from Venlo in the Netherlands departs to the PRC twice a week via the Middle Corridor. On 26–27 November 2019, Venlo hosted the European Silk Road Summit, a 2-day international event dedicated to the New Silk Road.

7 ADY Container LLC (a subsidiary of Azerbaijan Railways) and PRC's Xian Continental Bridge International Logistics Co. signed an agreement at the Second BRI Forum in Beijing in April 2019; both companies agreed to launch 30 container trains by the end of 2019.

improvements in the rail segments during the 2010s and the less dramatic improvements in the Caspian Sea crossing, they also emphasized that the Black Sea leg is still the Achilles, heel of the route, making it less popular among logistics providers. Boat services from the Georgian ports to Bulgaria, Romania, or Ukraine are slow and have outdated equipment.[8] Using the Baku–Tbilisi–Kars railway avoids the need for a Black Sea crossing, but involves congestion around Ankara and difficulties crossing the Bosporus due to problems of scheduling access to the Marmaray Tunnel.

1.5 COVID-19 and the Land Bridge: Outlook for the 2020s

COVID-19 is spreading economic suffering worldwide, and the Caspian region is no exception. The virus is contagious medically and economically. There are sources connected to the economic shocks, such as (i) medical shocks, which prevent workers from working (ill workers) and contributing to the gross domestic product; (ii) the economic impact on the social infrastructure, such as the closure of educational institutions (schools, universities, etc.); (iii) quarantine; (iv) travel restrictions; and so on.

The COVID-19 pandemic has seriously disrupted international maritime trade. Even as lockdowns eased and factories started up, containers and ships were in the wrong location as managers dealt with crew safety issues and dockside biosecurity. Manufacturers, distributors, and logistics agents, which had previously relied on maritime transport between East Asia and Europe, turned to overland freight routes. Although initially disruptive for many operators, the overland alternatives often became easier and more profitable than anticipated as users experienced reliable delivery schedules when the air freight alternatives had become increasingly expensive. In May 2020, at the height of the crisis in Europe, 52,500 TEUs were shipped on the land bridge, the highest-ever figure for a single month. The Middle Corridor via Turkey has been busier than ever, with the frequent announcement of new flows.[9]

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8 The attraction of entering the European Union (EU) via Bulgaria or Romania is offset by the poor state of the railway track in both countries and by the need to cross Serbia, which requires customs checks, en route to other EU countries.

9 This paragraph draws on the report posted on 20 August 2020 at https://www.railfreight.com/business/2020/08/20/new-silk-road-work-practices-are-a-success-story/. Watanabe, Shibasaki, and Arai (Chapter 8) made similar observations about the comparative advantage of overland versus ocean freight with respect to the Middle Corridor, although it is unclear whether biosecurity measures increased the transit times across the Caspian.

The year 2020 capped a decade of growth in rail connectivity across Eurasia (Table 1.1). The initial steps responded to specific requirements of car and electronics companies trying to link their European and Chinese operations. However, traffic growth has been remarkable as more services have encouraged greater traffic, allowing further specialization among service providers and competition for routes. The original routes ran north of the Caspian Sea, either via Kazakhstan or along the Trans-Siberian Railway. Moreover, their success has encouraged exploring alternative routes either south of the Caspian Sea to Iran or along the Middle Corridor with a sea crossing.

Table 1.1: Volume of Traffic on PRC–EU–PRC Container Trains, 2015–2020

Year	Number of Twenty-Foot Equivalent Containers (TEUs)
2015	46,000
2016	100,500
2017	175,800
2018	280,500
2019	333,000
2020	546,900

Note: Belarus, Kazakhstan, and the Russian Federation have equal shares in the joint stock company United Transport and Logistics Company (UTLC), which provides services for the transportation of containers via regular container block trains on the People's Republic of China (PRC)–Europe–PRC route through the three countries.

Source: UTLC website, www.utlc.com (accessed 22 February 2021).

The prospects for the Middle Corridor are examined in greater depth through a variety of modeling techniques. Kumagai, Tsubota, and Gokan (Chapter 7) used a spatial computable general equilibrium model to estimate the impacts at the subnational level. Azhgaliyeva et al. (Chapter 6) used enterprise data to identify the impact of variables, such as customs efficiency and internet access, on different types of firms (e.g., small, medium-sized, and large firms).

Crises always affect oil, be they financial crises or pandemics. In such situations, it is essential to distinguish the duration and the effect. Short-term disruption is inevitable, but people will quickly forget this. The COVID-19 pandemic is having immediately visible impacts

on economic activity. The rapid contraction in economic activity, the collapse of trade, and the dramatic increase in the unemployment rate are without precedent. The more fundamental question concerns the long-run consequences. It is possible to resolve this crisis only if the global oil demand picks up once lockdowns ease and economies recharge. A crisis such as the COVID-19 pandemic serves as a stress test for the system—a dye inserted and circulated to highlight its functioning in terms of efficiency and capacity.

The facts for the oil industry in 2020 speak for themselves: oil prices collapsed, and the demand had vanished. In April 2020, West Texas Intermediate cost minus $37 per barrel for the first time. Arguably, our energy future will no longer be business as usual. Indeed, the short-run health, economic, social, and psychological impacts of the disease have been unprecedented since the end of World War II.

Why has this happened? The possible answer lies in the issues of flexibility and storage. Some storage providers are benefiting from the current oil market state. However, the upside potential is quite limited as the world is close to reaching storage capacity. Storage expansion is a costly and lengthy process.

An alternative way to stabilize the market is to reduce the supply. Leaving aside the geopolitical and strategic questions, we concentrate on the economics of this approach. It is understandable oil companies are reluctant to cut their production. Such a process could become extremely costly. At the same time, there is a danger that closing the oil wells could permanently damage them, which could make the losses greater than the profitability damage incurred by temporarily selling oil at a price below the marginal costs or even below zero. In such a situation, at least some producers are ultimately less flexible as they cannot change production when necessary.

Another emerging question concerns the chance for the oil prices to become negative again. In the current storage situation, this possibility is limited. The supply and demand are becoming quite inelastic, and a large oversupply is temporarily present. There are good reasons to believe that negative oil prices might reappear.

Most of the time, finding storage availability is easy for the suppliers. According to Puranik of GlobalData, “Lack of demand is weighing on liquid storage, which is now edging towards full capacity. Consequently, oil producers and traders are turning to oil tankers as floating storage, thus leading to a surge in tanker chartering rates” (GlobalData 2020, p. 1).

The COVID-19 pandemic has severely impacted air travel (Reed 2020). At the beginning of the pandemic, individual behavioral changes

took place, such as fear-induced aversion to workplaces and other public-gathering places as well as people stopping driving. However, when the lockdown eased, traffic congestion apparently increased. As soon as Wuhan (the PRC) lifted its 76-day lockdown, traffic jams returned to normal. Roads are even more congested since people are wary of using public transport. The disruption is persistent and depends on people's attitude: do people want to travel on planes and so on?

If the oil demand cycle remains low for longer, that means a longer-term and significant impact on investments in exploration and production. Royal Dutch Shell is cutting dividends for the first time since World War II. The depth of the crisis shows there is no return, but the situation also depends on how people behave. In addition, the oil supply chain will change. Some firms will not survive. So, there is a critical risk for supply chains.

Oil experts have stated that there will be no return to normal (Barbosa et al. 2020). The present is a defining moment of "restructuring." The supply chain will gain a new shape, and new opportunities for large oil companies and private equity firms will arise. However, oil service providers and refineries will face exposure to the worst of the crisis. "The current disequilibrium in global energy markets is a signal that the post-COVID-19 new energy normal would be characterized by a more uncertain future for the oil and gas industry. To a certain extent, the COVID-19 pandemic has and will reshape our energy future. The oil and gas industry will experience short- and long-term impacts from the crisis to which it will have to adjust, with the potential for future oil demand to be significantly reduced from pre-pandemic forecasts" (Kalyuzhnova and Lee 2020, p. 174).

The Caspian region remains a key transport and logistics route. The COVID-19 pandemic, coupled with substantially depressed energy prices, is putting additional financial pressure on the Caspian governments, which are struggling with the serious medical challenges that the pandemic has created. The reality confronting the region is that medical threats do not recognize borders. Nevertheless, overcoming the challenges that the pandemic has created requires the cooperation and ability of the region's leaders. The collateral engagements and honesty in recognizing the problem of the pandemic will be preconditions for victory.

1.6 Conclusions and Policy Recommendations

Good transportation routes are necessary to make the Central Asian economies more diversified and competitive. Thirty years ago, all roads, railways, and pipelines from Central Asia ran north to the Russian

Federation. Since the 1990s, new pipelines and transport routes have become available, increasing the trade partner options for Central Asian producers and consumers. The Caspian region has reached a critical crossroads in politico-economic terms, and now it must decide which transportation directions to take. The future success of the countries in the region will depend on whether they can take advantage of the opportunities.

The economic impact of COVID-19 has been significant, and it will reverberate for the next few years. Some Caspian countries, like Iran, are among the hardest-hit economies; however, the fallout is also already apparent among all the Caspian states. Since the end of the resource boom (2014), the Caspian countries have banked on trade with their immediate neighbors as a stopgap remedy for their economic needs. This policy of prioritizing trade and other economic ties with immediate neighbors came under even more pressure due to COVID-19. Therefore, establishing trade corridors in the form of pipelines and railway lines, focusing on trans-Caspian links, is even more critical.

Central Asian countries recognize the desirability of economic diversification. The improved Eurasian connectivity with new pipelines from the Caspian countries to the PRC and the Mediterranean and new rail services from the PRC to Europe, Iran, and other destinations provide a window of opportunity for achieving this goal. To take advantage of the new transport options, including the trans-Caspian corridor, Central Asian countries need to implement domestic policy reforms to make it easier to start new businesses and trade across borders. Additionally, the region will benefit from common approaches to international trade, embodied in the commitments of the World Trade Organization and the World Customs Organization, and from regional cooperation through organizations such as the Central Asia Regional Economic Cooperation.

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2

CAREC Corridors: Increased Connectivity and Improved Trade

Iskandar Abdullaev and Shakhboz Akhmedov

2.1 Introduction

The economic corridor is much more than just road connectivity and mobility through it. Instead, it is an essential driver of the economic development of pertinent regions or countries that paves the fundamental ground for increased trade and cooperation. This directly impacts the movement and efficiency of productive factors. Moreover, the economic corridor offers enormous potential to eliminate poverty and achieve inclusive and sustainable development (CAREC Institute 2019a). This lends additional importance to the expected functions of an economic corridor.

Good economic outputs and successful trade stemming from cross-country connectivity are mostly subject to the degree of mobility of people and goods. Particularly, in transboundary cooperation, there is consensus that mobility is necessary for making the trade and supply chain of goods efficient and cost-effective. Thus, the economic corridor can promote connectivity and mobility across involved countries by providing competitive value for regional cooperation. Indeed, economic corridors for increased connectivity and trade, smoothly operating export and import without delays, and quick passage of goods and services are essential that may eventually have economic and social spillover in the broader region. Countries of the Central Asia Regional Economic Cooperation (CAREC) have achieved a certain success in this, yet there is more potential to be unlocked.

Improving border-crossing services reduces customs clearance time and related costs essential for CAREC corridors' competitiveness. At the same time, they impact poverty reduction and attract cross-

border investments in the region with increased trade and commerce activities along the corridors. Thus, increased business in trade and transportation service sectors around and along border points of the CAREC region contributes to increasing job opportunities, the social mobility of the communities, generating revenue, and decreasing the inequalities in income distribution.

Currently, the CAREC Program supports the Almaty–Bishkek Economic Corridor (ABEC) and is expanding the Shymkent–Tashkent–Khujand Economic Corridor (STKEC). These are two new interventions to support widening and improving connectivity and trade in Central Asia. At the same time, the opening of economies in the region, especially that of Uzbekistan, has provided a new impetus for increasing regional trade in Central Asia. New transport corridors linking the western and eastern parts of the region, especially areas in the northern part of Central Asia suffering from environmental disaster in the wake of the desiccating Aral Sea, could open more opportunities for trade and transport. Recently, Uzbekistan initiated a new corridor development with Afghanistan and Pakistan. Another transport corridor currently being discussed is between Uchkuduk and Kyzylorda cities. The latter could link the economically advanced zone of Uzbekistan's Navoi region with Kyzylorda, Kazakhstan, and then toward the main roads of Europe through the Caspian route.

Caspian corridors provide an alternative and shorter route for transporting goods from the CAREC region to Turkey, the Middle East, and Africa. However, road connectivity of Central Asian countries is poor, and only a few corridors link the countries. Therefore, connecting and linking countries via new transport corridors will also help increase the viability of the Caspian route. Moreover, the authors highlight the role of knowledge corridors: exchange of technology, knowledge, skills, and information. All these might, directly or indirectly, affect the utilization of the Caspian route.

CAREC region's emerging economies need more connectivity and mutual trade to release the region's huge economic potential. However, due to limited trade, low connectivity countries face obstacles in setting up effective economic collaboration.

By highlighting the potential benefits of economic corridor development in Central Asia, this chapter explores the current situation of CAREC corridors, opportunities, and spillover effects associated with them. The chapter is structured as follows: the first section captures the regional cooperation and integration dynamics in the CAREC region; the next section discusses the economic and social benefits of economic corridors. Next, Sections 2.3 and 2.4 analyze current and newly developing corridors. Finally, the last section, along with the concluding

part, outlines why it is crucial to integrate the elements of knowledge exchange into the corridors' operations and what countries can do.

2.2 Regional Cooperation and Integration

Followed by delivering economic and social values as spillovers, regional integration is one of the most effective ways to foster stability, address regional challenges, and spur economic growth (CAREC Institute 2019b). It is a process by which national economies become more connected regionally. Regional integration allows building stronger institutions and closer trade integration, intraregional supply chains, and more robust financial links that will enable economies of scale to be tapped (ADB 2017a). The economic corridor is often an explicit outcome of regional economic integration and is a central pillar of its sustainability. As CAREC strives to shape integration across many sectors, the economic corridor has a stimulating and driving role.

Regional integration has been a key driver of economic development since the mid-1970s, the Association of Southeast Asian Nations being among the pioneers of such regional integration initiatives. Similarly, international organizations and multilateral development banks also started providing substantial support to regional cooperation in Central Asia after the collapse of the Soviet Union in 1991. The Asian Development Bank (ADB) was the first to map out regional integration. ADB sees regional integration as a means for economic growth and poverty reduction in Asia. Its approach to regional integration is based on trust that economic interdependence will produce more economic outputs and trade, with fewer barriers and lesser bureaucracy (ADB 2019a).

The CAREC Program is one of ADB's initiatives to foster regional cooperation and trade. The program was launched in 2001 and is a partnership of 11 member countries. Its mission is to promote development through cooperation, leading to accelerated economic growth and poverty reduction, guided by the overarching vision of "Good Neighbors, Good Partners, and Good Prospects."[1] The program has become an intraregional cooperation, development, and trade initiative over time. During almost 20 years of its operations, ADB has increased financial support for the program. By 2018, the program had 190 projects totaling $33 billion (ADB 2017b).

The CAREC Program's investment portfolio includes the energy, trade, and transport sectors, out of which 77% of the share amounting

[1] More information about the CAREC Program can be obtained at www.carecprogram.org.

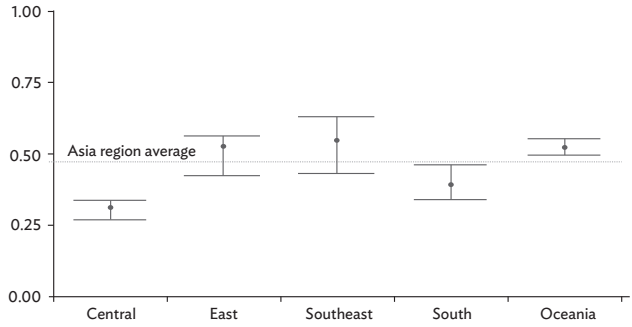
to $24.4 billion is allocated for transport (CAREC Institute 2019a). The energy sector received 21% ($6.6 billion), and trade-related activities received only 2% of the investments. Among CAREC member countries, the highest share of the investments was allocated to Kazakhstan, followed by Azerbaijan and Uzbekistan. While Kazakhstan and Azerbaijan are directly located on the Caspian route, Uzbekistan can intensify route utilization by increasing connectivity and trade.

ADB has developed the Asia-Pacific Regional Integration Index to measure regional integration, reflecting the level and degree of economic integration (Huh and Park 2018). Based on this activity, the CAREC Institute developed the CAREC Regional Integration Index (CRII), a multidimensional and multi-indicator index showing integration levels in the region (CAREC Institute 2019a). The CRII measures regional integration along six dimensions: (i) trade and investment integration, (ii) money and finance integration, (iii) regional value chains, (iv) infrastructure and connectivity, (v) free movement of people, and (vi) institutional and social integration.

The analyses in recent CAREC Institute reports, released in 2019 and 2021, show that despite investments by the CAREC Program, the region is still performing at low integration levels compared with other Asian subregions (Figure 2.1).

The barriers to economic integration and regional cooperation are linked with the institutional, legislative, infrastructure, and capacity deficiencies of the region's economies. Rigid regulatory systems, self-sufficiency policies, and competing structures of the economies are

Figure 2.1: Regional Integration Indexes for Asia and Oceania



Source: CAREC Institute (2019).

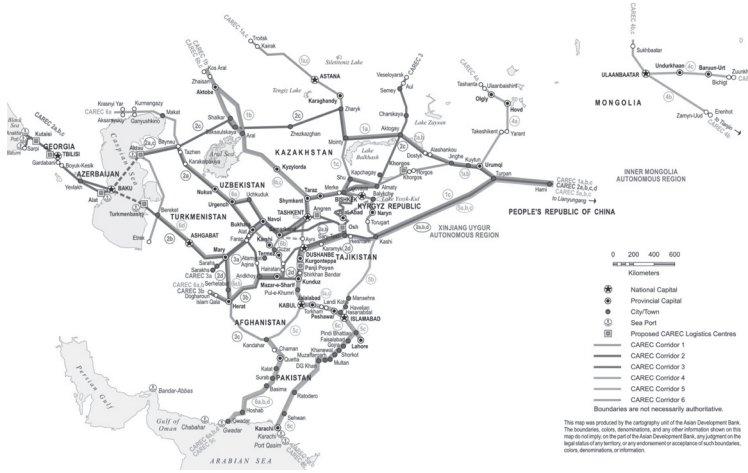
major obstacles to developing open trade systems in the CAREC region. Moreover, many countries are also landlocked and have extensive missing links in railways and roads.

2.3 Benefits of Economic Corridor Development

Economic corridors are the confluence of economic development and integrated growth in areas involving intensive interaction of productive factors (Brunner 2013). As a result, the areas enjoy cumulative benefits. Besides direct benefits the involved countries might reap, economic corridors have indirect values that affect many lives in adjacent areas. For example, the corridor may provoke the industrialization of lagging regions that bring jobs and other social opportunities. At the same time, this can accelerate regional integration in general.

CAREC corridors are economic arteries for trade, communication, and cooperation. Therefore, the performance of existing corridors and the creation of new ones will enhance the above-listed activities in the region. The current six corridors include essential bilateral and multilateral border-crossing points (BCPs) and cover all 11 member countries of the CAREC region (Figure 2.2, Table 2.1).

Figure 2.2: CAREC Corridors Schemes



CAREC = Central Asia Regional Economic Cooperation.

Source: ADB (2020a).

Table 2.1. CAREC Corridors: Border-Crossing Points and Countries

Country	CAREC Corridors	Key BCPs in CPMM
Afghanistan	2, 3, 5, and 6	Hairatan, Shirkhan Bandar, Spin Buldak, Torghondi, and Torkham
Azerbaijan	2	Baku (seaport), Boyuk Kesik, and Red Bridge
People's Republic of China	1, 2, 4, and 5	Alashankou, Erenhot, Irkeshtan, Horgos, Khunjerab, Kara-Suu, Takeshikent, Torugart, and Zuun Khatavch
Georgia	2	Gardabani, Sarpi, and Tsiteli Khedi
Kazakhstan	1, 2, 3, and 6	Altynkol, Dostyk, Khorgos, Konysbaeva, and Tazhen
Kyrgyz Republic	1, 2, 3, and 5	Ak-Tilek, Chaldovar, Gulistan, Irkeshtam, Karamyk, and Torugart
Mongolia	4	Altanbulag, Bichigt, Sukhbaatar, Yarant, and Zamiin-Uud
Pakistan	5 and 6	Chaman and Peshawar
Tajikistan	2, 3, 5, and 6	Dusti, Gulistan, Karamyk, Kulma, Pakhtaabad and Panji Poyon
Turkmenistan	2, 3, and 6	Farap, Sarahs and Serkhet Abad
Uzbekistan	2, 3, and 6	Alat, Doutata, Hairatan, Dustlik, Oibek, Saryasia, Termez, and Yallama

BCP = border-crossing point, CAREC = Central Asia Regional Economic Cooperation, CPMM = Corridor Performance Measurement and Monitoring.

Source: ADB (2020c).

To accurately assess the performance of CAREC corridors, ADB implements the Corridor Performance Measurement and Monitoring (CPMM) work. The CPMM mechanism (ADB 2020c) is an analytical tool designed by the CAREC Program[2] to evaluate and track the time and cost of moving goods across borders and along six CAREC corridors (Table 2.1), crossing 11 participating countries—Afghanistan, Azerbaijan, the People's Republic of China (PRC), Georgia, Kazakhstan, the Kyrgyz

[2] The CAREC Program is a partnership of 11 countries and development partners working together to promote development through cooperation, leading to accelerated economic growth and poverty reduction. It is guided by the overarching vision of "Good Neighbors, Good Partners, and Good Prospects." Since its inception in 2001 and as of September 2019, CAREC has mobilized $38.6 billion in investments that have helped establish multimodal transportation networks, increased energy trade and security, facilitated the free movement of people and freight, and laid the groundwork for economic corridor development.

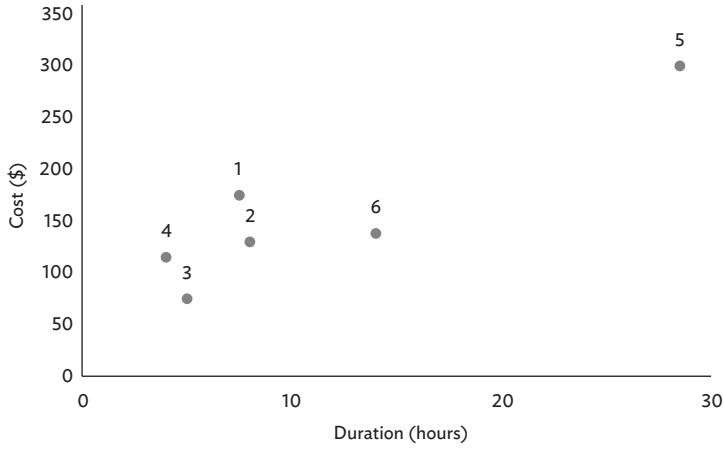
Republic, Mongolia, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan.

The tool assesses a set of trade facilitation indicators (TFIs) that help evaluate the overall annual performance and efficiency of CAREC corridors. The indicators, measured over time and across corridors, provide a comparative analysis that allows assessment and validation of the impacts of transport and trade initiatives in CAREC. The mechanism includes the following TFIs: (i) time taken to clear a BCP, (ii) cost incurred at a BCP, (iii) cost incurred to travel a corridor sector, and (iv) speed to travel along CAREC corridors.

Since the launch of the CAREC Program, the time for passing through six corridors has been tremendously improved (ADB 2020c). The almost triple decline of the travel time could be attributed to improved infrastructure, increased trade, and removal of many barriers to free trade in the CAREC region (ADB 2020a). The corridors have been vital in unlocking regional trade, cooperation, and integration. Initially, all corridors, being bilateral BCPs, later became a regional hub linking in the region and internationally. The CPMM analysis in 2019 indicates that all the corridors, except corridor number 5, have less than 10 hours and $200 of the cost (Figure 2.3).

CAREC corridors still have excessive costs and time for passage. Moreover, the number of corridors seems insufficient for handling current levels of the shipping of the goods regionally and globally.

Figure 2.3: Time and Duration to Cross CAREC Corridors



Source: ADB (2020c).

2.3.1 Economic Spillovers

Economic cooperation in the region is essential for future sustainable development, economic growth, and social stability. Trade and economic cooperation are key elements of sustainable development in the region. Improved economic development in countries of the region and increased regional trade and cooperation are major preconditions for long-term prosperity.

The CAREC region is among the least integrated in Asia with an average integration score of 0.373, significantly lower than the Asia and the Pacific's regional average of 0.474, while the intraregional trade is the lowest among all other components of the CAREC Regional Integration Index (CAREC Institute 2019a and 2021). This is largely due to security issues associated with uncontrolled drug trafficking in Afghanistan and many CAREC countries' constant insistence on non-interference in domestic affairs since the collapse of the Soviet system. These, coupled with water contests in the Central Asian region, though it seems to be appeasing lately, have overshadowed areas with more potential for economic cooperation over the years. However, the latest political developments in Central Asia, particularly in Uzbekistan, are likely to build a favorable intraregional environment for accelerated economic cooperation.

Yet today, the CAREC region's economic performance and development state are still uneven. While Kazakhstan and the PRC are upper-middle-income countries, some are least developed. Therefore, these countries are more compatible than competitive. However, due to many reasons, most of all strict regulations and high trade barriers, the region's countries are under-utilizing economic compatibility. Huge opportunities for the region's countries to be unlocked provided fewer barriers and limitations. For instance, CAREC countries exhibit a wide variety of heterogeneous factors that may positively impact intraregional trade. They include differences in population, land, natural resources, proximity to centers, and size of markets. Proximity of CAREC to the PRC, the world's second-largest economy, is a positive factor in stimulating cross-border trade. The CAREC region can leverage this strategic location to its advantage through enhanced intraregional trade with the PRC (CAREC Institute 2019a).

2.3.2 Social Spillovers

Social considerations have always been a significant part of economic development that mean mobility of people and affordable wage. Through economic corridors, the mobility of people can be eased, immensely impacting the lives of many socially. Moreover, as mobility becomes

easier, cheaper, and more convenient, more opportunities unlock for businesses, adjacent industries, spaces for innovation, and overall societal development. CAREC 2030 aims to strengthen these aspects of regional integration and development by fostering economic and social cooperation among cross-border communities (ADB 2020b).

The economic development levels of countries in the region differ significantly (ADB 2019a). Therefore, the levels of poverty and livelihood quality also vary largely. The economic slowdown and reduced job opportunities may further deteriorate the social situation in the region. However, increased trade, improved partnership, and regional cooperation may bring more opportunities for many poor in the region. Therefore, the region could benefit from the corridor improvements economically and socially.

2.4 Economic Corridors—Cases from the CAREC Region

The CAREC Program supports the Almaty–Bishkek Corridor and aims to extend partnership to the STKEC. These are two new interventions to support widening and improving connectivity and trade in Central Asia.

2.4.1 Almaty–Bishkek Economic Corridor (ABEC)

ABEC is the first economic corridor under the CAREC Program. The corridor connects these two big cities of Kazakhstan and the Kyrgyz Republic with relatively high economic activities concentrated in services in the cities and agriculture in their hinterlands (CAREC Program 2018). ABEC aims to reduce travel times between the two cities by creating one competitive market for health, education, tourism, and other services. Hence, the integrated Almaty–Bishkek region is envisaged to develop the regional economy based on export-oriented, knowledge-intensive, and creative services, including agribusiness and tourism as key growth drivers (CAREC Program 2016).

As both Kazakhstan and the Kyrgyz Republic are members of international finance and trade settings as the Eurasian Economic Union and the World Trade Organization, these aspirations of collaboration are likely to bring benefits soon. Yet, its full development is expected to last 10 to 15 years. The region's development strategy is to be reached by growing economic density, which will increase the size and volume of the economic zone and exchanges.

The corridor is expected to leverage the complementary advantages of both cities while integrating other surrounding regions. Although these cities are close enough to each other with a distance of only

240 km, the time spent at BCPs for around 30,000 people daily has been relatively long until recently.[3] ADB approved technical assistance of $1.75 million in 2017 to support the implementation of ABEC. Currently, investment projects, feasibility studies, and master plans in agriculture, tourism, and connectivity are being developed.

By 2030, the corridor is expected to combine two dense urban agglomerations, Almaty and Bishkek, into one economic space. The two cities will integrate areas of tradable economic activities such as advanced health and tertiary education services, logistics and transport services, other information and communication technology (ICT) and knowledge-based services, and agribusiness (CAREC Program 2016). As a spillover effect, smaller cities and rural areas across the corridor will be linked through transport and ICT infrastructure that will, in turn, improve agribusiness development and access to public goods and services.

2.4.2 Shymkent–Tashkent–Khujand Economic Corridor (STKEC)

Another initiative that ADB supports is STKEC, with a similar approach to and expectations from ABEC. The corridor targets these three cities and surrounding regions. These three cities are located relatively close to each other with easy access.

The STKEC can provide vast opportunities to diversify export products and markets of the adjacent countries. Several factors can positively affect trade across this corridor, making it successful. First, the STKEC involves three cities of neighboring countries in close distance. Therefore, it is easier to export higher value-added products, and lower transport and other costs because of the short distance (ADB 2021). Another favorable aspect of the close distance is that consumer interest can be easily identified. Since the brands are recognizable, consumers' tastes are better known or understood, and advertisement campaigns can be much more targeted and made cheaper (ADB 2021).

The further development of STKEC is expected to affect intra-STKEC trade positively. Table 2.2 shows the trade turnover between the regions of the three countries is expected to increase from $0.34 billion in 2018 to $0.79 billion in 2025 and $1.58 billion in 2030.

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[3] ABEC, https://www.almaty-bishkek.org/connectivity (accessed 12 December 2020).

Table 2.2: Intra-STKEC Merchandise Trade ($ million)

Exporter	Importer	2018	2025	2030
Shymkent + Turkestan oblast	Sugd oblast	14	50	110
Shymkent + Turkestan oblast	Tashkent city + oblast	136	320	660
Sugd oblast	Shymkent + Turkestan oblast	1	20	60
Sugd oblast	Tashkent city + oblast	78	140	220
Tashkent city + oblast	Shymkent + Turkestan oblast	76	200	450
Tashkent city + oblast	Sugd oblast	36	60	80
Total		341	790	1,580
Increase to 2018 (%)			131	363

STKEC = Shymkent–Tashkent–Khujand Economic Corridor.
Source: ADB (2021).

2.5 Potential of the Uchkuduk–Kyzylorda Corridor

Under its new leadership, economic reforms in Uzbekistan have unlocked more potential for intensive economic and trade cooperation in the Central Asian region since 2016. This momentum needs to be kept and leveraged to launch new ways of cooperation that are yet to be unleashed. The diverse resources of Central Asian states are the primary sources for innovative engagement in economic cooperation. The Mirziyoyev administration has resolved many issues, particularly water resource management, an inherited bottleneck from the Soviet period on the way to regional integration.

Mirziyoyev's presidency has triggered a fundamentally new page in political, economic, and trade relations with neighboring Central Asian countries, particularly Kazakhstan, which gave a new impetus to interact in many spheres. Trade between Kazakhstan and Uzbekistan since 2016 has tripled. Strong political will between the two countries is necessary for intensifying regional integration in Central Asia, which will undermine obstructions to regional cooperation, cross-border diplomacy, trade relations, and thornier issues over water and the energy trade (Putz 2017).

New transport corridors linking the western and eastern parts of the region, especially heavily impacted by continuous environmental disaster areas in the western and northern parts, could open more

opportunities for trade and transport while connecting roads further with the Caspian route. The Uchkuduk–Kyzylorda region can be a potential new corridor. The corridor would link the economically advanced zone of Uzbekistan (Navoi region) with Kyzylorda and then toward the main roads to Europe and the PRC through the Caspian route.

By connecting CAREC corridors 1-b, 2-a, and 6-a, the proposed economic corridor will further accelerate trade between these two countries while springing spillovers highlighted in previous sections. The basic concept is to join these two cities through transport infrastructure and unlock the potential for trade between them and the subregions along the road.

Discussions about the potential of this corridor are currently continuing with the engagement of high-level representatives of Kazakhstan and Uzbekistan. On 2 November 2020, the Kazakhstan delegation led by Deputy Prime Minister R. Sklyar visited Uzbekistan and met with Deputy Prime Minister - Minister of Investment and Foreign Trade S. Umurzakov. The parties discussed, among others, the possible opening of an international bus service between the major cities of Uzbekistan and Kazakhstan, construction of a high-speed railway to Turkestan–Shymkent–Tashkent, and an Uchkuduk–Kyzylorda transport corridor (MIFT 2020). Direct transport roads between Kyzylorda and Uchkuduk, when constructed, would reduce road congestion, mitigate delays, and increase road safety through the Tashkent region.

Beyond that, the corridor connects to the road leading to the Navoi Free Economic Zone (Navoi FEZ), which provides a wide range of business opportunities and competitive advantages for potential investors. Being adjacent to Navoi City, one of the most industrial cities of Uzbekistan, Navoi FEZ is granted a special legal regime including taxation, currency exchange, and customs regimes with connecting routes to other big cities, such as Samarkand and Bukhara. It also enjoys advanced infrastructure. Navoi FEZ is in immediate proximity to the international airport, E-40 highway, and railway lines of global significance, primarily enabling it to effectively exploit the advantages of the multimodal transport-and-logistics hub of Navoi.[4]

Going through the industrial zones of Uzbekistan, the corridor would provide excellent prospects for economic and traffic growth in the middle of Uzbekistan, where many main roads leading to the different CAREC corridors and the trans-Caspian route in the west of the country intersect.

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[4] Navoi Uzbekistan, https://www.feznavoi.uz/en (accessed 13 January 2021).

As a spillover effect, the tourism sector can benefit significantly from this corridor. Both Kazakhstan and Uzbekistan are boosting their touristic potential and planning combined tours across countries and the region. The to-be-introduced Silk Road visa is expected to enhance the competitiveness of the tourism industry of Central Asian countries by attracting more tourists. The corridor would help tourists make a shortcut to the main historical places of both countries while increasing cost and time efficiency that would allow tourists to visit several places over one trip.

2.6 Knowledge Corridors

Knowledge has become a critical economic resource in the age of the digital revolution. Investment promotion and advancing technology exchange are the main pillars of economic corridors. Still, knowledge exchange and the capacity to utilize knowledge are equally important when it comes to corridors of Central Asian countries, where a lack of human capital is often a central issue. The CAREC region is geographically landlocked and knowledge-locked, primarily due to historical and geopolitical reasons. A long historical split between "great powers" resulted in a knowledge divide in the CAREC region. In the last 30 years, former Soviet states and other parts of the CAREC region have built economic and cultural ties at varying degrees. However, knowledge exchange is still limited.

The outcome and objectives of knowledge corridors are similar to economic corridors. Knowledge corridors can be visualized as an interconnected web with virtual destinations, thoughts, and ideas of knowledge enablers (government), knowledge articulators (sector experts), knowledge generators (research entities), and knowledge transformers (business sector). The idea of knowledge corridors is to harness this immense potential, develop directional frameworks, and translate knowledge into tangible gains (CAREC Institute 2019a).

Economic corridors interlinked through hard and soft infrastructure are used for trading goods and services, leading to increased positive dependencies, value chains, enhanced economic activity, and greater regional integration. Therefore, the role of knowledge corridors in regional economic cooperation platforms is critical, considering the importance and need for a standardized and systematic approach in regional transport, trade, energy, and tourism development.

Recognizing the significance of multiple stakeholders and their complementing roles in knowledge corridors, the CAREC Institute brought all key players together on one platform during the Third

CAREC Think Tanks Development Forum held in Bishkek in 2018. The key stakeholders, such as governments, think tanks, research institutes, businesses, and development partners, discussed the need for clear roles and responsibilities for promoting knowledge exchange and working on priority knowledge clusters.

Think tanks are instrumental in helping governments make informed policy choices. More than 500 think tanks in the CAREC region, both independent and government-funded, play an essential role in closing a knowledge gap between the government and other stakeholders. Think tanks can translate academic research into policy and user-friendly information for governments and businesses. Universities are the crucible of knowledge. However, the primary contribution of universities in the region has focused on producing highly skilled professionals for local or international job markets rather than for high-quality research. Universities can diversify their research portfolios by adding to their curriculum topics and themes in which businesses have shown interest.

Development partners are essential to generating and sharing knowledge, linking knowledge actors, and mobilizing necessary technical and financial support. This is because they possess an excellent deposit of knowledge, experience, resources, and connections. In this regard, development partners may play a critical role in supporting the building blocks of the knowledge corridor.

The central idea of knowledge corridors is to make knowledge a profitable commodity or convert "data to dollars," which businesses must essentially do. Except for the PRC, the private sector in the CAREC region is either weak or focused on the service sector or manufacturing. Moreover, due to many impediments in businesses, investment in innovation is limited. Ideally, the data generated by universities and processed by think tanks will be converted into profits and reinvested in knowledge. It is especially beneficial for start-ups, who would have the opportunity to elevate profits by using innovation.

Rapid advancement in ICT, reduced time and cost to access information and data sharing, and higher connectivity and mobility facilitate knowledge exchange and partnership to a greater degree. Moreover, with its comparatively young and well-educated population, the region can significantly benefit from these emerging knowledge sharing and exchange platforms.

In the longer term, to continue economic growth and develop operational resilience in uncertain times, the stakeholders across the CAREC corridors may need to incorporate knowledge and data sharing practices increasingly. As the ongoing COVID-19 pandemic has shown, learning to exchange information quickly, adapting the workforce's

skills to the changing environment, and making available technological equipment will be crucial in preparing for the next economic, health, or other disruption. Moreover, as corridors enhance connectivity among countries, they will be instrumental in mobilizing necessary support during a crisis.

Regional knowledge exchange and intensive interaction among knowledge generators, enablers, articulators, and transformers will be essential for coordination among stakeholders and improving corridor performance. Hence, diffused knowledge across the whole region and stakeholders involved in economic activities will be imperative in the future. There will be more value in sharing and identifying new avenues for cooperation for reinforced trade and economic growth.

2.7 Conclusion

The CAREC region is the least integrated in Asia and has multiple opportunities to reap the current high levels of economic growth of member countries. Economic cooperation in the region is critical for future sustainable development, economic growth, and social stability. Increased trade levels will bring positive input to the gross domestic products of member states.

The countries of the region have tremendous opportunities for trade with fewer barriers and limitations. Therefore, the role of economic corridors for high trade rates, export–import operation without delays, and quick passage of goods and services will support economic spillover among CAREC countries. Moreover, information exchange, compatible standards, and certificates will also be required to enhance economic partnership, which will be acceptable for all member countries.

The Uchkuduk–Kyzylorda corridor, located at the midpoint of roads, can foster the agglomeration of economic and trade activities in closer areas to the Caspian Sea, helping the CAREC region link with Turkey, the Middle East, and Africa and reducing the road traffic in the Tashkent region. This corridor presents new opportunities to increase intraregional and interregional trade, and reduce logistical operation costs. However, without increasing connectivity (physical and knowledge) among the region's countries, most benefits of the Caspian region may remain untapped.

Rapid advancement in ICT, reduced time and cost of information and data sharing, and higher connectivity and mobility facilitate knowledge exchange and partnership to a greater degree. Moreover, with its comparatively young and well-educated population, the region can significantly benefit from these emerging knowledge sharing and exchange platforms.

Yet, while the economic growth level of CAREC countries varies considerably, the development of economic corridors will require relevant stakeholders in the region to surmount the following challenges: (i) absence of hard infrastructure and existing soft infrastructure bottlenecks, (ii) weak cross-border coordination, and (iii) limited private and human capital.

Hence, the most important factor shaping the long-term outlook for increasing connectivity and enhancing trade among CAREC countries would be setting up comprehensive yet simple procedures in existing CAREC corridors to move goods and services regionally. CAREC countries can increase trade and exchange goods, labor, and services through new corridors. Subsequently, increased internal connectivity among CAREC countries will help them step into and benefit from global value chains.

Overall, this chapter did not aim to provide a supportive mechanism for improved connectivity and trade a priori. Instead, it attempted to generate puzzle pieces for researchers, policy practitioners, and the wider public for adding value in sustaining existing economic corridors and operationalizing new ones.

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3

Trans-Caspian Transport Corridor Infrastructure: Oil and Gas Pipelines

Julian Lee and Yelena Kalyuzhnova

3.1 Introduction

Since the first days of the modern oil industry in the late 19th century, transporting produced oil from the Caspian Sea to an established market was often a greater challenge than getting it out of the ground. As the focus of exploration for and the development of hydrocarbon resources expanded eastward across the sea from the Caucasus to Central Asia in the 20th century, transportation over huge distances and across multiple national territories compounded the problem. This has remained a key issue facing producers in the 21st century (Cason 2015). As Acar and Gürol (2016: 78) pointed out "... the center of gravity of the World trade has shifted towards the east, Eurasian countries has [*sic*] appeared as ensuring sustainable economic growth by developing the trade relations among Eurasian countries as well as with other countries, and also European countries decided to expand the transport networks which facilitate trade relations."

Early solutions involving trains of pack animals carrying oil in sacks have been replaced by complex networks of trucks, railways, barges, ships, and pipelines to move oil from the fields of the Caspian Sea region to markets in Europe and Asia.

This chapter examines the development of those networks, the obstacles they still face, and how the COVID-19 pandemic is causing governments and oil companies to reassess future hydrocarbon developments in Central Asia and the Caucasus, along with the export networks needed to deliver the region's oil and gas to markets that will pay for it.

3.2 Historical Perspectives

The modern oil and gas industry in the Caspian Sea region dates back to the second half of the 19th century, when, in 1873, Robert Nobel arrived in Baku, Azerbaijan, hunting for a source of wood for rifle stocks that his brother Ludwig needed to fulfill a contract with the Russian government. Instead, Robert invested the money entrusted to him in an oil refinery outside the city (Yergin 1991).

Over the following decades, the oil industry centered around Baku was transformed from a small, essentially local enterprise to an international industry whose production even briefly surpassed that of the United States, then the world's largest oil producer.

But even in the earliest days, transporting oil from the shores of the Caspian Sea presented a critical problem. Before the arrival of the Nobels, trains of pack animals carried kerosene lamp oil in sheep- or camel-skin bags to Iran (Leeuw 2000). Alternatively, kerosene lamp oil was transported in expensive wooden barrels on a "six hundred miles north on the Caspian Sea to Astrakhan, then transferred to barges for the long journey up the Volga River, eventually reaching one or another rail line to which it was transferred for further shipment. Handling costs were enormous." (Yergin 1991: 59)

Transporting oil from Baku was so costly that until the railway from Baku was built, it was cheaper for residents of Tiflis city, just 341 miles away in Georgia, to import kerosene from more than 8,000 miles from the United States (Henry 1905).

Over the next decade, oil shipment from Baku was transformed. In 1878, the Nobels brought the first successful bulk oil tanker, the Zoroaster, on the Caspian Sea, slashing the cost of moving oil to Astrakhan. Five years later, a railway line was completed from Baku to Batumi on the coast of the Black Sea in Georgia, opening up the rest of the world to Caspian oil for the first time.

Oil deposits around the Caspian Sea, where Russian and early Soviet oil industries were built since before the 20th century, were largely neglected after the 1960s when huge oil reserves were discovered in the Soviet Union, first in the Volga-Urals basin and then in West Siberia (Lee 1998). The Soviet era saw the oil fields of Azerbaijan and subsequent discoveries, mostly of natural gas, in Central Asia dwindle into insignificance, and what exports there were from the region were firmly tied to a system of pipelines that carried hydrocarbons northward into the industrial heartland of the Soviet Union.

When the countries of the South Caucasus and Central Asia gained their independence from the Soviet Union in 1991, their links to the world's oil markets were a little more advanced than they had been in

the time of the Nobels (Soligo and Jaffe 2002). Nevertheless, the Caspian region was starting to emerge as one of the world's significant sources of oil supply from non–Organization of the Petroleum Exporting Countries members (Guliyev and Akhrarkhodjaeva 2009).

3.3 The Rationale for Trans-Caspian Oil and Gas Shipments

At first glance, shipping oil and gas across a landlocked sea seems to make little sense, particularly when ownership of that sea is disputed, and the seabed itself is prone to earthquakes that risk severing pipelines laid across it.

Transport routes involving multiple transfers of oil into and out of ships or requiring the laying of expensive pipelines beneath hostile waters are likely to be much more costly to build and operate than overland routes, even if they are shorter. The consideration of large-scale trans-Caspian oil and gas shipments results from the simple desire of the coastal states to ensure the reliable delivery of their hydrocarbons to markets that will pay international prices for them.

This objective is complicated by the region's history and the distrust between countries, particularly but not solely between the republics of the Caspian region and the Russian Federation.

Central Asian countries were, and remain, wary of swapping their previous dependence on the Russian Federation for reliance on another country. For that reason, the concept of using multiple export routes to various destinations lies at the heart of plans for the evacuation of oil and gas from the region.

Export routes northward into the Russian Federation already existed or could be created by reversing the flow of Soviet-era pipelines. Routes eastward to the People's Republic of China (PRC), though long, could be created with relative ease for Central Asian countries. Routes to the south, mainly to carry oil to a port on the Indian Ocean, make a great deal of commercial sense, providing the most cost-effective access to the rapidly growing markets of Asia. Unfortunately, these routes have run into seemingly insurmountable political obstacles—unrest in Afghanistan and sanctions on Iran—making them all but impossible.

The geography of the Caspian Sea region means that oil and gas exports to Western markets must cross the Caspian Sea if they are to avoid increasing the region's dependence on routes through the Russian Federation or hitting the roadblock of sanctions on Iran.

The risks to Central Asian gas producers being overly dependent on pipelines through the Russian Federation were amply demonstrated by

a massive explosion on the gas line from Turkmenistan to the Russian Federation in April 2009. Turkmenistan blamed the Russian Federation for the blast, suggesting that Gazprom might have deliberately triggered it suddenly and without warning, slashing the volume of gas it took through the pipeline. Although the pipe was quickly repaired, shipments of Turkmenistan's gas to the Russian Federation were not restored, resulting in the country's production grinding to a virtual halt.

Ever since Kazakhstan's independence, the expansion of its oil export capacity has been a delicate balancing act "treading a tightrope between developing a multi-directional oil export network that would secure it a degree of independence and the need to secure its existing oil export infrastructure by placating Transneft and the Russian government" (Lee 2007: 120). Trans-Caspian export routes have a role in that act.

3.4 Existing Trans-Caspian Oil Export Routes

3.4.1 By Ship from East to West

Despite the need to diversify oil and gas export routes from Central Asian countries to the west, the volumes of oil crossing the Caspian Sea now represent only a tiny proportion of total exports. In contrast, gas transmission has not even begun. However, that was not always the case.

Oil from Central Asia, originating in Kazakhstan and Turkmenistan, is exported across the Caspian Sea in tankers and rail tank cars and loaded onto cross-Caspian ferries for onward delivery to Black Sea terminals by rail or pipeline. There was also some trans-Caspian oil trade with Iran, which is dealt with separately below.

In the mid-1990s, Tengizchevroil (TCO), the consortium developing the giant Tengiz oil field in Kazakhstan, was shipping some of its output from the port of Aktau and sending it across the Caspian Sea to Baku in Azerbaijan for onward delivery by rail to the Black Sea port in Batumi, Georgia or sending it up the Volga–Don river and canal network to refineries in the Russian Federation.

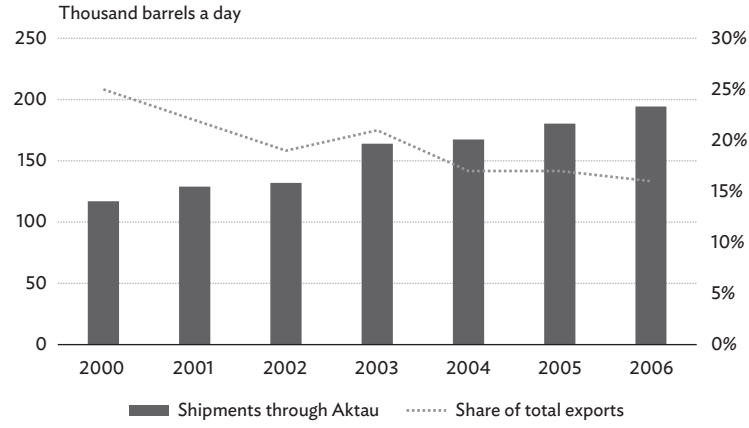
Until August 1998, when the first of three 12,000 deadweight ton (dwt) tankers to carry oil from Aktau to the terminal at Dubendi near Baku was delivered, Tengiz crude was carried across the Caspian in 5,000-ton barges.

Shipments across the Caspian Sea from Aktau continued to play an essential part in Kazakhstan's crude oil exports during the first decade of the 21st century, despite the expansion of the Atyrau–Samara pipeline into the Russian Federation and the construction of the Caspian Pipeline Consortium (CPC) pipeline to an export terminal on the Russian Federation's Black Sea coast.

In 2006, crude oil exports through Aktau totaled nearly 10 million tons, equivalent to about 190,000 barrels per day (bpd), up from less than 120,000 bpd in 2000. Approximately 500,000 tons (10,000 bpd) of these shipments were delivered by rail ferry, with the remainder carried in tankers and barges.

Even though the volume of crude shipped through Aktau was rising, the share of Kazakhstan's total crude exports accounted for by these trans-Caspian shipments was falling from 25% in 2000 to 16% by 2006 (Figure 3.1). By the first quarter of 2014, Kazakhstan was still shipping around 140,000 bpd of crude through Aktau. Still, it accounted for just 10.4% of the country's total crude exports; that share has fallen even further following the start-up of the giant Kashagan field and the expansion of the capacity of the CPC export pipeline around the northern shore of the Caspian.

Figure 3.1: Shipments of Kazakhstani Crude through Aktau Port



Source: Authors, calculations based on Argus FSU Energy 2000–2007, Nefte Compass 2000–2007.

From Aktau, crude oil from Kazakhstan is delivered to the western shore of the Caspian Sea at the Russian Federation port of Makhachkala or the Dubendi terminal north of Baku in Azerbaijan. From Makhachkala, oil enters the Chechen bypass section of the Baku–Novorossiysk pipeline or is delivered by rail either to Novorossiysk or to Batumi in Georgia. Crude delivered to Dubendi is also sent by rail to the Georgian export terminal at Batumi, or the Azeri-owned Kulevi terminal, also in Georgia.

In February 2008, KazTransoil, the transportation arm of Kazakhstan's state-owned oil and gas company Kazmunaigaz, bought Batumi Oil Terminal Ltd in Georgia. (For details, see Box 3.1.) The terminal had a nameplate throughput capacity of 15 million tons per year (300,000 bpd), and KazTransOil guaranteed a third of that volume (Argus Media 2007).

Box 3.1: Batumi Oil Terminal

Seven discharge railway estacades capable of simultaneously discharging or loading up to 204 rail tank cars, or more than 482 rail tank cars per day.

Crude oil tank farms: 37 tanks over 3 sites with a combined capacity of 287,000 cubic meters (or 1.8 million barrels).

Refined products tank farms: 2 sites with a combined capacity of 262,000 cubic meters (1.65 million barrels) for the storage of fuel oil, diesel fuel, and aviation kerosene.

Port facilities:

Berth	Product	Max. dwt	Max. length, meters
Single buoy mooring (SBM):	Crude oil	140,000	250
Berth No. 1:	All oil products except liquefied gas	45,000	200
Berth No. 2:	All oil products, including liquefied gas	16,000	140
Berth No. 3:	All oil products except liquefied gas	25,000	165

The Batumi Oil Terminal also hosts Georgia's only liquid petroleum gas (LPG) terminal designed to store, transship, and export LPG from Azerbaijan, Kazakhstan, and Turkmenistan.

dwt = deadweight ton.

Source: Batumi Oil Terminal, http://www.batumioilterminal.com/en/Comp_information/.

Deliveries of crude to the Dubendi and Baku terminals in Azerbaijan accounted for about half and two-thirds of the volumes shipped from Aktau. The remainder is sent to Makhachkala in the Russian Federation.

Although the cost of using the Aktau–Baku–Batumi route was higher than that of the pipeline system through the Russian Federation, it had one crucial advantage over the northern route: it was possible to

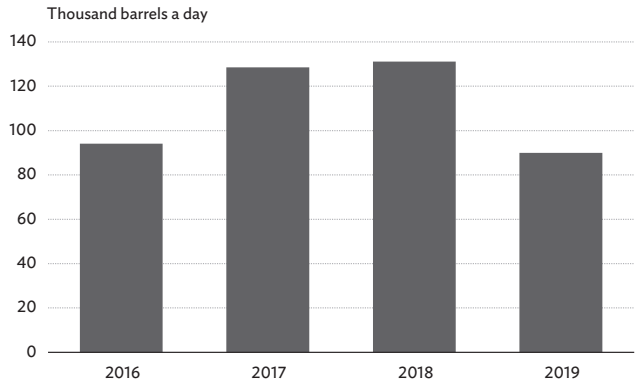
preserve the particular properties of the crude. This was particularly important for producers of light (good for making high-value products like gasoline and diesel) and sweet (containing low volumes of sulfur) crudes. These grades generally command higher prices than heavy, sour ones on international markets.

Crude exported via the Russian Federation was, and still is, blended into the country's Urals export stream and, to make matters worse, measured by weight, not volume. Nevertheless, the combination of the price differential and the volume loss suffered by converting from volume to weight was more than enough to offset the higher transport costs (Ruseckas 2006).

The routes used to export crude from Turkmenistan across the Caspian Sea have switched repeatedly, responding to economic opportunities and political pressures. In 2016, transit via the Russian Federation stopped, with all its crude shipped via Azerbaijan. Instead, oil trading companies, including Vitol and Trafigura, typically bought Turkmenistan's crude from producing countries at the export terminal and arranged for its onward delivery.

Trans-Caspian flows of crude from Kazakhstan and Turkmenistan, shipped onwards to the Mediterranean Sea via Azerbaijan's Baku–Tbilisi–Ceyhan (BTC) pipeline, slipped to 4.48 million tons (equivalent to 90,000 barrels a day in 2019), down from 6.53 million tons (130,000 barrels a day) in 2018, according to data compiled by one of the authors (Figure 3.2).

Figure 3.2: Shipments of Crude from Kazakhstan and Turkmenistan via Azerbaijan's BTC Pipeline



BTC = Baku–Tbilisi–Ceyhan.

Source: Authors' calculations based on data from Bloomberg 2016–2019, Socar 2016–2019.

Turkmenistan continues to use trans-Caspian shipping as the primary export route for small volumes of its crude sent to international markets. In January 2019, Russian oil pipeline monopoly Transneft and oil trading company Vitol signed an agreement on shipments of Turkmenistan's oil from the Russian Caspian Sea port of Makhachkala to the oil export terminal at Novorossiysk on the Black Sea (Tanas 2019). Initial monthly shipments were around 100,000 tons, equivalent to about 24,000 bpd. (For Caspian oil terminals, see Box 3.2.)

Box 3.2: Caspian Oil Terminals

Kazakhstan

Aktau is Kazakhstan's only significant oil port on the Caspian Sea, with four terminals for loading tankers.

Turkmenistan

The **Kyanli** terminal lies about 25 km northeast of the town of Turkmenbashi. In 2010, Malaysian state oil company Petronas processed and shipped condensate, a light form of crude extracted from gas fields, from its nearby processing plant.

The **Turkmenbashi** terminal, located on the southern side of the Krasnovodskiy Peninsula, ships crude from fields in the area and refined products from the Turkmenbashi refinery.

Alaja, on the southern side of the Cheleken Peninsula, manages crude from the Cheleken fields, particularly those being developed by Dragon Oil.

Okarem is the southern-most of Turkmenistan's oil ports, handling crude from the southern group of fields.

Azerbaijan

The **Dubendi** oil terminal, owned by Socar (the State Oil Company of the Azerbaijan Republic), is located on the eastern tip of the Absheron Peninsula, about 40 km east of Baku. The terminal accepts ships up to 130,000 dwt. In addition to providing transit facilities for crude from the eastern side of the Caspian Sea, Socar uses the terminal to receive crude produced from nearby fields for onward shipment to refineries or export via the Russian Federation.

Azpetrol's **Sangachal** terminal is situated 40 km south of Baku and 11 km from the Azerbaijan International Operating Company terminal and the start of the Baku–Tbilisi–Ceyhan (BTC) pipeline. It handles ExxonMobil's share of production from the Azeri-Chirag-Gunashli fields, delivered by rail from the terminal to the Batumi export terminal in Georgia. The Azpetrol terminal is linked to AIOC's Sangachal terminal by two 11 km pipelines. A 16-inch line carries ExxonMobil's share of ACG production to the Azpetrol terminal, while the other 30-inch line carries crude from the eastern side of the Caspian Sea for export through the BTC. The 30-inch pipeline linking the two Sangachal

continued on next page

Box 3.2 *continued*

terminals can deliver 8 million–9 million tons per year (160,000–180,000 bpd) of crude to the BTC pipeline. The terminal can handle 20 million tons of crude and refined products a year and accept ships up to 130,000 dwt.

Azpetrol also owns the **Baku** oil terminal, built in 2000 within the city limits on the site of the former timber berth at Baku port. The terminal can handle 5 million tons of crude and refined products per year and has 15 storage tanks with a combined capacity of 100,000 cubic meters.

Russian Federation

Makhachkala, the capital of Dagestan, is the only ice-free Russian port on the Caspian Sea. Its oil terminal can handle tankers up to 13,000 dwt. Crude discharged at Makhachkala can either be transported to the Russian Black Sea oil terminal at Novorossiysk through the Baku–Novorossiysk pipeline or loaded into rail cars for onward delivery to Novorossiysk or to terminals on the Black Sea coast of Georgia.

The **Volga–Don** network of rivers and canals links the Caspian Sea to oil refineries in the Russian Federation or the Black Sea. The 101 km Volga–Don Canal, opened in 1952, connects the two rivers at their closest points. The canal can accommodate vessels up to 5,000 tons cargo capacity, with a maximum length of 141 meters (m), a width of 55 m, and a depth of 3.6 m.

Iran

The **Neka** oil terminal on Iran's Caspian Sea coast can handle oil tankers up to 5,000 dwt. The oil port is linked by pipeline to the oil refineries at Tehran and Tabriz in northern Iran.

Vessel tracking data for July 2020 show that almost all oil shipments from Turkmenistan during the month were delivered to the Makhachkala terminal in the Russian Federation or carried through the Volga–Don River and canal system to the Black Sea. All the oil loaded at the Aladja and Okarem terminals was discharged at Makhachkala, while most cargoes loaded at Turkmenbashi passed through the Volga–Don system. Only two cargoes of oil from Turkmenistan were delivered to the Dubendi terminal in Azerbaijan. Shipments from the Kyanli terminal were exclusively delivered to the Sangachal terminal in Azerbaijan.

Shipments from Kazakhstan's Aktau port showed a wider range of destinations, with deliveries to the Sangachal terminal in Azerbaijan and Makhachkala in the Russian Federation.

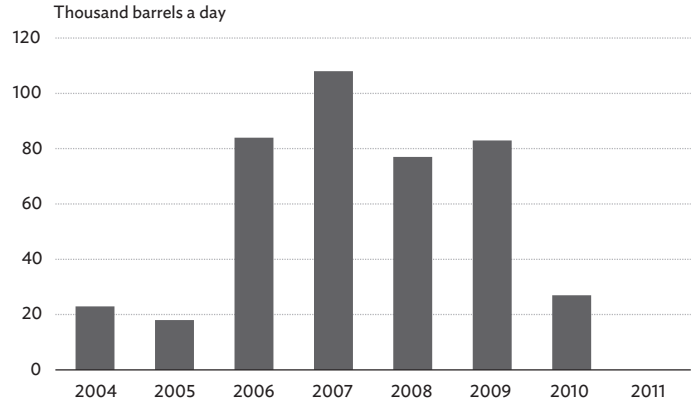
3.4.2 Swaps with Iran

Iran struck its first swap deal for crude from Central Asia in 1996, receiving its first cargo the following year. Since then, crude from Kazakhstan and Turkmenistan, and occasionally from Azerbaijan and the Russian Federation, was shipped south to the port of Neka on Iran's Caspian Sea coast. From there, it was pumped to refineries at Tehran and Tabriz in northern Iran for processing. These swap arrangements saw companies shipping Central Asian crude to Iran, lifting equivalent volumes of Iranian light crude from the country's Persian Gulf export terminal at Kharg Island.

Small volumes of Russian oil were also exported across the Caspian Sea from terminals close to Astrakhan on the Volga River Delta and from the 8-million-ton-per-year Makhachkala terminal. These volumes were delivered to Neka, but data suggest that the trade was erratic.

The volume of this trade jumped to 110,000 bpd in June 2006 from just 18,000 bpd 2 months earlier, reflecting the soaring prices offered by Iranian buyers and the improved economics of the route relative to the alternative of shipping across Azerbaijan and Georgia. But this was close to the high point of the trade, and volumes began to dwindle again from mid-2007. Although they held up at around 80,000 bpd in 2008 and 2009, they slumped the following year, before falling to almost zero in 2011, as Western pressure on Iran mounted, culminating in the imposition of sweeping sanctions on Iran in 2012, effectively bringing shipments to an end (Figure 3.3).

Figure 3.3: Crude Oil Swaps with Iran



Source: Author's, calculations based on data from Argus FSU Energy 2004–2011.

The Iranian oil swap trade did not revive after the implementation of the Joint Comprehensive Plan of Action that briefly gave Iran relief from sanctions in 2016. Other than two tankers carrying crude from Turkmenistan's Cheleken block, developed by Dragon Oil, and discharged at Neka in August 2017, no other shipments along the route were reported. The unilateral withdrawal of the United States (US) from that accord and the stiff sanctions applied to anyone dealing with Iran make it unlikely that the swap trade will be revived any time soon.

The Iranian swap trade was always subject to economic pressures, due to the different pricing mechanisms used for crude exports from former Soviet countries and Iran. For example, volumes shipped to Neka fell between June and August 2007 as its relative profitability declined compared to other routes. This was attributed to the strengthening of Brent crude, against which Former Soviet Union exports from the Black Sea were priced, relative to Dubai, a component of the formula used to price Iranian crude exports to Asia. The result was that the trade switched away from Neka and toward terminals in the Russian Federation and Azerbaijan.

3.5 Planned and/or Proposed Trans-Caspian Routes

3.5.1 A Trans-Caspian Oil Pipeline from Kazakhstan to Azerbaijan

A study of routes for moving Kazakhstan's crude from Aktau to the BTC pipeline, conducted by Gulf Interstate Engineering (GIE) in 2002, concluded that the best way of crossing the Caspian Sea would depend on the volume of oil to be shipped. For volumes up to 150,000 bpd, the study recommended using barges. For volumes between 150,000 bpd and 225,000 bpd, the recommended option was to build a pipeline from Aktau to either the Russian port of Makhachkala (if the existing Baku–Novorossiysk pipeline was available for onward delivery to Baku) or directly to the Azerbaijani capital via a landfall at Khudat, close to the international border between Azerbaijan and the Russian Federation. For volumes over 225,000 bpd and up to the assumed maximum flow of 450,000 bpd, GIE recommended constructing a second parallel pipeline along the selected route. Construction of a pipeline directly linking Aktau to Baku beneath the sea was ruled out as an option because of the lack of specialized equipment required to lay a seabed pipeline at the depths that would be met along the route between the two terminals. Routes further to the south were also rejected due to the number of active earthquake zones and mud volcanoes.

3.5.2 Kazakhstan Caspian Transport System

The Kazakhstan Caspian Transportation System (KCTS) envisages the construction of a new onshore oil pipeline in Kazakhstan, initially to carry up to 500,000 bpd (25 million tons/year) of oil around 800 km from the Kashagan landfall at Iskene to a new oil export terminal to be built at Kuryk, some 70 km south of Aktau. The onshore pipeline is expected to follow the existing line from Uzen to Atyrau, allowing the TCO to access the line at Kulsary. The KCTS project also envisages the construction of two new oil terminals, one at Kuryk and the other somewhere close to Sangachal in Azerbaijan, and a dedicated tanker fleet to carry oil across the Caspian Sea. A second phase of the project would see the pipeline's capacity to Kuryk increased to 38 million tons/year (750,000 bpd) depending on the needs of exporters.

The total cost of the KCTS was estimated in 2006 at $3 billion to $4 billion by foreign companies involved in developing the Kashagan oilfield.

Kazakhstan favored constructing a fleet of six 60,000 dwt tankers for the route, together with the deep-water terminals that would be required to load and unload them. However, the use of a few large vessels would reduce the route's flexibility and make it more vulnerable to the loss of a single vessel. In addition, a lack of suitable shipyards on the Caspian makes the construction of larger vessels questionable. In contrast, the use of 60,000 dwt vessels on the Kuryk–Azerbaijan route would require a new reduced-draught design to cope with the shallow waters around Kuryk. Other partners favor a larger fleet of smaller tankers, giving greater flexibility and allowing the fleet to be built up over time as the requirement to move oil through the KCTS increases.

Despite intergovernmental agreements between Azerbaijan and Kazakhstan in 2006 and 2009, a combination of delays to the start of production at the giant Kashagan project and expansion of the CPC pipeline across the Russian Federation has brought the need for the KCTS into question. At the current level of Kashagan production, around 370,000 bpd, the existing export infrastructure of the CPC pipeline and the Russian network is adequate. Linking the oil fields in western Kazakhstan to the existing pipeline to the PRC would open up the third outlet. "If the Chinese side offers commercial terms that are consistent with the western direction, then Kashagan oil will be pumped into the Kazakhstan–[PRC] pipeline," General Director of Government Relations of CPC-K Kairgeldy Kabyldin told reporters in 2016 (Rogtec 2016).

For now, the economic case for the KCTS appears questionable. However, suppose further development phases at Kashagan boost

output to 1.5 million barrels a day as initially envisaged. In that case, additional export routes will be needed, and plans for the KCTS may be dusted off again.

An alternative to a dedicated oil transport system might be a combined rail and sea operation where rail tank cars full of crude use roll-on/roll-off ferries forming part of a wider PRC–Central Asia–Caucasus–Europe transport system.

3.5.3 Neka–Jask Pipeline

In the mid-1990s, Iran was keen to promote itself as the natural and cheapest route for oil and gas from the Caspian republics to reach international markets. By 1998, some oil from Kazakhstan were already exported to Iran, though not on a large scale or continuous basis, while deliveries from Turkmenistan were due to start in July 1998.

In 1998, the National Iranian Oil Company proposed expanding the capacity of its Neka–Tehran pipeline from 40,000 bpd to 350,000 bpd by the autumn of 2000, and then to 450,000 bpd, with supplies reaching northern Iran by pipeline and being used to supply the central refineries of Isfahan and Arak, and those at Tehran and Tabriz. A third phase of the project envisaged reversing the flow in Iran's main oil pipeline, bringing crude oil from the country's oil fields near the Persian Gulf northward to the major refining centers, adding 800,000 bpd to the country's capacity to export Caspian crude.

A dedicated pipeline was proposed to be built to bring oil from Central Asia to the Iranian pipeline network at Tehran, although no particular route was suggested. In 2005, Kazmunaigaz, Total, Japan National Oil Corporation, and Inpex undertook a preliminary study on a possible Kazakhstan–Turkmenistan–Iran pipeline. However, Takachakov went on to say that "Kazmunaigaz regarded the Iranian route as a long-term option for exporting Kazakh oil and gas to South East Asia" (Lee 2007: 87).

In 2007, a new alternative was unveiled—a dedicated 1 million bpd crude pipeline to run from Neka on Iran's Caspian Sea coast to a purpose-built export terminal at Jask, just outside the Strait of Hormuz on the country's Indian Ocean coast. No construction work on this pipeline was undertaken in the subsequent 13 years. However, an export terminal is being built at Jask, which will be operational by March 2021, according to Iran's Minister of Petroleum Bijan Zangeneh (Tankterminals 2020).

Another speculative pipeline plan envisages the construction of an entirely new pipeline following a southerly route from Kazakhstan through Turkmenistan, Afghanistan, and Pakistan to a terminal opening onto the Arabian Sea. While this and a pipeline across Iran will help

open up the fast-growing Asian markets to Caspian crude oil, they remain unlikely until the US lifts its sanctions on Iran or the political situation in Afghanistan improves, both of which appear remote.

3.5.4 Gas

The traditional export route for gas from Central Asia has been northward into Russian Federation. During the Soviet era, there was no distinction between gas from Turkmenistan and supplies from the Soviet Union. However, that changed after the break-up of the Soviet Union in 1991. The two countries are now potentially competing suppliers for markets in both Europe and Asia.

The post-Soviet gas relationship between Turkmenistan and the Russian Federation has not been easy, reaching a low point with the explosion on the Central Asia-Centre gas pipeline in 2009 (see Section 3.3). Gas did flow from Turkmenistan to the Russian Federation again after the explosion, but only at greatly reduced volumes. The flow ceased after a price dispute that saw Gazprom halt purchases in January 2016 (Kuznetsov 2016). Turkmenistan resumed gas exports to the Russian Federation again in April 2019 (Khrennikov and Khrennikova 2019).

The collapse of exports along the northern route forced Turkmenistan to seek other outlets for its vast resources of natural gas. By January 2010, the country had taken two significant steps to diversify its natural gas exports, inaugurating new pipelines to the PRC in the east and Iran in the south. The PRC continued to tie up reserves of Central Asian gas. It signed supply deals with Kazakhstan, Turkmenistan, and Uzbekistan; invested heavily in projects to produce gas in the region; and built pipelines to transport the output to its western border and then across its territory to consumption centers along its coast.

In September 2010, Turkmen President Gurbanguly Berdimukhamedov, for the first time, explicitly raised the possibility of linking the country's East–West gas pipeline with proposed gas pipelines from the Caspian Sea to Europe and revived the project to build a gas pipeline across Afghanistan to Pakistan (Lee 2010).

3.5.5 Kazakhstan–Turkmenistan–Azerbaijan Pipeline

Proposals for a trans-Caspian gas pipeline to carry gas westwards from Central Asia—principally Turkmenistan—to Europe via the Southern Gas Corridor across Azerbaijan, Georgia, and Turkey have been put forward almost since the break-up of the Soviet Union. The fact that the proposals have not moved forward to a concrete project over the subsequent period of almost 30 years is evidence of many obstacles to such a project—not all have been fully overcome, even by 2020.

The most obvious route for a trans-Caspian gas pipeline would be from the coast of Turkmenistan, somewhere north of the town of Turkmenbashi, to the Sangachal terminal south of Baku in Azerbaijan. With the Azeri–Chirag–Gunashli oil fields and the Shah Deniz gas field and their pipeline infrastructure to the Azerbaijani coast located midway between the two countries, the newly built pipeline linking the two sides of the Caspian Sea would be little more than 130 km.

Bechtel and Enron conducted two feasibility studies for a gas pipeline from Turkmenistan to Turkey in the late 1990s. In February 1999, the Government of Turkmenistan selected the US company PSG International, a joint venture between Bechtel and General Electric Capital Structure Finance Group, to lead a consortium to build a 30 billion cubic meter (bcm) per year trans-Caspian gas pipeline (TCGP). Three months later, Turkmenistan and Turkey finalized a gas sales deal. Turkey agreed to buy 16 bcm/yr of gas from Turkmenistan for 30 years, with the remaining 14 bcm/yr of capacity in the TCGP used to carry the gas to Europe. Royal Dutch Shell subsequently took a 50% stake in the project, having already negotiated gas exploration and production contracts with Turkmenistan.

From the outset, both the Russian Federation and Iran opposed the plan to build a pipeline beneath the Caspian Sea, ostensibly on environmental grounds. However, negotiations with transit countries began and appeared to be progressing smoothly until BP plc's appraisal of the Shakh Deniz gas field off the coast of Azerbaijan.

Turkmenistan initially offered Azerbaijan 3 bcm/yr of space in the line, a figure subsequently raised to 5 bcm/yr. Azerbaijan held out for 16 bcm/yr and threatened to develop its export pipeline if its interests were not considered. During the early months of 2000, the TCGP project began to unravel. Turkmenistan disagreed with Azerbaijan over access rights. In May 2000, following Turkmenistan's refusal to renew its mandate for the project, the PSG Group and Shell stopped all work on the TCGP, closed their offices in the region, and redeployed staff (Lee 2001).

A decade later, interest in a trans-Caspian gas pipeline appeared to have revived. By May 2011, all parties who would be directly involved in, or benefit from, a pipeline beneath the Caspian Sea to carry gas from Turkmenistan to Azerbaijan for onward delivery through the "southern corridor" of the European Union (EU) appeared to want it to happen. But everybody involved seemed to be waiting for someone else to move the project forward.

In September 2011, the EU adopted a mandate to negotiate a legally binding treaty with Azerbaijan and Kazakhstan to build a trans-Caspian gas pipeline system and authorized the European Commission to negotiate and sign agreements on its behalf. The EU Energy Commissioner Günter Oettinger used a visit to Kazakhstan and

a presentation at the KazEnergy Forum in Astana to seek to expand the proposed pipeline project to include Kazakhstan.

The commissioner's view was not shared in Astana. Kazakhstan's Minister of Oil and Gas Sauat Mynbayev flatly contradicted the view put forward by Oettinger. "Right now, we don't have those kinds of resources," the minister told delegates at KIOGE in Almaty, which immediately followed the Astana event (Lee 2011: 1).

At that time, the three main participants in a trans-Caspian gas pipeline—Turkmenistan, Azerbaijan, and the EU—held quite different positions, which may not have changed much subsequently:

Turkmenistan said it wanted to sell up to 30 bcm/yr of gas to Europe and built a pipeline to carry the gas to the Caspian Sea shore from fields in the east of the country. However, it seemed to prefer selling gas at its border, leaving the buyer to build delivery infrastructure. It appeared not to want to be involved directly in building or financing a trans-Caspian pipeline. It also wanted the EU to persuade Azerbaijan to accept Turkmenistan's claim to the Serdar oil field in the Caspian Sea.

Azerbaijan wanted throughput guarantees for infrastructure on its territory from both Turkmenistan and Europe. It, too, had no appetite to build or finance the construction of a trans-Caspian pipeline. Moreover, Azerbaijan had little interest in acting as a transit route for Turkmenistan's gas while still seeking markets for its gas in Europe. Azerbaijan did consider buying Turkmenistan's gas at their shared border and reselling it in Europe but wanted purchase guarantees.

The EU wanted gas from Turkmenistan to diversify future supplies but appeared to have angered the Central Asian nation by bringing Turkey into negotiations without prior approval.

Azerbaijan has refused to get drawn into building a trans-Caspian gas pipeline hoping that Central Asian countries will use it. The decision to build a line should be made by the "country which owns the gas," Azeri President Ilham Aliev told reporters in August 2018. Should Turkmenistan decide to build a pipeline, Azerbaijan would consider it "with big interest," he added (Agayev 2018).

3.6 Obstacles to Trans-Caspian Oil and Gas Shipments

3.6.1 Superpower Geopolitics—The Role of the EU, Iran, the PRC, the Russian Federation, and the US

There has always been a strong geopolitical element to trans-Caspian export routes for oil and gas from Central Asia.

In broad terms, Western powers have seen them as a way to weaken the influence of the Russian Federation and Iran—and, more recently, the PRC—in the Caspian Sea region while securing competitive fuel supplies for European customers through a new supply route, the Southern Corridor.

For the European Union, reducing the bloc's dependence on Russian gas, or gas from third countries transported via the Russian Federation, has been paramount in supporting the Southern Corridor and trans-Caspian pipelines to supply additional molecules for that route.

For the US, championing the Southern Corridor and trans-Caspian pipelines initially reflected the post–Cold War shift in the power balance between the United States and the Russian Federation as the successor to the Soviet Union. Hydrocarbons were one of the few resources abundant in the Central Asian states. Getting them out to world markets through the North Atlantic Treaty Organization ally, Turkey, served several geopolitical ends for Washington: (i) reducing the Russian Federation's hold over the former Soviet states; (ii) bolstering Western interests in the region that were largely centered on projects to extract oil and, to a lesser extent, gas; (iii) preventing the Central Asian states from falling into the orbit of the PRC; and (iv) limiting Iranian influence in the region.

After the World Trade Center attack in 2001, US priorities shifted to conducting its "War on Terror" and confronting George W. Bush's "Axis of Evil"—Iraq, Iran, and the Democratic People's Republic of Korea (Adeebfar 2005). This gave added impetus to supporting the Southern Corridor across the Caucasus and Turkey, and trans-Caspian oil and gas projects.

The Russian Federation's aim in the region was to continue receiving cheap supplies of Central Asian gas to free up more of its output to sell at higher prices in Europe. A gas supply glut abruptly changed that policy to one of seeking to contain Central Asian gas and prevent it from reaching international markets at all. The Russian Federation hindered trans-Caspian projects successfully, arguing that they required unanimous endorsement of all five littoral states. The Russian Federation also argued that these projects posed an unacceptable environmental risk, even though they neglected to make similar arguments against pipelines built linking the Azeri–Chirag–Gunashli and Shah Deniz projects to shore installations.

Iran took a similar stance as the Russian Federation toward trans-Caspian projects. As a potential transit country seeking to carry Central Asian gas to Europe and Caspian oil to the Persian Gulf, it had little incentive to support pipeline projects that would bypass it. Furthermore, the Caspian Sea ranked well below the Persian Gulf in Iran's priorities in

oil and gas terms. If Iran could not get what it wanted in the Caspian—an equal one-fifth share of the sea's riches—it would not support projects that benefited others.

The PRC has little interest in supporting trans-Caspian pipelines that divert oil and gas from Central Asia westward. Instead, it has invested heavily in oil projects and pipelines in Kazakhstan and gas projects and pipelines across Central Asia.

Suggestions that trans-Caspian pipelines could be built to carry hydrocarbons from Azerbaijan eastward to the PRC are probably fanciful, with insufficient resources discovered on the western side of the sea to make such projects viable.

3.6.2 Alternative Routes

Alternative export routes have been developed and expanded while trans-Caspian oil and gas pipelines have been discussed and planned. However, their existence and effective operation over several years are eroding the need for trans-Caspian routes. Other alternatives are also still under consideration. Should they be built, it would indeed mark the end of any serious attempt to construct significant trans-Caspian oil and gas pipelines.

Caspian Pipeline Consortium

The CPC link from northwestern Kazakhstan to a Black Sea terminal in the Russian Federation has become the main export route for Kazakhstan's crude. The line came into operation in 2001. Three years later, after it started carrying Russian crude and supplies from Kazakhstan, throughput was already exceeding the initial design capacity of 500,000 bpd of Kazakh crude and an additional 110,000 bpd from Russian producers.

After lengthy delays, an expansion project was finally completed in 2018, allowing the line to pump 1.45 million bpd to the Black Sea. The bulk of the exports from Kazakhstan's three biggest oil projects—Tengiz, Kashagan, and Karachaganak—flow through the CPC pipeline. Delays to the start of production from Kashagan meant that the export capacity it needed was in place by the time production commenced, preventing for the time being the need for a trans-Caspian export route to evacuate Kashagan crude.

Oil and gas pipelines to the PRC

Crude oil and natural gas pipelines have also been laid from Central Asia to the PRC, arguably providing greater diversification for the region's hydrocarbon producers than trans-Caspian lines because they link the region to an entirely new market.

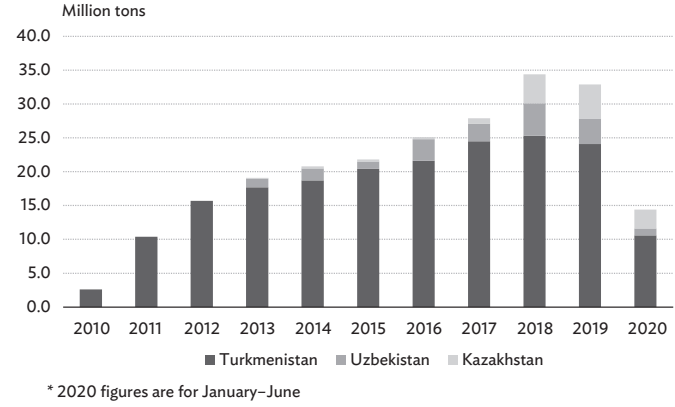
A crude oil pipeline now links fields in the Aktobe and South Turgay regions of Kazakhstan directly to the western PRC. A separate line connects Aktobe to the North Caspian region at Atyrau. A project is under way to reverse the Aktobe–Atyrau line to carry crude from Kashagan. The PRC's China National Petroleum Corporation holds an 8.33% stake in the Kashagan project, with each shareholder independently responsible for transporting and marketing its share of production.

With oil production in the South Turgay basin declining, the pipeline to the PRC now carries more Russian crude in transit across Kazakhstan than it does crude originating in the country itself. Should the Aktobe–Atyrau line be reversed, this could give Kazakhstan more capacity to export crude to the PRC and provide an outlet for additional volumes from subsequent developments at Tengiz and Kashagan.

The PRC has completed three parallel natural gas pipelines from Turkmenistan, which cross Uzbekistan and southern Kazakhstan. The lines completed in 2009, 2010, and 2014 have a combined capacity of 55 bcm/year. The first stage of a feeder line in Kazakhstan links the oil fields in northwest to southern Kazakhstan; the export pipeline was completed in 2013. By 2016, the PRC was importing more than 30 million tons of natural gas from Turkmenistan, Uzbekistan, and Kazakhstan. However, that figure will fall in 2020, with the PRC's demand hit by the country's response to the COVID-19 pandemic (Figure 3.4).

The fourth line from Turkmenistan to the PRC, crossing the Kyrgyz Republic and Tajikistan, is under construction. Upon its completion, it will have an annual throughput capacity of 30 bcm.

Figure 3.4: PRC's Natural Gas Imports from Central Asia



* 2020 figures are for January–June

Source: People's Republic of China Customs, www.customs.gov.cn.

Turkmenistan–Afghanistan–Pakistan–India gas pipeline

A gas export pipeline from Turkmenistan to Pakistan via Afghanistan was first proposed by the Argentine firm Bridas and Pakistan's state-owned Oil and Gas Development Corporation in 1993. Since then, the project has been through many iterations but remains little more than a plan.

Despite a ceremony to mark the "completion" of the pipeline's Turkmen sector in February 2018, little of the line appears to have been laid (Pirani 2018). Construction in Afghanistan has started, but there is little sign of purchase agreements from either Pakistan or India for gas from Turkmenistan. Without them, it is difficult to see the project making significant progress.

Nevertheless, this pipeline is the one new gas export project that the Government of Turkmenistan publicly supports.

3.6.3 Caspian Ownership Disputes

The five Caspian Sea states—the Russian Federation, Kazakhstan, Turkmenistan, Iran, and Azerbaijan—reached an agreement on sovereign rights to the sea in August 2018 after more than 2 decades of disagreement. Importantly for the question of trans-Caspian oil and gas shipments, the accord "allows each [country] to lay pipelines offshore with consent only from the neighboring states affected, rather than from all Caspian Sea nations" (Khrennikova 2018).

However, the agreement is unlikely to prevent other countries from opposing projects on environmental grounds, as has happened numerous times in the past. The agreement goes on to say that such projects must conform to ecological demands and standards. This "appears to be the same loophole that has held up construction of the TCP for all these years, though it is unclear whether this would represent an effective veto that other littoral states could employ to halt projects" (Pannier 2018).

The web of political and economic connections in the region is too complex to allow Azerbaijan, Kazakhstan, and Turkmenistan to completely ignore the wishes of the Russian Federation or Iran.

3.6.4 Competition for Distant Markets and the Economics of Supply

The proposed trans-Caspian export routes all aim to deliver oil and gas from Central Asian countries to international markets. However, the countries through which those hydrocarbon molecules must pass after they have crossed the Caspian Sea—whether Azerbaijan, Iran, or the

Russian Federation—are seeking to supply their oil and gas to those very same markets. This competition naturally reduces the attraction to such solutions, which would stimulate competition for their supplies.

Pirani has argued that "the economics of bringing gas from Turkmenistan to Europe would remain problematic, even if all the political issues were resolved" (Pirani 2018: 11). Pirani calculated the cost of delivering Turkmen gas to Europe via a trans-Caspian pipeline and the Southern Gas Corridor through Azerbaijan and Turkey between $10 and $11 per million btu. That compares with the cost of delivering the same gas to Austria via the Russian Federation in 2011 of $5.6–$6.8 per million btu.

3.6.5 Regional Rivalries

Rival interests in the Caspian Sea region take many forms and involve both coastal states and power further afield. The Russian Federation, Turkey, and the US all have geostrategic interests in the region, often to prevent each other from exerting too much influence.

Transit countries crossed by flows of oil and gas from Central Asia present their own challenges to exporters. Professor Paul Stevens identified the criteria for a "good" transit country (Stevens 1998) as follows:

- wants and can attract foreign investment,
- transit fee unimportant for forex earnings,
- transit fee unimportant for government revenue,
- relatively little economic rent available,
- dependent upon offtake from the line (it needs the oil or gas to flow),
- one of several alternative routes,
- no collusion likely with alternative routes,
- not a competing exporter.

Any pipeline to carry oil or gas westward from Central Asia must pass through Azerbaijan, Iran, or the Russian Federation. None of these countries fits Steven's definition of a "good" transit country. All are competing exporters of oil and gas, so none depends on offtake from any transit pipeline. Pipelines across all three countries offer the opportunity for considerable economic rent, the difference between depressed local prices on the shores of the Caspian Sea in well-supplied local markets and the international prices available at open-water ports. A couple of examples serve to illustrate some of the problems that have arisen.

The TCO briefly shipped its oil produced in Kazakhstan through the BTC pipeline between October 2008 and the end of 2009, with shipments

averaging around 160,000 tons per month (40,000 bpd) in 2009. The conventional wisdom is that the TCO stopped using the BTC pipeline at the end of 2010 because it could not reach an agreement over transit fees for its crude, despite Chevron holding an 8.9% stake in the pipeline. However, sources at the TCO denied this, saying that the real reason was that Socar insisted on the right to buy the Tengiz crude at the Sangachal terminal on Azerbaijan's Caspian Sea coast and subsequently sell it from the Mediterranean export terminal at Ceyhan, a demand unacceptable to the TCO (Lee 2013).

Azerbaijan is viewed in Europe as a transit corridor for oil and gas from Central Asia to markets in the EU. However, the view in Baku may be somewhat different. Azerbaijan's state oil and gas company, Socar, shows no sign of wanting to play the role of a transit carrier. Having developed a worldwide sales network, the company does not want to ship other people's oil through the BTC pipeline; instead, it prefers to buy Central Asian oil at Sangachal and market it as its own oil from Ceyhan. Its insistence on these terms has effectively kept Kazakhstan's oil out of the BTC since the end of 2010 and undermined trust on the eastern side of the Caspian Sea in Azerbaijan as a dependable future transit route, raising fundamental questions about the future of the KCTS (Lee 2012).

In 2019, Turkmenistan switched from exporting its crude through Azerbaijan to sending it via the Russian Federation, ditching Azerbaijan's Socar in favor of Swiss-based trader Vitol. Socar, which owns the largest fleet of the biggest (12,000–13,000 dwt) tankers on the Caspian Sea, refused to allow Vitol to use them. As a result, the trader could only secure sufficient ships from other sources to move about 60% of the usual volume of Turkmenistan's cross-Caspian exports until the Volga–Don River system became ice-free, allowing Vitol to secure tankers from outside the Caspian Sea (Ershov, Yagova, and Zhdannikov 2019).

3.6.6 Lack of Vessels

The size of vessels operating in the Caspian Sea has been increasing in recent years, with the delivery of 12,000–13,000 dwt vessels to several shipping companies. These include Azerbaijan's Caspar; Kazakhstan's Kazmortransflot; Mobilex, which uses an export terminal at Aktau; and Safinat An-Najaat, which operates the Makhachkala oil terminal. A 12,000 dwt tanker can carry approximately 1 million tons a year of oil across the Caspian Sea from Kazakhstan to either Baku or Makhachkala, equivalent to 20,000 bpd.

Kazmortansflot has a fleet of eight tankers, according to the company's website, comprising two Aframax vessels of 116,000 dwt

that operate in the Black Sea and the Mediterranean and six smaller ships of 12,000–13,000 dwt that run on the Caspian Sea. According to tanker tracking data monitored by Bloomberg, the ships operating on the Caspian Sea are mostly involved in shuttling crude from the Russian Federation's Yuri Korchagin field in the north Caspian to the Azpetrol terminal south of Baku.

These 13,000 dwt vessels are the largest that Caspian oil terminals can presently accommodate. Aktau, Baku, Dubendi, and Makhachkala, for example, can fully load vessels up to 10,000 dwt, while Aktau and Baku can part load 12,000 dwt vessels with up to 10,000 tons of oil. However, Turkmenistan's ports can only handle vessels up to 5,000 dwt, although dredging operations at Okarem should allow 7,000–10,000 dwt vessels to use the terminal. Dredging work has also been carried out at the Azpetrol terminal at Sangachal near Baku to offload 12,000 dwt vessels. The Russian Federation's Astrakhan terminal and Neka in Iran can only handle vessels up to 5,000 dwt.

Foreign oil companies operating on the eastern side of the Caspian Sea are extremely limited in the vessels they can use for cross-Caspian deliveries based on their internal safety standards. At present, they are restricted to using only the newest vessels operating in the Caspian.

3.7 The Potential Impact of the COVID-19 Pandemic on Trans-Caspian Pipelines

The economic toll of COVID-19 worldwide has been significant, and its full impact will only become known over the next few years. Azerbaijan and Kazakhstan are both major oil exporters, and their economies are dependent on oil revenues, while Turkmenistan is in a similar position with gas. All three will suffer financial shortfalls in 2020 as a result of the pandemic. The fiscal breakeven oil price—the price embedded in the budgets of both Azerbaijan and Kazakhstan—is $55 a barrel. But Brent crude, against which the export grades of both countries are priced, is expected to average just $41.20 a barrel this year and not get back to $55 until 2022, according to a survey of oil price forecasts compiled by Bloomberg. In addition, Turkmenistan faces much-lower-than-expected gas imports from the PRC, where demand has been hit by the shattering of parts of the economy for several months. According to the PRC Customs, shipments in the first half of 2020 were down 16% from the same period in 2019.

COVID-19 is also directly impacting oil and gas operations in the region, especially in Kazakhstan. For example, an outbreak at the Tengiz field led the operator to "effectively evacuate more than

20,000 people from the site" (Bloomberg 2020), where an expansion project is under way. Project leader Chevron said that production at the field "continues uninterrupted" (Gitzidinov 2020). Still, there is a risk that the project could be forced to a halt if the government were to impose strict quarantine measures. Overall, the current situation of the global energy industry is uncertain and volatile (Kalyuzhnova and Lee 2020).

Trans-Caspian oil and gas pipelines already faced an uncertain future before the 2020 COVID-19 pandemic. However, the response to the virus, coinciding with a broader shift away from fossil fuels, could permanently end such plans.

Economic recovery programs, particularly in Europe, have a strong environmental component, and the future of the bloc's oil demand, if not yet its gas demand, has become much less certain.

According to tanker tracking data from Bloomberg, the Mediterranean market accounts for about two-thirds of exports from the BTC pipeline and nearly 60% of those from the CPC. Any slowdown in oil demand in Europe will have a knock-on effect on existing exports from the Caspian Sea region and an even bigger impact on projects to carry additional oil westward from the region. With oil demand growth now firmly centered in Asia and likely to remain so in a post-COVID-19 world, trans-Caspian pipelines, certainly for oil, may be losing some of their appeal.

3.8 Conclusions and Policy Recommendations

Getting oil from Central Asia and the Caspian Sea region to international markets often poses a bigger challenge than getting it out of the ground.

As the oil and gas industries of the independent Caspian states have developed, the sea itself has been both a conduit for and a barrier to exports of oil and gas in a politically complex region.

The ambitions of the producing states, their close neighbors, and the home governments of foreign investors have frequently conflicted. New markets have emerged as old ones fade away, presenting the Caspian oil producers with a unique set of challenges and opportunities.

Networks of rail, ship, and pipeline routes have been developed to transport hydrocarbons from the region, and others are still being considered for the future.

Along with the export networks needed to transport hydrocarbons to markets, future hydrocarbon developments in Central Asia and the Caucasus are reassessed in the wake of the COVID-19 pandemic and the world's shift away from reliance on hydrocarbon fuels.

Energy companies may cut back on new exploration and may decide not to develop some of the reserves they discovered if they have more profitable opportunities elsewhere.

Host governments will have to be aware of the alternative investment opportunities open to potential investors and create ways to ensure that the resources they hold are the ones that get developed.

Some factors, like the geology of the deposits and the volumes of hydrocarbons in place, cannot be controlled. Others, like the fiscal and regulatory terms and the access to export infrastructure, can be.

Host governments in the Caspian Sea region must ensure sufficient export capacity in multiple directions, with transparent and fair rules and costs of access to ensure that getting hydrocarbons to markets does not become an obstacle to future investment.

Developing completely new export routes across or around the Caspian Sea may no longer be a viable option. But expanding and realigning existing routes, such as completing the reversal of flow along Kazakhstan's Kenkiyak–Atyrau pipeline or opening up the BTC oil route and the Trans-Anatolia gas system to third parties, can help ensure that investing in hydrocarbon development in the region remains attractive.

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PART II

Policy Development: Drivers and Barriers of Cross-Border Connectivity

4

The Middle Corridor: Policy Development and Trade Potential of the Trans-Caspian International Transport Route

Tristan Kenderdine and Péter Bucsky

4.1 Introduction

The Trans-Caspian International Transport Route (TITR, Middle Corridor) is a rail freight corridor linking the People's Republic of China (PRC) and the European Union (EU) through Central Asia, the Caucasus, Turkey, and Eastern Europe. We examine the institutional development and trade potential of the Middle Corridor by weighing policy, statistical, and infrastructural evidence. We focus acutely on the institutional development of the Middle Corridor, arguing that the project is ultimately dependent on the PRC's foreign policy, domestic industrial policy, and geo-economic and geo-industrial policies. The non-PRC Middle Corridor comprises a coalition of ports, logistics, and transport companies, either state-owned or strongly connected to state network monopoly industries. These institutions, their industries, and the states they represent lie between the EU and the PRC, forming a contiguous transport bloc from which it is possible to develop a new transport and trade macro region. The project carries great economic development and trade facilitation promise for the non-PRC, non-European states of the Middle Corridor. Yet, potential and extant problems with the development of the Middle Corridor containerized rail freight corridor neither originate with nor are policy-controlled by the non-PRC/non-EU states. Rather, institutional and policy implementation problems largely emanate from incompatibilities between the economic and political institutions on either side of the transcontinental rail system: in the PRC and the EU. It makes little economic sense for either the PRC

or the EU to engage in high levels of intercontinental rail trade while both have open ocean access. This leaves the economies in the middle of the transcontinental rail network with the largest potential economic benefit, yet also consuming the highest amount of policy capture risk from the larger PRC and EU institution makers.

The PRC, in particular, uses the Middle Corridor to take domestic industrial bureaucratic competencies abroad as part of the wider Belt and Road program of geo-industrialization. This geo-industrial policy leverages the public administration and government-led economic development interventions the PRC based its domestic industrialization drive upon. Competent public administration systems are the principal institution behind the development history of Northeast Asia's industrialization history (Chang 2002). However, these national systems of economic development create institutional path dependencies that shape the future of states' trade, industry, transport, and finance integration with regional, continental, and global economic institutions. The PRC remains a transition economy, with elements of both a market economy and a planned economy. For the PRC, experimenting with transition economics and still heavily dependent on public administration economic institutions, Belt and Road, Iron Silk Road, and China Railway (CR) Express in Eurasia represent an attempt to integrate with different economic macro regions without upgrading the country's domestic institutions responsible for trade, industry, and transport. Except for Turkey, the Middle Corridor countries are all post-Soviet economies. The development of a Middle Corridor institution ultimately connects the PRC through this post-Soviet economic geography to the advanced, developed markets of the EU. It is thus important to consider the Middle Corridor from the perspective of the institutionalization of the three regions involved—the PRC, the EU, and the post-Soviet economies plus Turkey. A simple breakdown of the three regions we examine presents the PRC as industrializing, the Middle Corridor economies as semi-industrialized, and Europe as post-industrial. Joining these three macroeconomic regions by unifying the containerized rail transport system is as difficult from a political-institutional perspective as it is from an economic-institutional one. How these three macro regions institutionally dock with the Middle Corridor transport mechanisms, political institutions, and trade functions will ultimately determine the success or failure of the project.

We contend that several impediments to the development of the Middle Corridor rail system exist. These are both distinctive to the institutional and physical geography of the countries that the rail system traverses and universal to all the corridors and freight lines on the PRC's CR Express intercontinental rail system. Private freight forwarding

companies provide rail transport services, which means that these agents within the broader institutional network must be able to make economically rational decisions. With central and regional governments coordinating with private, semi-private, and pseudo-private enterprises to develop regional transport hubs, the PRC's command economy institutions can artificially create traffic to fill the market that the central policy makers wish to create (Kenderdine and Bucsky 2021a; Kenderdine 2018c). However, at the European terminus, neither the EU nor the state governments directly intervene in the rail transport market, meaning that all international rail traffic must operate on market principles. For Central Asia, the Russian Federation, the Caucasus, Turkey, and Eastern European state economies, there is a policy incentive to organize domestic institutions and policy interventions to benefit from the PRC's expenditure, which drives network traffic. However, ultimately, the intercontinental rail network depends entirely on the PRC's policy and fiscal impetus.

This chapter is organized into four substantive sections. We first explore and locate our study within the broader world of economic development, national industrialization strategies, and the role of public bureaucracies in executing industrial policy. We then examine the PRC's central and local government policy environments for establishing, developing, and spatially planning the CR Express intercontinental rail freight system. We then explore some of the infrastructure and throughput realities of the Middle Corridor's built environment and natural geographies. We identify institutional problems and major physical infrastructure bottlenecks in developing an economically viable transcontinental rail system to link the PRC and Europe via Turkey. Next, we discuss some European statistics and argue that the EU side of the transport network is the best indicator of the actual container throughput and the potential for an intermodal shift to rail. The European statistics do not correlate with the PRC's policy and media hype about the Eurasian rail transport project. Finally, we conclude with policy recommendations for the Middle Corridor economies, the PRC, and third-party stakeholders, including multilateral development banks and the EU.

4.2 Political Institutions and Economic Geography

We analyze the Middle Corridor from several aspects. First, as it is fundamentally a PRC-initiated transport corridor, we examine the policy background of the international rail freight corridors in the PRC

following a public administration approach. State intervention in a catch-up economic development scenario (Gerschenkron 1962, Suehiro 2008, Puntigliano and Appelqvist 2011) is a well-accepted policy paradigm from the East Asian development model of industrialization (Johnson 1982; North 1989, 1990; Rodrik 2000; Chang 2002). The administrative arm of government is the principal policy agent in the PRC's domestic economy (Kenderdine 2018a, Wübbeke et al. 2016, Heilman and Shih 2013). The methodology of working in such an analytical tradition is based on public administration theory, which sees the administrative arm of government as an extant institution of state governance alongside the legislative, executive, and judicial arms of government (Wilson 1887). Taking this administrative governance institution as the basic unit of economic analysis, we obtain data on the economic aspects of the PRC's public administration by collecting policy documents at the central ministerial and subnational levels and examine the motivations of agents within the bureaucratic system, analyzed from an institutional perspective (Kenderdine and Bucsky 2021a; Bucsky and Kenderdine 2020a; Kenderdine and Lan 2019; Kenderdine and Han 2018; Kenderdine 2018a, 2017a).

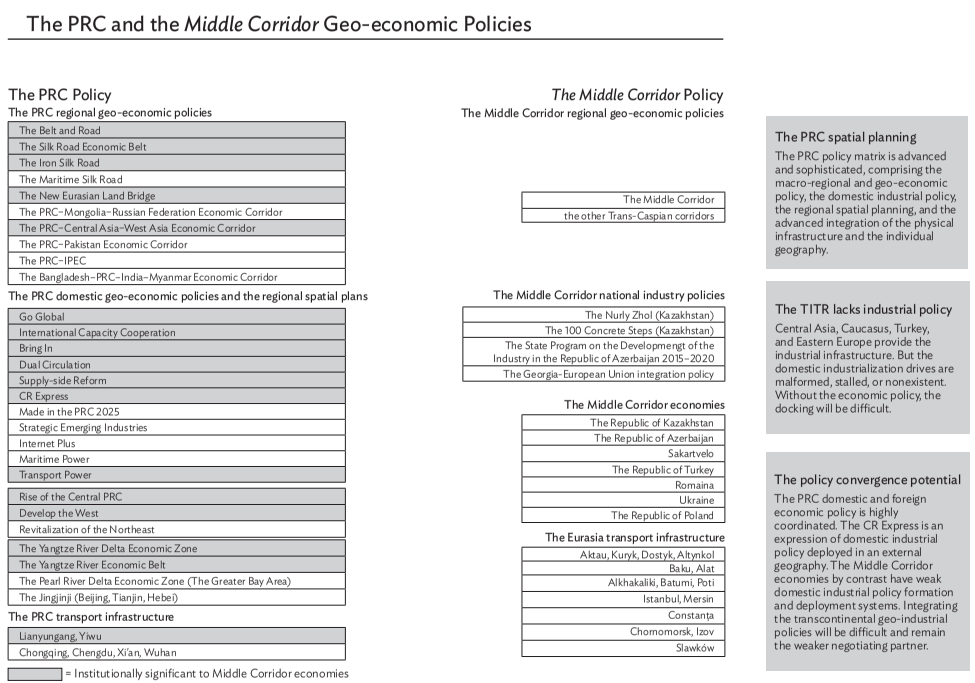
We created a historical institutional policy record to assess the PRC's discourse on the development of the Middle Corridor rail system to differentiate the transcontinental rail freight system from other forms of PRC domestic spatial policy and command economy policy functions. This policy analysis base focuses on qualitative methods of analyzing the PRC's public administration and policy apparatus. The qualitative approach assumes that a Listian national economic development process holds for both the PRC and the Central Asian economies and then deploys historical institutionalist and institutional economic approaches to the PRC's public policy system (List 1856, Veblen 1915, Skocpol 1979). Ministerial policy analysis of the PRC as a semi-industrialized state with generalizable variables akin to European and Northeast Asian industrial states, combined with known path dependencies in structural economic development, means that we can reasonably well understand the policy process and policy risk through textual analysis of the PRC's extant policy documents. For this project, we examine policy documents from the Ministry of Commerce, Ministry of Transport, National Development and Reform Commission (NDRC), and Ministry of Industry and Information Technology. However, limitations exist, and a deeper analysis would require subnational policy analysis among the cities developing the actual CR Express rail lines and higher-level PRC Communist Party policy.

Our research also integrates statistical analysis from data sets from the European side of the PRC–Europe intercontinental rail

governance institutions. This statistical analysis is necessary due to the overwhelmingly positive position of PRC policy makers and statistics manipulation, which invariably do not align with reality on the European side. For example, the number of trains and volume of twenty-foot equivalent unit (TEU) boxes that the PRC has reported as leaving the PRC for Europe does not match the number of trains and volume of TEUs arriving in the EU (Bucsky 2020; Li, Bolton, and Westphal 2018). Given that the policy record in the PRC includes state media that are prone to propaganda and statistical manipulation, independent statistical cross-referencing is essential to any analysis of the efficacy of a transcontinental rail system. Our analysis combines statistical analysis with structural economic geography and deep knowledge of rail freight capacity and the physical geography choke points of the Eurasian and European rail infrastructure (Bucsky 2020, 2018; Bucsky and Kenderdine 2020a; Vinokurov et al. 2018). This combination can identify physical bottlenecks and makes insincere statistical reporting obvious. Even ignoring policy misreporting and hard statistical anomalies, there remains a fundamental policy bottleneck in developing a two-way PRC–Europe Eurasian rail link as supply–demand dynamics govern the EU economic agents. The PRC pursues a command economy approach to developing new markets, infrastructure, institutions, and ultimately services. This leaves the economic strategies of the Central Asia, Caucasus, and Turkey economies for integrating transport connections with the PRC and the EU on uncertain institutional footing.

By triangulating EU statistics, extant physical-economic geography between the PRC, Eurasia, and Europe, and policy developments demonstrating future path-dependent behaviors of the PRC in developing the economic institutions surrounding the Middle Corridor, CR Express, and Belt and Road policies, we gain a clear picture of the future trade potential of the transcontinental PRC–Europe rail freight system. For example, a PRC policy from a central ministry to a subnational government to increase freight throughput via Istanbul will likely lead to institutional deployment on the PRC side, and yet meet a physical geographic bottleneck on the shores of the Bosporus and a freight-forwarding industry in Poland, with little incentive to ship containers back to the PRC via rail. The PRC's CR Express policy is thus caught between multiple policy frictions. Serious problems remain in analyzing the policy actions of the disparate actors of the non-PRC Middle Corridor economies. We consider the states in three macro-regional categories: the PRC; the EU as a whole and as an acute represented by Poland; and the Middle Corridor agent economies of Kazakhstan, Azerbaijan, Georgia, Turkey, and Ukraine.

Figure 4.1 : Vertical Integration of the PRC's Macroeconomic Industrial and Geo-industrial Policies and Horizontal Institutional Docking with the TITR Middle Corridor State Economic Policy



PRC = People's Republic of China, TITR = Trans-Caspian International Transport Route.

Source: Authors' database.

Most Eurasian economic integration and development is PRC policy–driven, while most institutional, economic, and market inertia stems from the EU. We can see a lack of institutional engagement or development from the remaining agent economies along the Middle Corridor either as individual states or as a contiguous economic unit. The organization of the Middle Corridor primarily takes place through the railroad and port institutions of the constituent economies. This means that little national-level state development of the economic corridors accompanies the rail freight development plans of the railroads, which are mostly state-owned. We argue that this lack of transport and trade integration is a disadvantage to regional economic development when (i) the PRC side is command-economy coordinated, (ii) the EU is operating on market principles, and (iii) the third states have neither well-marketized institutions nor an effective state industrial policy.

There remains a persistent erroneous narrative that the PRC is investing in railroad infrastructure in Central Asia and Caucasus. The reality is that the CR Express system is simply a freight subsidy scheme to generate greater containerized rail traffic flow between the PRC and Europe along existing physical infrastructure corridors (Bucsky and Kenderdine 2021). The policy benefit to the PRC in opening these trade channels is extant. The policy-making apparatus in Beijing has deemed the trade routes to have sufficient strategic value to subsidize them directly. However, the structurally transformative potential of the PRC's policy and fiscal intervention to create new markets and new traffic flows faces the inertia of existing physical geography, political institutions, and real-world economic costs. These could slow or halt the growth of such a system entirely. Progressive PRC state interventions in regional economic development policy and real-world economic use of the rail freight lines are the two frictions at play in developing all of the PRC's CR Express intercontinental rail freight lines and the Middle Corridor. For the transport channels to genuinely benefit the local economies, the Middle Corridor would need significant infrastructure investments to overcome rail freight bottlenecks, long-term subsidized support from the PRC, and efficiency gains and lowering of transit costs that still seem unrealizable. The benefit to the Eurasian economies is clear so long as PRC subsidies create traffic volumes. However, the value to the PRC is strategic, not economic, and for European stakeholders there is virtually no long-term benefit.

4.3 Intercontinental Rail Freight Policy Development

Connecting the PRC and the EU overland with containerized rail freight transport via the Belt and Road and CR Express is an ambitious prospect (Kenderdine 2018c). In 2015–2020, most of the PRC's economy underwent supply-side reform to restructure the economy via decapacity in the industrial economy and deleveraging in the financial economy. However, in the railway and freight sectors, the PRC increased subsidization to expand rail freight infrastructure, services, and institutions (Kenderdine 2017b, 2017d, 2018b).

In September 2019, the Central Committee of the PRC Communist Party released the "Outline for the Construction of a Transport Power" (State Council of the People's Republic of China 2019). The Transport Power policy is a standard PRC mid-to-long-term economic planning and governance instrument. It lays out policy guidance for developing national and international rail, road, intermodal, and logistics goals for two periods: 2021–2035 and 2035–2050. It intersects with other major planning documents, such as the joint Layout and Construction Plan of National Logistics Hubs from the National Development and Reform Commission (PRC NDRC 2018). The PRC's supply-side policy development of the domestic Middle Corridor enabling transport infrastructure is built on an institutionalized spatial planning legacy. The ability to construct this transport network is not so much connected to the PRC's newer deployment of techno-industrial policy but far more complementary to the heavy industry planning policies of the past. The prospects of the Middle Corridor depend inherently on the PRC's domestic transport and industrial policy making, which is dependent on the country's national and subnational transport and industrial policy institutions, political–economic systems, and spatial planning policy.

The Belt and Road is already a domestic and international hyper policy that lays out Eurasian connectivity as an institutionalized economic good. Connection of the PRC and the Russian Federation's pan-Eurasian geo-economic policies is referred to as the "Grand Eurasian Partnership" on the Russian side and as the "One Belt, One Union" on the PRC side (Fang 2020). This hyper policy aims to cover the PRC's other umbrella macro policies that guide infrastructure investment, capacity transfers, and policy bank investment. These include International Capacity Cooperation, Go Global, Bring In, and the technology and capacity transfers under Made in China 2025 and Strategic Emerging Industries (Kenderdine 2017a; Kenderdine and Lan 2019). These macro-industrial policies acutely intersect with the rail sector and state-owned

rail enterprises through national and international rail industrial policy development strategies (Pepermans 2019).

However, much of the PRC's Eurasian policy agenda is weakly aligned with that of the Russian Federation. Many Eurasian transport policies are simply codifications of existing multilateral development projects. For example, the key seaport for Middle Corridor development is Lianyungang in far northern Jiangsu. This is the designated terminus of the Central Asia Regional Economic Cooperation (CAREC) connectivity corridor, which CAREC established long before the PRC's Belt and Road policy. Central PRC policy designates this as the key strategic port to open to Central Asia, offering the Kazakhstan government and, by extension, the Middle Corridor partner economies access to the Pacific Ocean (Blanchard and Flint 2017). The transport corridor uses the Longhai railroad from Lanzhou (Long) to Lianyungang (Hai), one of the PRC's oldest and most important rail transport corridors. Lianyungang is strategic for multiple agents for multiple reasons. It is situated in Jiangsu province, at the extreme edge of the Yangtze River Delta cluster. The Yangtze River Delta Economic Corridor integrated transport plan pulls the Lianyungang port infrastructure into line with regional rail freight and intermodal services radiating outwards from the Shanghai center. Jiangsu is also part of the inland-facing Yangtze River Economic Belt connecting Shanghai with Chongqing, and Lianyungang is also a northern port near the Rizhao and Qingdao Yellow Sea port infrastructure cluster. Lianyungang is therefore also adjacent to the Jingjinji Beijing area consumer and import market cluster and the advanced transport network infrastructure of northeast PRC.

Along with Zhejiang and Fujian, Jiangsu is also a primary designated province for the Maritime Silk Road policy development. Lianyungang is thus located on a spatial planning policy pivot comprising the Middle Corridor, the Yangtze River Economic Belt, the Yangtze Delta Economic Zone, and the Maritime Silk Road. Its physical location at the terminus of the Longhai railroad makes Lianyungang an important geo-economic hub in the PRC's spatially planned international transport system, with a large sea-borne container capacity, but without being as busy and potentially overloaded as nearby ports like Tianjin or Qingdao.

The development of the intercontinental rail system depends heavily on individual provinces, sub-provincial cities, and prefectures forging their freight lines toward Eurasia. The principal terminals of the Central PRC provinces—Wuhan, Chengdu, Chongqing, Xi'an, and Zhengzhou—all had intercontinental railroads in operation predating both Belt and Road and CR Express. PRC–Europe rail freight volumes were also higher before, not after, the introduction of the Belt and Road policy (Bucsky and Kenderdine 2020a). The central-level CR Express

Table 4.1: CR Express Europe, CR Express Central Asia, and Extant Ex-Europe Containerized Rail Lines in Operation in 2020

Major Intercontinental Containerized Rail Freight Lines in Operation in 2020			
CR Express Europe		CR Express Central Asia	Extant European–Eurasian Lines
Yiwu–Madrid	Guangzhou–Moscow	Yiwu–Tehran	Varma–Minsk–Klaipeda "Viking"
Yiwu–London	Dongguan–Duisburg	Yiwu–Almaty	Talinn–Riga–Minsk–Ukraine Ports–Oknitsa "ZUBR"
Xiamen–Łódź	Suzhou–Warsaw	Lianyungang–Almaty–Tashkent	Duisburg–Brest–Moscow "Moscovite"
Wuhan–Dubice	Kunming–Rotterdam	Tianjin–Ulaanbaatar	Kaliningrad/Dragiste–Moscow "Merkury"
Wuhan–Lyon	Harbin–Ekaterinburg	Qingzhou–Almaty	Brest–Kaluga–Nizhny Novgorod "Volkswagen Group RUSS"
Zhengzhou–Hamburg	Harbin–Hamburg	Linyi–Almaty	Vessel–Brest–Vorotynsk "Peugeot-Citroen-Mitsubishi"
Changsha–Duisburg	Changchun–Schwarzheide	Binzhou–Tashkent	Mlada–Boleslav–Brest–Zaschita "SKODA"
Chongqing–Duisburg	Shenyang–Hamburg	Qingdao–Almaty, Bishkek	Zhilina–Brest–Zaschita "KIA"
Chengdu–Łódź	Yingkou–Warsaw	Hefei–Almaty–Central Asia	Malaszewicze–Brest–Yelabuga/Tikhonovo "FORD"
Lanzhou–Hamburg	Yingkou–Dobra	Kuytun–Tbilisi	Alashankou–Kena–Motskava "Saule"
Urumqi–Moscow	Yingkou–Lida	Xi'an–Almaty	Brest–Aktobe–Alashankou "Kazakhstan Vector"
Urumqi–Chelyabinsk	Yingkou–Moscow	Xi'an–Zhem, Kazakhstan	Panerial–Kostanai "Baltic Wind"
Urumqi–Duisburg	Yingkou–Kaluga	Wuwei–Almaty	Brest–Ulaanbaatar–Erenhot "Mongolian Vector"
Yining–Kupavna	Yingkou–Khovrino (Moscow)	Lanzhou–Almaty	Berlin–Moscow "Eastern Wind"
Shihezi–Chelyabinsk	Dalian–Hamburg		Leipzig–Shenyang "BMW"
Korla–Duisburg	Shijiazhuang–Minsk		

Source: Authors' database.

system gathered these different provincial and prefectural rail lines to Europe and Central Asia, which the provinces and municipalities had themselves developed and subsidized, and created a centralized national plan under the coordination of the NDRC with new central subsidies. The CR Express transcontinental rail system is the centralized marshaling of existing disparate city-level PRC–Europe and PRC–Central Asia rail freight services into a unified national system.

4.4 Infrastructure Realities of the Middle Corridor

Compared with other transport modes, rail transport along the Middle Corridor has historically played a minor role. However, even before the PRC's Iron Silk Road and Belt and Road policies, there had been long-term multilateral institutional transport integration development programs. The most prominent was the Transport Corridor Europe–Caucasus–Asia (TRACECA), initiated by the EU. The EU, the five Central Asian republics, the three South Caucasus republics, Turkey, and Moldova signed multilateral agreements in 1993, with Iran and Ukraine subsequently joining. However, the development and use of the Central Asian and Caucasus transport corridors under TRACECA have been underwhelming. The TRACECA corridor is still slower and more expensive than routes connecting Central Asia and the PRC through Kazakhstan and the Russian Federation to Europe. High costs and slower transit times make it practically uneconomical for commercial use (UNECE 2017). The main problem with the corridor is that it involves slow and costly ferry legs to cross the Caspian Sea and then the Black Sea from Georgia to Romania or Bulgaria or utilizes an underdeveloped rail route through Turkey. Even though the EU has funded 14 transport projects in the region since 1995, the projects have not significantly impacted the development of regional corridors.

The rail transport corridors from the PRC to Central Asia via Kazakhstan to the Caspian Sea ports along the TRACECA corridors are well established. In contrast, a proposed new corridor via the Kyrgyz Republic does not seem feasible (Bucsky and Kenderdine 2020b; Kenderdine 2017c). The most important development of the past 25 years was the finalization of the Baku–Tbilisi–Kars railroad in 2017, which reopened direct rail transport between the Caucasus region and Turkey after the closure of the railroad between Armenia and Turkey due to the Armenia–Azerbaijan conflict in the early 1990s. Another significant achievement was the finalization of the Trans-Kazakhstan railroad in 2014, a 988 km Zhezkazgan–Saksaulskaya–Shalkar–Beyneu line that cut

the east–west transport route between the PRC border and the Caspian Sea port of Aktau by around 1,000 km (Rodemann and Templar 2014), but also allowed more frequent shipments, flexibility and sustainability. This became important after the opening of the second Kazakhstan–PRC rail border crossing at Khorgos–Altynkol in 2011. However, this Khorgos crossing is still highly underutilized in normal economic operation and has also suffered from politicized bottlenecks (Kenderdine and Bucsky 2021b; Bucsky and Kenderdine 2020a; Ruehl 2019).

East–west from the PRC to Europe, crossing the Caspian Sea is a major bottleneck as ferry and port services are insufficient to balance rail throughput capacity on either side (Badambaeva and Ussembay 2018). The rail ferry to Baku has been operational for more than 3 decades, but it only introduced container services in 2019 (PortsEurope 2019). The roll-on–roll-off (RoRo) vessel fleet has expanded in recent years, and 13 are now servicing the Baku–Aktau and Baku–Turkmenbashi routes (ASCO 2019). Azerbaijan has built a new port in Alat, with a first-phase capacity of 10–11.5 million tons of general cargo and 40,000–50,000 TEU containers, with plans for further expansion. On the Caucasus rail side, the Baku–Tbilisi–Poti/Batumi main line is an electrified, mainly double-tracked line with heavy freight traffic capacity. Both Georgia and Azerbaijan have invested in rail track development over the past decade, meaning that this segment of the corridor is now in good condition. The line currently carries mainly hydrocarbon products from Azerbaijan to the Georgian Black Sea ports, but container transport has become much more significant on the return route. In 2019, 45% of Georgian Railways' traffic volume was oil products, while 38% was transit trade—almost entirely to and from Azerbaijan (Georgian Railways 2019). The year 2021 was the scheduled completion date for developing a new deep-water port in Anaklia with a projected capacity of 100 million tons per year. However, Georgia pulled out of the contract in 2020 (Lomsadze 2020). From western Georgia, two routes are available, one by ferry across the Black Sea and one overland through Turkey. In both cases, reaching the targeted Central European markets is challenging because the routes lead through either Ukraine or Romania, where the rail infrastructure is fairly poor (Popa and Schmidt 2013, Miecznikowski and Radzikowski 2017).

Across the Black Sea by ferry to Varna in Bulgaria, the onward rail corridors pass through Serbia which is not an EU member. Crossing the border is then much more time-consuming due to customs procedures. The state of the Serbian transport infrastructure is also insufficient, the speed limits are sometimes as low as 20–40 km/h, and the network is overwhelmingly single track. However, upgrading work is ongoing along the rail corridor between the Bulgarian and Hungarian

borders to rehabilitate existing lines and expand most lines to double track. Black Sea rail ferry services between Romania and Bulgaria to Georgia first ran in 1978. The Bulgarian state-designated shipping company Navibulgar provides services from Georgia to both Bulgaria and Ukraine. Navibulgar operates under a special intergovernmental triple agreement between the governments of Bulgaria, Ukraine, and Georgia regarding the operation of direct rail ferry services between the ports of Varna (Bulgaria), Chornomorsk (Ukraine), and Poti and Batumi (Georgia). According to the timetable, there are monthly ferries between Poti and Varna. Navibulgar is the only company serving the Black Sea region with rail ferry services between Georgia and the EU. It has two vessels for this purpose, both built in 1978 (Navibulgar 2019b). The route of the ships forms a triangle between Varna, Poti, and Chornomorsk (Navibulgar 2019a, 2019b). The rail ferry connection to the Romanian port of Constanța was already operational before 1990, and the infrastructure for rail ferries exists, but none currently operate. In 2003, there was a plan to start a new rail RoRo ferry from Constanța to the Georgian port of Poti, but this never transpired (UNESCAP 2003). Despite this limitation, container transport between the two ports is currently available, but transshipment is needed at both ports. As the rail gauge systems are different anyway, this is not a great problem as cheaper and faster loading is possible for containers than rail wagons. The capacity for rail wagons on RoRo ferries is very limited though, with ships having a capacity of 50–106 wagons, which translates to one to two full trains (Viking Rail 2015).

Ukraine's Chornomorsk port has operational Black Sea rail ferry connections to Varna (Bulgaria), Batumi and Poti (Georgia), and Samsun (Turkey). However, only four ships service all routes, so the frequency is around two to four per week. Costs are also high at $1,500–$2,000 per container (Viking Rail 2019). On routes connecting wide-gauge tracks, rail ferries can be more viable as they cut transshipment costs. However, it is notable that, in practice, rail RoRo ferries transport special cargo, such as tank wagons and dangerous goods, for which transshipment would be more costly than containerized freight. The turnover has been 6,000 to 8,000 wagons per year in recent years on these routes (Ukrferry 2014). Interestingly, Ukrferry's fleet consists of ferry ships (the Greifswald, Kaunas, and Vilnius) that East Germany built between 1987 and 1989 for the Soviet Union–German Democratic Republic rail ferry between Mukran and Klaipeda (Retzlaff and Wingeß 2006). These ferry connections are seldom run and are also slow. According to the timetable, the approximately 1,100 km Varna–Poti route takes 4 days, meaning an average speed of 11.5 km/h or 275 km/day. This is much slower than the approximately 1,000 km/day by rail. Overland transport

on the Poti–Varna route via Turkey by rail became possible in 2017, but major limitations exist. First, the railroad from Georgia to Istanbul is single track, and it is not electrified between the Georgian border and Ankara. Second, freight trains cannot use the direct Kars–Ankara–Istanbul line but have had to detour through Konya since 2016 due to the high traffic load of the Ankara suburban trains (Uysal 2019a). Only the first flagship PRC–Czech Republic train gained permission to use this direct corridor. This demonstrates that, while the policy hype of the PRC–Europe rail connection can sometimes make media headlines, actual throughput capacities limit future upscaling potential.

Ankara to Istanbul comprises a single-track conventional, mixed-traffic line and a high-speed line (HSL). Although research has analyzed the possibility of using the HSL, freight trains still use conventional lines (Ertem and Özcan 2016). However, the major bottleneck is the Greater Istanbul area: the rail lines from Gezbe on the Asian side to Halkalı were partially closed for reconstruction from 2004 to 2019. This meant that trains from Europe had to terminate in Halkalı and, from there, the only option for crossing to the Asian side was to travel by road. The capacities of both Halkalı and Gezbe stations are limited. This is a highly constricting factor for using the Marmaray tunnel at night for regular freight traffic. A portion of European container trains must use Çerkezköy station due to insufficient space in Halkalı (UNECE 2017). Therefore, it is unrealistic for more than two to four trains per night per direction to use the tunnel. Until 2017, Halkalı station, the busiest intermodal terminal in Turkey, could receive only two trains daily. Even after the completion of the upgrade in 2019, the suburban Marmaray trains still heavily use Halkalı. Their interval is every 8 minutes in peak hours, with the first trains departing at 6:00 a.m. and the last trains arriving at 00:12 a.m. at the terminus stations. Therefore, it is only possible to run freight trains at night. The first freight train to use the Marmaray tunnel was a magnesite train from Çukurhisar in Turkey to Austria in October 2019 (Uysal 2019b). However, the Railway Gazette (2019b) erroneously published that the first PRC–Europe train was the first train to use it in November 2019. These, though, were both exceptional cases. For non-exceptional trains, transport is much more complicated.

As the Marmaray tunnel is generally closed to freight trains, the possibility for rail transport between the Asian and the European sides of the Turkish rail network only arose again after 2013 with the Tekirdağ–Derince rail ferry (UTİKAD 2014). However, this still serves as a bottleneck: in September 2019, the ferry closed for maintenance for 15 days, blocking all rail traffic between the two sides of Turkey completely (Uysal 2019c). There is also a proposal for a new project to start cross–Mamaray ferry services from Bandirma port, but the development has

not yet commenced. The Tekirdağ–Derince rail ferry travel time is 8 hours, with an additional 2 hours for loading and unloading, and the cost is high: starting at €13.6/ton, which means €300–€400 per TEU or around €1,000 for a standard rail wagon. As the costs for PRC–Europe transport start at €5,000 per TEU, the Istanbul section becomes a crucial cost element. Moreover, ports and ships have since undergone privatization, and no usage statistics are available now.

The Turkish State Railways (Türkiye Cumhuriyeti Devlet Demiryolları, TCDD) only kept the Haydarpasa–Sikerci terminal and Lake Van ferries. The first plays a marginal role in special transport and mainly serves TCDD's internal needs; it only transported 1.3 million tons in 2018 (TCDD 2019a, 2019b). The Lake Van ferry though is crucial as it is the only means of transport from Turkey to Iran and beyond to Pakistan. Two ferries serviced traffic for the non-electrified single-track rail line, but the capacity of 15,000 wagons was a severe bottleneck. Therefore, new ships began operating in 2018, increasing the capacity to 115,000 wagons per year (TCDD 2018). This still only means a capacity increase from one train to seven to eight trains per day. While a substantial increase, it nevertheless considerably limits the cargo volumes and potential international throughput capacity. A total of 11,216 rail wagons used the Lake Van ferry in 2017 and 19,856 in 2018, showing that the utilization of the Turkey–Iran line is still low. There is thus no realistic chance for a rail freight connection between the Asian and the European side of Turkey even in the coming decade.

Furthermore, the single-track and non-electrified Istanbul–Bulgaria border section began an upgrade in the second half of 2019 using EU co-funding of €1.2 billion (Railway Gazette 2019a). This will extend the already-electrified line to a double-track line with modern signaling for mixed-use traffic, which will more than double capacity. However, work will not likely finish until 2022.

This all demonstrates that from Georgia to Europe, neither overland transport through Turkey nor RoRo Black Sea ferries can be economically competitive on time and cost. It is more realistic to assume that in the future only one to two trains daily can use the Black Sea route. Major physical infrastructure development is necessary along substantial segments of the Turkey rail system if the Middle Corridor transport volume grows significantly. However, we cannot expect new investments to overcome these physical geography limitations in the short to medium term. Therefore, the full transcontinental throughput capacity of the Middle Corridor will remain limited mainly due to the physical bottlenecks around the two Turkish metropoles of Istanbul and Ankara and the limited ferry-crossing capacities on the Black Sea and the Caspian Sea.

Table 4.2: 2019 Freight Tariff Rates from Lianyungang, PRC, to Turkey and the Caucasus via the TITR Middle Corridor on Block Trains and as Single Carriages

Tariff Rate for Transport as Part of a **Block Train** on the Lianyungang–Altynkol–Aktau–Baku–Tbilisi/Poti/Istanbul/Izmir Route. SOC (Shipper's Own Container)

		(<24 t)	(>24 t, ≤28 t)	(≤28 t)	
Departure	Destination	20'	40'	45'	Delivery Time
Lianyungang	Baku (Azerbaijan)	$4,455	$2,760	$3,005	15–17 days
Lianyungang	Tbilisi (Georgia)	$4,515	$2,900	$3,145	16–18 days
Lianyungang	Poti (Georgia)	$4,615	$3,075	$3,320	18–20 days
Lianyungang	Istanbul (Turkey)	$5,485	$3,440	$3,685	21–23 days
Lianyungang	Izmir (Turkey)	$5,565	$3,470	$3,715	24–26 days

Tariff Rate for Transport of **Single Containers** on the Lianyungang–Altynkol–Aktau–Baku–Tbilisi/Poti/Istanbul/Izmir Route. SOC (Shipper's Own Container)

		(<24 t)	(>24 t, ≤28 t)	(≤28 t)	
Departure	Destination	20'	40'	45'	Delivery Time
Lianyungang	Baku (Azerbaijan)	$4,445	$2,920	$3,165	15–17 days
Lianyungang	Tbilisi (Georgia)	$4,875	$3,270	$3,515	16–18 days
Lianyungang	Poti (Georgia)	$4,975	$3,350	$3,595	18–20 days
Lianyungang	Istanbul (Turkey)	$5,895	$3,790	$4,035	21–23 days
Lianyungang	Izmir (Turkey)	$5,940	$3,820	$4,065	24–26 days

PRC = People's Republic of China, TITR = Trans-Caspian International Transport Route.
Source: Middle Corridor (2019)—direct translation.

Table 4.3: TITR Freight Rates for Transit through Kazakhstan from the PRC to the Caucasus and Turkey via Aktau Sea Port[a]

Transit through the Republic of Kazakhstan from the PRC. SOC (Shipper's Own Container)

	20'	20'	40' DV/HC	Delivery Days	
	(<24 t)	(>24 t, ≤ 28t)	(≤28 t)	Block	Single
ex Altynkol (Korghos)		To Turkey			
Mersin	$2,129	$2,129	$3,324	15	22
Istanbul	$2,363	$2,363	$3,634	16	23
Izmit (Kosekoi)	$2,358	$2,358	$3,627	16	23
Izmir (Alsandzhak)	$2,375	$2,375	$3,650	16	23
ex Altynkol (Korghos)		To Azerbaijan			
Port Baku (Alyat)	$1,358	$1,358	$2,333	9	16
Zibat	$1,358	$1,358	$2,333	9	16
Kyshli	$1,358	$1,358	$2,333	9	16

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Table 4.3 *continued*

	20'	20'	40' DV/HC	Delivery Days	
	(<24 t)	(>24 t, ≤ 28t)	(≤28 t)	Block	Single
ex Altynkol (Korghos)			To Georgia		
Tbilisi	$1,540	$1,540	$2,580	10	17
Port Poti	$1,584	$1,584	$2,656	10	17
Port Batumi	$1,591	$1,591	$2,661	10	17

PRC = People's Republic of China, TEU = twenty-foot equivalent unit, TITR = Trans-Caspian International Transport Route.

[a] FOR stands for "free on road", a variation of the more standard maritime free on board (FOB). COC stands for carrier's own container, while SOC means shipper's own container and SU stands for set up (ready for the next operation). The delivery times quoted are either for dedicated block trains, meaning quicker times, or for single TEU containers on mixed cargo trains, meaning slower times.

Source: Middle Corridor (2019)—direct translation.

Table 4.4: TITR Freight Rates from Kazakhstan to Turkey

Exports from the Republic of Kazakhstan to Turkey. FOR Kazakhstan, FOR Mersin, COC or SOC

	20'	20'	40' DV/HC	Delivery Days	
	(<24 t)	(>24 t, ≤28 t)	(≤28 t)	Block	Single
Zaayatskaya	$2,031	–	$3,179	–	17
Anar	$2,008	–	$3,136	–	18
Taincha	$2,043	–	$3,198	–	18
Culye	$2,052	–	$3,218	–	18
Novoichimskaya	$2,033	–	$3,183	–	17
Kostanay	$2,019	–	$3,155	–	17
Kokshetau	$2,028	–	$3,170	–	18
Kzyl-Tu	$2,072	–	$3,202	–	19
Kurort-Borovoe	$2,029	–	$3,170	–	18
Kairankule	$2,036	–	$3,186	–	18
Karagai	$2,036	–	$3,187	–	18
Pavlodar	$2,075	–	$3,257	–	20
Nur-Sultan	$2,025	–	$3,169	–	18

COC = carrier's own container, FOR = free on road, SOC = shipper's own container, TITR = Trans-Caspian International Transport Route.

Source: Middle Corridor (2019)—direct translation.

4.5 Assessing Demand-Side Development from Europe

In 2018, the EU published a new policy on Europe–Asia connectivity, with rail transport a central element (European Commission 2018). The EU had already invested heavily in regional connectivity: between 2014 and 2020, it allocated €1.1 billion to the Central Asian Development Cooperation Instrument. The European Investment Bank and the European Bank for Reconstruction and Development have also invested €11.3 billion in the region, with regional infrastructure investment many times higher than that of the PRC (Russell 2019). Container traffic between Europe and each Middle Corridor country by rail though is currently negligible (Figure 4.4). For example, in 2019, only 216 registered TEUs were transported to Kazakhstan and 32 TEUs to Uzbekistan. These country-specific statistics are available from the International Union for Road–Rail Combined Transport (UIRR)—the major intermodal transport association in Europe—with members whose networks comprise one-third of total EU containerized transport (UIRR 2019). In 2018, the EU–Middle Corridor value of goods transported by rail had only a 2.3% modal share by value and 1.4% by volume. The largest Middle Corridor state share was that of double-landlocked Uzbekistan.

Table 4.5: 2019 TITR Freight Rates from Kazakhstan to Turkey and Georgia via Aktau Sea Port SOC, $

FOR Akhalkalaki (Georgia), FOR Kazakhstan

	20' (<24 t)	20' (>24 t, ≤28 t)	40' DV/HC (≤28 t)	Days*
Kazakhstan	1,511	1,578	2,461	13
Mangystau	1,160	1,180	1,815	18
Almaty-1	1,612	1,716	2,619	17
Aktobe-2	1,427	1,483	2,307	12
Nur-Sultan	1,647	1,739	2,702	16
Atyrau	1,347	1,392	2,157	11
Balkash-1	1,612	1,704	2,632	15
Taraz	1,571	1,659	2,555	15

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Table 4.5 *continued*

	20' (<24 t)	20' (>24 t, ≤28 t)	40' DV/HC (≤28 t)	Days*
Karaganda	1,597	1,682	2,610	15
Kokshetau-1	1,650	1,738	2,713	15
Kostanay	1,580	1,657	2,587	14
Kulsari	1,300	1,338	2,072	10
Kyzylorda	1,513	1,580	2,464	13
Pavlodar-Yzhnyi	1,720	1,827	2,832	17
Semey-Gruzovoy	1,742	1,858	2,864	18
Shymkent	1,555	1,638	2,531	15
Taldykorgan	1,691	1,808	2,762	18
Zhylaevo	1,535	1,606	2,503	13
Oskemen-1	1,897	2,048	3,072	18
Sairam	1,556	1,638	2,532	14
Shetpe	1,180	1,203	1,853	8
Kapshagay	1,626	1,733	2,643	17
Temirtau	1,614	1,702	2,640	15
Turkesten	1,539	1,616	2,505	14
Medeu	1,612	1,716	2,620	17
Zhezkazgan	1,541	1,612	2,516	13

SU Port Poti (Georgia), FOR Kazakhstan

	20' (<24 t)	20' (>24 t, ≤28 t)	40' DV/HC (≤28 t)	Days*
Kazakhstan	$1,450	$1,517	2,495	11
Mangystau	1,099	1,119	1,849	7
Almaty-1	1,551	1,655	2,653	15
Aktobe-2	1,366	1,422	2,341	10
Nur-Sultan	1,586	1,678	2,736	14
Atyrau	1,286	1,331	2,191	9
Balkash-1	1,551	1,643	2,666	14
Taraz	1,510	1,598	2,589	14

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Table 4.5 *continued*

	20' (<24 t)	20' (>24 t, ≤28 t)	40' DV/HC (≤28 t)	Days*
Karaganda	1,536	1,621	2,644	13
Kokshetau-1	1,589	1,677	2,747	14
Kostanay	1,519	1,596	2,621	12
Kulsari	1,239	1,277	2,106	9
Kyzylorda	1,452	1,519	2,498	11
Pavlodar-Yzhnyi	1,659	1,766	2,866	15
Semey-Gruzovoy	1,681	1,797	2,898	16
Shymkent	1,494	1,577	2,565	13
Taldykorgan	1,630	1,747	2,796	16
Zhylaevo	1,474	1,545	2,537	12
Oskemen-1	1,836	1,987	3,106	17
Sairam	1,495	1,577	2,566	13
Shetpe	1,119	1,142	1,887	7
Kapshagay	1,565	1,672	2,677	15
Temirtau	1,553	1,641	2,674	13
Turkesten	1,478	1,555	2,539	12
Medeu	1,551	1,655	2,654	15
Zhezkazgan	1,480	1,551	2,550	12

SU Port Batumi (Georgia), FOR Kazakhstan

	20' (<24 t)	20' (>24 t, ≤28 t)	40' DV/HC (≤28 t)	Days*
Kazakhstan	1,450	1,517	2,495	11
Mangystau	1,099	1,119	1,849	7
Almaty-1	1,551	1,655	2,653	15
Aktobe-2	1,366	1,422	2,341	10
Nur-Sultan	1,586	1,678	2,736	14
Atyrau	1,286	1,331	2,191	9
Balkash-1	1,551	1,643	2,666	14
Taraz	1,510	1,598	2,589	14

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Table 4.5 *continued*

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Semey-Gruzovoy	1,681	1,797	2,898	16
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Zhylaevo	1,474	1,545	2,537	12
Oskemen-1	1,836	1,987	3,106	17
Sairam	1,495	1,577	2,566	13
Shetpe	1,119	1,142	1,887	7
Kapshagay	1,565	1,672	2,677	15
Temirtau	1,553	1,641	2,674	13
Turkesten	1,478	1,555	2,539	12
Medeu	1,551	1,655	2,654	15
Zhezkazgan	1,480	1,551	2,550	12

FOR = free on road, SOC = shipper's own container, SU = setup, TITR = Trans-Caspian International Transport Route.

* There are no block trains on these services; all the quoted delivery days are for single-unit transport.

Source: Middle Corridor (2019)—direct translation.

Table 4.6: Major Trade Partners of the Countries in the Area of the Middle Corridor (2018)

Country/Partner	PRC %	EU %	Russian Federation %	Turkey %	US %	Major Partner's Share, %	Trade Total (million $)
Armenia	9	23	31	2	0	65	6,195
Azerbaijan	3	53	8	3	6	73	31,390
Georgia	10	27	13	6	13	69	12,039
Kazakhstan	22	35	20	2	2	82	88,900
Kyrgyz Republic	52	10	17	0	4	83	10,882
Tajikistan	29	5	17	0	7	58	5,293
Turkey	6	47	7	5	0	65	383,980
Turkmenistan	68	7	4	0	6	85	12,365
Uzbekistan	23	11	16	1	7	58	26,776
Total	11	41	10	4	2	68	577,821
Total (without Turkey)	23	30	16	2	5	76	193,841

EU = European Union, PRC = People's Republic of China, US = United States.
Source: IMF Direction of Trade Statistics.

Table 4.7: PRC–Middle Corridor Port Capacity Comparison ('000 TEU)

PRC Port Throughput				Central Asia and Caucasus Port Throughput		
Shanghai	40,233	Dongguan	3,910	Turkey	Ambarli (Istanbul)	3,132
Shenzhen	25,209	Rizhao	3,238		Mersin	1,592
Ningbo-Zhoushan	24,607	Nanjing	3,170	Georgia	Poti	173
Hong Kong, China	20,770	Fuzhou	3,007		Batumi	90
Guangzhou	20,370	Yantai	2,702	Azerbaijan	Baku	35
Qingdao	18,262	Tangshan	2,530	Turkmenistan	Turkmenbashi	19
Tianjin	15,040	Quanzhou	2,303	Kazakhstan	Aktau	16
Xiamen	10,380	Zhuhai	2,270			
Dalian	9,707	Dandong	1,866			
Yingkou	6,278	Haikou	1,640			
Taicang	4,514					

PRC = People's Republic of China.

Note: Port container traffic measures the flow of containers from land to sea transport modes, and vice versa, in twenty-foot equivalent units (TEU) standard-sized containers. The data refer to coastal shipping and international journeys. We count transshipment traffic as two lifts at the intermediate port (once to off-load and again as an outbound lift), including empty units.

Source: Lloyds List (2018); Port Aktau (2018a, 2018b); PortsEurope (2018); Port News (2020).

Due to lack of data, only EU data have sufficient detail to calculate a theoretical shift in traffic mode to rail. Table 4.8 shows the potential modal shift to rail traffic for EU–Middle Corridor transport. It is not easy to estimate the potential of current trade flows that could shift to rail, but the most critical factors for transport mode choices are cost, travel time, and value of goods. If rail connectivity improvements were to result in sufficient capacity and similar transport times to those in the EU and the Russian Federation, rail transport would be competitive. For rail to increase its intermodal share, the value by volume of goods must be lower than some other forms of transportation that it could replace. To this end, we create an estimate based on the major product categories and the mode of transport. In all cases in which the value per volume (€/ton) is currently higher by sea than by rail, we assume that conversion to rail is possible (these figures do not include the PRC) (Table 4.8). In those cases where products transported by sea have a lower value per volume than rail, we assume that the amount of difference is the same amount that could shift to rail.

In 2018, 124.4 million tons traveled between the EU and the countries along the Middle Corridor, but only 2.2 million tons traveled by rail. However, the maximum potential for conversion to rail is 84.4 million tons. This is a rather theoretical calculation though, as a wide range of other factors influence transport mode selection. For example, maritime transport will still be more efficient than rail by default from port region to port region. However, this analysis shows that a substantial portion of the current trade flow could, in theory, shift to rail. A principal goal of the development of the Middle Corridor is to encourage transit route traffic from the Russian Federation to transfer to this new corridor. It is, therefore, interesting to investigate the traffic volume development between the Middle Corridor economies in recent years.

Table 4.10 shows that PRC to Middle Corridor economy traffic via the Russian Federation is almost nonexistent: there is negligible potential to attract these volumes (we exclude Kazakhstan as transport to and from the PRC is already direct). The case of Turkey is interesting as it is the closest country to the EU. Yet, rail has a very small modal share due to the country's particularly underdeveloped rail freight infrastructure and services. Turkey's political connections to the EU have also worsened over the past decade. Still, the two remain strongly economically interlinked: the EU is responsible for 47% of Turkey's trade while Turkey is responsible for 3.9% of EU trade.

Table 4.8: EU Trade with Middle Corridor Region Countries and the Potential of Trade to Shift to Rail

	Rail		Sea		Rail	
	€/ton		€/ton		tons (1,000)	
	Imports	Exports	Imports	Exports	Imports	Exports
Agricultural products and live animals	596	292	961	554	5.4	41
Foodstuffs and animal fodder	874	472	1,177	828	64.6	184
Solid mineral fuels	80	259	86	226	105.8	18
Petroleum products	429	1,431	462	525	256.7	26
Ores and metal waste	75	256	674	243	18.7	31
Metal products	2,081	850	738	881	40.3	145
Crude and manufactured minerals, building materials	144	171	90	253	217.0	209
Fertilizers	232	741	208	296	0.3	3
Chemicals	1,488	1,390	532	1,011	128.9	228
Machinery, transport equipment, manufactured articles, and miscellaneous articles	2,919	5,296	4,641	4,044	156.9	286
Total	**953**	**1,817**	**738**	**852**	**997.3**	**1,181**

	Sea		Potential to Shift to Rail, %		Potential to Shift to Rail, tons	
	tons (1,000)					
	Imports	Exports	Imports	Exports	Imports	Exports
Agricultural products and live animals	784	1,297	100	100	784	1,297
Foodstuffs and animal fodder	1,479	1,558	100	100	1,479	1,558
Solid mineral fuels	1,159	125	100	87	1,159	109
Petroleum products	52,653	6,807	100	37	52,653	2,499
Ores and metal waste	1,253	14,372	100	95	1,253	13,642
Metal products	7,631	3,751	35	100	2,704	3,751
Crude and manufactured minerals, building materials	9,495	1,049	62	100	5,930	1,049
Fertilizers	546	348	89	40	488	139
Chemicals	3,871	5,866	36	73	1,385	4,267
Machinery, transport equipment, manufactured articles, and miscellaneous articles	5,618	3,511	100	76	5,618	2,681
Total	85,590	38,810	77	47	66,240	18,191

EU = European Union.

Source: Own calculations based on the Eurostat database.

Table 4.9: 2020 Comprehensive Tariff Rates for Universal Container Transport with Ferry Use on the TITR, $/container

Route	Distance (km)	TEU SOC/ COC	FEU SOC/ COC	TEU SOC/ SOC	FEU SOC/ SOC
Altynkol–Aktau/Kuryk–Batumi/ Poti–Istanbul and reverse direction (via Caspian Sea ferry; from Batumi to Istanbul by truck)	5,714	2,962	4,007	2,823	3,724
Altynkol–Aktau/Kuryk–Baku (Alat)–Kars–Istanbul and reverse direction	6,382	2,144	3,337	1,981	3,011
Altynkol–Izov–Sławków (Poland via Ukraine) and reverse direction	6,893	3,082	4,857	2,897	4,488
Altynkol–Vadul-Siret/Mostyska (Romania/Poland via Ukraine) and reverse direction	6,333	2,897	4,621	2,714	4,255
Altynkol–Chop (Hungary via Ukraine) and reverse direction	6,569	2,922	4,657	2,736	4,284
Altynkol–Uzhhorod (Slovakia via Ukraine) and reverse direction	6,597	2,840	4,578	2,653	4,204
Batumi–Saryagash (expedited) (Uzbekistan) and reverse direction	3,509	1,539	2,487	1,592	2,581
Kokshetau–Kars (Turkey) and reverse direction	4,851	1,719	2,514	1,621	2,515
Altynkol–Kars–Mersin (Turkey) and reverse direction	5,644	1,909	3,033	1,746	2,707
Karaganda (marshaling)–Batumi/ Poti (ferrosilicon)	3,518	1,163	1,959	1,083	1,826

COC = carrier's own container, FEU = forty-foot equivalent unit, SOC = shipper's own container, TEU = twenty-foot equivalent unit, TITR = Trans-Caspian International Transport Route.

Source: Middle Corridor (2019).

Figure 4.2: PRC–Europe Rail Freight Distribution in Europe ('000 TEU, both directions)

Germany	157.2
Poland	83.2
Netherlands	30.3
Belgium	18.3
Spain	5.7
Finland	3.8
Hungary	2.5
Sum	300.9
Of total EU	302.6

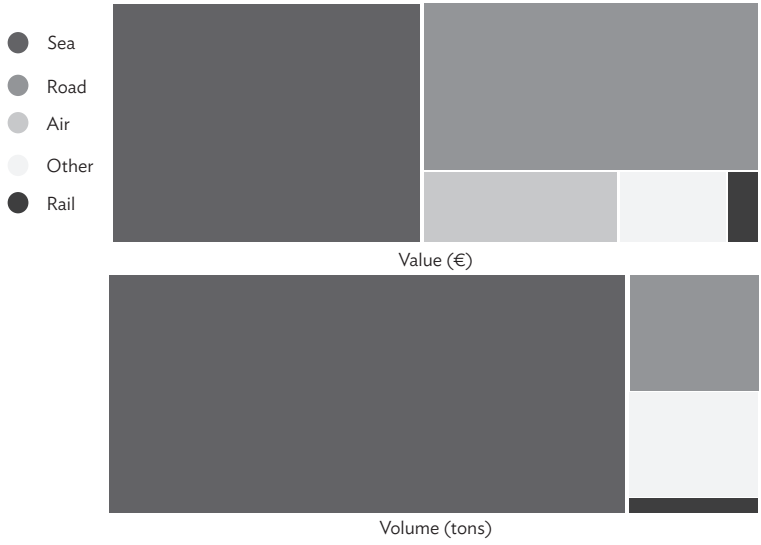
unit: '000 TEU

EU = European Union, PRC = People's Republic of China, TEU = twenty-foot equivalent unit.

Source: Eurostat (2020).

Figure 4.3: Modal Share of EU Trade with Trans-Caspian Countries (2018 in value [€] and volume [tons])

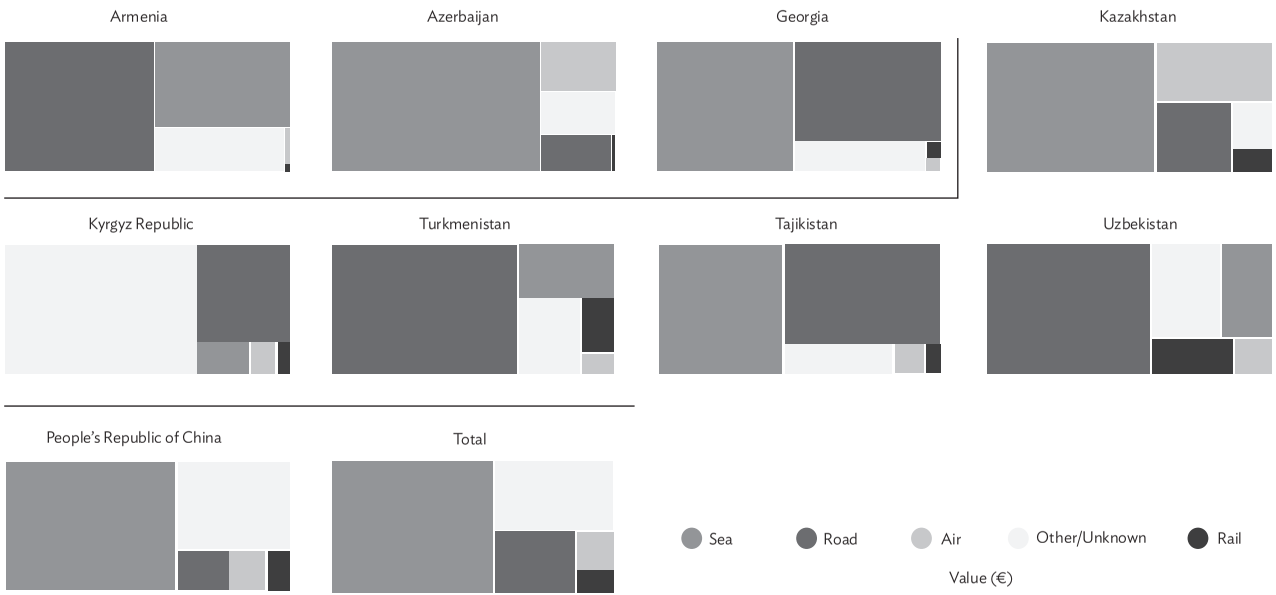
Modal Split (2018)					
	Sea, %	Rail, %	Road, %	Air, %	Other/Unknown, %
Value (€)	48	1.5	37	9	5
Tons	80	1.4	10	0	9



EU = European Union.

Source: Eurostat (2020).

Figure 4.4: Aggregate Modal Share of EU Trade with Trans-Caspian Countries



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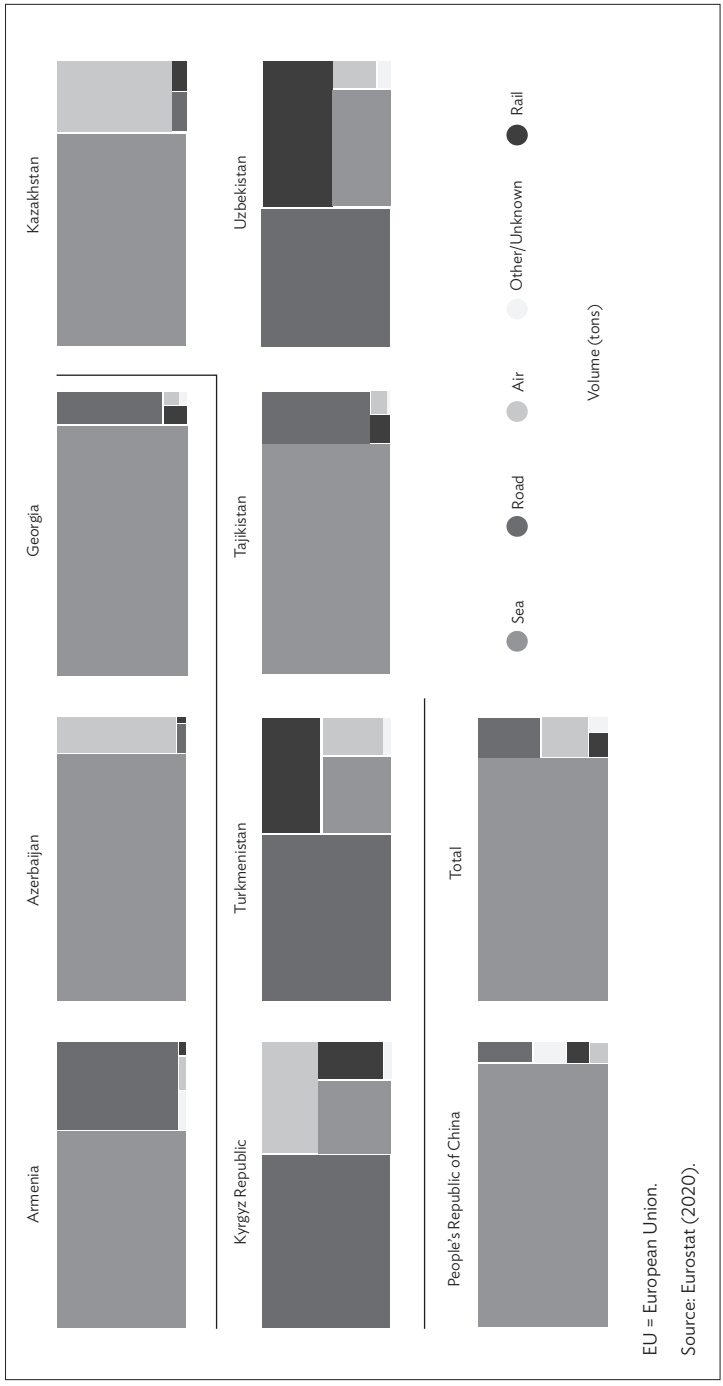

Figure 4.4 *continued*

EU = European Union.

Source: Eurostat (2020).

Table 4.10: Rail Transport between the PRC and Middle Corridor Countries via the Russian Federation ('000 tons)

Flow	Imports				Exports			
Year	2016	2017	2018	2019*	2016	2017	2018	2019*
EU	576.7	1,109.6	1,315.1	1,599.7	278.3	604.4	654.7	733.3
Azerbaijan	0.9	0.7	0.9	1.1	0.1	0.1	0.1	1.1
Georgia	0.6	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Iran	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

EU = European Union, PRC = People's Republic of China.
* indicates the December estimate.
Source: Own calculations based on Cargo Report 2020.

The EU has been developing transport corridors with Turkey, Central Asia, and the Caucasus for decades. However, trade volumes between the EU and the Middle Corridor economies remain low despite clear policy goals and concerted regional engagement. Due to structural economic geography limitations, the opportunity to increase rail share in the intermodal mix in these corridors is also limited. Except for landlocked economies with no alternatives, we find only limited potential for increasing rail share in the regional intermodal mix. Trade overwhelmingly leaves the European economic zone by sea, later transferring to other forms of transport where necessary. Direct rail links for transcontinental containerized transport thus make little economic sense when regional trade by rail between the EU and the Middle Corridor economies is negligible.

4.6 Policy Recommendations for Institutional Development

The PRC's regional economic development subsidization for, initially, transport integration and, ultimately, trade, industry, and investment integration in Middle Corridor economies through policy interventions and fiscal transfers is plausible in economic theory. A major policy goal of the PRC's Belt and Road is the immeasurable market creation effects of broadening trade, investment, production, and investment networks that come with regional economic integration. The individual countries of the Middle Corridor project have already organized

themselves, through effective policy measures, to function as a single economic unit for containerized rail freight transport, to facilitate this ambitious regional economic development project. Greater regional integration would benefit the individual states in the economic zone between the PRC and Europe. It would also help align the economically underdeveloped economies of the former Soviet Union with the macro-regional policies of the PRC and the EU.

Institutional development of the Middle Corridor rail freight cooperation mechanism would seem to be an excellent mechanism for enhancing investment from the PRC and trade facilitation between the PRC and the EU. However, a mismatch between expectation and reality remains. Regional cooperation for better transport corridors and economic corridor development has the potential to be an economic, social, and political good. However, the PRC's subsidization of the Middle Corridor containerized rail freight channel alone will not facilitate intra-regional trade between the Middle Corridor countries or extra-regional trade from the region to the PRC or to Europe. Therefore, we propose some policy and institutional development recommendations for the three polities involved: the Middle Corridor states, the PRC, and third-party stakeholders, including the EU and multilateral development banks and agencies.

4.6.1 Policy Recommendations for the Middle Corridor States

- Liberalize trade to attract more trade and transport volumes, and expand the Middle Corridor logistics grouping into a formal trade bloc.
- Develop a regional trade zone. A trade area between trans-Central Asia (excluding Turkmenistan), the Caucasus, and Turkey could engage more effectively with the PRC and EU trade policy, practices, standards, and technical and legal developments.
- Develop stronger intergovernmental dialogue mechanisms. Practice inter-ministerial and cross-government engagement in domestic economies to develop integrated institutions for transport, trade, industry, and other institutional forms of integration.
- Develop intra-regional economic integration policies to harmonize industrial development in the Central Asia and Caucasus regions.
- Develop extra-regional economic integration policies to engage with the EU and the PRC in developing the Middle Corridor

area economies into an attractive trade and investment environment.
- Focus policy on attracting freight volumes from the existing northern corridors connecting Europe and the PRC.

4.6.2 Policy Recommendations for the PRC

- Communicate policy intentions more clearly and transparently.
- Engage local stakeholders more effectively.
- Become a more engaged stakeholder with the EU and multilateral development banks in Central Asia and the Caucasus.
- Work more with existing multilateral stakeholders rather than practicing unilateral engagement policies.
- Transparently coordinate between central and local governments and clarify with which level of PRC government the partner economies should engage.
- Work within existing international systems, institutions, and paradigms to target world's best practice in institutional development across all Eurasian economic integration policies.

4.6.3 Policy Recommendations for the EU, Multilateral Development Banks, and Other Engaged Stakeholders

- Pursue and foster greater operational transparency and policy communication with PRC central and local governments and the Middle Corridor states.
- Establish third-party institutions to better monitor development and coordinate policy responses to CR Express, Middle Corridor, and wider transcontinental rail development.
- Develop third-party institutions for setting and implementing trade and legal standards.
- Ensure that the European legal environment prevails in any trade and logistics disputes.
- Implement multilateral organization best practices for further Middle Corridor development.
- Engage more with provincial and prefectural-level governance stakeholders in the PRC.
- Clearly separate the Belt and Road, Eurasian Economic Union, and Greater Eurasian Partnership policies from practical trade, transport, and logistics policy.
- Involve the EU more as an engaged regional stakeholder and infrastructure investment leader.

- Engage multilateral development banks and local programs like CAREC and TRACECA to help implement best practice for the countries, economies, people, and institutions in the Middle Corridor states.

The Middle Corridor economically connects states that are not naturally economically integrated. The Middle Corridor could have been the vanguard of a range of regional multilateral institutions representing a series of poles to uphold the Silk Road Economic Belt, the Iron Silk Road, the Greater Eurasian Partnership, and the CR Express Europe and CR Express Central Asia class rail systems. For the Belt and Road Eurasian transport policy to have succeeded, it would have needed third-party independently evolved institutions to dock with these Middle Corridor host economies. If the PRC were policy-determined to support the land component of the Eurasian Belt and Road program, then the intermodal Middle Corridor could have been a lynchpin for likely future success.

However, against the PRC's subsidy-based development policy, we find serious limitations in the economic geography and structural capacity of Middle Corridor states as well as the Europe demand-side positions. The development of the Middle Corridor's Central Asia and Caucasus states' containerized rail freight infrastructure exists in a vacuum in which institutional agency is largely limited to reactionary policy emanating from the markets on either side of the region, in the PRC and in the EU. The Middle Corridor states are limited to reactionary policies to facilitate freight transport and trade policy. The evidence to date indicates that these states are coordinating institutions, governments, transport infrastructure, private enterprise, and both intra-regional and extra-regional institutions. However, against this positive institutional development, we find that Middle Corridor states' economic policies will eventually face the development ceiling of demand-side factors from the EU. For Middle Corridor economies, transparent pricing, openness to foreign investment, and transparent international agreements all point to a greater level of economic integration across the Middle Corridor economic area, with possibilities for future multilateral trade bloc integration. Creating a uniform transport bloc could better facilitate trade with Europe. However, we ultimately find the prospects for continued economic development, transport expansion, and institutionalized trade growth for Central Asia, the Caucasus, and Turkey limited by the lack of demand from the European side.

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5

Enhancing Connectivity and Trade between CAREC Countries and the World: Benefits, Risks, and Policy Implications

Yelena Kalyuzhnova and Hans Holzhacker

5.1 Introduction

Increased trade and business relations have resulted in the rise of linkages among countries of the Central Asia Regional Economic Cooperation (CAREC) region and the rest of the world. This has intensified since the CAREC region has become an important transit area for Euro–Asian trade. In 2006, as part of an initiative of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), the Trans-Asian Railway Network Agreement was signed by 17 Asian nations to build a transcontinental railway network between Europe and Pacific ports in the People's Republic of China (PRC). As linkages increase, the debate about the risks and the benefits of such connectivity has grown.

Both separate CAREC and overreaching initiatives contributed to increasing connectivity in the region. Kazakhstan adopted a program called *Nurly Zhol* (Bright Way), in which infrastructure construction, particularly roads and railways, plays a significant role. Important transcontinental transport routes are being established between Europe and Asia, such as the Western PRC–Western Europe Corridor and the New Silk Road within the PRC's Belt and Road initiative. In December 2014, a new railway connecting Central Asia with the Persian Gulf through Iran was officially opened. Turkmenistan is building a railway

line to Tajikistan via Afghanistan, bypassing Uzbekistan. Talks about a Pakistan–Afghanistan–Uzbekistan railway have recently intensified. In addition, there are longstanding plans for constructing a PRC–Kyrgyz Republic–Uzbekistan railway.

The development of Eurasian transit routes and the contribution of Central Asian economies to these routes are essential enablers of enhancing the region's trade potential. However, this potential is not yet fully utilized due to challenges related to connectivity, market access, lack of large-scale and focused trade facilitation programs, institutional differences, and limited bilateral relations. Despite the region's large potential as transshipment routes, realizing this potential requires intensified, coordinated efforts and international actions.

Several CAREC countries are landlocked with limited (or no) direct access to the sea. They are remote from major world markets. In addition, these countries have a low economic density and long distances. Fragmented supply chains combine with inadequately structured transit procedures. This can result in significantly higher transport costs for landlocked countries in reaching the nearest ports, inhibiting the realization of the full trade potential. Smooth and timely supply chain management is particularly vital for agricultural and agribusiness products. Therefore, trade connectivity plays a significant role in the overall economic prosperity of the CAREC countries.

Without a doubt, better connectivity can increase the CAREC region's linkage to international networks. Countries with very low or very high levels of connectivity are more resilient to shocks in global networks—in the first case, due to the limited number of partners and, in the latter, due to the limited number of diversified connections, which could provide alternative routing.

This chapter analyzes the importance of better connectivity for CAREC countries and discusses the need for further steps in developing products based on natural or historically accumulated comparative advantages. The chapter suggests that initiatives can be clustered into economic corridors that provide economies of scale and scope and good connectivity. Therefore, their impact can be scaled up.

The chapter concludes that progress will require redesigning schemes, both for local and foreign investments, along with the development of capital markets. Trade facilitation remains an overarching objective. Better coordination of sectoral policies and priorities by measures for collaborative policy formulation and implementation, alignment of national and regional planning, and regulatory convergence in the region are required.

5.2 Trends in CAREC's Connectivity

5.2.1 Trade Costs

Enhanced connectivity and regional and global integration contribute to the diversification of the economy through new jobs and opportunities. Improvements in the transport sector and digitalization are expected to lower transportation costs and time, better integrate rural areas into national and regional economic centers, and increase trade volumes. In addition, improved transport systems contribute to the re-clustering of manufacturing industries alongside transportation networks. This also provides greater opportunities for knowledge transfers (Duernecker, Meyer, and Vega-Redondo 2014), which will allow the Central Asian countries to adapt and increase competitiveness. However, better connectivity will also intensify import competition.

New transportation corridors enable the reduction of trade costs, triggering further Euro–Asian economic integration (Pomfret 2019). At the same time, economic growth and enhanced integration call for new, more efficient, and more environment-friendly transport solutions.

Investments into physical infrastructure need to be prioritized on the grounds of commercial viability, the priorities of individual countries, regional cooperation options, and the expected enhanced role of transit routes (Pomfret 2010). Coordinated action is required toward institutional improvements. There are inefficiencies related to complicated tariff structures, customs procedures, sabotage, and other rules and procedures inhibiting smooth logistics. Sometimes skills and personnel are lacking within the responsible authorities. There is the need to standardize, digitalize, and simplify procedures to establish corridors in the legal, procedural, and technical sense. Transport costs account for only about 38% of trade costs for goods trading, according to the World Trade Report 2018 (WTO 2018). The rest of the costs are due to logistics, border crossing, information and transactions, trade policy, and others. For trade in services, transport costs account only for about 15%, and the rest are "soft" costs. The CAREC countries have a legacy of high trade costs (Pomfret 2019) and will only benefit if governments can further reduce barriers that increase the trade costs.

Many issues remain to be resolved for improving connectivity infrastructure in CAREC, especially soft infrastructure. The *CAREC Corridor Performance Measurement and Monitoring Annual Report 2019* (ADB 2020) shows that there have been improvements in rail transportation, especially since 2015. The speed for rail transport to travel on CAREC corridors rose from 27.2 kilometers (km)/hour in 2010 to 45.0 km/hour in 2019, net of delays. However, with delays of

various kinds, the average speed for rail transport was only 19 km/hour in 2019. The average time needed to cross a border via rail transport was 20.6 hours in 2019, a lot less than in 2014, but only slightly below 22.1 hours in 2010. For more information on the trade opportunities of the CAREC Trans-Caspian Corridor, see Box 5.1.

Box 5.1: Trade Opportunities and Impediments of the CAREC Trans-Caspian Corridor

The Central Asia Regional Economic Cooperation (CAREC) framework,[a] supported by the Asian Development Bank (ADB), includes six transport corridors, of which corridor-2 is a wide-ranging multi-modal corridor that links the Lianyungang seaport of the People's Republic of China (PRC) in the east and the Georgian Black Sea ports in the west, passing the Caspian Sea. It has four sub-corridors. From the PRC–Kazakhstan and PRC–Kyrgyz Republic borders, the sub-corridors move through the Uzbek Fergana valley, Kazakh steppe, and Turkmen steppe and end up in Aktau, Kuryk, and Turkmenbashi ports at the Caspian Sea. After crossing the Caspian Sea, all sub-corridors converge in Azerbaijan and continue to Georgia through the 836-km-long Baku-Tbilisi-Kars (BTK) railway or, alternatively, the road network. From there, cargo can go further to Europe either from Georgian or Turkish ports.

CAREC corridor-2 has road, rail, and water crossings that make it a complex corridor. It also coincides partially with the Transport Corridor Europe Caucasus Asia (TRACECA) middle corridor, alternatively also called Trans-Caspian International Transport Route (TITR), the western Europe–western PRC International Transit Corridor, and the Lapis Lazuli route, which is supported by ADB.

The three Caspian economies of Turkmenistan, Kazakhstan, Azerbaijan (plus Uzbekistan, which is not a Caspian economy but plays a big role in the corridor) are rich in mineral fuels. The revenues generated by mineral fuels have allowed these states substantial investment in port, road, and rail infrastructure.

The three new Caspian ports in Turkmenistan, Kazakhstan, and Azerbaijan were put in operation almost simultaneously in the second half of 2018. The Turkmenbashi International Seaport was inaugurated in May 2018 after 5 years of construction, which cost the government over $1.5 billion. The improvements have increased the cargo handling capacity from approximately 18 million tons (excluding oil products) to 26 million tons a year. Also, a 564 km toll road connecting Ashgabat to Turkmenbashi seaport was completed in 2018.

[a] Includes Afghanistan, Azerbaijan, the PRC, Georgia, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan.

continued on next page

Box 5.1 *continued*

On the other hand, Kazakhstan opened Kuryk port, in addition to Aktau, in August 2018 and this new port took all rail-ferry operations. Kazakhstan also started introducing public–private partnership models, revised the railway law, and implemented the Automated System for Customs Data (ASYCUDA) in July 2016.

Azerbaijan, from its side, put a new Baku International Sea Trade Port (Alat terminal) into operation in 2018, and endorsed strategic roadmaps for the development of the national economy and its economic sectors, including logistics and trade. The port's construction started in 2012, and the construction of phases 2 and 3 is still ongoing. The new port has a capacity of 15 million tons per year of bulk cargo freight and 100,000 twenty-foot equivalent unit (TEU) containers. The Azerbaijan Caspian Shipping CJSC (ASCO) launched a regular feeder line in the Alat-Turkmenbashi-Alat direction in 2021.

Notably, CAREC corridor-2 countries have a strong rail sector, a large rail network (with 21,000 km in Kazakhstan, nearly 7,000 km in Uzbekistan, over 5,000 km in Turkmenistan, nearly 3,000 km in Azerbaijan, and over 2,000 km in Georgia), and most of them are expanding these networks extensively. The rail network is complemented with over 365,000 km of roads in the mentioned countries. During 2.5 years of operations, as of mid-2021, the BTK railway handled 33,267 TEU containers, including 26,828 TEU transit.

ASCO plays a connecting role in the Caspian. The company's fleet consists of 58 vessels: 24 tankers, 13 ferries, 19 general cargo, and 2 Ro-Ro ships, while the offshore support fleet is made of 205 vessels. At present, 7 ferries and 2 Ro-Ro vessels with a capacity of 28 wagons in the ASCO fleet have reached the useful lifespan (25 years). ASCO plans to replace these ships as per its fleet renewal plan 2030. ASCO ferries operate in the directions of Kazakhstan and Turkmenistan and make 2–3 trips a day on average. These carriers have the potential to carry 95,000 wagons per year (only wagons with ferries). In 2019, ASCO transported 44,159 wagons across the Caspian Sea and 37,424 in 2020.

While infrastructure investment around the Caspian has shown a strong dynamic during 2018–2021, the share of intra-CAREC trade (excluding the PRC) in the region's trade with the outside world remains quite modest. It averaged only 6.8% in 2003–2019 (CAREC Institute, Economic Brief, Holzhacker, June 2021[b]). The PRC's share, by contrast, increased from 7.6% in 2003 to 23.2% in 2019. In 2019, 11 CAREC countries traded $87 billion within CAREC, out of which the PRC alone exported $47 billion into the rest of CAREC, and the 10 other CAREC members exported $29 billion worth to the PRC, where $19 billion was trade in mineral fuels.[c] If we remove the PRC from the equation, the 10 remaining CAREC countries traded $11 billion in 2019 among themselves, where $3 billion came from mineral fuels.

[b] https://www.carecinstitute.org/wp-content/uploads/2020/06/CI-HH-Econ-Brief-Intra-CAREC-Trade-29-June-2020-1.pdf

[c] https://comtrade.un.org/

continued on next page

Box 5.1 *continued*

Given the reality of industrial and service structures and the production capacity of the CAREC members (excluding the PRC), trade prospects look good in transit.

Each year, the PRC ships about 10 million containers of cargo by sea and more than 400,000 containers over the New Eurasia Land Bridge (which involves the PRC, Kazakhstan, Mongolia, the Russian Federation, and Belarus). The PRC and Europe trade, on average, over €1 billion a day. Most of this trade is in goods, and only about 10% is trade in services. More than 90% of PRC–European Union tradable goods are transported through maritime routes and through railways along the New Eurasia Land Bridge.

The Trans-Caspian Corridor is expected to reduce the time for cargo shipments between Asia and Europe to 1 week from 1 month by rail, and to 2 weeks from 45 days by sea.

For this objective to be achieved, the CAREC members along the Trans-Caspian Corridor need to implement a number of changes, which include the following:

(1) Develop a clear legal supranational framework to harmonize transportation tariffs along the corridor and address the issue of supply chain disconnectedness.
(2) Speed up the development of joint customs procedures to prevent duplication of customs operations, and achieve optimal use of human and technical resources.
(3) Speed up the development of free trade zones (FTZs), which can attract important value-added enterprises that contribute to the promotion of new industries.
(4) Refine FTZ-related and state-owned enterprise privatization-related legislation and address privatization shortcomings.
(5) Address legal loopholes in railway laws.
(6) Prioritize the development of single windows.
(7) Speed up the development of inland dry ports and container terminals.
(8) Deploy cargo tracking technologies and enhance information and communication technology integration into transport operations.
(9) Facilitate efficient handling and standardization across break-in-gauge and wagon quantity issues, chargeback arrangements, wagon repair standards, settlement of repair charges, shunting, marshalling, loading and unloading, etc.
(10) Deploy gauge change innovation at various border-crossing points to achieve efficiency.
(11) Increase railway capacity to handle "long" PRC trains with 42-44 forty-feet equivalent units.
(12) Alleviate the visa bottleneck.
(13) Create transport-expeditor associations.

Source: This box was prepared by Tamar Berdzenishvili, Senior Knowledge Management Specialist, CAREC Institute. Data are sourced from CAREC working group meetings and CAREC Institute business correspondence with CAREC member governments, unless otherwise indicated.

There has been some modal shift of PRC–EU trade as shipping and air services were disrupted by COVID-19 (and rail was not). The modal shift is also due to longer-term developments because rail transport is often more suitable for just-in-time delivery. Rail offers speed and reliability while ships are slower and subject to disruption by weather, pirates, etc. (this is a good development for landlocked countries hoping to participate in global value chains [GVCs]) (Kalyuzhnova and Pomfret 2020). Table 5.1 indicates the rapid growth in Eurasian rail traffic by the United Transport and Logistics Company–Eurasian Rail Alliance, founded by Belarus, Kazakhstan, and the Russian Federation in 2014.

Table 5.1: Number of Twenty-Foot Equivalent Containers (TEUs), 2015–2020

Year	Number of TEUs
2015	46,000
2016	100,500
2017	175,800
2018	280,500
2019	333,000
2020	546,900

Source: UTLC website, www.utlc.com (accessed 16 February 2021).

Unfortunately, there was much less progress on road transportation. The "speed without delay" for road transport to travel on CAREC corridors was 43.6 km/hour in 2019, only slightly above the 2010 figure of 41.0. "Speed with delay" slowed to 22.6 km/hour in 2019 from 24.4 in 2010. The border-crossing time remains critical. The average time needed to cross a border for road transport was 12.2 hours in 2019, up from 6.3 hours in 2010. This increase was mostly the result of lengthy customs controls, commercial inspection, loading and unloading at high-traffic border-crossing points, and lengthy physical examination of trucks associated with anti-smuggling operations.

5.2.2 Globalization in Transition

To profit from reduced trade costs and live up to the new economic realities and competition on the Euro–Asian continent, CAREC countries must turn transport corridors into economic corridors. If CAREC

countries can do so, modernize production, and find appropriate export niches, then reduced trade costs would positively impact economic growth (Demidova 2008).

The technological change that is under way currently modifies how GVCs can be organized. Digitalization, robotics, and 3D printing lead to revised production schemes (Giroud and Ivarsson 2020). Some of the revisions might be in opposite directions, such as insourcing and outsourcing or reshoring and offshoring, based on technological disruptions involved in the industrial process. However, whatever the reorganizing of GVCs looks like exactly, the net result is likely to be even faster growth of trade in services than in goods than is already the case. Trade in telecommunication and information technology services and business services is rising especially fast. A trend toward growing trade in services, against stagnating trade in goods and tangible foreign direct investment flows, was already visible in the past decade. This will become even more pronounced now. COVID-19 has boosted digitalization and is moving the world additionally toward intangibles.

Globalization reached a turning point in the mid-2000s. Value chains for the production of goods have become less trade-intensive. Goods production and trade in goods continue to grow in absolute terms, but a smaller proportion of goods are traded across borders now. Trade in services grows significantly faster than trade in goods and generates larger economic value. At the same time, less than 20% of cross-border trade in goods is now based on labor cost arbitrage. GVCs are becoming more knowledge-intensive and relying on a highly qualified workforce. Investments in intangible assets (such as research and development, brands, and intellectual property) have more than doubled since 2000, from 5.5% to 13.1% (McKinsey Global Institute 2019). Technological change such as 3D printing allows value chains to become more regionally concentrated in the future. As a result, companies may increasingly build their production closer to demand.

In his work, Antràs (2020) evaluated to what extent the world economy has entered a phase of de-globalization and provided some thoughts on the future of GVCs in the post-COVID-19 age. The observed slowdown in globalization is a natural consequence of the rapid increase in globalization in the late 1980s, 1990s, and early 2000s. The COVID-19 pandemic might negatively influence the future of globalization if heavy policy tensions across countries will prevail.

The popularization of digital life by the COVID-19 pandemic will further speed up the adoption of digital technologies in all spheres of life (Iivari, Sharma, and Ventä-Olkkonen 2020), thus also boosting related technologies. While the COVID-19 pandemic might slow the adoption of innovative technologies because of weaker investment due

to worsened finances and sentiment, it will speed up adoption in the mid to long run. One reason for this is that companies less adaptable to the new environment will go out of business or at least significantly lose importance (Deimler and Reeves 2011).

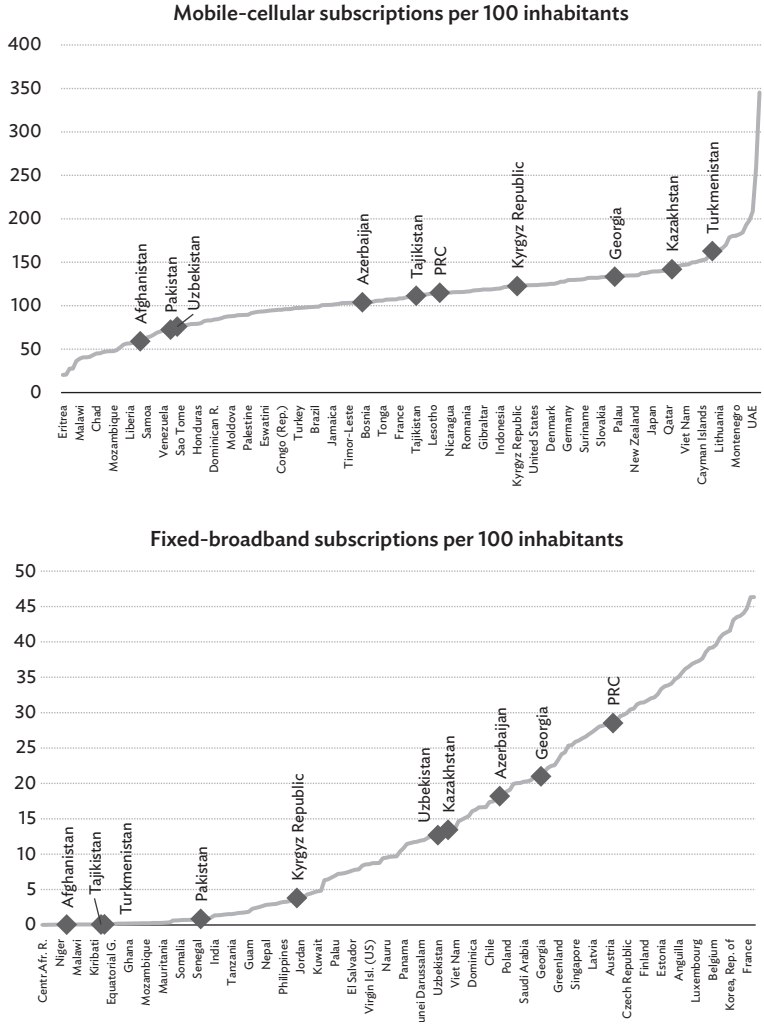
Besides significant social and economic impacts in the short run, the COVID-19 pandemic has substantial implications for the CAREC countries eventually due to its modification of global development trends.

Attracting multinational enterprise operations and related foreign direct investment, local sourcing, and consequent job generation might become even more difficult due to the reorganization of the GVCs. It will be challenging if there is insufficient infrastructure, an insufficiently qualified workforce, and an insufficient technological and business level of local suppliers. At the same time, opportunities arise to participate in the GVCs, but supply chain digitalization will cause the GVCs to be more platform-based and asset-light. GVC participation will require high-quality hard and soft digital infrastructure and adequately skilled local labor and suppliers (Christianty and Hidayati 2020).

Digital preparedness varies quite substantially among the CAREC countries. Turkmenistan, Kazakhstan, and Georgia are quite advanced regarding mobile phone subscriptions, whereas Afghanistan, Pakistan, Uzbekistan still need to catch up quite a lot (Figure 5.1). Broadband subscriptions, more important for industrial purposes, better reflect the digital preparedness of countries. The People's Republic of China (PRC), Georgia, and Azerbaijan are doing well with regard to broadband, whereas Afghanistan, Tajikistan, and Turkmenistan find themselves on the low end.

The World Bank's Digital Adoption Index ranks Kazakhstan, Georgia, and Azerbaijan as best prepared among the CAREC countries; Turkmenistan, Tajikistan, and Afghanistan have to catch up most (Figure 5.2). The index also measures digital adoption across three sectors—government, business, and people. It ranges from 0 to 1, with 1 indicating the most advanced digital adoption. Globally, Singapore ranks best on the index at 0.87, and the Central African Republic worst the at 0.15. The Kyrgyz Republic, Mongolia, Tajikistan, and Turkmenistan do best on the "business" subindex. All other CAREC countries are best rated on the "government" subindex. Several CAREC countries are relatively successfully running e-government programs but need to do more to support the private sector.

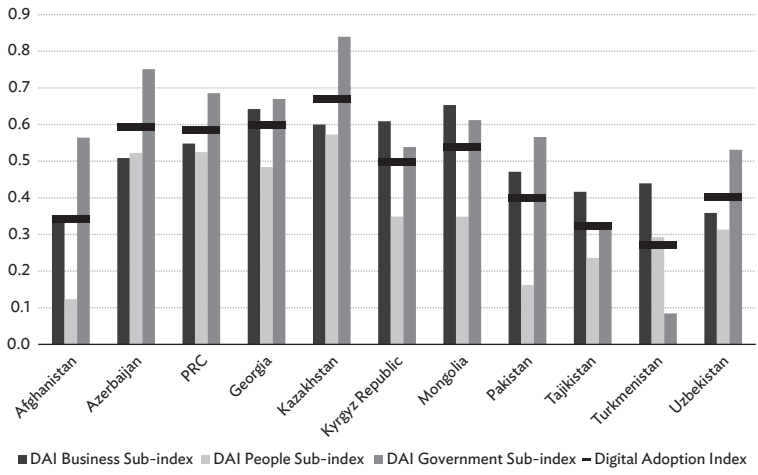
Figure 5.1: Digitalization in CAREC Countries



PRC = People's Republic of China, UAE = United Arab Emirates.

Source: ITU, https://www.itu.int, 2018 data; authors' calculations.

Figure 5.2: Digital Adoption Index, CAREC



CAREC = Central Asia Regional Economic Cooperation, DAI = Digital Adoption Index, PRC = People's Republic of China.

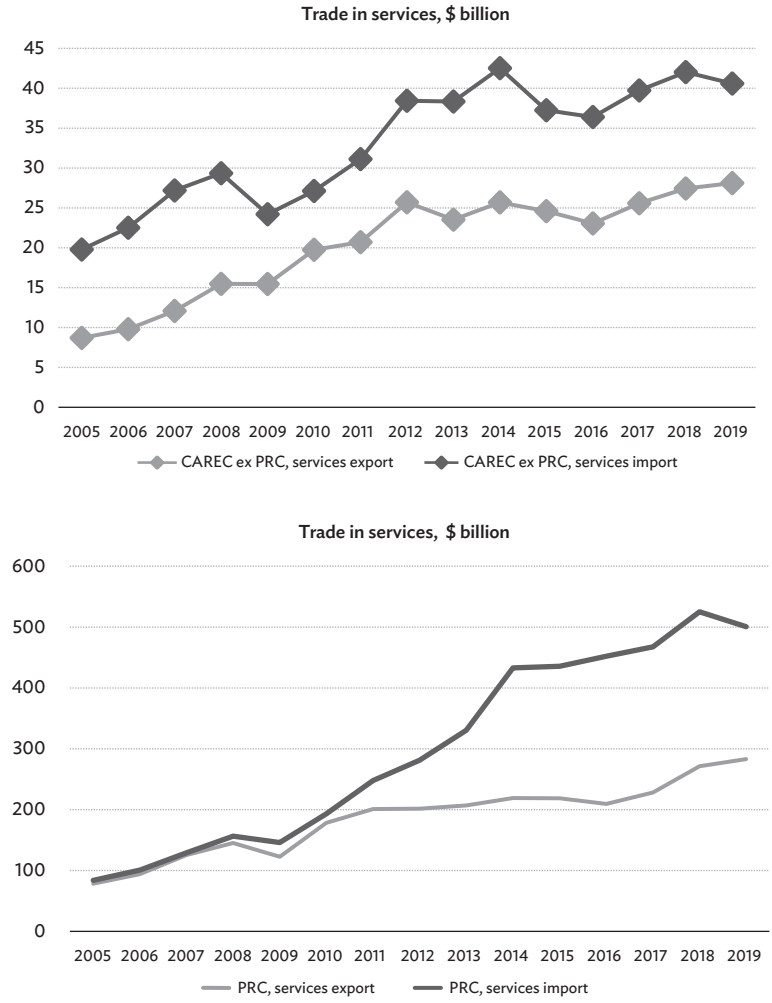
Source: World Bank, https://www.worldbank.org/en/publication/wdr2016/Digital-Adoption-Index, 2016 data; authors' calculations.

Whereas global trade in services is expanding fast, CARECexPRC's[1] trade in services is somewhat stagnating (Figure 5.3). CARECexPRC's share in global services exports fell from a peak of 0.56% in 2012 to 0.46% in 2019. This indicates that CARECexPRC is not sufficiently well prepared to provide services, including in tourism. Also, the region's earnings from transit are not as high as its geostrategic location would allow. The ability to provide services at a reasonable quality/cost combination will have to be augmented. The PRC's rising services imports should offer new opportunities to the CAREC countries and should be investigated carefully.

CARECexPRC's services import is also stagnating. Fewer engineering services for mining related to the current phases of oil field development can in part explain this for Kazakhstan. The stagnation is

[1] Because of the large weight of the People's Republic of China (PRC) in the Central Asia Regional Economic Cooperation (CAREC) region, and its special strategic role, it is often informative to look at indicators characterizing the region excluding the PRC ("CARECexPRC").

Figure 5.3: CAREC Ex-PRC Services Trade Is Stagnating, 2012–2019



CAREC = Central Asia Regional Economic Cooperation, PRC = People's Republic of China.
Source: Trade Map, www.trademap.org; authors' calculations.

problematic because it reflects the insufficient use of advanced services from abroad, e.g., financial services; information and communication technology services; and use of intellectual property such as patents, utility models, trademarks, and registered designs, which can adversely affect the economic and social development in the region.

5.3 Connectivity and Diversification

5.3.1 Export Diversification

Ricardo's comparative advantage approach (Ricardo 1817) emphasized that a country should develop those industries for which it has the relatively best endowments and trade the goods produced by these industries for goods for which the country is relatively less well endowed.

Global trade and integration processes have been extensively discussed in academic literature (Hausman and Klinger 2006; Hidalgo et al. 2007; Krugman 1985). Many scholars emphasize that the gains from trade will be realized if trade costs are sufficiently low, whereas others, such as Porter (1990), emphasize that price responses alone are not enough, and that prosperity is policy-driven.

Porter believes that "National prosperity is created, not inherited. It does not grow out of a country's natural endowments, its labor pool, its interest rates, or its currency's value, as classical economics insists. A nation's competitiveness depends on the capacity of its industry to innovate and upgrade" (Porter 1990, p. 73).

Porter's approach (Porter 1990) claims to open opportunities for developing countries to depart on a way of innovation, diversification, and relatively fast catching up. In contrast, the comparative advantage approach is sometimes accused of being a theory cementing the prevailing international division of labor in the interest of the advanced, well-diversified, high value-added-producing countries.

Among the strategies he recommends are (i) cost leadership, attempting to offer products or services at the lowest costs; (ii) product differentiation, attempting to provide a variety of products, services, or features to consumers that competitors are not yet offering or are unable to offer; and (iii) innovation, attempting to leapfrog other market players via the introduction of completely new or notably better products or services.

However, history shows that it is not easy to diversify away from commodity production. Moreover, theoretical discussions on how much diversification is optimal continue.

"The long-term experience of nations—such as the United Kingdom and the United States, Australia and Canada, and Argentina and

Brazil—suggests that economic diversification is neither necessary nor sufficient for economic development...The United States and the United Kingdom increased their per capita incomes tenfold since 1870, and have diversified exports. Australia and Canada's economies have also grown as quickly, but their exports remain specialized" (Gill et al. 2014: 8).

Hausmann and Klinger (2006) point out that the probability a country will develop the capability to be good at producing one good is related to its installed capability in producing similar ones, for which the currently existing productive capabilities can be easily adapted.

It will not be easy to diversify away from fuels and metals. The challenge is to find the optimal path for utilizing a country's natural endowments, existing facilities, acquired capabilities for moving toward innovation and diversification in a realistic and financeable way.

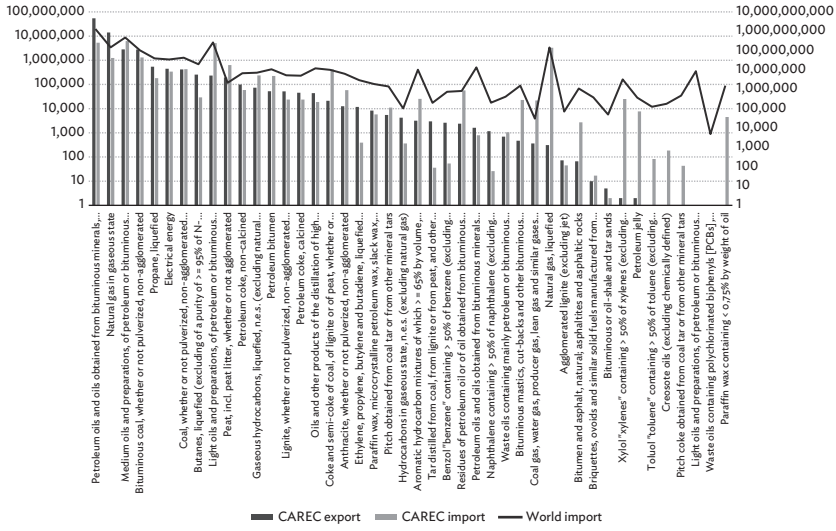
The New Trade Theory (Melitz 2003) stresses the importance of firms rather than sectors for understanding the challenges and opportunities countries face in the age of globalization. Within the very same industry, some firms cannot cope with international competition while others thrive. The resulting intra-industry reallocations of market shares and productive resources are much more pronounced than inter-industry reallocations driven by comparative advantage.

In industries where the output required to attain economies of scale represents a significant proportion of external demand, only a small number of enterprises are viable. Typically, this is in industries with high fixed costs. The first-mover advantage might limit competition because new entrants have no chance to develop sufficient large economies of scales, given incumbents already serve a large chunk of the market. Some argue that economies of scale and other barriers to entry require government intervention and strategic trade policy.

5.4 CAREC Starting Points and Potential Directions of Diversification?

A starting point for CAREC countries' diversification is downstream production. Downstream production is insufficient in the long run and does not replace finding niches for backward linkages in the GVCs. Still, it is a beginning based on CAREC countries' comparative advantages. CAREC countries produce and export a large volume of mineral fuels. However, within this industry (Number 27 according to the Harmonized System of trade classification), the portfolio of (6-digit) products is strongly concentrated on the left-hand side of Figure 5.4, much more than world demand (depicted as black line in Figure 5.4). In addition, the CAREC region's import demand would also corroborate that. There might be opportunities to increase the production of at least some of the

Figure 5.4: CAREC Foreign Trade and World Import in Industry HS 27 Mineral Fuels, 2018 ($ '000)



CAREC = Central Asia Regional Economic Cooperation.

Source: Trade Map, www.trademap.org; authors' calculations.

products located more on the right-hand side of the chart, given that CAREC countries already export them, as the blue bars in Figure 5.4 indicate. The mineral fuels industry is only one example where downstream activities appear necessary; a similar reasoning applies to metals and agricultural products.

There are activities to build petrochemical industrial complexes in Azerbaijan, Kazakhstan, Turkmenistan, and Uzbekistan. In June 2020, Globuc announced that Jizzakh Petroleum JV LLC, a joint venture of JSC Uzbekneftegaz and Gas Project Development Central Asia (a subsidiary of Gazprom International), will carry out a major revamp of the Ferghana oil refinery that will enable the introduction of a hydrocracking process and the launch of production of AI-92 motor gasoline and Euro-5 diesel fuel on 1 July 2023 (Globuc 2020). During 2014–2018, the oil refinery in Shymkent, one of three refineries in Kazakhstan, was modernized (*The Astana Times* 2018). Ethylene was Uzbekistan's fifth-biggest export in 2019 (WTO 2020).

However, developing downstream production is not an easy task, as the recent withdrawal of Borealis from investing in the construction of a polyethylene factory in the Atyrau region of Kazakhstan shows (CHEManager 2020).

Diversifying is more urgent since global decarbonization strategies will reduce the use of these fuels for heating purposes, energy generation, and the running of combustion engines (Kalyuzhnova and Pomfret 2017).

Due to the COVID-19 pandemic, even more emphasis is being put on the green economy transition (Sandbrook, Gómez-Baggethun, and Adams 2020), with some loans and investments aimed at reviving the global economy with conditionality of progress in this direction. Although the process might still take a while, global demand for, and prices of, mineral fuels might remain subdued for some years and in the longer term (Kalyuzhnova and Lee 2020).

CAREC countries have already undertaken initiatives and should further intensify developing production based on their natural or historically accumulated comparative advantages, especially by broadening the product portfolio of the mineral fuels, metals, and agricultural industries (World Bank 2011).

In its February 2020 publication about its CAREC regional integration update, the CAREC Institute emphasizes that smart diversification is especially important for CAREC to adjust to the new global environment and increase its global economic weight. CAREC countries adopted various plans for industrial and agricultural development, energy sector development, tourism, and other sectors. CAREC countries need to foster industries able to process downstream the region's rich endowments with natural resources, such as metal ores, hydrocarbons, and arable land (CAREC Institute 2021).

Green transition and decarbonization strategies, intensively discussed in connection with measures aimed at reviving the economy to overcome the outfall of the COVID-19 pandemic (Kuzemko et al. 2020), along with the substantial decrease in the cost of renewable energy, make change in the CAREC countries' production portfolio even more necessary.

Although this transition might not advance as fast as is desirable, it will substantially affect the CAREC region's global export opportunities and revenue sources both for the business sector and governments in the medium run. At the same time, the green transition and the general move to more science-intensive production provide opportunities for new products and employment. The CAREC economies can also exploit their proximity to the PRC with its fast-growing gross domestic product and household incomes and drive for modernization and high-quality

products. The PRC's 14th Five-Year Plan will probably put a stronger emphasis on sourcing closer to the domestic shore.

Organizing or supporting techno-parks, special economic zones, and business incubators, including through the cooperation of more than one country, and supporting universities and think tanks can help foster technological skills and developing business services and exporting (Szabó 2006).

The development of services exports is important. It includes joint CAREC efforts to profit from the global growth in services trade. This might be slowed in branches such as tourism due to the COVID-19 pandemic, but longer-term joint tourism initiatives should pay off. Digitalization has further advanced during the pandemic. This opens additional opportunities for business services. Trade in services like information and communication technology, banking, logistics, aviation, etc. complement economic expansion and integration in multiple ways.

If initiatives can be clustered into economic corridors that provide economies of scale and scope and good connectivity, the impact can be scaled up. If CAREC countries can turn transport corridors into economic corridors, modernize production, and find appropriate export niches, reduced trade costs would positively impact economic growth (Demidova 2008).

Greater Mekong Subregion countries, economic corridor pioneers, have had encouraging experiences with economic corridors. At least in part, thanks to economic corridor development, intra-regional trade grew from $26 billion in 2000 to $483 billion in 2017. Foreign direct investment flows among the region's countries increased from $0.4 billion in 2010 to $1.4 billion in 2017. International visitor arrivals rose from 16 million in 2000 to almost 66 million in 2016 (ADB 2021).

There are two important economic corridor projects in Central Asia. The Almaty–Bishkek Economic Corridor covers Almaty city of Kazakhstan, Bishkek city of the Kyrgyz Republic, and the areas around and between these cities. It aims to advance health, education, tourism services, and aggregate agricultural product marketing, including exports (CAREC 2016). The Shymkent–Tashkent–Khujand Economic Corridor, currently under development, opens new opportunities for a broad range of goods and services, including food and textile products, construction materials, chemical products (such as fertilizers and pharmaceuticals), and tourism-related services. There are plans for developing horticulture value chains, modernizing sanitary and phytosanitary measures, and developing food-quality certification services, and marketing regional tourism products. In addition, establishing cross-border special economic zones is also planned (ADB 2021). The corridor is envisaged between Shymkent city and

the Turkestan region in Kazakhstan, Tashkent city and the Tashkent region in Uzbekistan, and the Sugd region (including Khujand city) in Tajikistan.

The PRC–Pakistan Economic Corridor is another significant corridor undertaking, a project with big projects in transportation infrastructure, including the port of Gwardar, in energy, agriculture, and science and technology.

These economic corridors have contributed to the development in certain areas. However, some projects have not lived up fully to expectations. To improve their impact, they have to be better aligned with the overall economic policies and development plans of the countries involved.

5.5 Conclusions and Recommendations

CAREC countries need to develop their foreign trade further. It is vital to have effective transportation corridors and to reduce trade costs to do so. The product portfolios of the CAREC countries' industry and agriculture must be broadened. This will intensify intra-CAREC trade and the region's global exports.

Without this, CAREC countries may face intense import competition and will become pure transit territories in the worst-case scenario.

Global decarbonization efforts, green transition, and the consequences of the COVID-19 pandemic—such as accelerated digitalization and the high levels of human capital relative to income and wage levels in some CAREC countries—open new avenues for development and bring about new opportunities. However, these also make change more urgent, especially for oil- and gas-exporting countries. At the same time, the shift to technologically more advanced production and the green transition will provide opportunities for new jobs and new types of products and services.

The broadening and expansion of the export range require a robust set of measures in trade policy, coordination of sectoral policies, diversification, and business reforms. This chapter discusses the importance of such initiatives by CAREC countries and highlights the need to develop production based on countries' natural or historically accumulated comparative advantages.

CAREC countries are still in search of appropriate global and regional niches for their products and services. Cooperation among them would provide economies of scale and scope and amplify opportunities.

Advancing production and services to higher levels to meet the requirements of the new economic area is a complex task. This requires a full set of measures, ranging from further improving the business and

investment climate over advancing digitalization to trade facilitation, developing better channels for technology transfer, knowledge exchange, and much more (CAREC Institute 2021).

Initiatives could be clustered into economic corridors that provide much-needed transport and digital infrastructure, qualified labor supply, or specific economic policy measures to upgrade the countries' economic capabilities. However, corridor development must be well aligned with the countries' overall economic policies and development plans.

We suggest several recommendations to enhance connectivity between CAREC countries.

(1) Continue efforts to improve connectivity, especially focusing on soft infrastructure. To implement this, governments in cooperation with the private sector must provide second-order connectivity to local users to help them utilize the transcontinental transportation routes.
(2) Develop transport corridors into economic corridors to achieve economies of scale and scope. Businesses should be encouraged to settle in the corridor area, if needed, by establishing special economic zones with good energy and digital connectivity supply. Occasionally, some tax relief would also be a logical step.
(3) Facilitate better coordination of sectoral policies within countries and between them.
(4) Rethink infrastructure investment plans and, more importantly, plans to requalify the labor force and active labor market policies to cope with accelerated technological change, such as digitalization and decarbonization.
(5) Speed up the development of capital markets and initiatives to attract high-quality foreign investment. At the same time, avoid over-indebtedness by putting proper risk mitigation systems in place.
(6) Continue relevant reforms to improve the business and investment climate.
(7) Advance regulatory convergence in the region to allow smoother trade and better integration into regional and global supply chains, together with better alignment of national and regional planning for effective connectivity in the CAREC countries.

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PART III

Measuring the Economic Impacts of the Trans-Caspian Corridor

6

Infrastructure and Firm Performance in CAREC Countries: Cross-Sectional Evidence at the Firm Level

Dina Azhgaliyeva, Ranjeeta Mishra, Naoyuki Yoshino, and Kamalbek Karymshakov

6.1 Introduction

Effective infrastructure projects positively affect a region's economic growth, known as the "spillover effect." An adequate infrastructure project builds infrastructure, such as roads, railways, water supply, electricity, etc., and leads to the region's growth, along with that infrastructure (Yoshino, Azhgaliyeva, and Mishra 2020). In addition, an effective infrastructure affects firms by improving connectivity and ease of doing business, leading to more sales, including exports.

Improving understanding of the economic impacts of infrastructure is needed to identify and attract private finance (Azhgaliyeva 2021). Financing the access to infrastructure and improving the quality of infrastructure in Central Asia is challenged by low user charger rates, low population density, and large distances. This chapter studies the importance of infrastructure quality for firm performance in Central Asia.

There is a dearth of empirical studies on infrastructure in Central Asia due to a lack of data; most studies have focused on a single country (Yoshino et al. 2021). This study fills the gap in the literature by providing empirical evidence based on a firm-level enterprise survey among nine Central Asia Regional Economic Cooperation (CAREC) member countries: Afghanistan, Azerbaijan, Georgia, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, and Uzbekistan. Data

are sourced from the World Bank enterprise survey pooled data from 2008, 2009, and 2013.[1]

The above data show that the access to and quality of infrastructure vary significantly across CAREC member countries. Below we compare nine CAREC member countries based on the World Bank enterprise survey data. The average duration of power outages is over 7 hours per month. For example, the average duration of power outages is higher in Uzbekistan and Azerbaijan, with over 12 and 11 hours per month, respectively. Only around half (54%) of firms have access to broadband internet. For example, access to broadband internet is lower in Afghanistan, with just over 10% of firms reporting access to broadband internet. Customs efficiency is also low in these nine CAREC member countries with an average index of customs efficiency at 2.29, compared to that of high-income countries of 3.29, according to the World Bank Logistics Performance Index (LPI)[2] (2018). The customs efficiency index measures the efficiency of the clearance process, i.e., speed, simplicity, and predictability of formalities, by border control agencies, such as customs. It takes values from 1 (low) to 5 (high), with 5 being the most efficient.

Based on the above data for empirical estimation, this study demonstrates the positive spillover effect of access and quality of infrastructure, i.e., access to broadband, customs efficiency, and the quality of electricity connection, on firms' sales, including exports. In addition, this study shows how the impact differs for small, medium, and large firms. Based on this evidence, we provide policy recommendations for improving access to and quality of infrastructure for small, medium, and large firms. Since improvements in the access to and quality of infrastructure in nine CAREC member countries require substantial financing, differentiated policy support for small, medium, and large firms will allow firms to be supported cost-effectively.

The rest of the chapter is structured as follows. Section 6.2 reviews the literature on infrastructure in Central Asia. Section 6.3 explains the methodology. Section 6.4 describes the data, and Section 6.5 provides and discusses results. Finally, Section 6.6 concludes and presents policy recommendations.

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1 World Bank. Enterprise Surveys Data. https://www.enterprisesurveys.org/en/data (accessed 15 November 2019).

2 World Bank. 2018. Logistics Performance Index, https://data.worldbank.org/indicator/LP.LPI.CUST.XQ (accessed 15 November 2019).

6.2 Literature Review

Several research papers focusing on a larger sample of Eurasian countries highlight the importance of infrastructure for trade and performance among firms in Central Asian countries (Shepherd and Wilson 2007; Iimi 2011). Thus, Iimi (2011), using firm-level enterprise survey data for Europe and Central Asia, investigated the impact of the quality of infrastructure services on firms' costs and found that electricity outages and longer durations increase costs.

To the best of our knowledge, few papers focus on infrastructure and trade relationships in the context of Central Asian countries. Thus, Raballand (2003) measured the impact of the landlockedness on trade in Central Asian economies. He argued that landlockedness causes high transport costs, which in turn significantly reduces international trade. Grigoriou (2007) analyzed the impact of internal infrastructure development and landlockedness on Central Asian countries' trade. He argued that while the effect of internal infrastructure appears to be limited, the infrastructure of transit countries is expected to affect the trade of Central Asian countries significantly.

Some studies at the regional level of a specific country show that infrastructure investment demonstrates a spillover effect on the socioeconomic conditions of regions, increasing economic growth and decreasing poverty level (Yoshino and Abidhadjaev 2017; Karymshakov and Sulaimanova 2021a; Yoshino, Azhgaliyeva, and Mishra 2020).

Among them, Karymshakov and Sulaimanova (2021b), examining the impact of infrastructure on trade in three Central Asian countries, noted that the quality and quantity of infrastructure impact trade, though this effect varies by country. Thus, a positive relationship between infrastructure and trade flows is indicated in the case of Kazakhstan. In contrast, with their limited railroad and air transportation infrastructure, the Kyrgyz Republic and Tajikistan did not demonstrate such an effect.

The main contribution of this study to the existing literature is that it provides empirical evidence of the role of access to and the quality of infrastructure in firms' sales and exports, highlighting that the impact depends on firms' size. For example, electricity expenses affect small firms more, and customs affect medium and large firms more, while broadband significantly impacts all firms. Thus, policies should target the most affected firms. Using the results, we provide policy recommendations for CAREC member countries.

6.3 Methodology

Several indicators can measure firm performance. However, following the primary purpose of this chapter and the importance of understanding infrastructure as a factor for firm performance and international trade, we use (i) total sales, (ii) the share of the firm's capacity utilized during the last fiscal year, (iii) the firm's status as to whether it is an exporter, and (iv) the share of export in total sales. Thus, the first two indicators refer to general firm performance, while the last two indicate the extent to which a firm engages in international trade.

Firms' total sales are a continuous variable, while the share of capital utilization and export sales is given in percentage norms (from 0 to 100). Also, the exporting status of firms is expressed as a dummy variable taking the value 0 if a firm does not export, and 1 if it does. Therefore, for modeling total sales, a linear regression model is applied (Eq. 1). For capital utilization and share of export in total sales, a *tobit* model is employed, while for exporting status, a *probit* model is used (Eq. 2 and Eq. 3).

$$Y = \beta_0 + \beta_1 INFR + \beta_2 X + \varepsilon_i \quad (1)$$

Thus, Y refers to the log of total sales of firms during the last fiscal year. *INFR* indicates variables used to measure the infrastructure. This study uses four variables to approximate infrastructure: (i) the number of power outages experienced in a typical month in the last fiscal year; (ii) electricity expenses as the share of total annual costs of electricity in the last fiscal year to total sales—this variable may approximate the cost of electricity consumption for firms and indirectly show the extent to which electricity is accessible for firms; (iii) a dummy variable showing whether firms have a high-speed, broadband internet connection to examine the effect of internet infrastructure; (iv) an indicator of the efficiency of customs and border management clearance from the World Bank's LPI to approximate the potential impact of customs infrastructure and state regulations on the exporting activities of firms. The LPI is generated based on a survey of logistics professionals who are asked questions about the foreign countries where they operate. The customs efficiency index measures the efficiency of the clearance process, i.e., speed, simplicity, and predictability of formalities, by border control agencies, such as customs. It takes values from 1 to 5, with 5 being the most efficient.

$$Z = w\delta + \varepsilon \quad (2)$$

Another group of outcome variables is the capacity utilized and the share of exports in total sales. As the share value ranges from 0 to 100, the *tobit* model is used (Eq. 2). Z is the dependent variable showing utilized capacity and share of export, while w is a vector of exogenous variables, including infrastructure indicators.

A dummy variable measures the exporting status of firms, and hence a *probit* model is used for estimation:

$$P(y_i = 1|x_i) = F(\beta_0 + \beta_1 INFR + \cdots + \beta_k x_k) \qquad (3)$$

where y_i is the discrete dependent variable, taking the value 1 if a firm exports and 0 if it does not. *INFR* and x_i show infrastructure and the set of other explanatory variables, respectively.

Firm performance may depict differences according to the size of firms. Therefore, estimations of each equation are performed for the total sample, including an explanatory variable on firm size (Model 1) and by firm size: small firms (Model 2), medium firms (Model 3), and large firms (Model 4). Definitions of firm size given in the survey data are used in this study, too. Small firms refer to firms with fewer than 20 employees, medium firms are those with 20–99 employees, and large firms have more than 100 employees.

Along with infrastructure, other exogenous variables affect firm performance. The explanatory variables include managerial and firm characteristics, location, industry, and other exogenous factors. Table 6.1 describes the variables.

Managerial characteristics include the gender and experience of the top manager in the sector. Included among the firm's characteristics are the years since the establishment of the firm. A critical determinant of firm performance in emerging markets is the internationalization of firms. Therefore, foreign capital participation in the ownership structure is included among explanatory variables. Generally, foreign capital via corporate governance practices and technology transfers is expected to positively impact firm performance (Douma, George, and Kabir 2006; Thomas 2006).

Firms may demonstrate varying performance according to the labor force employed. Thus, the number of employees is included in the set of exogenous variables. An important determinant of firm performance is access to financial resources. Availability of financial resources promotes higher investment and faster growth of firms (Fafchamps and Schündeln 2013, Fowowe 2017). To approximate the access to finance effect, we include a dummy variable indicating whether a firm has a loan or credit from financial institutions. Firm performance is affected by external factors, too. Another source of variation of firm

Table 6.1: Description of Variables

Dependent Variables	
Log of total sales	Log of total annual sales in last fiscal year
Share of capacity utilized	Capacity utilization of firm in last fiscal year (in %)
Export	0 – firm does not have export sales, 1 – firm has export sales
Share of export	Share of export to total sales (in %)
Explanatory Variables	
Infrastructure	
Duration of power outages	Average duration of power outages in hours per month
Electricity expenses	Ratio of total annual costs of electricity in the last fiscal year to total sales (in %)
Broadband internet	Firm has a high-speed, broadband internet connection (0 – no, 1 – yes)
Customs	Efficiency of customs and border management clearance from the Logistics Performance Index
Manager characteristics	
Gender	0 – manager is male, 1 – manager is female
Experience	Number of years of experience of the top manager in the sector
Firm characteristics	
Years since establishmw ent	Number of years since the establishment of the firm
Foreign capital participation in the ownership structure	Private foreign individuals or companies own the firm (0 – no, 1 – yes)
Credit	The firm has lines of credit and outstanding loans (0 – no, 1 – yes)
Number of employees	Total number of full-time employees, adjusted for temporary workers
City size	1 = if city has population over 1 million; 2 = from 250,000 to 1 million; 3 = if 50,000 to 250,000; 4 = if less than 50,000
Informal payment	Share of informal payments paid by the firm in total annual sales (in %)
Sector	1 = food and beverages; 2 = light industry; 3 = heavy industry; 4 = construction; 5 = trade; 6 = hotels and restaurants; 7 = other services

Source: Own elaboration using data from World Bank (2008, 2009, and 2013).

performance is the institutional environment and the barriers firms face in their operation. Burdensome government regulations and incentives for informal payments can be regarded as essential obstacles to firm performance. A variable indicating the share of total annual sales paid in informal payments is used to consider this potential effect. Higher shares of informal payments are expected to decrease indicators of firm performance.

The performance of enterprises varies by industry type. We use the ISIC codes and classify industries into seven categories: food and beverages, light industry, heavy industry, construction, trade, hotels and restaurants, and other services. Also, we consider the location of firms in terms of city sizes among explanatory variables.

6.4 Data

The empirical analysis is based on enterprise survey data from the World Bank for 2008, 2009, and 2013. The data set includes nine CAREC countries: Afghanistan, Azerbaijan, Georgia, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, and Uzbekistan. Table 6.2 shows that the availability of data for these countries varies according to the survey years. The 2013 survey data set includes almost all countries in the sample, except for Afghanistan. However, the 2008 and 2009 survey data sets include different countries. Afghanistan, Georgia, Tajikistan, and Uzbekistan were surveyed in 2008, and

Table 6.2: Sample Distribution, by Country

Country	2008	2009	2013	Total
Afghanistan	535	0	0	535
Azerbaijan	0	380	390	770
Georgia	373	0	360	733
Kazakhstan	0	544	600	1,144
Kyrgyz Republic	0	235	270	505
Mongolia	0	362	360	722
Pakistan	0	0	1,247	1,247
Tajikistan	360	0	359	719
Uzbekistan	366	0	390	756
Total	1,634	1,521	3,976	7,131

Source: Own elaboration using data from World Bank (2008, 2009, and 2013).

Azerbaijan, Kazakhstan, the Kyrgyz Republic, and Mongolia in 2009. Also, Pakistan survey data are available only for 2013. Given this distribution of countries in the sample by survey years, using panel data with repeated observations over the survey years is difficult. However, an enterprise survey contains essential information about firm activities and enables the measurement of the impact of relevant factors. Therefore, considering firm-level information provided by the enterprise survey data set, this study uses pooled data for 2008, 2009, and 2013 and applies a cross-sectional estimation approach.

The total sample size of the data set constructed from the above-noted survey years and countries accounts for 7,131 observations, of which 3,274 are small firms and 2,663 medium firms, while large firms account for 1,194 observations.

The survey questionnaire includes questions related to firm performance, trade, and other characteristics of firms. For example, to measure the infrastructure used in this study, the survey questionnaire includes questions on the duration of power outages, electricity costs, and whether firms have access to broadband internet. The firms did not answer all the questions. Hence, depending on the variables used in the analysis, the sample size may vary.

Table 6.3 presents the distribution of observations by variable and firm size used in the empirical analysis. Thus, total sales are observed in 5,400 firms, while data on the share of utilized capacity exist for 2,522 firms. Their values demonstrate that, on average, the capacity utilized does not exceed 75%, being highest for large firms, at 74.22%, and lower for small firms, at 69.92%. Out of the total sample, 11.96% responded that they conduct exporting activities, with the share among small firms being only 5.65%, while it is more than 29% for large firms. The share of export sales in total sales for the total sample is more than 5%, slightly higher than the 2% for small firms, while it is more than 14% for large firms.

Among the variables used to measure the infrastructure in this study, power outages are generally longer than 7 hours and do not vary significantly by firm size. However, in terms of the electricity cost expressed as expenses on electricity as the share of total sales, firm size shows an increasing trend—large firms spend almost 34% of their annual sales on electricity consumption. Access to broadband internet increases with firm size: 45% of small firms indicate having access to the internet, while the rate is 62% among medium firms and more than 74% for large firms. Another indicator used to measure the impact of customs management, which is vital for trade activity, is the score for customs from the LPI. A higher score reflects more efficient customs management. Its score is around 2.3. Although the infrastructure

Table 6.3: Descriptive Statistics, by Firm Size

	Observations	Total Sample	Small	Medium	Large
Observation number		7,131	3,274	2,663	1,194
Dependent Variables		Mean	Mean	Mean	Mean
Log of total sales	5,400	16.43	15.06	16.87	19.25
Share of capacity utilized (%)	2,522	69.92	68.33	69.00	74.22
Export (1 = firm is exporting, 0 = no; in %)	7,131	11.96	5.65	11.79	29.64
Share of export sales (% of total sales)	7,008	5.27	2.20	5.13	14.05
Explanatory Variables	Observations	Total Sample	Small	Medium	Large
Infrastructure					
Power outages (hours per month)	3,216	7.59	7.4	7.79	7.61
Electricity expenses (as % of total sales)	4,781	24.29	21.88	22.92	33.93
Broadband internet (1= firm has access to broadband internet, 0 = no, in %)	4,220	54.26	45.02	61.46	74.49
Customs efficiency index (from 1 to 5)	6,758	2.29	2.26	2.3	2.33
Firm and manager characteristics	Observations	Mean	Mean	Mean	Mean
Gender (1 = if female)	7,116	15.26	17.81	13.57	12.00
Experience of the manager (years)	6,908	14.62	13.99	14.84	15.88
Firm age (years since establishment)	6,942	14.38	11.63	14.91	20.76
Labor (number of employees)	7,094	88.04	9.96	41.93	408.50
Foreign capital participation in the ownership structure (%)	7,065	4.39	2.53	4.51	9.24
Loan (1 = if firm has loan)	7,131	25.35	19.53	26.96	37.99
Informal payments (% of sales)	6,973	3.20	1.73	1.99	1.82

continued on next page

Table 6.3 *continued*

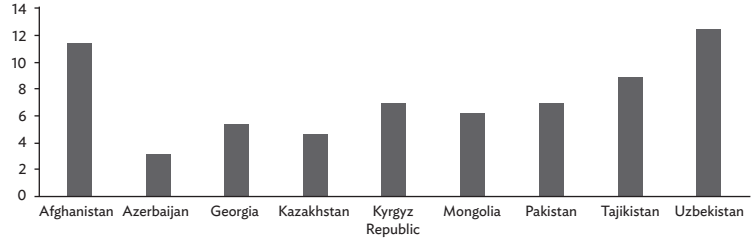
	Observations	Total Sample	Small	Medium	Large
City size	Observations	*%*	*%*	*%*	*%*
City with population over 1 million	2,726	38.23	38.00	38.27	38.78
From 250,000 to 1 million	1,628	22.83	21.01	23.66	25.96
50,000 to 250,000	1,363	19.11	19.55	18.33	19.68
Less than 50,000	1,414	19.83	21.44	19.75	15.58
Sector	Observations	*%*	*%*	*%*	*%*
Food and beverages	841	11.79	9.59	13.14	14.82
Light industry	820	11.50	9.56	11.53	16.75
Heavy industry	1,344	18.85	15.64	20.50	23.95
Construction	837	11.74	8.49	14.72	13.99
Trade	2,428	34.05	44.26	28.69	18.01
Hotels and restaurants	361	5.06	5.74	4.88	3.60
Other services	500	7.01	6.72	6.53	8.88

Source: Own elaboration using data from World Bank (2008, 2009, and 2013).

indicators used in this study described in Table 6.3 reported average terms, this may vary by country.

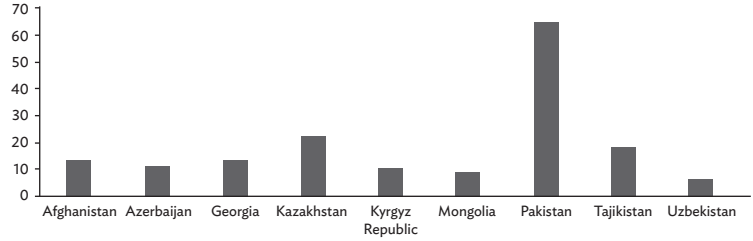
Figures 6.1–6.4 compare infrastructure variables by country samples. The average duration of power outages is higher in Uzbekistan and Afghanistan, with more than 12 and 11 hours, respectively. It is comparatively low in Azerbaijan and Georgia, about 3 and 5 hours, respectively. In terms of expenses on electricity, the share of total sales in Pakistan is more than 60%, while Azerbaijan and Uzbekistan indicate a low share of about 10%. As an approximation of telecommunication infrastructure, access to broadband internet data shows that more than 80% of firms have access to broadband internet in Kazakhstan. While in Afghanistan and Uzbekistan, about 10% and 40% of firms, respectively, indicated a positive response. Georgia and Pakistan have the highest customs scores, while Afghanistan has the lowest.

Figure 6.1: Average Duration of Power Outages by Country (hours/month)



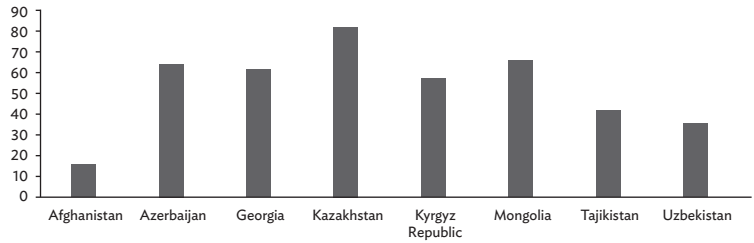
Source: Own elaboration using data from World Bank (2008, 2009, and 2013).

Figure 6.2: Average Electricity Expenses (as % of total sales)



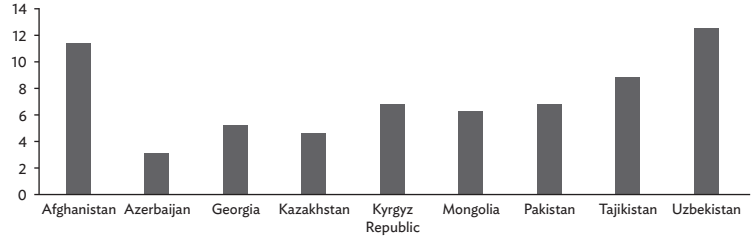
Source: Own elaboration using data from World Bank (2008, 2009, and 2013).

Figure 6.3: Average Access to Broadband Internet (% of access)



Source: Own elaboration using data from World Bank (2008, 2009, and 2013).

Figure 6.4: Customs Efficiency Index



Source: Own elaboration using data from World Bank (2008, 2009, and 2013).

As for the other explanatory variables, it is worth noting that small firms have a comparatively higher share of female managers; as firm size increases, the share decreases. More than 17% of managers are female among small firms, while the rate is about 12% for large firms. Along with this, manager experience and years since establishment increase with firm size. Another essential characteristic is that access to finance approximated by the dummy variable of whether firms have an outstanding credit line varies significantly by firm size. Thus, more than 19% of small firms have credit, while almost 38% of large firms have outstanding credit. A similar tendency can be noted for the participation of foreign capital in the ownership of firms. Among small firms, foreign capital accounts for about 2.6%, while in large firms, it accounts for more than 9%. Another critical variable used to measure the institutional environment faced by firms is the percentage of total annual sales paid in informal payments. Although medium firms report a comparatively high rate of informal payment, at almost 2% of total sales, there is no high variation by firm size.

6.5 Estimation Results

Tables 6.4 and 6.5 summarize estimation results. Full results are presented in Tables 6.A1–6.A4 (Appendix). As expected, the results demonstrate a significant impact of infrastructure—i.e., electricity, broadband, and customs efficiency—on the performance of firms. Broadband access and customs efficiency have the most significant effect on firm performance, and electricity (outages and cost) has the smallest impact.

Estimation results indicate a statistically significant positive effect of access to broadband internet on the total sales of all firm

sizes (small, medium, and large) (Table 6.4). Although this effect is comparatively higher for large firms, large, medium, and small firms with a broadband internet connection have sales that are 80.7%, 38.4%, and 41.3% (respectively) greater than firms without a broadband internet connection. Capacity utilization shows a strong positive impact in medium firms only (Table 6.4). Broadband internet has an important influence on export activities, too (Table 6.5). Thus, firms with a broadband internet connection on average are more likely to be exporters by 2.4% than firms without a broadband connection. However, this effect is statistically significant only for the total sample. Also, firms with a broadband internet connection on average have more export sales by 1.68 percentage points in relation to total sales than firms without a broadband internet connection. The impact is particularly high for small firms. Small firms with broadband connections on average have greater export sales by 2.21 percentage points vis-à-vis total sales than small firms without a broadband internet connection. These findings underline the fact that telecommunication infrastructure is one of the significant conditions for increasing firm performance. The results show that a broadband internet connection increases the total sales of firms and export sales. This may be related to the importance of online communication for promoting products and expanding markets for sales. This is more evident for small firms, in particular. Improving access to, and the affordability of, a broadband internet connection could positively affect sales, including export sales. This finding is particularly relevant for countries with low access to a broadband internet connection. According to our data sample from the World Bank Enterprise Survey, three out of nine CAREC countries have access to broadband below the sample average (54%). They are Afghanistan (16%), Uzbekistan (35%), and Tajikistan (42%) (Figure 6.3).

Another indicator measuring the impact of infrastructure on export activities is the efficiency of the customs and border management clearance index from the LPI (Table 6.5). As expected, it shows a positive impact on the probability of being an exporter and the share of export sales. Higher efficiency of customs and border management promotes firms in terms of being exporters and increasing export sales. However, this effect is not statistically significant for small firms. This is probably because small firms are less likely to be affected by cross-border trade.

The magnitude of the impact on large and medium firms is considerable. Large and medium firms located in countries with greater customs efficiency by 1 unit of the index (which takes values from 1 to 5) are more likely to be exporters by 121.7% and 59.6%, respectively. They have a greater share of export sales in total sales by 52.068 and 25.491 percentage points, respectively. This result is important for all

CAREC member countries because the average customs efficiency index is very low at 2.29 (index takes values from 1 to 5) (Table 6.3). Large and medium firms from all CAREC countries could benefit from improved customs efficiency. According to our data sample from the World Bank's LPI, the lowest customs efficiency index is in Afghanistan (1.3), followed by Mongolia (1.89), Azerbaijan (2.02), Uzbekistan (2.09), and Tajikistan (2.16) (Figure 6.4), with a customs efficiency index below the sample average of nine CAREC countries (2.29).

As expected, the duration of power outages negatively impacts total sales and the share of capacity utilized (Tables 6.4, 6.5, and 6.A1). However, it has a statistically significant negative impact on capacity utilization in the total sample only. Also, the effects of power outages on capacity utilization are relatively small. A 1-hour increase in power outage duration per month decreases the share of utilized capacity by 0.139 percentage points (Table 6.4). This means that firms experiencing 1 hour per month less power outages utilize their capacity by 0.139 percentage points. Capacity utilization does not have a statistically significant impact on exports (Table 6.5). This shows that the quality of energy infrastructure is important for firm performance in CAREC countries. This finding is particularly relevant for countries with the longest outages in the CAREC region, according to our data sample from the World Bank's Enterprise Survey, namely, Uzbekistan (12.51 hours/month) and Afghanistan (11.46 hours/month) (Figure 6.1). Reduction of outages by Uzbekistan and Afghanistan to the sample average of 7.59 hours/month (Table 6.3) will allow firms' capacity utilization to increase on average by 0.68 percentage points in Uzbekistan and 0.54 percentage points in Afghanistan.

Another indicator used to measure the infrastructure in this study is electricity expenses, as the share of total sales demonstrates the expected negative impact on total sales and the capacity utilization rate. Although the effects of electricity expenses are mainly minimal, its impact is large for small firms' total sales. Small firms (those with fewer than 20 employees) with more electricity expenses by 1% in total sales have lower sales by 1.697% (Table 6.4). This means that small firms are susceptible to electricity charges. For the capacity utilization outcome variable, this influence is statistically significant for the sample of large firms only, however, the magnitude of the impact is very small (Table 6.4). Overall, this finding supports the view that the cost of electricity is one of the fundamental factors for firm performance and its level of significance varies by firm size. Small firms may be more impacted by this effect.

Interestingly, export activities are not affected by electricity expenses (Table 6.5). Although energy prices are low in most CAREC countries

due to price control or subsidies, usually energy prices are lower for residential users and higher for commercial users. Differentiated electricity rates according to firm size (or consumption size), with lower rates for smaller firms, could significantly improve the performance of small firms. Electricity expenses (% of total sales) are particularly high in Pakistan (66%), Kazakhstan (23%), and Tajikistan (18%), according to our data sample from the World Bank's Enterprise survey.

Although Tables 6.4 and 6.5 include the primary variable of interest, the effect of other explanatory variables can be analyzed from Appendix Tables 6A.1 to 6A.4, which include total sample estimation results for each model of infrastructure indicator. Among these variables, the gender of the manager is important; a female manager negatively impacts the total sales of firms. In addition, firms with a longer history

Table 6.4: Infrastructure Impact on Total Sales and Capacity Utilization

	Log of Total Sales			
	Total Sample	**Small Firms**	**Medium Firms**	**Large Firms**
Duration of power outages (hours per month)	−0.00337	−9.07e-05	−0.00646	−0.0163
	(0.00397)	(0.00585)	(0.00541)	(0.0128)
Electricity expenses (% of total sales)	−0.000343***	−1.697***	−0.0102***	−0.000336***
	(2.54e-05)	(0.242)	(0.00185)	(3.06e-05)
Broadband connection (0 or 1)	0.548***	0.413***	0.384***	0.807***
	(0.0710)	(0.0926)	(0.114)	(0.235)
	Capacity Utilization (%)			
	Total Sample	**Small Firms**	**Medium Firms**	**Large Firms**
Duration of power outages (hours per month)	−0.139**	−0.170	−0.176	−0.162
	(0.070)	(0.144)	(0.109)	(0.132)
Electricity expenses (% of total sales)	−0.001***	−0.131	−0.036	−0.001***
	(0.000)	(3.462)	(0.029)	(0.000)
Broadband connection (0 or 1)	1.549	−2.077	6.717**	−8.497
	(2.167)	(3.442)	(3.254)	(5.641)

Note: Estimations include other explanatory variables described in Table 6.1. Capital utilization represents marginal effects from the tobit models. Full estimation results are available from the authors upon request.
Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.
Source: Own elaboration using data from World Bank (2008, 2009, and 2013).

Table 6.5: Infrastructure Impact on Export Activities

	Export Dummy (0 or 1)			
	Total Sample	Small Firms	Medium Firms	Large Firms
Duration of power outages (hours per month)	0.000852	0.000678	0.00126	−0.00263
	(0.000577)	(0.000936)	(0.000849)	(0.00225)
Electricity expenses (% of total sales)	3.13e-06	0.0105	0.000703	7.50e-06
	(3.65e-06)	(0.0177)	(0.00112)	(6.31e-06)
Broadband connection (0 or 1)	0.0240**	0.0227	0.0159	0.0248
	(0.0122)	(0.0150)	(0.0196)	(0.0553)
Customs	0.393***	0.0550	0.596**	1.217**
	(0.138)	(0.177)	(0.252)	(0.522)
	Export Sales (% of Total Sales)			
	Total Sample	Small Firms	Medium Firms	Large Firms
Duration of power outages (hours per month)	0.037	−0.022	0.047	−0.042
	(0.033)	(0.033)	(0.041)	(0.096)
Electricity expenses (% of total sales)	0.000	0.211	0.052	0.000
	(0.000)	(0.985)	(0.061)	(0.000)
Broadband connection (0 or 1)	1.680***	2.210***	0.611	1.584
	(0.605)	(0.852)	(0.888)	(2.737)
Customs	14.168*	−1.150	25.491*	52.068*
	(7.777)	(9.613)	(14.569)	(30.460)

Note: Estimations include other explanatory variables described in Table 6.1. Share of export sales represents marginal effects from the tobit models. Export dummy estimation results include marginal effects from the probit model. Full estimation results are available from the authors upon request.

Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

Source: Own elaboration using data from World Bank (2008, 2009, and 2013).

measured through the years since their establishment have a higher volume of total sales and export activities.

In almost all four models, participation of foreign capital in the firm's ownership structure and the firm's having a current credit line from financial institutions increase its performance. These findings indicate that, along with the infrastructure, access to finance and foreign capital positively impacts a firm's total sales, increases the probability of it being an exporter, and boosts its share of export sales. Inclusion of the firm size category in total sample estimations indicates that medium

and large firms perform better than small firms in almost all measured performance criteria.

Thus, estimation results indicate that stability of electricity, its cost expressed as expenses share in total sales, access to broadband internet, and efficiency of customs significantly affect the performance of firms. On the other hand, these effects vary according to the size of firms. Thus, broadband internet access and electricity expenses are important for small firms. Medium and large firms mostly benefit from higher efficiency of customs and border management.

6.6 Conclusions and Policy Recommendations

This chapter investigated the impact of infrastructure on firm performance in nine CAREC countries using the World Bank's Enterprise Survey pooled data in 2009, 2013, and 2019. Firm performance was measured by total sales, the share of utilized capacity, dummy variable as to whether a firm exports, and the share of export sales. Infrastructure was evaluated via the duration of power outages, electricity expenses as the share of total sales, access to broadband internet, and efficiency of customs. Our results suggest that the impact of infrastructure access and quality varies across firm sizes.

Empirical findings indicate that infrastructure significantly impacts firm performance in the CAREC member countries. Broadband internet connection and customs efficiency have the most significant impact on firm performance. The effects of power outages and electricity expenses on firm performance are smaller. In particular, access to broadband internet has a strong positive impact on total sales and export sales, with this effect being especially notable in small firms. Efficient customs increase the probability of being an exporter and the share of export sales, especially in large and medium firms. Higher electricity expenses negatively impact total sales and capacity utilization. Longer hours of power outages reduce capacity utilization, too.

Along with its empirical findings, this study has some limitations. First, being based on pooled data, the study does not use panel data estimation techniques because of limited data. Further studies incorporating the analysis of observations over several survey waves may provide more details on firm performance. Second, although several indicators are used to assess the infrastructure impact, transportation is among the key factors affecting firm performance and international trade. However, the survey data used in this study has limited information on transportation. Future studies focusing on transportation infrastructure using firm-level data may suggest more insights into its relationship with firm performance in CAREC countries.

6.6.1 Policy Recommendations

The impact of infrastructure depends on firm size. Table 6.6 summarizes the results for small, medium, and large firms. While considering their potential limitations, these findings have several policy implications, listed as follows:

- Improving access to and affordability of a broadband internet connection can positively affect sales, including export sales. Thus, policy in this direction should be oriented toward widening access to and affordability of internet for firms, particularly in Afghanistan, Tajikistan, and Uzbekistan
- Improvements in customs efficiency could positively affect firms' exports, particularly of medium and large firms. Customs efficiency is very low in nine CAREC member countries: Afghanistan, Azerbaijan, Georgia, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, and Uzbekistan. These countries could benefit from the improvement of customs efficiency. Further bilateral and multilateral cooperation for reducing trade barriers, digitalization, and other measures improving customs efficiency may stimulate firms' engagement in international trade.
- The importance of stable energy infrastructure—a decrease in the number of power outages—could improve firm performance, particularly in Afghanistan and Uzbekistan.
- Electricity expenses have a significant negative impact, particularly on small firms. Reducing electricity expenses for small firms could improve firms' performance, particularly in Kazakhstan, Pakistan, and Tajikistan. This necessitates government policies aimed at reducing electricity costs of small firms, for example, by providing progressive electricity tariffs with lower rates for smaller consumers/firms.

Table 6.6: Summary of Results and Policy Recommendations

Firm Size	Broadband +	Customs +	Electricity Outages −	Electricity Expenses −
Small	Large	No impact	No impact	Large
Medium	Large	Large	No impact	Small
Large	Large	Large	No impact	Small
All	Large	Large	Small	Small
Policy	Improve access and affordability of broadband	Improve customs efficiency	Reduce electricity outages	Progressive electricity tariffs
CAREC countries for attention	Afghanistan, Uzbekistan, Tajikistan	Afghanistan, Azerbaijan, Georgia, Kazakhstan, Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Uzbekistan	Uzbekistan, Afghanistan	Pakistan, Kazakhstan, Tajikistan
CAREC countries for good examples	Kazakhstan		Azerbaijan	Uzbekistan, Mongolia, Kyrgyz Republic

CAREC = Central Asia Regional Economic Cooperation.

Source: Own elaboration using data from World Bank (2008, 2009, and 2013).

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Appendix 6.1

Table 6A.1: Impact of Duration of Power Outages on Firms' Performance

	Total Sales	Capital Utilization	Export Dummy	Share of Export Sales
Duration of power outages	−0.00337	−0.139**	0.000852	0.037
	(0.00397)	(0.070)	(0.000577)	(0.033)
Gender (1 = if female)	−0.286*	−0.033	0.0417	1.904
	(0.150)	(3.522)	(0.0257)	(1.496)
Experience of the manager	−0.00375	0.153	−0.000903	−0.053
	(0.00504)	(0.094)	(0.000876)	(0.052)
Years since establishment	0.00953**	−0.100*	0.000112	0.000
	(0.00372)	(0.058)	(0.000579)	(0.033)
Number of employees	0.00196***	0.006	5.75e-05	0.002
	(0.000279)	(0.004)	(3.78e-05)	(0.002)
Foreign capital participation	0.00772***	−0.053	0.00113**	0.063**
	(0.00298)	(0.057)	(0.000456)	(0.026)
Credit	0.535***	−2.561	0.0667***	4.300***
	(0.122)	(2.377)	(0.0196)	(1.152)
City size	−0.0731	−0.214	0.0110	0.971*
	(0.0514)	(0.993)	(0.00915)	(0.533)
Informal payment	−0.00857	−0.255	−0.00223	−0.143
	(0.00886)	(0.177)	(0.00163)	(0.098)
Sector (reference category: food and beverages)				
Light industry	−0.440**	0.557	0.0827**	7.540***
	(0.173)	(2.249)	(0.0358)	(2.176)
Heavy industry	−0.346**	0.175	0.0254	2.079
	(0.160)	(2.098)	(0.0308)	(1.666)
Construction	−0.142	3.629	−0.119***	−5.999***
	(0.198)	(12.491)	(0.0269)	(1.224)
Trade	−0.135	6.294	−0.0691**	−2.238
	(0.162)	(10.136)	(0.0276)	(1.459)
Hotels and restaurants	−0.971***	9.380	−0.113***	−4.688***
	(0.251)	(13.796)	(0.0313)	(1.577)

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Table 6A.1 *continued*

	Total Sales	Capital Utilization	Export Dummy	Share of Export Sales
Other services	−0.583***	29.958***	0.0205	1.733
	(0.220)	(1.722)	(0.0419)	(2.345)
Firm size (small firm is reference category)				
Medium firm	1.347***	1.717	0.0430**	3.193***
	(0.103)	(1.962)	(0.0172)	(0.959)
Large firm	2.581***	5.901**	0.140***	8.517***
	(0.167)	(2.747)	(0.0337)	(1.996)
Year	+	+	+	+
Country	+	+	+	+
Constant	15.41***			
	(0.230)			
Observations	1,358	697	1,590	1,581
R-squared	0.730			

Note: Estimations are based on a full sample without firm size subsamples. Capital utilization and share of export sales represent marginal effects from the tobit models. Export dummy estimation results include marginal effects from the probit model. Full estimation results for subsamples based on firm size are available from the authors upon request.

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Own estimations using data from World Bank, Enterprise Surveys Data, https://www.enterprisesurveys.org/en/data.

Table 6A.2: Impact of Electricity Expenses on Firms' Performance

	Log of Total Sales	Capital Utilization	Export Dummy	Share of Export Sales
Electricity expenses	−0.000343***	−0.001***	3.13e-06	0.000
	(2.54e-05)	(0.000)	(3.65e-06)	(0.000)
Gender (1 = if female)	−0.245***	1.557	0.00749	0.221
	(0.0946)	(2.476)	(0.0176)	(0.981)
Experience of the manager	−0.00173	−0.023	−0.00109*	−0.058
	(0.00343)	(0.073)	(0.000636)	(0.036)
Years since establishment	0.00697***	−0.164***	0.000584	0.025
	(0.00264)	(0.051)	(0.000422)	(0.023)
Number of employees	0.00161***	0.007**	6.76e-05***	0.002
	(0.000206)	(0.003)	(2.39e-05)	(0.001)
Foreign capital participation	0.00507***	0.022	0.000982***	0.057***
	(0.00194)	(0.041)	(0.000299)	(0.016)
Credit	0.460***	0.009	0.0507***	2.439***
	(0.0800)	(1.823)	(0.0138)	(0.770)
City size	−0.112***	−0.296	−0.00474	0.085
	(0.0298)	(0.732)	(0.00591)	(0.328)
Informal payment	−0.00331	−0.275*	−0.000907	−0.051
	(0.00747)	(0.157)	(0.00134)	(0.075)
Sector (reference category: food and beverages)				
Light industry	−0.604***	−0.056	0.0390	3.808**
	(0.126)	(1.923)	(0.0264)	(1.520)
Heavy industry	−0.244**	0.472	−0.0154	−0.578
	(0.116)	(1.785)	(0.0225)	(1.175)
Construction	−0.158	0.615	−0.0957***	−5.134***
	(0.149)	(11.389)	(0.0236)	(1.072)
Trade	0.0556	12.878	−0.0700***	−2.896***
	(0.111)	(9.084)	(0.0209)	(1.089)
Hotels and restaurants	−0.987***	30.329***	−0.103***	−4.704***
	(0.179)	(1.392)	(0.0254)	(1.229)
Other services	−0.633***	28.082***	−0.0294	−0.757
	(0.175)	(3.040)	(0.0327)	(1.791)

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Table 6A.2 *continued*

	Log of Total Sales	Capital Utilization	Export Dummy	Share of Export Sales
Firm size (reference category: small firm)				
Medium firm	1.461***	3.331**	0.0359***	2.296***
	(0.0722)	(1.617)	(0.0127)	(0.667)
Large firm	2.946***	7.449***	0.139***	8.137***
	(0.121)	(2.290)	(0.0268)	(1.541)
Year	+	+	+	+
Country	+	+	+	+
Constant	15.27***			
	(0.178)			
Observations	2,071	1,025	2,394	2,384
R-squared	0.823			

Note: Estimations are based on a full sample without firm size subsamples. Capital utilization and share of export sales represent marginal effects from the tobit models. Export dummy estimation results include marginal effects from the probit model. Full estimation results for subsamples based on firm size are available from the authors upon request.

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Own estimations using data from World Bank, Enterprise Surveys Data, https://www.enterprisesurveys.org/en/data.

Table 6A.3: Impact of Access to Broadband Internet on Firms' Performance

	Log of Total Sales	Capital Utilization	Export Dummy	Share of Export Sales
Broadband internet	0.548***	1.549	0.0240**	1.680***
	(0.0710)	(2.167)	(0.0122)	(0.605)
Gender (1 = if female)	−0.283***	−2.134	−8.12e-05	−0.017
	(0.0852)	(2.780)	(0.0143)	(0.688)
Experience of the manager	0.00151	0.025	−0.000555	−0.036
	(0.00313)	(0.089)	(0.000527)	(0.026)
Years since establishment	0.00374	−0.200**	0.00111***	0.044**
	(0.00277)	(0.079)	(0.000409)	(0.019)
Number of employees	0.00161***	0.007	4.52e-05*	0.002
	(0.000203)	(0.004)	(2.50e-05)	(0.001)
Foreign capital participation	0.00538***	0.034	0.000843***	0.037***
	(0.00177)	(0.044)	(0.000227)	(0.011)
Credit	0.436***	−3.077	0.0345***	1.232**
	(0.0740)	(2.187)	(0.0117)	(0.561)
City size	−0.0664**	−1.235	−0.00460	−0.015
	(0.0272)	(0.839)	(0.00484)	(0.230)
Informal payment	−0.00646	0.088	0.00107	0.052
	(0.00749)	(0.325)	(0.00106)	(0.051)
Sector (reference category: food and beverages)				
Light industry	−0.625***	−0.720	0.0435	2.746
	(0.147)	(2.579)	(0.0319)	(1.703)
Heavy industry	−0.307**	−3.527	−0.0101	−0.822
	(0.130)	(2.273)	(0.0252)	(1.244)
Construction	−0.139	−0.386	−0.0928***	−4.824***
	(0.131)	(12.155)	(0.0215)	(1.035)
Trade	0.0934	5.296	−0.0530**	−2.544**
	(0.115)	(7.161)	(0.0218)	(1.092)
Hotels and restaurants	−0.835***	14.661	−0.0663**	−3.672***
	(0.169)	(16.279)	(0.0275)	(1.234)
Other services	−0.698***	24.782***	0.0126	−0.340
	(0.151)	(5.564)	(0.0300)	(1.458)

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Table 6A.3 *continued*

	Log of Total Sales	Capital Utilization	Export Dummy	Share of Export Sales
Firm size (reference category: small firm)				
Medium firm	1.216***	5.425***	0.00766	0.666
	(0.0669)	(2.077)	(0.0109)	(0.512)
Large firm	2.598***	5.207	0.0779***	3.967***
	(0.119)	(3.178)	(0.0243)	(1.221)
Year	+	+	+	+
Country	+	+	+	+
Constant	15.23***			
	(0.151)			
Observations	2,151	709	2,652	2,637
R-squared	0.844			

Note: Estimations are based on a full sample without firm size subsamples. Capital utilization and share of export sales represent marginal effects from the tobit models. Export dummy estimation results include marginal effects from the probit model. Full estimation results for subsamples based on firm size are available from the authors upon request.

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Own estimations using data from World Bank, Enterprise Surveys Data https://www.enterprisesurveys.org/en/data.

Table 6A.4: Impact of Customs Management on Firms' Performance

	Export Dummy	Share of Export Sales
Customs	0.393***	14.168*
	(0.138)	(7.777)
Gender (1 = if female)	0.0106	0.306
	(0.0149)	(0.808)
Experience of the manager	−0.000522	−0.033
	(0.000518)	(0.028)
Years since establishment	0.000605	0.028
	(0.000372)	(0.019)
Number of employees	6.64e-05***	0.002**
	(2.04e-05)	(0.001)
Foreign capital participation	0.00112***	0.058***
	(0.000247)	(0.013)
Credit	0.0466***	2.341***
	(0.0117)	(0.635)
City size	−0.00212	0.148
	(0.00504)	(0.271)
Informal payment	−0.000623	−0.031
	(0.00104)	(0.057)
Sector (reference category: food and beverages)		
Light industry	0.0246	3.221**
	(0.0242)	(1.368)
Heavy industry	−0.0119	−0.237
	(0.0210)	(1.082)
Construction	−0.121***	−5.778***
	(0.0185)	(0.888)
Trade	−0.0683***	−2.642***
	(0.0193)	(0.991)
Hotels and restaurants	−0.0982***	−4.623***
	(0.0238)	(1.104)
Other services	−0.0141	−0.621
	(0.0267)	(1.387)

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Table 6A4 *continued*

	Export Dummy	Share of Export Sales
Firm size (reference category: small firm)		
Medium firm	0.0356***	2.255***
	(0.0107)	(0.561)
Large firm	0.113***	6.659***
	(0.0215)	(1.207)
Year	+	+
Country	+	+
Constant		
Observations	3,448	3,425

Note: Estimations are based on full sample without firm size subsamples. Share of export sales represents marginal effects from the tobit model. Export dummy estimation results include estimation marginal effects from the probit model. Full estimation results for subsamples based on firm size are available from the authors upon request.

Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

Source: Own estimations using data from World Bank, Enterprise Surveys Data https://www.enterprisesurveys.org/en/data.

7

Corridor Developments for Transforming Central Asia: A Spatial Computable General Equilibrium Model

Satoru Kumagai, Toshitaka Gokan, and Kenmei Tsubota

7.1 Introduction

Unlocking landlocked areas is a challenge for geographically disadvantaged regions and people as it is important not to leave them behind in development. Given the location of resources and existing cities, the historical trade structure of regions has shaped the transport networks and reinforced the relationships among regions. Large-scale infrastructure investments, such as the Central Asia Regional Economic Cooperation Program (CAREC) and Trans-Caspian International Transport Route (TITR), are interventions that can change the existing hierarchy of regions in a system of cities and regions.

The CAREC corridors constitute a set of many international logistics infrastructure projects within an initiative under the leadership of the Asian Development Bank (ADB) for the global coordination of international infrastructure projects. This is one of the flagships of the CAREC Program. The TITR is a logistics-oriented project stretching from the People's Republic of China (PRC) through Kazakhstan, the Caspian Sea, Azerbaijan, and Georgia to Turkey and European countries. The web page of the organization promoting the TITR, a consortium of logistics public companies in these countries,[1] shows that this platform offers integrated logistics along the TITR, effective operation, and better

[1] https://middlecorridor.com/

processing of customs procedures and border-related administration to promote the competitiveness of user companies.

As the CAREC corridors and the TITR play essential roles in developing Central Asian countries, this chapter conducts an economic analysis of these infrastructures. Specifically, we developed a spatial computable general equilibrium model to evaluate the infrastructure investments in transportation networks. This model is based on spatial economics using subnational data from across the world, called the Institute of Developing Economies–Geographical Simulation Model (IDE-GSM). This framework is notable as it employs spatial economics, which allows us to examine the clustering of industries and urbanization, called agglomeration economies.[2] Since transport infrastructure developments can potentially change regional economies, such projects are parts of the national development strategies and industrial policies. Therefore, by showing the possible landscapes at the subnational level by industry, our results can directly assist the policy makers working on such national developments.

This chapter evaluates the CAREC corridors and the TITR and shows how they can affect the surrounding regions at the subnational level and the industries in these regions. Based on the project plan of the CAREC corridors and the TITR, we set the scenario that these projects can reduce transport costs and time. Our scenario-based analyses show that the economic impacts are widely apparent over regions and are not limited to the regions directly implementing the projects. As these projects improve the accessibility of some transport links, they directly and indirectly affect the accessibility of other regions. Population and industries will probably shift to regions with better connectivity by virtue of the corridor developments. We also find that the implementation of both the CAREC corridors and the TITR could have larger regional economic impacts than individual projects. We refer to these as "synergy effects," suggesting that the projects are complementary. Furthermore, the analysis reveals that the projects' economic impacts may derive mainly from the growth in the service sector, suggesting the need for additional public investments, such as special economic zones, to boost industries other than services.

For clarification, the difference from the Global Trade Analysis Project, the most popular computable general equilibrium model,

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[2] Spatial economics is sometimes called "New Economic Geography," following Paul Krugman. Krugman (1998) described the original idea well, and Proost and Thisse (2019) published a recent review of the literature.

consists of two main points: the modeling strategy and the geography. Our model employs product differentiation at the firm level, not at the country level, and it uses subnational data and transport networks. This setup can only allow us to analyze the detailed regional impacts of transport infrastructure projects like the CAREC corridor and the TITR.

The remainder of the chapter proceeds as follows. Section 7.2 briefly explains the scope of the CAREC corridors and the TITR. Section 7.3 provides the details of our model, the IDE-GSM, such as the structure of the model, data, assumptions for simulations, and scenarios. We also make some brief remarks on our baseline assumption. Finally, Section 4 presents the results of the analyses.

7.2 Overview: Central and West Asian Countries

This section presents our underlying data to provide some snapshots of the regions. First, we compiled gross regional domestic product (GRDP) data of three economic sectors—namely, agriculture, manufacturing, and the service sector—at the regional level for eight Central West Asian (CWA) countries.[3]

Table 7.1 provides the summary statistics of the data set. Regions within and between countries exhibit major differences in population, GRDP per capita, and population density. For instance, Georgia's population, the largest in the region, is 24 times that of the smallest population. Azerbaijan, the country with the highest GRDP per capita, is 21 times richer than the region with the lowest GRDP per capita. With the highest population density, Tajikistan is more than 2,000 times denser than the country with the lowest population density.

The regional population densities in the CWA countries are generally low. Nevertheless, some areas exhibit higher population densities, such as Armenia, Azerbaijan, and Georgia; the border areas between the Kyrgyz Republic, Uzbekistan, and Tajikistan; and the capital cities of each country.

The GRDP capita for the regions in mountainous areas is relatively low. Some have a higher GRDP and a low population density; these are largely oil-producing regions.

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[3] For the industrial composition statistics, we utilized some data from international organizations and local agencies combined with INDSTAT2 from UNIDO.

Table 7.1: Summary Statistics of Regional Data for Central and West Asian Countries in 2010

	Number of Regions	Population ('000)				GRDP per capita ($)				Population Density (person/km^2)			
		Min.	Mean	Median	Max	Min.	Mean	Median	Max	Min.	Mean	Median	Max
Armenia	11	56	295	279	1,117	989	1,989	1,523	5,359	24	535	74	5,007
Azerbaijan	11	228	818	570	2,065	681	4,623	3,751	13,964	36	159	77	969
Georgia	11	48	404	388	1,152	1,714	2,451	2,242	4,553	10	201	64	1,600
Kazakhstan	16	503	1,013	441	2,512	2,955	11,272	613	37,599	3	335	30	4,360
Kyrgyz Republic	9	229	602	754	1,118	396	867	9,034	2,059	6	2,199	5	12,955
Tajikistan	5	207	1,524	870	2,699	418	738	4,485	1,591	3	1,514	12	7,311
Turkmenistan	6	429	840	1,737	1,151	4,487	4,487	4,487	4,487	3	240	88	1,389
Uzbekistan	14	714	2,000	2,155	3,119	1,299	2,048	1,566	4,286	8	167	146	607

GRDP = gross regional domestic product.

Source: Authors' compilation of statistics from each country and Asian Development Bank.

7.3 Methods

Our research starts by building a general equilibrium model. For clarity regarding the differences of our model from the typical computable general equilibrium models, we should mention the model, the modal choice, and the data. The model is a monopolistic competition model à la Krugman and contains transportation costs. As we have intra-national and international geography, we have many layers of different transport networks, allowing us to reproduce the complex modal choice by commodities and the combination of regions. Having such transport networks implies that our data are at the subnational level and by industry. In the following subsections, we briefly explain the setup.

7.3.1 The Model

We built our model on those of Krugman (1991) and Puga (1999). We focus on seven sectors in the model: agriculture, services, and five separate manufacturing sectors. The agriculture sector uses labor and land as its inputs under constant returns to scale technology. We assume that agricultural land rents accrue to households in the same region. Furthermore, we follow the Armington assumption that goods are differentiated by location.

Manufacturing firms produce under increasing returns to scale technology, which requires the goods produced in the sector and labor. Firms in the service sector use only labor under increasing returns to

scale technology. We assume that workers are mobile within countries and between sectors but not among countries. All products and services are tradable. We choose the iceberg-type transportation costs. Specifically, the value of a product melts en route, like an iceberg, for the sake of transportation costs. Thus, only some portions of the value arrive. We assume that there are no costs for transporting goods within the same region. The details of the model are available from Kumagai et al. (2013) and Isono et al. (2016).

7.3.2 Data

The most crucial variables in our model are population, GRDP, industrial composition, and the area size of arable land. We incorporated these into our geospatial data from various sources. There are three primary sources: national statistics, international statistics, and satellite data. When available, we checked the compatibility of national and international statistics. When national statistics were not available, we utilized public, international,[4] and satellite data for the industrial or regional decomposition.[5] For each region, we compiled industrial data for seven sectors: agriculture, five manufacturing sectors, and services. The five manufacturing sectors are automobiles, electrical and electronic equipment (E&E), textiles, food processing, and other manufacturing.

We looked for the manufacturing census or equivalent information by industry and region for the detailed industrial composition. When this was not available, we used the national industrial composition from the national statistics or INDSTAT2, which the United Nations Industrial Development Organization compiled.

When national statistics were not available for the geographical composition, we utilized two sources of satellite data for regional decomposition. One is the nighttime light, and the other is the land cover. Nighttime light is strongly correlated with the manufacturing and service sectors. On the other hand, land cover can capture the agriculture sector. Using these, we decomposed the national total into regional data.

All regional data refer to the transport network nodes, and we constructed four layers for road, ship, rail, and air.

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4 We constructed these data for these countries from United Nations data.

5 See the following website for details on the construction and sources of our data: http://www.ide.go.jp/English/Data/Geda/make.html.

7.3.3 Simulation Procedure

The IDE-GSM uses a repeated two-step procedure for its simulation. The first step obtains the short-run equilibrium for a given distribution of employment and GRDP by sector and region. In the second step, given the short-run equilibrium obtained, workers (a mobile factor in our model) migrate to the industry in a region offering the highest real wages. With this migration of workers, we obtain an updated distribution of employment and GRDP by sector and region. In our simulation model, 1 year corresponds to these two steps. By repeating these two steps, we calculate the baseline scenario and other specific scenarios.

7.3.4 Basic Assumptions and Baseline Scenario

We made some basic assumptions for our simulations. First, the population grows at the speed that the United Nations Population Division forecast. Second, there is no international migration.[6] Third, the model already includes all changes for tariffs, non-tariff barriers, and others from the free trade agreements and economic partnership agreements currently in effect. Finally, technological progress will occur at the same speed as between 2005 and 2010 for each country.[7] We simulated the model and obtained the baseline scenario with no infrastructure projects or institutional agreements following these basic assumptions.

7.3.5 How We Evaluate Alternative Scenarios

The alternative scenarios correspond to specific development projects and policy measures in or from the specific year. After translating the alternative scenarios, we enforce the simulation procedure into the operational assumptions on the specific parameters, mainly changing the transportation costs and time. Then, we compare the GRDP and

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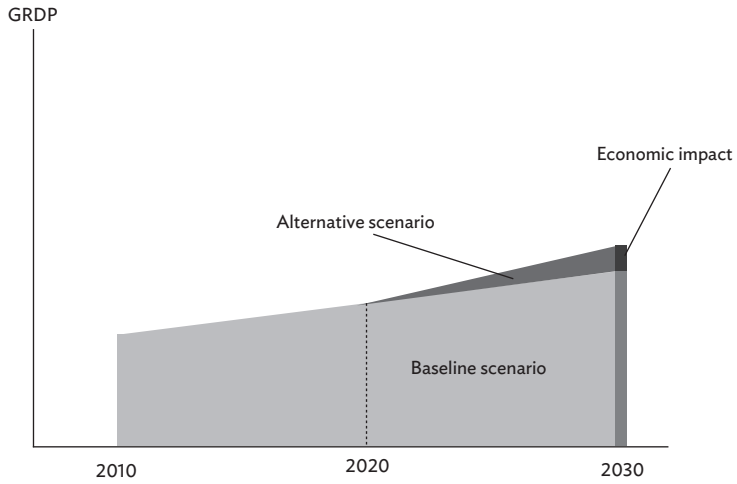
[6] We take this migration parameter from Barro and Sala-i-Martin (1992) and calibrate it to replicate the actual population growth in representative cities during 2005–2010. We set our parameter as 0.20. Other studies have shown that it may be around 0.26 for the United States and 0.27 for Japan.

[7] Note that, as we know, there are periodical global crises. In 2020, we experienced the coronavirus pandemic. Experiencing such crises and acting against them, we assume that the growth in the following years may be similar to the average from 2005 to 2010. This means that various monetary and fiscal policy measures mitigate the coronavirus pandemic shocks in 2020. The baseline scenario includes all such policy measures except the infrastructure projects that the text discusses.

GRDP per capita against the baseline scenario in 2030 or another year. When the GRDP or GRDP per capita of a region under an alternative scenario is higher or lower than that under the baseline scenario, we consider the surplus or deficit as the economic impact (Figure 7.1). Note that negative impacts for a region under an alternative scenario do not always mean that the region would be worse off than in the current situation. It indicates relatively slower growth than in the baseline scenario, which does not mean negative economic growth.

Figure 7.1: Illustrative Image of Regional Impacts: Differences between the Baseline and the Alternative Scenarios (An Example of Positive Impacts)



GRDP = gross regional domestic product.

Source: Authors.

7.3.6 Assumptions for Road Development

As mentioned in Section 7.2, we set certain assumptions regarding the speeds on roads by differentiating the quality of the existing roads and that of the upgraded roads. We observed broadly three types of road quality around East Asia and Southeast Asia: (i) low level (19.5 km/h), (ii) intermediate level (38.5 km/h), and (iii) high level (80 km/h). On

the railways, we set several speeds for each country as they differ widely among countries. Upgrades in the quality of an existing road imply an increase in the average speed.

7.3.7 The Mechanism[8]

The direct impacts of the projects are the reductions in transportation costs and time. Given the decrease in trade and transport costs and time, the optimal routes for all the regions for all products will change. Then the increased profitability of firms will increase in wages, which will call for more migration of people. At the same time, it will encourage the entry of firms into this sector, decreasing the price index for firms and consumers by expanding the available varieties.

This is the typical mechanism for improving transport infrastructures, the main topic that spatial economics analyzes.[9] Our simulation scenarios mainly involve the changes in accessibility measures. With such a reduction in transportation and trade costs, these scenarios will induce the migration of people and firms and increase consumption and sales, producing changes in the economic impacts.[10]

We can define the accessibility of each district as the total of all market sizes discounted by the distance between districts. Then, some changes in the accessibility within the networks will inevitably change the accessibility for all districts. Of course, the magnitude of the impacts depends on proximity and market size. Consequently, these changes will affect labor demand, labor wages, the profitability of firms, and the direction of trade.

7.4 Results

This section shows the results in three steps. Subsection 7.4.1 shows the baseline scenario. Subsection 7.4.2 contains the results for individual corridor projects for the CAREC corridor and the TITR. Then subsection 7.4.3 presents the results for the combination of the CAREC corridors and the TITR.

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8 The spatial impacts with maps are available but not shown in this chapter.

9 See, for example, Redding and Rossi-Hansberg (2017).

10 See, for example, Fajgelbaum and Schaal (2020).

7.4.1 Baseline Scenario

We assume that the baseline scenario has minimal additional infrastructure development after 2010. The summary statistics in Table 7.2 show steady growth in many parts of the world in the baseline scenario. The number of regions with less than 1,000 per capita GRDP dropped from 30.5% to 12.7%. Many regions graduating from this category are in East Asia or South Asia. In particular, the number of regions with a per capita GRDP between 500 and 1,000 dropped sharply. Comparing the baseline scenario regarding the per capita GRDP between 2010 and 2030 also shows that inland African regions remain in similar categories.

Table 7.2: Transition of Per Capita GRDP, 2010–2030

Per capita GRDP	2010		2030	
x < 500	280	–8.60%	137	–4.20%
500 < x < 1,000	714	–21.90%	279	–8.50%
1,000 < x < 3,000	1,095	–33.50%	1,195	–36.60%
3,000 < x <10,000	593	–18.20%	885	–27.10%
10,000 < x	582	–17.80%	768	–23.50%
Mean	7,043		9,928	
median	1,722		3,018	
# of region	3,264		3,264	

GRDP = gross regional domestic product.
Source: IDE-GSM calculations.

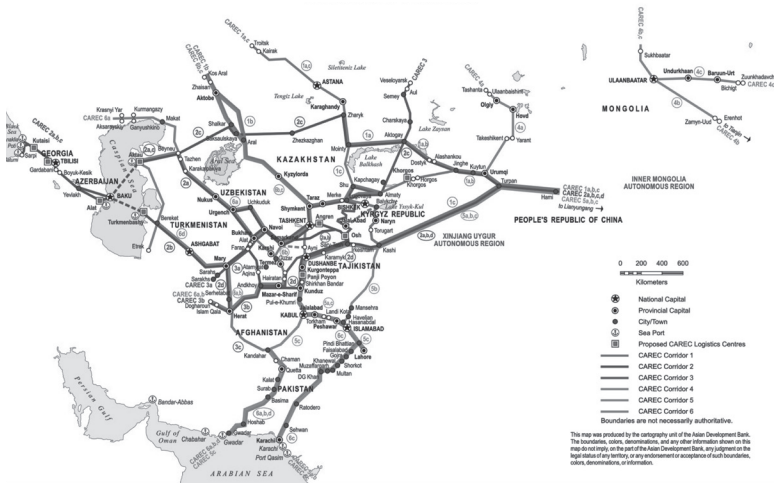
7.4.2 Economic Impacts of CAREC Corridors

In this subsection, we conduct simulation analyses using the IDE-GSM concerning the combination of the following two types of corridor developments:

- Highways: Raising the average speed of specified roads in the CAREC corridor from 19.25 km/h to 38.5 km/h
- Railways: Raising the average speed of specified railways in the CAREC corridor from 19.1 km/h to 40.0 km/h

The CAREC Transport Strategy 2030 (ADB 2020) shows the list of corridors. As this paper aims to analyze Central Asia, we deselect CAREC Corridor 4, which is mainly for Mongolia. We also do not include CAREC corridors passing through Afghanistan, Iran, and Pakistan, for which connectivity with Central Asia is still largely lacking, and the prospects for the completion of the construction are uncertain. We restrict our analysis to infrastructure improvements. Though it is possible to implement them, we reserve the impacts from trade facilitation for future study.

Figure 7.2: CAREC Corridors



CAREC = Central Asia Regional Economic Cooperation Program.

Source: https://www.carecinstitute.org/wp-content/uploads/2019/01/2017-PUBL-CAREC-6-Corridors.pdf (accessed 9 September 2021).

Table 7.3 contains concise results for each CAREC corridor and all the CAREC corridors. The number shows the increase in the GRDP per capita for each region and the standard deviation, the unit being US dollars per person. The following sections explain each scenario in detail.

Table 7.3: Simulation Results of the Impacts of CAREC Corridors ($/person)

	CAREC 1		CAREC 2		CAREC 3		CAREC 5		CAREC 6		CAREC All	
Country	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Armenia	23.71	0.1	44.58	0.2	0.30	0.0	0.00	0.0	4.88	0.2	21.23	0.1
Georgia	8.03	0.0	16.58	0.0	0.09	0.0	0.00	0.0	9.75	0.2	6.63	0.2
Kazakhstan	321.74	7.5	143.37	6.0	43.93	0.6	0.00	0.0	51.76	0.9	152.13	2.0
The Kyrgyz Republic	0.78	0.0	0.19	0.0	0.37	0.0	0.04	0.0	0.26	0.0	0.74	0.0
Tajikistan	1.07	0.0	0.21	0.1	0.29	0.1	0.10	0.1	1.04	0.1	1.23	0.1
Turkmenistan	1.01	0.1	22.61	0.7	4.95	0.2	−0.00	0.0	12.72	0.5	13.95	0.3
Uzbekistan	1.72	0.0	17.08	0.2	6.97	0.2	−0.00	0.0	9.92	0.1	14.35	0.1

CAREC = Central Asia Regional Economic Cooperation Program.

Note: Unit is $/person.

Source: IDE-GSM calculations.

CAREC Corridor 1

CAREC Corridor 1 connects the PRC and Europe through Kazakhstan and the Kyrgyz Republic. In Kazakhstan, Corridor 101 connects Dostyk near the PRC border with Kairak near the Russian Federation border through Astana, Kazakhstan's capital. Also, in Kazakhstan, Corridor 102 connects Altynkol near the PRC border and Aktobe near the Russian Federation border. In the Kyrgyz Republic, Corridor 103 connects Torugart near the PRC border and Kairak near the Russian Federation border through Chaldovar in the Kyrgyz Republic; Merke in Kazakhstan; and Astana in Kazakhstan. In this scenario, we suppose that implementing and completing the road and railway enhancement projects specified as CAREC Corridor 1 are assumed to occur in 2020.

Comparing this with the benchmark scenario, we find that the positive impacts are substantive in North Kazakhstan, Akmola, Kyzylorda, and Mangystau. We find that the project's impacts on each industry in terms of the percentage changes in the per capita real GDP differ among countries. In Armenia, only E&E and services receive negative impacts, and agriculture receives significant positive impacts. In Azerbaijan, all industries receive positive impacts. Only E&E has negative impacts in Georgia, while the other industries have positive impacts. Kazakhstan's agriculture and services enjoy huge increases, but other manufacturing receives negative impacts. In the Kyrgyz Republic, services receive positive impacts whereas other manufacturing receives negative

impacts. The percentage changes for food and mining differ among regions. In Tajikistan, agriculture, automobiles, and textiles receive positive impacts, but E&E, the food industry, other manufacturing, and services receive minor negative effects. In Turkmenistan, E&E receives negative impacts, but the impact on the specific industry is not as clear since it depends on the location. Uzbekistan's agriculture, mining, and other manufacturing sectors benefit, but the food industry receives negative impacts.

CAREC Corridor 2

CAREC Corridor 2 connects the PRC and the Caucasus and Mediterranean regions through the Caspian Sea. The corridor passes through six out of eight CWA countries: Azerbaijan, Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan. Corridor 201 connects Irkeshtam in the Kyrgyz Republic near the PRC border with Aktau in Kazakhstan through Tashkent, Uzbekistan's capital. It crosses the Caspian Sea to Baku, Azerbaijan, and Tbilisi, Georgia's capital. Corridor 202 connects Irkeshtam and Turkmenbashi in Turkmenistan and crosses the Caspian Sea to Baku, Azerbaijan, and Tbilisi, Georgia. Corridor 203 connects Dostyk, Kazakhstan near the PRC border and Aktau, Kazakhstan through Zhezkazgan and crosses the Caspian Sea to Baku, Azerbaijan, and Tbilisi, Georgia. Finally, Corridor 204 connects Irkeshtam and Serhetabat in Turkmenistan through Dushanbe, Tajikistan's capital. In this scenario, we suppose that the implementation and completion of the road and railway enhancement projects specified as CAREC Corridor 2 would be in 2020.

The positive impacts are strong in Western Kazakhstan, Uzbekistan, and Turkmenistan. The regions along the corridor in Kazakhstan appear to be beneficial, albeit to a small degree. We find that the project impacts on each industry in terms of the percentage changes in the per capita real GDP differ among countries. Armenia's agriculture, mining, textiles, and food receive positive impacts, and so do almost all industries and areas in Azerbaijan. In Georgia, agriculture mainly receives positive impacts. In Kazakhstan, agriculture and services mainly receive positive impacts, but other manufacturing receives negative impacts. In the Kyrgyz Republic, almost all industries and regions receive positive impacts. In Tajikistan, the regional difference is clearer than that among industries, but services receive positive impacts. In Turkmenistan, the regional difference is clearer than that among industries, but agriculture, textiles, and food receive positive impacts. Uzbekistan's services receive strong positive impacts, but automobiles and other manufacturing receive negative impacts.

CAREC Corridor 3

CAREC Corridor 3 connects the Russian Federation and the Middle East through Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan. Corridor 301 connects Aul in Kazakhstan near the Russian Federation border and Sarahs, Turkmenistan, near the Iranian border through Tashkent, Uzbekistan's capital. Corridor 302 connects Semey in Kazakhstan and Termez in Uzbekistan near the Afghanistan border, through Jalal-Abad, Kyrgyz Republic, and Dushanbe, Tajikistan's capital. In this scenario, we suppose that the implementation and completion of the road and railway enhancement projects specified as CAREC Corridor 3 are planned for 2020.

We observe positive impacts along the corridor. The impacts are stronger in the Navoi region of Uzbekistan, the Lebap region of Turkmenistan, and the Almaty region of Kazakhstan. We find that the project impacts on each industry in terms of the percentage changes in the per capita real GDP differ among countries. In Armenia, agriculture and services have relatively significant positive impacts, but other manufacturing has a relatively large negative impact. In Azerbaijan, except in Nakhchivan, the tendency among industries is clear, and only the textile and food industries receive negative impacts. All manufacturing sectors in Georgia receive negative impacts but agriculture, mining, and services receive positive impacts. In Kazakhstan, agriculture, E&E, and the food industry receive positive impacts. However, the sign of the percentage changes differs among regions in the remaining industries (services tend to receive large positive impacts). In the Kyrgyz Republic, agriculture and textiles receive positive impacts, but the percentage changes in the remaining industries differ among regions. In Tajikistan, the sign of the percentage changes differs among regions in an industry. Turkmenistan's automobiles and E&E receive negative impacts, but the remaining sectors receive positive impacts. In Uzbekistan, agriculture and services receive positive impacts, but the percentage changes in the remaining industries differ among regions.

CAREC Corridor 5

CAREC Corridor 5 connects the PRC and the Arabian Sea through the Kyrgyz Republic and Tajikistan. Corridor 501 connects Irkeshtam in the Kyrgyz Republic at the PRC border, and Panji Poyon in Tajikistan near the Afghanistan border through Dushanbe, Tajikistan's capital. Corridor 503 also connects Irkeshtam in the Kyrgyz Republic at the PRC border and Panji Poyon in Tajikistan near the Afghanistan border through Dushanbe. In this scenario, we suppose implementing and completing the road and railway enhancement projects specified as CAREC Corridor 5 would be in 2020.

Positive impacts are observable, but the magnitudes are smaller than for the other corridors. The positive impacts are relatively significant in the regions in eastern Tajikistan. We find that the project impacts on each industry regarding the percentage changes in the per capita real GDP differ among countries. In Armenia, only services have negative impacts, but the impact on each industry in Tavush is slightly different from that in the other areas. In Azerbaijan, E&E and other manufacturing receive positive impacts, while services have negative impacts. In Georgia, agriculture, automobiles, food, and other manufacturing receive positive impacts, and E&E and textiles receive negative impacts. However, the percentage changes in mining differ among regions. In Kazakhstan, the differences in the impacts are mainly observed in the food and service sectors. In the Kyrgyz Republic, positive impacts spread to all industries, but a few industries and regions receive negative impacts. In Tajikistan, other manufacturing receives negative impacts, but the signs of the impacts on the other industries differ among regions. In Turkmenistan and Uzbekistan, manufacturing industries receive positive impacts, but the percentage changes in the other industries differ among regions.

CAREC Corridor 6

CAREC Corridor 6 connects the Russian Federation, the Caspian Sea, and the Arabian Sea through Kazakhstan, Tajikistan, Turkmenistan, and Uzbekistan. Corridor 601 connects Kurmangazy in Kazakhstan and Bukhara in Uzbekistan. Corridor 602 connects Zhaisan in Kazakhstan at the Russian Federation border and Termez in Uzbekistan through Tashkent, Uzbekistan's capital. Corridor 603 connects Zhaisan in Kazakhstan and Panji Poyon in Tajikistan through Tashkent in Uzbekistan. Finally, Corridor 604 connects Kurmangazy in Kazakhstan and Etrek in Turkmenistan. In this scenario, we suppose the implementation and completion of the road and railway enhancement projects specified as CAREC Corridor 6 would be in 2020.

Positive impacts are strongly observable along the corridor. The regions away from the corridor in Kazakhstan seem to suffer negative effects, albeit small. We find that the project impacts on each industry in terms of the percentage changes in the per capita real GDP differ among countries. Agriculture, textiles, food, other manufacturing, and mining receive positive impacts, and the remaining industries receive negative impacts in Armenia. Automobiles and other manufacturing receive positive impacts, but the percentage changes in each remaining industry differ among areas in Azerbaijan. Agriculture, automobiles, and textiles receive positive impacts, but the percentage changes in each remaining industry differ among areas in Georgia. Agriculture, E&E, and the food industry receive positive impacts, but the percentage changes in each

remaining industry differ among regions in Kazakhstan. All industries except mining receive positive impacts, but the percentage changes in mining differ among areas in the Kyrgyz Republic. Agriculture, textiles, and services receive positive impacts, other manufacturing receives a negative impact, and the percentage changes in each remaining industry differ among areas in Tajikistan. Agriculture, textiles, and food receive positive impacts, but the percentage changes in mining differ among areas in Turkmenistan. Agriculture, textiles, and services receive positive impacts, food and other manufacturing receive negative impacts, and the percentage changes in each remaining industry differ among areas in Uzbekistan.

All CAREC corridors

In this scenario, we assume that the implementation of all CAREC corridors—1, 2, 3, 5, and 6—takes place simultaneously and reaches completion by 2020. Although the magnitude of the economic impacts is not uniform, most regions seem to experience positive effects from combining all CAREC corridors.

We find that the impacts of the combination of the projects in each industry regarding the percentage changes in the per capita real GDP differ among countries. For example, in Armenia, agriculture, textiles, food, and services receive positive impacts; other manufacturing and mining receive negative impacts; and the percentage changes in automobiles and E&E differ among regions. In Azerbaijan, E&E, textiles, and food receive positive impacts; other manufacturing receives negative impacts, and the percentage changes in each remaining industry differ among areas. In Georgia, agriculture, automobiles, and textiles receive positive impacts; food, other manufacturing, and mining receive negative impacts; and the percentage changes in each remaining industry differ among areas. In Kazakhstan, services receive extremely positive impacts. In the Kyrgyz Republic and Tajikistan, services receive large positive impacts. In Turkmenistan, services receive substantial positive impacts in almost all areas, but other manufacturing receives significant negative impacts. In Uzbekistan, services receive large positive impacts, but other manufacturing and mining receive negative impacts.

7.5 Economic Impacts of the CAREC Corridors and the TITR

In this section, we discuss the economic impacts of the TITR. We also examine the spillover and synergy effects between the CAREC corridors and the TITR by comparing the impacts with those in the previous section.

The TITR is a logistics-oriented project stretching from the PRC, through Kazakhstan, the Caspian Sea, Azerbaijan, and Georgia to Turkey and the European countries. As the map on the TITR web page shows, the transport route comprises railway links and shipping links connecting the PRC through Central Asia to Europe. Our analysis slightly modifies the network by dropping European networks in Eastern Europe, such as Poland, Romania, and Ukraine.[11] As discussed in the previous sections, railway networks in CAREC are developing as CAREC corridors. At the same time, as a subset of the larger transport networks, parts of the CAREC railway corridors appear within the TITR.

The railway links in our database cover Central Asia and most Asian countries, and even include sea routes in the Caspian Sea, the Black Sea, and the Mediterranean Sea. Some parts of the TITR existed in 2010 or around 2013, but some are still missing links. In our simulation, we assumed that all the networks were operational in 2020. We obtained some critical information on parameters from the field studies that Watanabe, Shibasaki, and Arai (Chapter 8) conducted.

Our simulation results confirm that regional impacts are widely observable across regions, including those that the TITR does not cross directly. This precisely shows the spillover effects in the transport networks. There are also some negatively affected regions in the northeastern provinces in the PRC. Due to the relative increase in accessibility in the PRC's central and western regions, we expect that the northeastern regions have lost their relative position, and economic activities may have relocated.

We further compare all CAREC corridors and all CAREC corridors plus the TITR, involving a comparable analysis with and without external connections from Central Asia, specifically the corridor passing through Turkey and the PRC. Clear contrasts in the results are apparent in Turkey and the PRC. As no specific connections in the scenario contain all CAREC corridors, these two ends can enjoy direct benefits from the projects within their countries and indirect benefits from having a better connection to the European market (for the PRC) and the Asian market (for Turkey).

A more detailed comparison of the two scenarios (CAREC corridors with and without external connectivity via the TITR) can show the synergy effects of the two corridors, namely, the CAREC and TITR corridors. Figure 7.3 shows the benefits of external links via the TITR on the y-axis and the initial benefits of the CAREC corridors on the x-axis. The observations are regions in the CAREC countries. The higher the score on the vertical axis, the greater

[11] https://middlecorridor.com/en/route

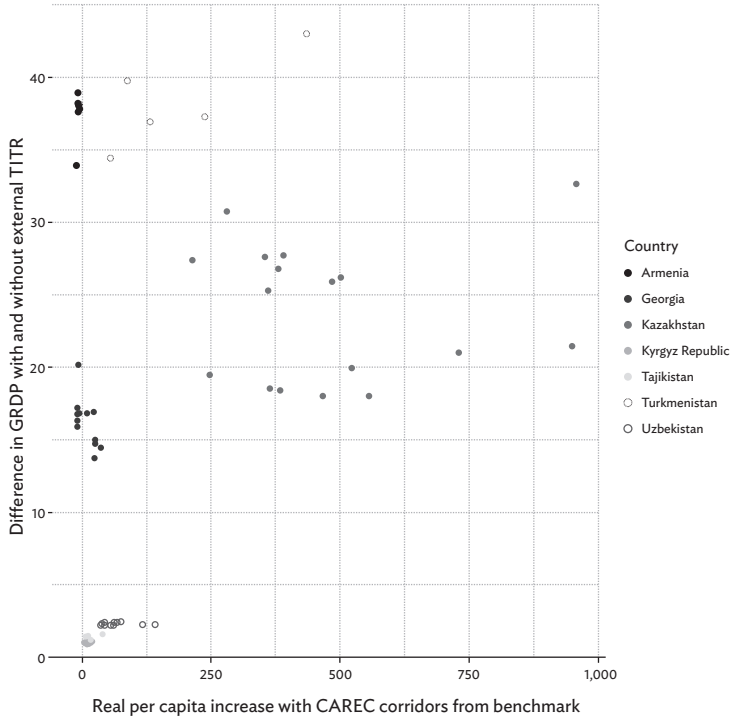
the benefits of having external linkages via the TITR. When the observations are on the right side of the horizontal axis, it means the benefits of having all the CAREC corridors (without the TITR, which we then compare with the benchmark) are larger. As is evident in the figure, areas in Kazakhstan show bigger benefits from CAREC corridors and receive benefits from connecting via the TITR at the middle level of about $20–$30 per capita. On the other hand, Armenia and Turkmenistan show larger synergy effects of the TITR. Georgia follow the first and second groups mentioned above. The rest of the regions are ranked lower and have smaller synergy effects.

Comparing the y-axis and x-axis scales shows that the direct impacts from the CAREC corridor (x-axis) are much larger than the synergy effects (y-axis), at about one-digit difference. Thus, for the CAREC region's growth, improvements of transport infrastructures within the regions are vital. With the TITR corridors, we can confirm the whole CAREC region can enjoy positive benefits.

Regarding industrial composition, the benefits primarily arise in the service sectors in terms of the percentage changes in the per capita real GDP. In Armenia, other manufacturing and services receive large positive impacts. In Azerbaijan, services receive significant positive impacts in some regions and negative impacts in others. In Georgia, services receive large positive impacts in some regions. In Kazakhstan, services receive extremely large positive impacts, while other manufacturing receives large negative impacts. In the Kyrgyz Republic, services receive large positive impacts, but mining receives negative impacts. Tajikistan's services receive large positive impacts, but other manufacturing receives negative impacts. In Turkmenistan, each region receives large positive impacts in either services or other manufacturing, but the regions receive negative impacts in either services or other manufacturing. In Uzbekistan, services receive large positive impacts, but other manufacturing and mining receive negative impacts.

For further discussion, we can consider the impacts on the neighboring countries: the PRC, the Russian Federation, and Turkey. Two forces are apparent from the analysis: the spillover effects of the CAREC corridors and the synergy effects of CAREC + TITR. Since there is no project in these countries, we can view any impacts from the CAREC corridors as spillover effects. Such impacts may be positive if regions are complementary or negative if regions are substitutive. The results show both types of areas in the three countries. However, the average spillover effects are positive in the PRC and slightly negative in Turkey and the Russian Federation. In terms of the synergy effects

Figure 7.3: Comparison of Economic Impacts With and Without the TITR (External Connectivity of CAREC Corridors)



CAREC = Central Asia Regional Economic Cooperation Program, GRDP = gross regional domestic product, TITR = Trans-Caspian International Transport Route.

Notes: The figure shows the benefits of external links via the TITR on the y-axis and the initial benefits of the CAREC corridors on the x-axis. Specifically, the y-axis is the differential of the real GRDP per capita, obtained from the real GRDP per capita in the scenario with all the CAREC and TITR corridors. The x-axis is the increase in the real per capita GRDP with the implementation of the CAREC corridors from the benchmark case (without any projects).

Source: Calculated by IDE-GSM.

of the TITR, highly positive impacts are evident in all these countries. Specifically, the average impacts are around 330 for Turkey and 40 for the PRC, meaning that these can be ranked as the top two in the countries involved.

7.6 Conclusions

This study evaluates the transport infrastructure projects of the CAREC Program and the TITR corridors. Using our spatial computable general equilibrium model, i.e., the Geographical Simulation Model, we show the extracts of the results: spatially wider economic benefits, spillover effects, and synergy effects.

First, we confirm that the projects shall bring spatially significant impacts and transformed regional advantages. As the economic impacts are not spatially limited to the regions that have implemented projects, these impacts can be regarded as spillover effects of the projects. This is because the improvements in parts of the transport networks can affect much broader spatial scopes. Population and industry will likely shift to regions with better connectivity through corridor development. Developing an economic corridor can benefit the region away from the corridors but does not necessarily benefit all subnational regions. It is because the induced developments from the infrastructure project shall change the relative attractiveness of each region. The results suggest that a combination of multiple corridors can provide balanced regional development. Further initiatives with complementary development programs would ensure stronger developments in multiple sectors and across wider regions.

Second, we also find a synergy effect that the impacts from the CAREC corridors can be magnified by the combination with the TITR corridor. The combination of the CAREC corridors and the TITR shall bring greater economic growth in the CAREC region, the PRC, Turkey, and other neighboring countries.

Third, the analysis reveals that the economic impacts of the projects are mainly observable in the service sector. This is because the current level of industrialization in the CWA countries is generally insufficient to benefit from corridor development. Further research should consider establishing special economic zones and implementing other industrial development policies alongside transport development projects.

The results show that connecting a large city with railways is better than linking it with its hinterland to further spread economic activities by developing and improving new and existing infrastructures. It will be straightforward to calculate the expected profits resulting from such linkages, and a priori, we can expect the link to strengthen the relative importance of the large cities. The drawback of building railroads only in the hinterlands lies in the difficulty of predicting whether the new infrastructure will lower the transport costs enough to bring new industries to the periphery.

There is still some room to improve our analysis. First, it is always desirable to have more reliable economic data at the subnational level, such as the GRDP by industry. We attempted to compile those series in this study but the unavailability or nonexistence of official national data impeded us. We should point out that the lack of manufacturing surveys prevented us from analyzing industrial clusters. Second, it is better to have reliable noneconomic data on international connectivity, such as customs clearance, waiting times, loading and unloading times, etc. Each border-crossing point has very different facilities and other conditions. Precise data would allow us to examine the impacts of efforts for regional integration. These are particularly important for landlocked countries like those in the CWA.

As a caveat, the model we used cannot accommodate cultural, social, environmental, and other aspects, which may be necessary to the lives of the people in the region. It also ignores diversity and heterogeneity of preferences, situations, and wealth. Thus, by plausibly combining any factors, the impacts of certain scenarios may have different results for some groups of people and regions. It is necessary to pay particular attention to the distribution of positive economic benefits. In addition, we do not fully understand the impacts of COVID-19, and our analysis does not incorporate such uncertain shocks. Kumagai et al. (2020) attempted to explore the impacts of COVID-19 using the same model, finding negative effects on economic growth worldwide. Bearing this in mind, we can point out possible overestimation in the simulation results in this study. However, the spatial relationships among the large markets and road networks are the same, and the predicted distributions of spatial impacts will be similar.

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8

Logistics Policy Analysis and Network Model Simulation for Cross-Border Transport in the Trans-Caspian Transport Corridor: The Global Intermodal Logistics Network Simulation Model

Daisuke Watanabe, Ryuichi Shibasaki, and Hirofumi Arai

8.1 Introduction

The countries in Central Asia—Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan—are all former republics of the Soviet Union. They are all inland or landlocked countries with no ocean coastlines. Although Kazakhstan and Turkmenistan have inland water ports in the Caspian Sea, all Central Asian countries must utilize an overland route through neighboring countries to access a seaport and global trade. The Central Asia Regional Economic Cooperation (CAREC) Program was established in the mid-1990s through the Asian Development Bank (ADB), the World Bank, the United Nations, and others to promote international collaboration for managing these transport handicaps. Since then, progress has been made to reduce friction at the Central Asian regional borders, develop infrastructure, and implement economic cooperation. Other than the Central Asian countries, member countries of the CAREC Program include the People's Republic of China (PRC), Pakistan, and Azerbaijan; the Russian Federation is yet to join. One important objective of the program is to improve the interconnections between these partner countries and

the Central Asian countries. Belarus, Kazakhstan, and the Russian Federation launched the Eurasian Customs Union in 2010, expanding it to the Eurasian Economic Union in 2015 with the Kyrgyz Republic and Armenia, which have lowered barriers at their borders with member countries.

The PRC currently promotes the Belt and Road Initiative (BRI). The overland route across the Eurasian continent consists of essential parts of the BRI. Railroad container transport from the PRC to Europe and the Russian Federation, which passes through Kazakhstan, has rapidly increased in recent years. The Kazakhstan government has enacted policies to accelerate this traffic further. Kazakhstan aims to diversify the transit routes throughout its territory, and the Trans-Caspian Transport Corridor (TCTC) can provide an alternative way to southern Europe and the Near East.

International organizations such as ADB (2014, 2020), the World Bank (Rastogi and Arvis 2014), and the Eurasian Development Bank (Lobyrev et al. 2018; Vinokurov et al. 2018) had published many reports, comprehensively summarizing the logistical environment of the Central Asian region. Tanaka et al. (2014) suggested that partial statistical data on international cargo volume could be obtained from the customs records of each country. However, such data often contain incorrect or biased information. Yang and McCarthy (2013), Smith (2016), and Wang and Yeo (2018) are examples of research focusing on Kazakhstan's logistical environment and international transport routes. Furthermore, from the Russian Federation's perspective, Zuenko and Zuban (2016) compared the route's competitiveness via Kazakhstan with that via the Russian Far East. Finally, Tanabe, Shibasaki, and Kato (2016) and Shibasaki et al. (2019) analyzed the expected impacts of improved border-crossing services on international freight transport in Central Asia using a freight traffic network assignment model.

This study focuses on Kazakhstan as a crossroad country at the heart of the Eurasian continent. Kazakhstan, where transit cargo to and from the PRC is diverted to various directions, plays a leading role in developing the TCTC. This chapter summarizes the current status of logistics in Kazakhstan based on a document survey and on-site interviews. Then, the global logistics intermodal network simulation (GLINS) model, which the authors developed to cover the Eurasian continent in the context of the PRC's BRI (Shibasaki, Arai, and Nishimura 2019; Shibasaki et al. 2020) is extended to simulate the impact of Kazakhstan's policies on logistics and cross-border transport in the TCTC. This includes the improvement of ferry services and rail networks along the corridor. The simulation results would support related policies on infrastructure development for cross-border transport within the international collaboration framework. Although the TCTC refers to

a route connecting the PRC and Europe via the Caspian Sea, it is less competitive than the ocean and the land transport routes through the Russian Federation because it crosses more national borders. Therefore, the simulation focuses on the eastern section between the PRC and the Caucasian countries, Iran, and Turkey. This study also aims to highlight future prospects, especially from the perspective of the effects on the transport of cargo originating in Kazakhstan.

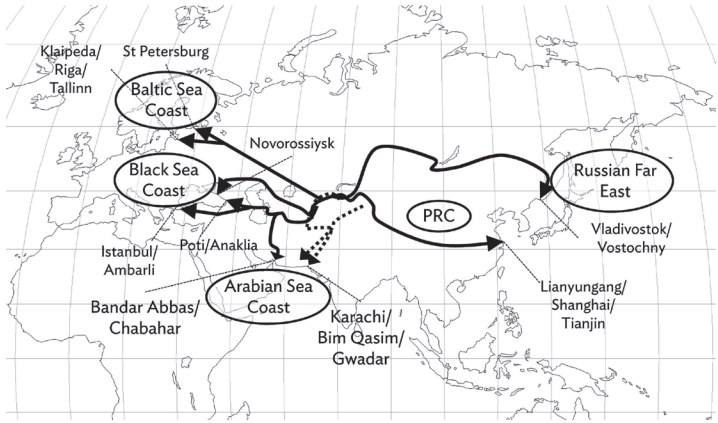
This chapter is structured as follows. Section 8.2 discusses the current status of international logistics in Kazakhstan, including how transit has been boosted through the PRC's BRI. Section 8.3 describes the proposed simulation model, scenarios, and results. Section 8.4 explains the impact of the COVID-19 pandemic on the TCTC. Finally, Section 8.5 contains the conclusion and policy recommendations.

8.2 Current Status of International Logistics in Kazakhstan

8.2.1 Overview of Sea Access Routes from Kazakhstan

Figure 8.1 shows the main gateway seaports to and from Central Asian countries, including Kazakhstan. The figure shows that the Eurasian continent broadly covers three directions divided into six routes.

Figure 8.1: Main Gateway Seaports to and from Central Asia



PRC = People's Republic of China.

Source: Shibasaki et al. (2019).

The shortest overland route from Central Asia to a seaport is to the south, leading to ports on the Arabian Sea. The most commonly used seaport to the south is Bandar Abbas in Iran. In addition, current investment in a route from the Xinjiang Uygur Autonomous Region over the Pamir Mountains will give direct access to Pakistan. If a link is made to Pakistan via high-grade highways and rail, then in the future, cargo from Central Asia can also travel via the PRC to ports in Pakistan. For the eastern direction, used in most transport to the Far East and Southeast Asia, two major routes access the seaports in the PRC and the Russian Far East.

In the western direction are also two main routes to reach Central Asia. One is the TCTC involving multimodal transport routes that combine a ferry over the Caspian Sea and land transport routes through the Russian Federation, South Caucasus countries, or Turkey. Both ways reach the Black Sea ports, including Novorossiysk (the Russian Federation), Poti (Georgia), and Ambarli (Turkey). In Georgia, the Anaklia Deep Seaport is being developed as a new container terminal for transit over the Black Sea. In 2017, the Baku–Tbilisi–Kars railway opened as a transport corridor connecting Azerbaijan and Turkey via Georgia. The other route in the western direction goes to the northwest Baltic Sea, including Saint Petersburg (the Russian Federation) and Riga (Latvia).

8.2.2 Transit through Kazakhstan Boosted by the PRC's BRI

The PRC's BRI is designed to enhance land freight transport across the Eurasian continent as the PRC develops a land bridge connecting Europe with the Far East. In the Soviet era, the only land bridge across the Eurasian continent was through the Trans-Siberian Railway. Eventually, with the breakup of the Soviet Union and the development of relationships between the PRC and Central Asian countries, the focus shifted to the development of new land bridge routes through the PRC. This eventually resulted in the New Eurasian Land Bridge, a shorter transcontinental railway route connecting the PRC with the European part of the Russian Federation and European countries via Kazakhstan. However, in early years, the new land bridge transport was regarded as inferior to sea transport across the continent because it crossed many national borders, including a railway gauge breakpoint at the PRC–Kazakhstan border.

Even though the original concept of the land bridge through the PRC was to connect Japan and the Republic of Korea with Eurasian countries

in the 1990s, the focus now is to transport cargo originating from the PRC cities. This is because the growth of the PRC economy has shifted the transport center of East Asian origin to those cities. In particular, inland cities in the PRC, such as Chongqing, Chengdu, Xian, Wuhan, and Urumqi, have a dual motivation to develop land bridge transport. Not only is the distance to Europe shorter than that from the PRC coastal cities, Japan, and the Republic of Korea, but sea transport from those regions also requires domestic long-distance transport within the PRC by railway, truck, and inland waterways, which increases the costs and requires more time.

The first container train running between the PRC's inland cities and Europe began in March 2011 from Chongqing to Duisburg and Moscow. Such services eventually gained the brand name of China Railway (CR) Express. Table 8.1 shows the observed transport volume and the number of container rail services between the PRC and European countries. Table 8.1 suggests difficulties in securing cargo during the early years. However, from around the fall of 2013 when the BRI was announced, the number of trains operated and the transport volumes rapidly increased, doubling each year until 2017. This rapid increase was frequently suggested to be made possible by political support from the PRC—for the investment in infrastructures such as national border facilities and high-speed railways (resulting in increased cargo transport capacity for conventional railways) and for the subsidies of freight charges provided by the PRC's regional governments.

Moreover, as Table 8.1 shows, an imbalance in cargo volume for both directions was one of the critical issues of the CR Express. Compared with westbound cargo from the PRC to Europe, the transport volume for eastbound cargo (from Europe to the PRC) was insufficient, as demonstrated by the fact that there was no eastbound transport in the first 3 years of operation. The eastbound transport volume is about 80% of the westbound volume due to the above-mentioned freight discounts and other policy efforts.

Another feature of container rail services to and from the PRC is the increase in the number of cities connected on the PRC and European sides. On the European side, from the original designations of the Russian Federation, Poland, and Germany, container rail services expanded to the west, such as Spain, and to the south, such as the South Caucasus countries, Turkey, and Iran.

The rest of this section focuses on the directions of container block trains in the territory of Kazakhstan. The following description is based on on-site interviews obtained in 2017. The information gathered from these interviews contains data on the railway containers that passed

Table 8.1: Number of Container Rail Services and Cargo Volume between the PRC and European Countries

Year	Number of Container Rail Services			
	PRC–European Countries	European Countries–PRC	Total	Change from the Previous Year, %
2011	17	0	17	
2012	42	0	42	247
2013	80	0	80	190
2014	280	28	308	385
2015	550	265	815	265
2016	1,130	572	1,702	209
2017	2,399	1,274	3,673	216
2018	3,710	2,667	6,377	174
2019	4,525	3,700	8,225	129
Year	Cargo Volume (20-foot equivalent units, or TEUs)			
	PRC–European Countries	European Countries–PRC	Total	Change from the Previous Year, %
2011	1,404	0	1,404	
2012	3,674	0	3,674	262
2013	6,960	0	6,960	189
2014	23,804	2,266	26,070	375
2015	47,132	21,770	68,902	264
2016	97,400	47,400	144,800	210
2017	212,000	105,930	317,930	220
2018	320,252	223,068	543,320	171
2019	402,130	323,181	725,311	133

PRC = People's Republic of China.
Source: Vinokurov et al. (2018) and EACLLA (2020).

through Kazakhstan on block trains in 2016. The data include containers between countries other than the PRC but do not include containers to or from Kazakhstan (Table 8.2). The CR Express (both eastbound and westbound) passed through Dostyk (and Altynkol in Khorgos village, partially) on the PRC border and Zhaysan on the Russian Federation border. Meanwhile, a smaller amount of westbound container cargo from the PRC to the Russian Federation passed through Tobol and Semiglavyy Mar on the Russian Federation border.

Rail containers going through Kazakhstan to or from Afghanistan and other Central Asian countries from or to the PRC and the Russian Far East passed through Saryagash as a western exit from Kazakhstan. Containers from the PRC went through Altynkol or Dostyk, and those from the Russian Far East passed through Sharbakty or Aul.

Furthermore, containers from the PRC to Turkey were shipped from the Aktau port on the Caspian Sea (although in tiny quantities). In contrast, containers from the PRC to Iran were transported via a new railway that opened in 2014 on the east coast of the Caspian Sea, exiting Kazakhstan at the Bolashak station. In addition, a small amount of rail container cargo from Europe to Central Asia started in Latvia, passed through the westernmost region of Kazakhstan in Semiglavyy Mar and Oazis, and reached Uzbekistan or Tajikistan after passing through the Republic of Karakalpakstan in northwest Uzbekistan.

Table 8.2: Railway Container Freight Volume for Each Border Point in Kazakhstan in 2016

Station (Neighboring Country)	Inbound	Outbound
Altynkol (PRC)	18,995	266
Dostyk (PRC)	70,728	35,223
Aul (Russian Federation)	8,463	2,490
Sharbakty (Russian Federation)	10,768	23,204
Tobol (Russian Federation)	0	1,164
Zhaysan (Russian Federation)	31,397	69,891
Semiglavyy Mar (Russian Federation)	254	2,132
Aktau (Caspian Sea)	0	166
Bolashak (Turkmenistan)	0	64
Oazis (Uzbekistan)	0	254
Saryagash (Uzbekistan)	29,786	35,537

PRC = People's Republic of China.

Source: Authors, based on the material provided by the Kazakhstan Forwarder Association.

8.2.3 Kazakhstan Initiatives for the TCTC

The Kazakhstan government and Kazakhstan Railways (Kazakhstan Temir Zholy, or KTZ) have made efforts to improve the transit environment for international cargo. For example, at borders with the PRC where cargo must be transshipped because of rail gauge

differences, prolonged delays were common at the border a decade ago. However, delays no longer occur due to improved transshipment facilities in Dostyk and newly constructed facilities in Khorgos. Another important investment is a new railway construction between Zhezkazgan and Beyneu, which creates a shortcut across Kazakhstan between the eastern border with the PRC and the western border with the Russian Federation. The facility development of the Caspian seaports is no less significant, especially from the viewpoint of TCTC development.

At the end of 2019, the Kazakhstan government formulated a state program for infrastructure development called *Nurly Zhol* (Bright Path) for 2020–2025 (Government of the Republic of Kazakhstan 2019). It provides a wide range of target indicators, including transit container volume, designed to help reach the goal of 1,661,000 20-foot equivalent units (TEUs) in 2025 (compared to 537,000 TEUs in 2018). The program plans to implement physical and nonphysical measures to achieve this goal. The nonphysical measures include simplifying customs procedures, introducing an e-Transit scheme, and providing online services at My Page. Significant railway infrastructure development includes modernization of the Dostyk–Moyynty section, electrification of the Moyynty–Aktogay and Tobol–Nikel'tau sections, and construction of a bypass route between Kokpekty and Karagayly away from Karasor Lake to reduce the risk of flooding.

The TCTC is the focus of the *Nurly Zhol* program and the other transit routes across Kazakhstan. According to the program, Kazakhstan continues to explore a sophisticated freight tariff policy for export cargo from Kazakhstan and the transit cargo from the PRC, Uzbekistan, and other Central Asian countries along the TCTC. The program is expected to increase the transit cargo volume through the Caspian ports from 0.2 million tons in 2018 to 1.4 million tons in 2025.

As the TCTC passes through multiple countries, the cooperation of all transit countries to promote the route's usage is a key issue. Kazakhstan plays a leading role by serving as the secretariat of an international association called the Trans-Caspian International Transport Route (TITR), established in February 2017 to coordinate all stakeholders involved. As of early 2020, the TITR comprises eight regular members, including the national railway companies of Azerbaijan, Georgia, Kazakhstan, Turkey, and Ukraine. In addition, it involves 13 logistics companies as associate members, including two from the PRC. Kazakhstan's regular members are Aktau Sea Commercial Port and the KTZ and its associate members include Aktau Marine North Terminal, Kazmortransflot, and Port Kuryk.

The TITR's efforts to develop the TCTC include promoting marketing activities, enhancing competitiveness, and simplifying administrative procedures. A tangible result of its coordination is a block train service between Lianyungang in the PRC and Istanbul in Turkey, running since November 2018. Another outcome is the April 2019 launch of a regular container short-sea shipping service between the ports of Aktau and Baku in the Caspian Sea.

8.2.4 KTZ Development Strategy and Caspian Ports

The KTZ gives significant attention to container transport through the country in its development policy. Its latest strategy (approved in 2019) stipulated that it would take all necessary measures to maximize the transit potential by taking advantage of the geographical location of Kazakhstan (Kazakhstan Temir Zholy 2019), as follows:

(1) *Enhancing commercial activities in the PRC and Europe*. To achieve the ambitious target of significantly increasing the transit volume between the PRC and Europe, the KTZ should improve sales in these regions.

(2) *Enabling competitive delivery times*. It is essential to minimize the entire delivery time along the transit route to attract transit cargo. To this end, the KTZ should work on:
   - improving the efficiency of the transit system, including increasing the number of container block trains throughout Kazakhstan and minimizing the processing operations of wagons and containers;
   - optimizing the length of trains;
   - modernizing rail sections with insufficient capacity on all major routes in both Kazakhstan and other countries;
   - collaborating with stakeholders in other countries such as the Russian Federation, Belarus, the PRC, and European Union countries for increasing rail speed and diversifying directions; and
   - increasing the efficiency of container flatcar use on the route to the (South) Caucasus countries and Turkey, which will be achieved through technological innovations.

(3) *Realizing competitive freight charges*. The KTZ can optimize freight charges by further implementing a cost reduction program via optimizing cargo flow routes. This can be done by, for example, fully utilizing electrified tracks and sections, which can reduce the necessity of a physical expansion of rail capacity.

The KTZ has implemented several measures in line with the current strategy and the previous one. For example, regarding commercial activity, the KTZ Express, a subsidiary of the KTZ operating block trains and trans-shipment facilities at Khorgos, joined with the operation at the Lianyungang port in the PRC as one of the cross-shareholders for their joint terminal.

The KTZ development strategy also emphasized the importance of the Caspian ports because the TCTC can connect Kazakhstan more easily with the South Caucasus countries, Turkey, and Eastern European countries via the Black Sea. Because linking the Caspian ports in Kazakhstan with the Baku port in Azerbaijan could avoid passage through Uzbekistan and Turkmenistan, improvements for the Aktau port were completed, and a new ferry terminal in the neighboring Kuryk district was constructed.

The Aktau port opened in 1963 to transport uranium ore and oil extracted in Mangyshlak. It is operated by the Aktau International Sea Commercial Port, a subsidiary of the KTZ. DP World, one of the world's leading port terminal operators, participates in the operation (it also acts with the Khorgos SEZ as an advisor to the KTZ). Major port facilities include a ferry complex, oil terminal, grain terminal, dry bulk terminal, and multipurpose terminal. The ferry travels to and from the Baku port in Azerbaijan in 18–20 hours (253 miles), although most cargo is destined to Iranian ports. The ferry can carry 54 rail freight cars and 35 large trucks and major items, including petroleum products, consumer goods, grains, and fertilizers. Furthermore, the Aktau north port was established in the north of the Aktau port in 2014 and is operated by Aktau Marine North Terminal, also a KTZ subsidiary. The primary port facilities include a grain terminal, general cargo terminal, and container terminal.

The Kuryk port, operated by another KTZ subsidiary, is located approximately 60 km south of Aktau. The ferry terminal was completed in December 2016 and has been operating since March 2017. Compared with the Aktau port, it has an advantage in that the sailing time can be shortened by about 8%–12% on the sea routes for Iran and Azerbaijan. Between Lianyungang and Istanbul, freight could be delivered in 13–14 days with intermodal transport via the Kuryk port. Expansion plans include a multipurpose terminal, liquid cargo terminal, distribution center, and manufacturing area.

This route would provide the shortest way from the PRC and Kazakhstan to the South Caucasus countries and Turkey, and be a transport path to Europe that would not need to transit through the Russian Federation. Thus, it would serve to diversify risk in the PRC's BRI policies.

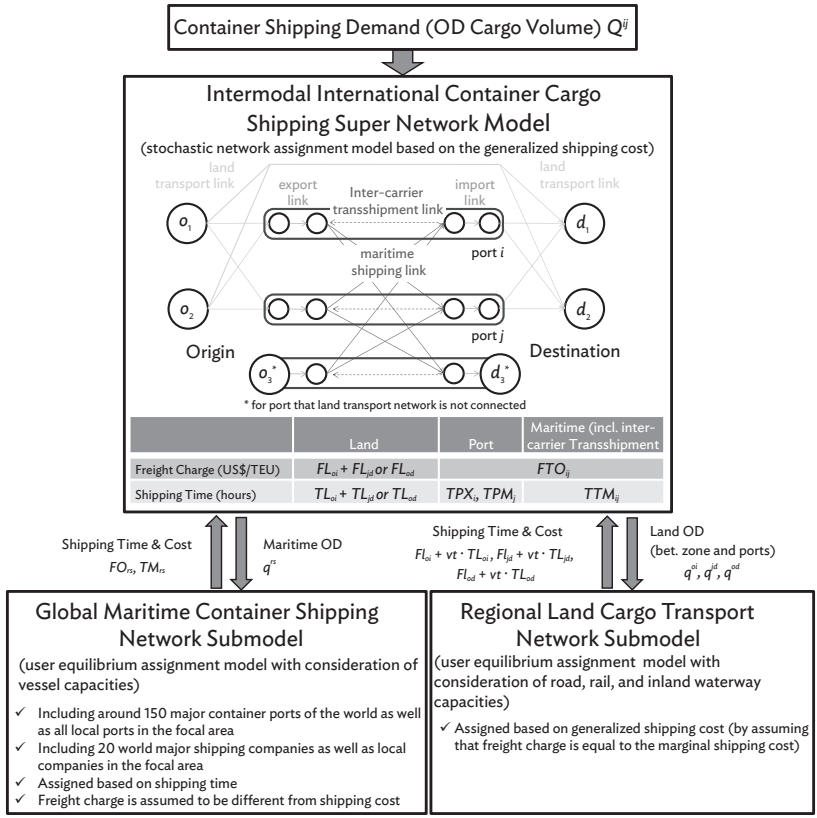
8.3 Simulation Model

8.3.1 Model Description

The authors developed the GLINS model for simulating cargo flow on a global intermodal transport network (Shibasaki et al. 2017; Shibasaki, Kato, and Ducruet 2020) and applied it to the Eurasian continent (Shibasaki, Arai, and Nishimura 2019; Shibasaki et al. 2019, 2020). This study uses the GLINS model to simulate the impact of the TCTC, mainly from the Kazakhstani perspective. In the GLINS model (Figure 8.2), the cargo shipping demand (maritime containers and "container-equivalent" land cargo are the targets of the model) and level of service (e.g., shipping cost, frequency, capacity, speed, and link distance) in transport networks are inputs. The cargo flow of each link is an output. The GLINS model is a two-layered traffic network assignment model: the upper layer consists of a stochastic assignment model in the intermodal super network. The lower layer comprises two user equilibrium assignment submodels in the real networks representing maritime shipping and land transport. One feature of the GLINS model is that it considers the capacity constraint of each transport mode (i.e., roads, railways, inland water transport, and maritime shipping).

The authors also confirm how the GLINS model describes the actual situation of global logistics from several viewpoints. For example, the authors can calculate the modal share of maritime containers and "container-equivalent" land cargo for each combination of origin and destination country in the Eurasian continent using the Global Trade Atlas forecasting data provided by IHS Markit Inc. The calculated share of cargo transported by land between the target countries (where the land transport network is considered in the model) in the Eurasian continent was 40.9% in 2016, whereas that estimated by the model was 38.1%. Furthermore, Figure 8.3 compares the calculated amount and share of cargo transported by land for a combination of these countries. As this figure shows, the amount and share of cargo transported by land are estimated accurately by the model, with only a few exceptions.

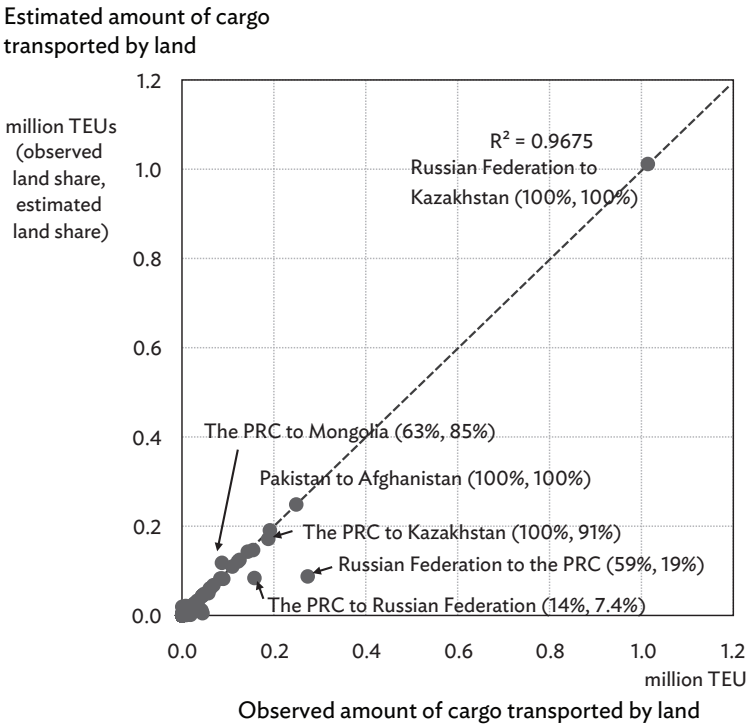
Figure 8.2: Structure of the GLINS Model



GLINS = global logistics intermodal network simulation.

Source: Shibasaki, Kato, and Ducruet (2020).

Figure 8.3: Comparison between Observed and Model-Estimated Amount and Shares of Cargo Transported by Land



PRC = People's Republic of China, TEU = 20-foot equivalent unit.

Source: Shibasaki et al. (2020).

8.3.2 Simulation Scenarios and Results

Based on the discussions in this study, five stepwise scenarios on the promotion of the TCTC other than the baseline scenario are prepared for the model simulation described in the previous section. Specifically, the authors assume the following policies are implemented to promote the use of the TCTC in the future:

(1) *Construction of a new rail in and around Kazakhstan*. We include the new building of railways across Kazakhstan in the east–west direction and those connecting Kazakhstan and Iran via Turkmenistan along the Caspian Sea, which was excluded in the original network.

(2) *Speeding up rail transport in Kazakhstan*. We assume the average train speed in Kazakhstan is twice that of the current speed (20 km/h).
(3) *Increasing the frequency of the Caspian ferry between Aktau (or Kuryk) and Baku*. The frequency is raised from one per week to three per day.
(4) *Reducing ferry usage costs in the Caspian Sea by stabilizing the operation*. The shipping cost via ferry is reduced by a factor of three from $3/km/TEU to $1/km/TEU.
(5) *Reducing the freight charges of the CR Express by subsidies or other means*. The freight charges of all container trains to and from the PRC are reduced. We assume stepwise declining rates at 25%, 50%, and 75% for the scenario analysis because, according to the authors' past research, the rate significantly affects the traffic volume (Shibasaki et al. 2020).
(6) *Reducing border barriers between the TCTC countries*. The border barriers between the PRC, Kazakhstan, Azerbaijan, Georgia, and Turkey are assumed to be half the current level because this also significantly affects the traffic volume, according to research conducted by the authors (e.g., Shibasaki, Arai, and Nishimura 2019; Shibasaki et al. 2019, 2020).

Table 8.3 summarizes the settings of each scenario with the combination of policies (1 to 6). We assume the deployment of policies (1 to 4) in Kazakhstan for all scenarios and focus on sensitivity analysis for rate reductions in policies 5 and 6.

Table 8.3: Scenario Settings for the Model Simulation

Scenario	New Rail Construction and Increasing Level of Service of Kazakhstan Railways and Caspian Ferry (1–4)	Reducing Rate of Freight of the CR Express (5), %	Decreasing Rate of Border Barrier between the TCTC Countries (6)
Base	No	0	0
S1	Yes	0	0
S2	Yes	25	0
S3	Yes	50	0
S4	Yes	75	0
S5	Yes	75	50

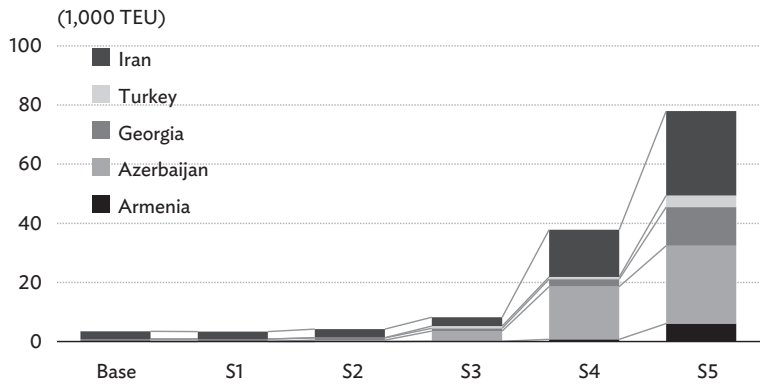
TCTC = Trans-Caspian Transport Corridor.
Source: Authors.

Figure 8.4 shows the estimated annual amounts of laden containers transported by land from the PRC to South Caucasus countries, Turkey, and Iran. Figure 8.5 also shows the estimated shares of laden containers transported by land from the PRC to these countries. Note that Armenia and Iran are excluded from the TCTC countries. Figure 8.4 shows the estimated number of containers transported by land in S4, assuming that the rail freight charge is reduced by 75%, increases compared with previous scenarios (i.e., S1 to S3). In particular, the share of containers transported by land to Azerbaijan, which shares a border with Kazakhstan via the Caspian Sea, significantly increases (Figure 8.5).

Moreover, in S5, assuming that the barriers at the national borders between the TCTC countries are reduced, the estimated shares of containers transported by land from the PRC to Georgia and Armenia increase (Figure 8.5). Because these countries share a border with Azerbaijan, the impact of the policies to reduce the shipping and border-crossing costs is extended there. The reason the share of land transport to Armenia is larger than that to Georgia, despite Armenia not being the target of reducing border barriers, is that Georgia is located on the Black Sea and is easier to access by maritime shipping.

On the other hand, the estimated number and share of containers transported by land to Turkey are small, even if the land shipping cost is

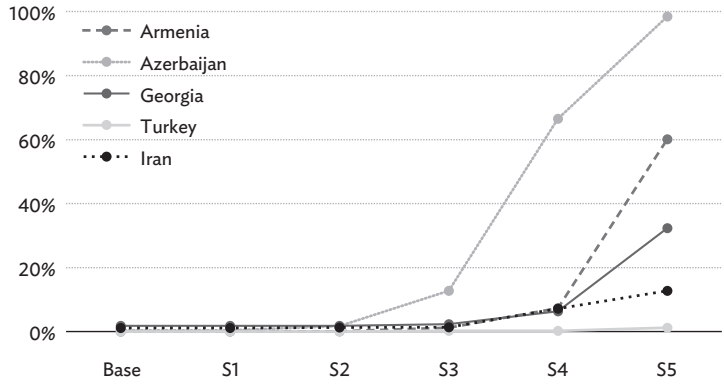
Figure 8.4: Estimated Annual Amount of Laden Containers Transported by Land from the PRC (1,000 TEUs)



PRC = People's Republic of China, TEU = 20-foot equivalent unit.

Source: Authors.

Figure 8.5: Estimated Shares of Laden Containers Transported by Land from the PRC (%)



PRC = People's Republic of China.

Source: Authors.

significantly decreased and border barriers between the TCTC countries are reduced. The estimated share to Iran in each scenario is also small, although the estimated number is not negligible. From this result, if the container ferry in the Caspian Sea between Kazakhstan and Iran is frequently operated and the border barriers between these countries are reduced, which are not considered in this study, we expect the amount and share of land transport to increase significantly. Regarding Turkey, because container trains cross many national borders from the PRC and direct maritime shipping is available from Turkish seaports, it is more difficult to encourage land transport. However, the result from the simulation that some containers use the land route reveals that the land route will secure the redundancy of the trade route.

8.4 Impact of the COVID-19 Pandemic on the TCTC

The outbreak of COVID-19 has significantly impacted the global supply chain. Just after the pandemic started in the PRC until mid-February 2020, cargo volume from the PRC to the European Union, Central Asia, the Persian Gulf, and South Caucasus countries significantly decreased

due to a decline in the PRC's factory utilization rate. In addition, most air freight services were globally canceled or reduced, and airfares were significantly raised. Therefore, cross-border block trains have been used as an alternative to air transport. In April 2020, these services numbered 976 trains, the highest ever-recorded in a single month (EACLLA 2020). The block trains were also used to transport epidemic-prevention goods from the PRC to European countries.

The volume of cargo handled along the TCTC has increased significantly due to the pandemic, and close cooperation between ports resulted in cargo movement without delays (Meretkylichev 2020). Representatives from four Caspian ports (including Aktau and Kuryk), who discussed joint measures to combat the COVID-19 pandemic in May 2020, presented this fact. However, there is still a quarantine requirement for vessels to prevent the spread of COVID-19. Kazakhstan's Ministry of Industry and Infrastructure Development announced that the transport of people and vehicles with drivers arriving from Azerbaijan and Iran at the Aktau and Kuryk ports in March 2020 was temporarily suspended. Container shipping services at the Aktau port and rail transport at the Kuryk port would not be interrupted. Still, ferry transport services at the Kuryk port will be affected by the restriction for vehicle drivers.

As for the effect of COVID-19, there is an advantage of rail transport between the PRC and Europe in terms of redundancy in the logistics network in the long term. However, marine transport across the Caspian Sea is disadvantaged in the short term due to the quarantine requirement for vessels to prevent the pandemic.

8.5 Conclusion and Policy Recommendations

This chapter focused on the effectiveness of logistics policy and infrastructure development for cross-border transport along the TCTC using a simulation analysis based on a network equilibrium assignment model. The literature review and on-site interview-based surveys in Kazakhstan summarized international trade and port access routes from Kazakhstan and the recent rapid increases in land bridge transport via railway containers between the PRC and Europe. Notably, Kazakhstan's national railway, the KTZ, actively initiated the development of block trains along the TCTC, including port developments in the Caspian Sea. Thus, this study concludes that the TCTC can be an alternative route to and from Europe, especially eastern and southern Europe, without passing through Russian Federation territory.

This study used the GLINS model, which the authors developed to cover intermodal freight transport networks (i.e., roads, railways, ferries, and maritime shipping) across the Eurasian continent for policy

simulation in Central Asia. In particular, the impact of the logistics policies related to cross-border transport in the TCTC, including the improvement of the ferry services and rail networks along the corridor, was incorporated. The simulation results support related policies on infrastructure development for cross-border transport within the international collaboration framework. The major outcomes of the simulation analysis are as follows:

(1) As the rail freight charge is significantly reduced by 75%, the estimated number of containers transported by land from the PRC to the South Caucasus countries substantially increases, especially those to Azerbaijan, which shares a border with Kazakhstan via the Caspian Sea.
(2) If the barriers at national borders between the TCTC countries are reduced, the estimated shares of containers transported by land from the PRC to Georgia and Armenia increase.
(3) The estimated shares of containers transported by land to Iran and Turkey are still small, even if the land shipping cost is significantly decreased and border barriers between the TCTC countries are reduced.

The simulation results support the Kazakhstani approach, emphasizing transit time reduction and transport tariffs while enhancing cooperation within the TITR association. As for the limitation of our model analysis, we need to consider the priority for developing related infrastructure in railway sections and ports in Kazakhstan because we assumed possible policies, including new rail construction and increasing the level of service of Kazakhstan railways and Caspian ferry in all scenarios.

In addition, although it is difficult to foresee how COVID-19 will affect society in the long term, the experiences mentioned above suggest the importance of redundancy in the logistics network. From this point of view, further investigation, including a simulation analysis of the entire TCTC route between the PRC and Europe, will be required. Another challenge is that this study focused on the transporting cargo through Kazakhstan (originating from or destined for the PRC) because of its significant volume. However, the real interest of the Kazakhstani government must be how their policies benefit the Kazakhstani economy. More specifically, it needs to consider how it will reduce the freight transport cost of the cargo originating from or destined for Kazakhstan and encourage increased cargo volume. To discuss this issue, the simulation analysis in this chapter should be integrated with another module, such as that presented in Kumagai, Tsubota, and Gokan (Chapter 7), to forecast the future trade amount by considering the economic impact of decreased transport costs.

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9

Regional Economic Impacts of Trans-Caspian Infrastructure Improvement and Implications for the Post-COVID-19 Era: A Computable General Equilibrium Analysis

Xinmeng Li, Kailai Wang, and Zhenhua Chen

9.1. Introduction

As the growth engine of Central Asia, the Caspian region plays a vital role in facilitating trade between Asia and Europe and promotes regional economic development. The region, which includes Azerbaijan, Armenia, Georgia, Iran, Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkey, Turkmenistan, and Uzbekistan, has been actively seeking to cooperate with other major economies, such as the Russian Federation, the United States (US), and the People's Republic of China (PRC), to export its energy resources (e.g., Bilgin 2009; Marketos 2009; Garibov 2016). Since 2013, the PRC's implementation of the Belt and Road Initiative (BRI) has provided new opportunities for economic development in this region. One aim of the BRI is to facilitate trade flows between the PRC and European countries. Under this circumstance, transporting commodities and merchandise goods through Central Asia and adjacent regions, broadly referred to Trans-Caspian International Transport Route (TITR) countries, is inevitable. As global economic activity will need time to recover after the coronavirus disease (COVID-19) pandemic (Fernandes 2020; McKibbin and Fernando 2020), attracting transportation infrastructure financing is becoming even more challenging given the uncertainty of foreign investments. This chapter intends to provide empirical evidence on

the economic benefits of transportation infrastructure to the countries along the TITR corridor based on several hypothetical infrastructure investment scenarios.

Large transportation infrastructure projects are the drivers of local and regional economic growth. Positive externalities usually occur with improved regional and interregional connectivity, reduced trade costs, and market integration (Gillen 1996; Harmatuck 1996; Feitelson and Salomon 2000; Bilgin 2009; Rivera, Sheffi, and Welsch 2014; Haynes and Chen 2017; Wang et al. 2020). The booming economy of the PRC, which is progressing from an impoverished developing country to a global superpower, is a particular example of how infrastructure investments can be the primary growth engine. However, studies have also widely discussed the potential negative externalities of large projects, such as environmental, social, and corruption risks due to weak governance (Fukuyama, Bennon, and Bataineh 2020; Wang et al. 2020). This research aims to evaluate the impacts of transportation infrastructure on trade and the economy of the TITR countries, considering the uncertainty of investment strategies.

The outbreak of COVID-19 has severely disrupted the global economy. Given the uncertain nature of the global economy and trade in the post-COVID-19 era, this study estimates the economic impacts of transportation infrastructure under different scenarios for the TITR countries. We begin by fitting statistical models to historical data collected from the World Bank and the Caspian countries. More specifically, we consider that the cost change of cross-border and interregional trade influences multiple infrastructure projects. Then, we adopt the Global Trade Analysis Project (GTAP) model, with 13 regions and 14 sectors, to assess the impact of Trans-Caspian infrastructure investment on the transit countries. The assessment focuses on the change in real gross domestic product (GDP) due to the reduction of trade costs.

This study has the following research highlights compared with previous related works. Given the nature of the bidirectional influence between infrastructure projects and economic growth (Boopen 2006; Hong, Chu, and Wang 2011; Deng et al. 2014; Chen and Haynes 2015; Chen et al. 2016), this study adopts a combined statistical and simulation approach to analyze the economic impacts of infrastructure investments under different hypothetical scenarios. The growth rates of real GDP and employment are two measures of economic indicators. To the authors' knowledge, this is the first assessment to use the computable general equilibrium (CGE) model for the TITR countries. The results improve our understanding of the impacts of infrastructure projects on real GDP change as a response to enhanced transportation connectivity and reduced trade costs among the TITR countries. In particular, our study

demonstrates two effects of transport improvement on international trade: increased competition in domestic markets and stimulation of the economy through the channel of exports. In addition, we evaluate the complex relationship between the change of trade volume and the transportation infrastructure development of different freight transport modes (sea, air, rail, and road). We expect that the policy implications will help formulate effective responses for multilevel stakeholders in the post-COVID-19 era.

The rest of the paper proceeds as follows. Section 9.2 reviews the current literature and identifies the research gaps. Section 9.3 introduces the background and status quo of infrastructure development in the TITR countries. Sections 9.4 and 9.5 discuss the data and methodology, respectively. Section 9.6 presents the simulation results, while section 9.7 concludes with remarks and policy implications.

9.2 Literature Review

Transportation infrastructure investments play an essential role in stimulating economic growth. The development of large-scale infrastructure systems increases the demand for goods and services from customers across different locations, expands regional and national transportation networks, and reduces the cost of firms' inventories (Gillen 1996; Harmatuck 1996). There are several critical transportation networks: pipelines, highways, rail, air, and telecommunications (Feitelson and Salomon 2000; Bilgin 2009). The improvements in logistics-related infrastructure may generate industrial agglomeration gains. Relevant companies and professional workers tend to have more face-to-face interactions and dialogues that widen and deepen the labor market (e.g., Rivera, Sheffi, and Welsch 2014). The widespread use of information and communication technologies and improved transportation infrastructure can jointly promote accessibility for industries and individuals, reducing travel time and costs. The time savings can lead to the spatial redistribution of economic activities (Haynes and Chen 2017). These conclusions come from a wide range of empirical studies conducted in the US, the PRC, and European countries.

The endogeneity of transportation infrastructure investments is one of the most widely discussed economic phenomena. Some studies adopted advanced econometric methods to explore panel data and determined that transportation infrastructure and economic growth have a bidirectional relationship (e.g., Boopen 2006; Hong, Chu, and Wang 2011; Deng et al. 2014). Moreover, different spatial contexts may lead to differences in regional performance when facing exogenous effects (Chen et al. 2016). As a simulation-based framework, the CGE model can assess the regional impacts of transportation infrastructure improvements

and reveal the potential difference between the short and the long run (Chen and Haynes 2015). Using this assessment tool, Villafuerte, Corong, and Zhuang (2016) and Zhai (2018) attempted to evaluate the economic impact of infrastructure development in the BRI countries. The predictions showed that infrastructure construction could positively stimulate worldwide economic growth. Some scholars, focusing on a particular region or sector, have attempted to assess the economic impact of infrastructure development in the BRI countries using CGE analysis. For instance, Mukwaya and Mold (2018) indicated that, due to the BRI, the GDP growth in East Africa is about 0.4%–1.2% with the decline in trade margin costs. Assuming that the cost of using capital for the PRC's iron and steel firms decreases by 50%, Yuan and Tsigas (2017) showed that welfare would increase by $4.78 million in Kazakhstan. Assessing the trade cost reduction effect of BRI projects, Chen and Li (2021) also demonstrated that the economic impact is quite uneven among the related countries.

Recently, a growing body of literature has focused on other economic activities in the BRI countries (e.g., Fukuyama, Bennon, and Bataineh 2020; Wang and Chen 2020). Shi et al. (2018) concluded that many economies in the study region are mainly energy-based after analyzing spatiotemporal patterns of electric power consumption during 1992–2013. The purpose of this study was to reveal regional economic structures. GDP is a better predictor of electric power consumption growth among the studied countries than population size. Chen and Yip (2018) paid special attention to the population dynamics of BRI countries. The results suggested that the proportion of the older population may be a barrier to economic development for these countries in Eastern Europe and East and Southeast Asia. Some studies assessed the associations between transportation infrastructure and economic growth. De Soyres, Mulabdic, and Ruta (2019) studied the effects of transportation infrastructure using structural general equilibrium models. The authors estimated the effects of transportation infrastructure on trade, GDP, and welfare. The model showed that BRI countries' GDP would increase by up to 3.4%. Wang and Chen (2020) examined the linkages between infrastructure and regional economic growth in the BRI countries. Through a dynamic shift-share analysis, they confirmed that regional economic disparities exist across the BRI countries. The lack of local advantages in logistics infrastructure causes some subregions to lag behind the others. These lagging subregions are the Commonwealth of Independent States, mid-Asia, and Eastern Europe. Indeed, this study performed a descriptive analysis without considering the direct link between changes in employment and infrastructure investments. Fukuyama, Bennon, and Bataineh (2020) discussed the BRI from the perspective of PRC project developers. Because of the domestic experience, PRC project developers appear to

overestimate the positive externalities and underestimate the negative ones. The authors further compared the PRC and Western models. They argued that the PRC should follow international standards more closely and reminded Western development agencies to be more realistic about the increasingly intense competition in the global market.

The uncertainty surrounding the impacts of the COVID-19 pandemic calls for a better understanding of the relationship between transportation infrastructure investments and economic growth in the TITR countries. Our study contributes to the literature by offering a combined statistical and simulation analysis regarding the economic impacts of transportation infrastructure projects among the TITR countries. The following section introduces the status quo of infrastructure development in the TITR countries.

9.3 Infrastructure Development in the Trans-Caspian Corridor

The PRC unveiled the BRI in 2013. It is a global initiative that PRC President Xi Jinping proposed to promote regional economic development and integration across Eurasian countries. Well-connected transport corridors can facilitate access to international markets, promoting trade and commerce between the PRC and European countries via goods transported through Central Asia and adjacent regions (Silin et al. 2017).

The TITR is one of the BRI's most important interstate trade corridors. Building this 6,500 km-long corridor provides Central Asia and the Caucasus countries with benefits in trade and investment flows and logistics infrastructure (Gigauri and Damenia 2019). The TITR corridor reduces the time of freight transportation from 60 days to 14 days via a modal shift from sea shipping to railroad transportation. In addition, the total cost is expected to decrease by roughly four times compared with air transport (*China Daily* 2018). The affordability and efficiency of this corridor make it attractive and will enable current and future stakeholders to become more productive.

From a geopolitical perspective, the TITR countries and adjacent regions have been facing constant aggressive foreign policies of regional hegemonies and destructive local conflicts and crises. The Russian Federation has played a dominant role in this region over the past several decades. Nowadays, the PRC's growing influence in Central Asia is speeding up the competition among the Russian Federation, the US, and other major powers regarding their interests. Therefore, the BRI can positively impact regional economic growth and mitigate severe political conflicts (Jopp, Kuhn, and Schulz 2018; Kenderdine 2018).

The TITR route increases connectivity across Eurasian countries and gives post-Soviet republics more trading autonomy in the South Caucasus and Central Asia. The BRI has expressed a strong desire to extend cooperation, including a broader spectrum of trade and investment activities. The total trade between the PRC and Central Asia increased from less than $1 billion a year to $41.7 billion a year from 1990 to 2018 (Sun 2007; Umarov 2020). In particular, most of the PRC's infrastructure investments focused on transportation and telecommunication facilities. The TITR represents an integral part of the extensive transportation system that the PRC assimilated into the BRI's framework, enabling the PRC to have a more substantial presence among Eurasian countries.

However, the outbreak of the COVID-19 pandemic has caused unprecedented negative impacts on global economic activity. Companies across the world, regardless of their size, are dependent on inputs from others. The functioning of global supply chains is severely disrupted. Millions of people have lost their jobs, and many companies have shut down their operations. Consumers have also changed their consumption behaviors, resulting in uncertain effects on the global supply chain system. Therefore, it is not surprising that foreign investments in infrastructure projects will likely decrease substantially in the TITR countries and beyond (Fernandes 2020; McKibbin and Fernando 2020).

As part of the BRI, the TITR is an ambitious transportation project that can improve the economies of the participating countries and their neighboring economies. Starting in Southeast Asia and the PRC, this route passes through Kazakhstan, the Caspian Sea, Azerbaijan, and Georgia toward European countries. It is noteworthy that agriculture and fossil fuel extraction primarily drive the GDP of the TITR countries.

9.4 Data

In our study, we use the transport infrastructure quality to measure the stock of transportation infrastructure investment. We obtain the data for this assessment from various sources for the period 2011–2015. Following Wessel (2019), we obtain the transport infrastructure quality data from the Global Competitiveness Report of the World Economic Forum.[1] The data describe the quality of railroad, port, and air transport infrastructure. The infrastructure quality index is an average score based on logistics professionals' perceptions of a country's

[1] World Bank. Quality of Overall Infrastructure. https://tcdata360.worldbank.org/indicators/he81eeee0?indicator=535&viz=line_chart&years=2007,2017 (accessed 2 June 2021).

quality of trade and transport-related infrastructure. The original score ranges from one to seven, seven referring to an excellent condition of infrastructure. Specifically, the respondents rated the transport in their country of operation on a scale from one (underdeveloped) to seven (extensive and efficient by international standards). We collect trade cost data from the ESCAP-World Bank Trade Costs Database[2] and other variables, such as the GDP, population, and tariff, from the World Bank Open Data Website.[3] The trade cost data appear in a tariff-equivalent form (percentage share of cost, insurance, and freight [CIF] prices). Table 9.1 provides a statistical summary of our variables of interest.

Table 9.1: Descriptive Statistics of the TITR Countries

		TITR Countries				Major Trading Partners				Worldwide
Variables		Azerbaijan	Georgia	Kazakhstan	Turkey	Poland	Romania	PRC	Ukraine	Mean
Trade cost	2011	287.8	268.3	251.7	196.9	212.6	–	181.9	226.5	268.5
	change rate	16.8%	5.1%	19.9%	–9.8%	–6.2%	–	–	–6.4%	–2.1%
GDP ($ trillion)	2011	66	15	193	833	529	183	7,552	163	516.8
	change rate	–19.5%	–1.0%	–4.3%	3.3%	–9.7%	–3.0%	45.9%	–44.2%	2.2%
Tariff	2011	8.78	1.2	7.43	2.42	2.12	2.12	8.13	4.11	6.8
	change rate	–3.0%	–64.2%	–7.0%	11.6%	23.1%	23.1%	–3.8%	–0.7%	–12.6%
Quality of road	2011	3.76	4.24	2.50	4.76	2.33	2.10	4.41	2.05	4.03
	change rate	5.4%	–8.4%	24.8%	2.5%	63.7%	31.3%	6.4%	18.7%	1.4%
Quality of rail	2011	3.88	3.87	3.92	2.74	2.47	2.36	4.62	4.36	4.03
	change rate	–1.8%	0.3%	7.7%	12.6%	25.5%	16.9%	8.8%	–4.6%	–16.5%
Quality of airport	2011	5.03	4.20	3.89	5.50	3.65	3.64	4.57	3.90	4.03
	change rate	0.1%	–7.5%	3.9%	–2.8%	11.3%	–2.4%	4.6%	–5. 1%	9.3%
Quality of port	2011	3.71	3.70	3.20	4.58	2.90	2.44	4.88	3.29	4.27
	change rate	5.2%	–4.3%	–18.8%	7.9%	16.7%	24.2%	1.8%	–14. 1%	–4.4%

GDP = gross domestic product, PRC = People's Republic of China, TITR = Trans-Caspian International Transport Route.

Notes: The trade cost is in a tariff-equivalent form (share of cost, insurance, and freight [CIF] prices). The denotation "–" indicates that the value is not observable in the original database. We calculate the change rate using the data from 2011 to 2015.

Source: Authors' calculation.

2 ESCAP. ESCAP-World Bank Trade Cost Database. https://www.unescap.org/resources/escap-world-bank-trade-cost-database (accessed 2 April 2021).

3 World Bank. https://data.worldbank.org/indicator/TM.TAX.MRCH.SM.AR.ZS (accessed 2 April 2021).

Our study considers that the shock of trade cost reduction will occur in the four TITR countries, namely, Azerbaijan, Georgian, Kazakhstan, and Turkey, as the core TITR economies. Moreover, we focus on the spillover economic effects in the trading partner countries with close geographic relationships with the TITR countries: Poland, Romania, the PRC, and Ukraine.

9.5. Methodology

We implement the assessment of the economic impact in our model in two steps. In the first step, we use regression analysis to estimate the trade cost elasticity of the infrastructure quality in four different modes of transportation. In the second step, we adopt the changes in the trade cost in different regions as the impact drivers for the CGE simulation. Then, we calculate the level change of the trade cost in different modes based on the estimated trade cost elasticity and volume of investment. We then summarize and compare the macroeconomic outcomes resulting from the trade cost change shocks among the TITR countries and their partner countries.

9.5.1 Estimating the Elasticity of Trade Costs

We measure the stock of infrastructure investment as the transport infrastructure index on a country-by-country basis. Following Francois, Manchin, and Pelkmans-Balaoing (2009), we estimate the elasticity of trade cost change concerning the transportation infrastructure investment through the OLS regression equation:

$$ln\ \tau_{i,t} = \beta_0 + \beta_1\, lnpGDP_{i,t} + \beta_2\, lntar_{i,t} + \beta_m\, lnINF_{i,m,t} + \varepsilon_{i,j,t} \qquad (1)$$

where i represents region i and t denotes time. In the regression model, $\tau_{i,t}$ denotes the trade costs in year t, which appear in a tariff-equivalent form (share of cost, insurance, and freight [CIF] prices) in the World Bank data; $lnpGDP_{i,t}$ represents the logged GDP per capita of the country in region i; $tar_{i,t}$ denotes the tariff in region i; and $INF_{i,m,t}$ represents the quality index of the infrastructure of mode m. We denote the elasticity of the trade cost with respect to the transportation infrastructure investment of mode m in country i as β_m. Table 9.2 summarizes the estimated results.

We observe that the infrastructure quality of seaports and airports has a stronger correlation with international trade costs. On the other hand, the coefficients of the quality of rail and road are relatively small. In the GTAP model, we assume that sea and air transportation

Table 9.2: Regression Results of the Coefficients of Infrastructure Investment, by Mode

Mode	Rail		Sea		Air		Road	
Variables	Coefficient	t-sta.	Coefficient	t-sta.	Coefficient	t-sta.	Coefficient	t-sta.
$lnINF_{i,m,t}$	−0.149***	−6.29	−0.241***	−8.28	−0.203***	−4.99	−0.086***	−2.74
$lnpGDP_{i,t}$	−0.056***	−10.40	−0.055***	−11.85	−0.060***	12.14	−0.067***	−13.74
$lntar_{i,t}$	0.037***	3.13	0.048***	4.47	0.051***	4.34	0.063***	5.27
Constant	7.037***	54.44	7.190***	63.11	7.273***	60.54	7.223***	59.29
Number of obs.	375		451		451		451	
R-squared	0.480		0.524		0.48		0.46	

Note: *** indicates significance at the 1% level.
Source: Authors' calculation.

infrastructures have a more significant effect on trade costs, with identical investment growth rates in the four modes. The public and private infrastructure investments in Central and West Asia in 2010–2014 represent 2.9% of GDP. However, the necessary infrastructure investment will account for 6.2% of GDP in 2016–2030 (ADB 2015). This implies that the infrastructure investment in Central and West Asia should increase by about 29% every 5 years to meet future needs. Combining the regression results of the coefficients, we assume that, in general, the trade costs in rail, air, sea, and road modes will fall by 4.3%, 5.9%, 7.3%, and 1.9%, respectively.

9.5.2 GTAP Model

We adopt the GTAP model, which Hertel (1997) developed, for the economic impact assessment. The model consists of 120 regions and 14 economic sectors. We conduct this analysis as an ex-post assessment of the transportation infrastructure improvement in different modes in 2013–2019. The model is based on the Walrasian general equilibrium theory and has an advantage for economic impact assessment related to the effect of trade policy and the change in transport margin on the macroeconomic performance and international trade flow (Mukhopadhyay and Thomassin 2010). Our analysis adopts a static version of the GTAP model, which captures multi-market interactions of producers and consumers, given the changes in price, regulations, external shocks, and the constraints of resources, such as capital, labor, and natural resources (Wei, Chen, and Rose 2019). Essentially, CGE models depict an economy as a set of interrelated supply chains.

Researchers have widely used the model to analyze international trade and tax policy (Dixon and Jorgenson 2012). As Rose (1995) indicated, the strength of CGE models lies in their multisector detail, focus on interdependencies, a full accounting of all inputs (including intermediate goods and not just primary factors of production), behavioral content, a reflection of the actions of prices and markets, nonlinearities, and incorporation of explicit constraints (Wei, Chen, and Rose 2019).

This study adopts the GTAP 9 database, which has been used for exploring various impact assessments of global economic issues. The database also contains information on import and export shares and trade costs in different transportation modes. This study focuses on the trade margin reduction between the four core Trans-Caspian countries and the other four trading partner countries (Table 9.1).

We base our simulation on the GTAP 9 database, with a reference base of 2004, 2007, and 2011. The original CGE model assumes full employment of all factors to measure the shock in the long term. To gauge the short-run economic impact of transportation infrastructure investment, we apply the short-run closure rule, also known as the Keynesian rule. The labor supply and demand change after the exogenous shock, which were adjusted until the factors were equal again at the initial wage.

9.5.3 Simulation Scenarios

According to GTAP's official website, the variable *tms* measures the power of the tax on imports. Meanwhile, the variable *txs* measures the power of export subsidy. This model uses these two variables to simulate the trade reduction effect on exports and imports separately in the countries along the TITR.

In this model, we assume that the TITR construction directly affects Azerbaijan, Georgia, Kazakhstan, and Turkey by reducing the trade cost on imports. We simulate the spillover effect of the trading partner countries near those along the TITR: Poland, the PRC, Romania, and Ukraine. The COVID-19 outbreak will also cause the construction of interregional transportation infrastructures in the TITR to generate different international trade effects. To capture the uncertainty of infrastructure investment given the influence of COVID-19, we evaluate other impacts as a response to the shocks, such as different modes of transportation (including rail, road, sea, and air); types of trade (exporting and importing); and levels of investor confidence. Our model considers five scenarios of trade cost reduction: very conservative, conservative, general, positive, and very positive. In a case of very positive confidence in investment, we assume that the trade cost reduction will likely be 50% stronger than that in the general case.

Table 9.3: Trade Cost Reduction in Five Scenarios (%)

Scenario	1. Very Conservative	2. Conservative	3. General	4. Positive	5. Very Positive
Rail	−2.2	−3.5	−4.3	−5.6	−6.5
Air	−2.9	−4.7	−5.9	−7.7	−8.8
Sea	−3.5	−5.6	−7.0	−9.1	−10.5
Road	−1.0	−1.5	−1.9	−2.5	−2.9
Mean	−2.4	−3.8	−4.8	−6.2	−7.2

Source: Authors' calculation.

In contrast, the effect will likely be 50% weaker in a case with very conservative confidence in the investment. Therefore, in scenarios four (positive) and five (very positive), we assume the trade cost reduction levels to be 125% and 150% of those in the general case, respectively. In contrast, in scenarios one (negative) and two (very negative), we assume that the trade cost reduction levels will account for 75% and 50% of those in the general case. In sum, Table 9.3 summarizes the trade cost reduction resulting from different transportation modes and various levels of investor confidence.

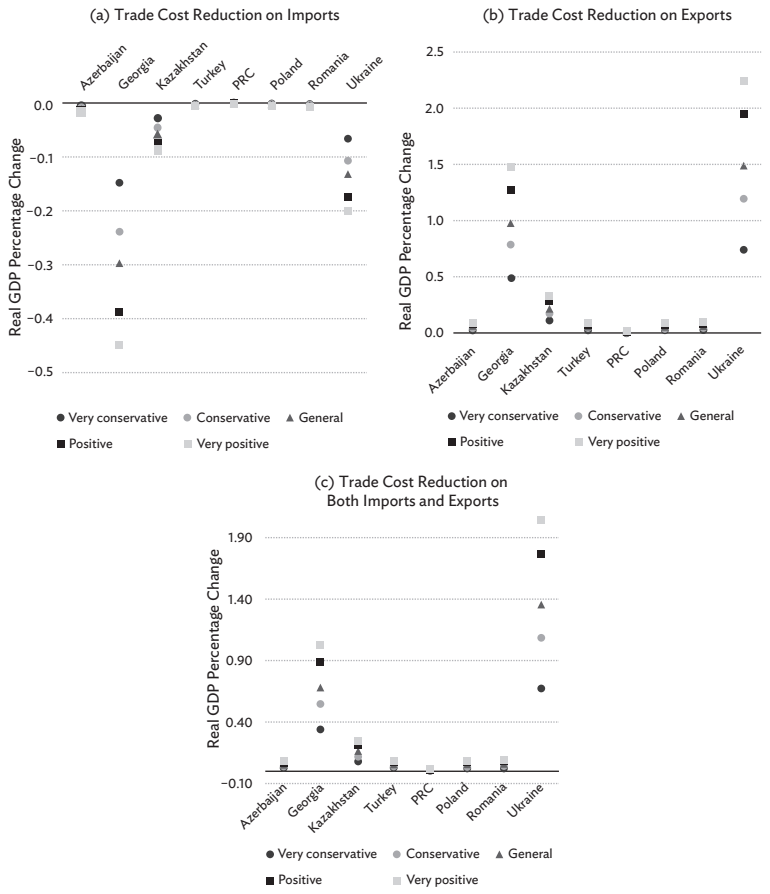
9.6. Simulation Results

Appendix 9A summarizes the simulation results of various scenarios. Our results suggest that transportation infrastructure investment tends to reduce interregional trade costs significantly, generating positive impacts on the real GDP in the countries around the TITR. The trade cost reduction causes two opposite effects through the channel of imports and exports. First, when the trade costs for imports are lower, the local markets are more competitive, negatively affecting the domestic firms. Second, lower trade barriers also stimulate local production through the channel of exporting. As a result, the second effect is more substantial in the countries along the TITR. With the construction of transportation infrastructure, the countries along the TITR benefit from GDP growth with lower trade costs. For instance, in the general case (scenario 3) in which the trade costs in the four modes decrease by 4.8% on average, the average GDP growth rate is 0.3% when considering both channels. We further observe that the effects of trade reduction among the different countries are uneven. For instance, Ukraine benefits from the most considerable GDP growth of 1.36% with decreasing trade costs in the general case. However, the stimulation effects on the GDP are relatively

minor in the PRC and Azerbaijan, with growth rates of 0.01% and 0.05% in scenario 3, respectively.

Figure 9.1 shows that all the countries suffer a loss in real GDP with decreasing trade costs for imports from foreign markets. For instance, Georgia experiences a significant negative impact from the trade cost reduction on imports, with a GDP change of −0.3% in the general case.

Figure 9.1: Real GDP Changes as a Response to Transportation Infrastructure Investment (%)



GDP = gross domestic product, PRC = People's Republic of China.

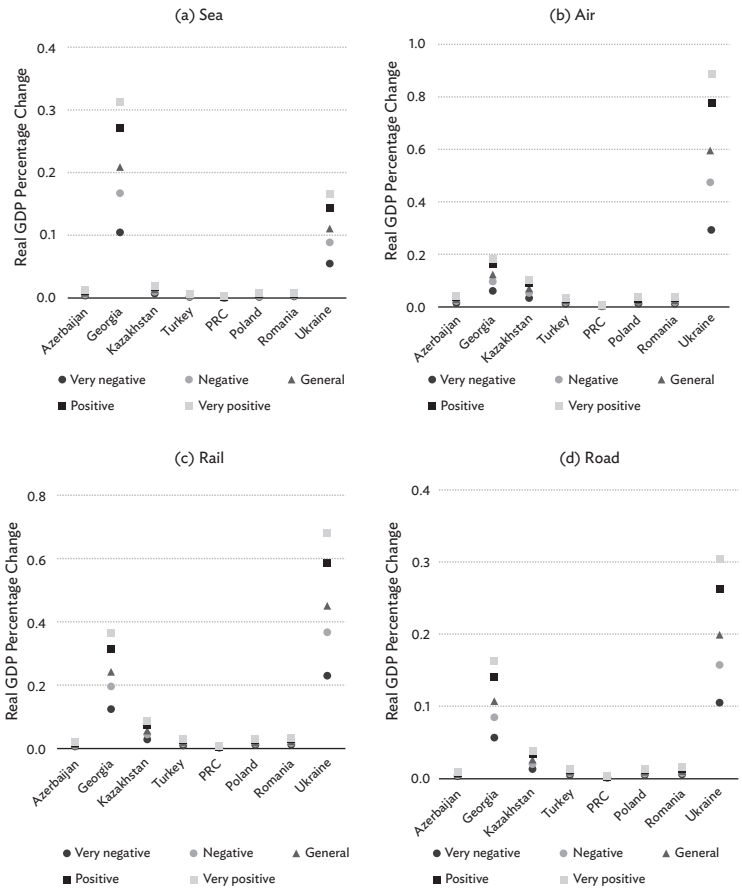
Note: The mean levels of various scenarios of trade reduction in all four modes are as follows: very conservative: −2.4%, conservative: −3.8%, general: −4.8%, positive: −6.2%, very positive: −7.2%.

Meanwhile, all the countries are substantially impacted through exports when the trade costs are lower. Specifically, the mean GDP growth rate resulting from lower exporting trade costs is 0.369% in the general case. As a result, the economic impact of the improved transportation infrastructure quality is positive. Thus, we can conclude that investment in transportation infrastructure in the countries along the TITR may positively stimulate economic recovery through trade cost reduction after the shock of COVID-19. Additionally, countries should carefully consider the costs and benefits when implementing this strategy since the results suggest that it may not be effective in some countries.

We also analyze the economic impacts of trade cost reduction for four modes of transportation infrastructure: seaport, airport, rail, and road. Figure 9.2 summarizes the results of the real GDP growth rate in different modes.

Our results suggest that the construction of transportation infrastructure in airports and railroads stimulates GDP growth more extensively through trade cost reduction. Specifically, the trade costs in the air and rail modes decrease by 5.9% and 4.3% in scenario 3, leading to average GDP growth rates of 0.11% and 0.10%, respectively. The trade cost reduction in the sea mode is −7.0% in the general case. Georgia benefits most from the investment in seaport construction, with a GDP growth rate of 0.21% in the general case. Regarding the trade cost reduction effect of the other three modes—air, rail, and road—the GDP growth rate is more considerable in Ukraine. For instance, the GDP change rate in Ukraine as a response to the trade cost reduction in the air mode (−5.9% in the general case) is 0.60%. According to the regression model results, trade cost and investment coefficients are more significant for seaports and airports. With the assumption of uniformly increasing investment rates, the positive effects are more significant in the models for air and rail. Our study calculates the marginal effect of trade reduction, which equals the real GDP change over the value of trade cost reduction. The growth rates resulting from the construction in all four modes are relatively minor in Poland, the PRC, Romania, and Turkey, with marginal effects smaller than 0.005%. Our results indicate that infrastructure investments in airports and railroads have larger positive impacts on GDP growth than seaport and roadway infrastructure investments. According to the regression results in Table 9.2, the coefficient of the quality of railroads is lower than that of the other three modes. Hence, with an identical change rate of the quality index, the railroad's trade reduction effect is more negligible. Furthermore, countries along the TITR are mainly inland countries where the role of waterway transportation in international trade is smaller.

Figure 9.2: Real GDP Changes as a Response to Transportation Infrastructure Investment in Different Modes (%)



GDP = gross domestic product, PRC = People's Republic of China.

Notes: The levels of the trade reduction for each scenario of each mode are as follows:
Sea: very conservative: –3.5%, conservative: –5.6%, general: –7.0%, positive: –9.1%, very positive: –10.5%.
Air: very conservative: –2.9%, conservative: –4.7%, general: –5.9%, positive: –7.7%, very positive: –8.8%.
Rail: very conservative: –2.2%, conservative: –3.5%, general: –4.3%, positive: –5.6%, very positive: –6.5%.
Road: very conservative: –1.0%, conservative: –1.5%, general: –1.9%, positive: –2.5%, very positive: –2.9%.

Source: Authors' summary.

9.7 Conclusion and Policy Recommendations

The BRI is a long-term investment program of the PRC that aims to speed up regional economic integration. As a crucial component of the BRI's integrated trade corridors, the TITR corridor comprises extensive transportation infrastructure systems linking trade and economic activities in Eurasian countries. The current outbreak of COVID-19 will exert long-term effects on the global economy and financial markets. This study explores the economic impacts of transportation infrastructure investments for the TITR under various hypothetical scenarios. The results have important implications for multilevel stakeholders as we consider the uncertainty of investment strategies carefully.

This research provides important policy implications. Our econometric analysis enables us to achieve more comprehensive assessment outcomes of improving transportation infrastructure by building different scenarios for the trade cost reduction effects. The economic impact of improving the regional connectivity among different markets is twofold. The lower trade barriers to imports lead to more competitive local markets, negatively affecting the domestic firms. Meanwhile, trade liberalization positively stimulates the economy by encouraging exports. Our results reveal that strengthening infrastructure investments can be a valuable tool to stimulate the economy while reducing the negative impact of the epidemic in the Trans-Caspian countries. Specifically, the improvement of transportation, especially in the quality of airports and railroads, leads to an overall positive effect on real GDP growth in the TITR countries.

Nevertheless, our estimation also demonstrates that the stimulation effects are relatively small in the sea and road modes in the TITR countries and their trading partner countries. Hence, our study suggests that policy makers should be aware that the investments in various transportation modes may generate quite different impacts on the economy. The favorable growth rates are minor in some TITR countries, such as Poland and Turkey. This implies that transport improvement is also related to market structure and involvement in international trade. Therefore, investing in transportation infrastructure could still limit stimulating GDP growth directly.

We analyze several countries along the TITR from 2011 to 2015, including Azerbaijan, Georgia, Kazakhstan, Poland, the PRC, Romania, Turkey, and Ukraine. The study estimates the elasticity of trade costs regarding infrastructure investments for four transport modes: rail, sea, air, and road). The analytical results in this step indicate that infrastructure investments in Central and West Asia should increase by almost one third every 5 years to fulfill future needs. Based on the

regression estimates, this study conducts a scenario-based analysis. One notable finding is that transportation infrastructure investment can reduce interregional trade costs substantially. The construction of transportation infrastructure benefits the TITR countries by offering GDP growth with lower trade costs. According to the regression model results, the economic effects of the quality of airports and railroads are larger than those of the other two modes. Consistent with the regression model, we also find that infrastructure investments in airports and railroads have bigger positive effects on GDP growth than seaport and roadway infrastructure investments. As for the differences across the countries studied, these investments have a relatively smaller impact on Poland, the PRC, Romania, and Turkey. The spillover effects of our simulation only influence these four countries. The decreases in trade costs have a much more substantial adverse impact on imports in Georgia than in other countries.

This study provides detailed guidance for the countries in the TITR region regarding new development in the post-COVID-19 era. We acknowledge that our work has several limitations requiring consideration in future studies. First, we calculate the elasticity of trade costs based on the statistical model. The quality of the data sources could significantly influence the values. We encourage future researchers to verify the estimated elasticity of trade costs using a more comprehensive data set. Second, this study designs simulation models following the standard GTAP model. Third, the basic CGE does not account for the possible spatial and temporal effects of infrastructure investments. Thus, our estimations for these TITR countries and their neighbors may be biased. It would be worthwhile employing better approaches that incorporate a spatial and temporal component into the CGE framework. Despite these limitations, this research offers policy makers and transport practitioners a better understanding of how to formulate effective policy responses to the uncertainties in the post-COVID-19 era.

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Appendix 9.1

Table 9A.1: Real GDP Changes and the Marginal Effect of Different Shock Scenarios (%)

Scenario	Country	Azerbaijan	Georgia	Kazakhstan	Turkey	PRC	Poland	Romania	Ukraine	Mean
Trade Cost Reduction on Imports	Very conservative	−0.006	−0.148	−0.029	−0.002	−0.001	−0.002	−0.003	−0.066	−0.032
	Conservative	−0.009	−0.239	−0.046	−0.004	−0.001	−0.004	−0.004	−0.107	−0.052
	General	−0.011	−0.297	−0.058	−0.005	−0.001	−0.005	−0.005	−0.134	−0.065
	Positive	−0.014	−0.388	−0.075	−0.006	−0.001	−0.006	−0.007	−0.175	−0.084
	Very positive	−0.017	−0.449	−0.087	−0.007	−0.001	−0.007	−0.008	−0.201	−0.097
	Marginal effect	**−0.002**	**−0.062**	**−0.012**	**−0.001**	**0.000**	**−0.001**	**−0.001**	**−0.028**	**−0.013**
Trade Cost Reduction on Exports	Very conservative	0.032	0.487	0.110	0.030	0.006	0.030	0.033	0.739	0.183
	Conservative	0.051	0.785	0.178	0.049	0.009	0.049	0.054	1.194	0.296
	General	0.064	0.978	0.222	0.061	0.011	0.061	0.067	1.490	0.369
	Positive	0.083	1.276	0.289	0.079	0.015	0.079	0.087	1.944	0.482
	Very positive	0.096	1.475	0.334	0.092	0.017	0.091	0.101	2.241	0.556
	Marginal effect	**0.013**	**0.203**	**0.046**	**0.013**	**0.002**	**0.013**	**0.014**	**0.308**	**0.077**
Trade Cost Reduction on Both Imports and Exports	Very conservative	0.03	0.34	0.08	0.03	0.01	0.03	0.03	0.67	0.153
	Conservative	0.04	0.55	0.13	0.04	0.01	0.05	0.05	1.09	0.245
	General	0.05	0.68	0.16	0.06	0.01	0.06	0.06	1.36	0.305
	Positive	0.07	0.89	0.21	0.07	0.01	0.07	0.08	1.77	0.396
	Very positive	0.08	1.03	0.25	0.08	0.02	0.08	0.09	2.04	0.459
	Marginal effect	**0.01**	**0.14**	**0.03**	**0.01**	**0.00**	**0.01**	**0.01**	**0.28**	**0.061**

continued on next page

Table 9A.1 *continued*

Scenario	Country	Azerbaijan	Georgia	Kazakhstan	Turkey	PRC	Poland	Romania	Ukraine	Mean
Sea	Very conservative	0.004	0.104	0.007	0.002	0.001	0.002	0.002	0.055	0.022
	Conservative	0.006	0.167	0.011	0.004	0.001	0.004	0.004	0.089	0.036
	General	0.008	0.209	0.014	0.004	0.001	0.005	0.005	0.111	0.044
	Positive	0.010	0.271	0.018	0.006	0.001	0.006	0.006	0.144	0.058
	Very positive	0.012	0.313	0.020	0.007	0.001	0.007	0.007	0.166	0.067
	Marginal effect	**0.002**	**0.047**	**0.003**	**0.001**	**0.000**	**0.001**	**0.001**	**0.025**	**0.010**
Air	Very conservative	0.014	0.061	0.034	0.012	0.002	0.012	0.012	0.293	0.055
	Conservative	0.023	0.098	0.055	0.019	0.003	0.019	0.020	0.474	0.089
	General	0.028	0.123	0.069	0.023	0.004	0.024	0.025	0.596	0.111
	Positive	0.037	0.161	0.091	0.030	0.005	0.031	0.032	0.777	0.146
	Very positive	0.042	0.184	0.103	0.035	0.006	0.036	0.037	0.888	0.166
	Marginal effect	**0.006**	**0.028**	**0.016**	**0.005**	**0.001**	**0.005**	**0.006**	**0.133**	**0.025**
Rail	Very conservative	0.006	0.124	0.029	0.010	0.002	0.010	0.011	0.231	0.053
	Conservative	0.010	0.197	0.046	0.016	0.003	0.016	0.018	0.367	0.084
	General	0.012	0.242	0.056	0.020	0.004	0.019	0.022	0.451	0.103
	Positive	0.015	0.315	0.073	0.026	0.005	0.025	0.029	0.587	0.134
	Very positive	0.018	0.366	0.085	0.030	0.006	0.029	0.034	0.681	0.156
	Marginal effect	**0.003**	**0.056**	**0.013**	**0.005**	**0.001**	**0.005**	**0.005**	**0.105**	**0.024**
Road	Very conservative	0.003	0.056	0.013	0.005	0.001	0.005	0.005	0.105	0.024
	Conservative	0.004	0.084	0.020	0.007	0.001	0.007	0.008	0.157	0.036
	General	0.005	0.107	0.025	0.009	0.002	0.009	0.010	0.199	0.046
	Positive	0.007	0.141	0.033	0.011	0.002	0.011	0.013	0.262	0.060
	Very positive	0.008	0.163	0.038	0.013	0.003	0.013	0.015	0.304	0.070
	Marginal effect	**0.003**	**0.056**	**0.013**	**0.005**	**0.001**	**0.005**	**0.005**	**0.105**	**0.024**

PRC = People's Republic of China.

Source: Authors' calculation.

UNLOCKING TRANSPORT CONNECTIVITY IN THE TRANS-CASPIAN CORRIDOR

Spanning from the People's Republic of China through Central Asian countries along the Caspian Sea to Europe, the Trans-Caspian Corridor is an increasingly important channel for transportation and cross-border trade. The corridor also has significant potential as a driver of inclusive and sustainable development, but considerable financing gaps and other challenges must be addressed to meet its rapidly expanding infrastructure needs.

Unlocking Transport Connectivity in the Trans-Caspian Corridor examines physical infrastructure development in the region, particularly transport and energy infrastructure, and its implications for trade and economic opportunities. It also provides policy insights on boosting the development of the Trans-Caspian Corridor, the economic spillover effects of physical infrastructure growth in local areas, and new interlinking trade and transit routes.

The book is an invaluable resource for policy makers, researchers, and others interested in better understanding how infrastructure development and policy recommendations for attracting greater private investment in new infrastructure projects can support more prosperous, inclusive, sustainable, and resilient economies in Central Asia and beyond.

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